STERLING 360™ WORKSHOP MANUAL

Models: COE 30
COE 45
COE 50

STI-475-08 (11/07P)

Published by
Freightliner LLC
4747 N. Channel Ave.
Portland OR 97217
Printed in U.S.A.

STERLING 360™

WORKSHOP MANUAL

2008 Model Year

FOREWORD

This Workshop Manual contains maintenance and repair methods for the Sterling 360™. The purpose of this manual is to assist the service technician when the vehicle is serviced.

IMPORTANT: Descriptions and specifications in this manual were in effect at the time of printing. Freightliner LLC reserves the right to discontinue models, and to change specifications or design at any time without notice and without incurring obligation. Descriptions and specifications contained in this publication provide no warranty, express or implied, and are subject to revision and editions without notice. For additional information, please contact Freightliner LLC, Service Systems and Documentation, P.O. Box 3849, Portland, OR 97208-3849, U.S.A. or refer to **http://www.Freightliner.com** and **http://www.SterlingTrucks.com**.

Whenever you see instructions in this manual to discard materials, you should attempt to reclaim and recycle them. To preserve our environment, follow appropriate environmental rules and regulations when disposing of materials.

NOTICE: Do not replace suspension, axle, or steering parts (such as springs, wheels, hubs, and steering gears) with used parts. Used parts may have been subjected to collisions or improper use and have undetected structural damage.

© 2007 Freightliner LLC

All rights reserved. No part of this publication, in whole or in part, may be translated, reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of Freightliner LLC.

GROUP INDEX

GENERAL 00
MAINTENANCE SCHEDULE 01
ENGINE 11
LUBRICATION 12
FUEL AND ENGINE CONTROL 13A
COMMON RAIL SYSTEM 13EA
AUTO CRUISE AND VEHICLE SPEED LIMITATION SYSTEM 13EB
ECU REWRITE AND PROGRAMMING 13ECU
COOLING 14
INTAKE AND EXHAUST 15
EMISSION CONTROL 17
AUTOMATIC TRANSMISSION 23
PROPELLER SHAFT 25
FRONT AXLE 26
REAR AXLE 27
WHEEL AND TIRE 31
FRONT SUSPENSION 33
REAR SUSPENSION 34
BRAKE 35A
ANTI-LOCK BRAKE SYSTEM (ABS) 35E
PARKING BRAKE 36
STEERING 37
BUMPER AND FRAME 41
CAB 42
DOOR 43
EXTERIOR 51
INTERIOR 52
ELECTRICAL 54
HEATER, AIR CONDITIONER, AND VENTILATION 55

GROUP 00 INDEX

EQUIPMENT TYPE CODES LIST 00-2

POWER TRAIN TABLE 00-3

HOW TO READ THIS MANUAL 00-4

CHASSIS NUMBER, ENGINE NUMBER,
POWER TRAIN LABEL 00-10

VEHICLE IDENTIFICATION NUMBER 00-11

PRECAUTIONS FOR MAINTENANCE OPERATION 00-12

PRECAUTIONS FOR ELECTRIC WELDING 00-21

JACKING THE VEHICLE 00-23

DIAGNOSIS CODES

1. Diagnosis Codes 00-25

2. Reading and Erasing the Diagnosis Code 00-26

TABLE OF STANDARD TORQUE VALUES 00-31

EQUIPMENT TYPE CODES LIST

Component	Name plate marking					Code description
Engine						
4M50-T	4	M	5	0	T	
						Turbocharged Order of development within same series Order of development among different series Diesel engine No. of cylinders (4)
Clutch						
C5W33	C	5	W	33		
						Disc OD Facing material (W: Woven) Load carrying capacity of truck class (tonnage) on which the clutch is primarily used Initial letter of the clutch
Transmission						
M036S5W	M	036	S	5	W	
						Variation (W: With directly-mounted transfer) Forward speeds Type of mesh (S: Synchromesh) Load carrying capacity of truck class (tonnage) on which the transmission is primarily used Initial letter of the transmission
Propeller shaft (driveshaft)						
P3	P	3				
						Load carrying capacity of truck class (tonnage) on which the propeller shaft is primarily used Initial letter of the propeller shaft
Front axle						
F200T	F	200	T			
						Vehicle type (T: Truck) Load carrying capacity of truck class (tonnage) on which the front axle is primarily used Initial letter of the front axle
Rear axle						
R033T	R	03	3	T		
						Vehicle type (T: Truck) Order of development within same series Load carrying capacity of truck class (tonnage) on which the rear axle is primarily used Initial letter of the rear axle
Reduction and differential						
D033H	D	03	3	H		
						Tooth profile (H: Hypoid gear) Order of development within same series Load carrying capacity of truck class (tonnage) on which the component is primarily used Initial letter of the reduction & differential

POWER TRAIN TABLE

Vehicle model	Engine	Clutch	Transmission	Propeller shaft	Rear axle	Reduction & differential
FE84DD6SLSUE	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DE6SLSUE	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DG6SLSUE	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DH6SLSUE	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DDZSLSUE	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DEZSLSUE	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DGZSLSUE	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DHZSLSUE	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE85DDZSLSUE	4M50-T8	Torque converter	M036A6	P3	R035T	D035H
FE85DEZSLSUE	4M50-T8	Torque converter	M036A6	P3	R035T	D035H
FE85DGZSLSUE	4M50-T8	Torque converter	M036A6	P3	R035T	D035H
FE85DHZSLSUE	4M50-T8	Torque converter	M036A6	P3	R035T	D035H
FE85DJZSLSUE	4M50-T8	Torque converter	M036A6	P3	R035T	D035H

HOW TO READ THIS MANUAL

This manual consists of the following parts:
- Specifications
- Structure and operation
- Troubleshooting
- On-vehicle inspection and adjustment
- Service procedures

Specifications

- This section gives crucial dimensions, fluid quantities, or tolerances needed to keep the vehicle in good working order.

Structure and operation

- This section gives general information about the component or system and explains how the component or system works.

Troubleshooting

- This section gives specific information about how to read fault codes and correct common service problems.

On-vehicle inspection and adjustment

- This section contains procedures for inspection and adjustment of individual parts and assemblies, including specific items to check and adjust. Whether specified or not, check for looseness, excessive play, backlash, cracks, damage, etc.
- Service standards are given in the manual to provide criteria for acceptance or rejection of any part.
- Even if not mentioned specifically in the service procedure, always do a routine visual check and cleaning of reused parts before installing them on the vehicle.

Service procedures

- This section contains procedures for servicing vehicle components and systems, including removal, installation, disassembly, assembly, inspection, etc.

Alert messages

- This workshop manual contains important hazard messages under the following four headings that identify the nature and importance of the information:

DANGER ⚠	Imminent hazards that will result in severe personal injury or death.
WARNING ⚠	Hazards or unsafe practices that could result in severe personal injury or death.
CAUTION ⚠	Hazards or unsafe practices that could result in minor personal injury and/or damage to products or property.
NOTE	Relevant information that is helpful or informative but not associated with any risk or hazard.

Terms and Units

● Front and rear

The front is the forward direction of the vehicle and the rear is the reverse direction.

● Left and right

When facing forward, towards the front of the vehicle, objects on the left are on the left-hand side of the vehicle and objects on the right are on the right-hand side of the vehicle.

● Standard values

Standard values include the design dimensions of individual parts, the standard clearance between two parts when assembled, and the standard value for a parts assembly.

● Limit

Limits indicate wear dimensions of parts that become no longer serviceable when worn and must be replaced or repaired.

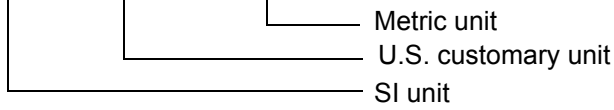
● Torque values

- In each section, specific values are given for non-standard fasteners.
- When no torque value is specified, use the “Table of standard torques” in this section. (Values for standard torques are based on thread size and material.)
- When a fastener is to be tightened “wet,” this will be indicated. Where there is no indication, assume it is dry.

● Units

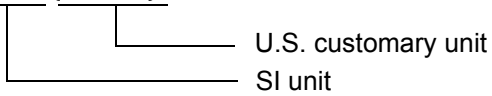
Torque values and other measurements are given in SI* units with U.S. customary and metric units added in brackets { }.
*SI: Le Système International d’Unités

Example: 390 N·m {290 lbf·ft, 40 kgf·m}



Unit		SI unit {U.S. customary, metric unit}	Conversion factor
Force		N {lb, kgf}	9.80665 N {2.2046 lb, 1 kgf}
Moment of force		N·m {lbf·ft, kgf·m}	9.80665 N·m {7.2329 lbf·ft, 1 kgf·m}
Pressure	Positive pressure	kPa {psi, kgf/cm^2}	98.0665 kPa {14.22 psi, 1 kgf/cm^2}
	Vacuum pressure	kPa {inHg, mmHg}	0.133322 kPa {0.03937 inHg, 1 mmHg}
Volume		J {BTU, kcal}	4186.05 J {3.96825BTU, 1 kcal}
Heat quantity		W {BTU/h, kcal/h}	1.16279W {3.96825BTU/h, 1 kcal/h}

Example: 30 mm {1.18 in.}

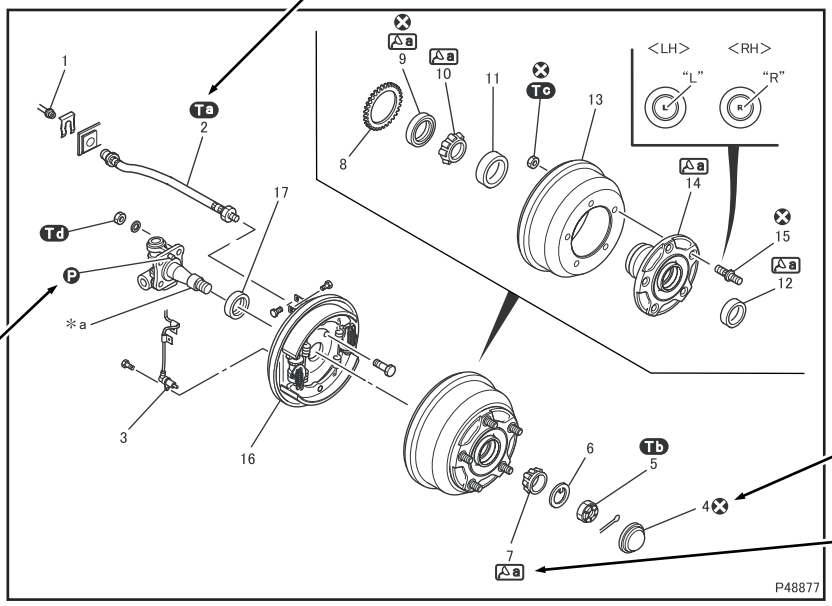


Unit	SI unit {U.S. customary unit}	Conversion factor
Length	mm {in.}	1 mm {0.03937 in.}
	m {ft.}	1 m {3.2808 ft.}
	km {mile}	1 km {0.6214 mile}
Weight	kg {lb}	1 kg {2.2046 lb}
	g {oz}	1 g {0.035274 oz}
Temperature (in degree Celsius)	°C {° F}	1°C {(1°C × 1.8 + 32)° F}
Velocity	km/h {mph}	1 km/h {0.6214 mph}
	m/s {ft/s}	1 m/s {3.281 ft/s}
Volume	L {qt}, L {gal}	1 L {1.05336 qt}, 1 L {0.2642 gal}
	cm^3 {cu.in.}	1 cm^3 {0.061023 cu.in.}
Area	m^2 {in^2}, m^2 {ft^2}	1 m^2 {1.550 × 10^3 in^2}, 1 m^2 {1.076 × 10 ft^2}

Symbol	Denotation	Application	Remarks
Ta	Torque value	Parts not tightened to standard torques (standard torques specified where necessary for servicing)	Specific values are shown in the tables. See Table of Standard Torques for fasteners for which no specific values are specified.
P	Locating pin	Parts to be positioned for installation	
⊗	Expendable part	Parts not to be reused	Replace the part whenever removed.
△a	Lubricant and/or sealant	Parts to be coated with lubricant or sealant for assembly or installation	The type of lubricant and/or sealant, and the quantity required, etc. are specified in the table.
Ca	Special tool	Parts for which special tools are required for service operation	Tool name/shape and part number are shown in table.
*a	Associated part	Parts associated with those removed/disassembled for servicing	

Denotes that tightening torque is specified.

WHEEL HUB AND BRAKE DRUM



Indicates position of locating pin.

Identifies non-reusable parts.

Denotes that coating with lubricant or sealant is required.

P48877

● Disassembly sequence

1 Brake pipe
2 Brake hose
3 Wheel speed sensor
4 Hub cap
5 Lock nut
6 Lock washer
7 Outer bearing inner race
8 Anti-lock brake system rotor
9 Oil seal
10 Inner bearing inner race
11 Inner bearing outer race
12 Outer bearing outer race
13 Brake drum
14 Wheel hub
15 Hub bolt
16 Front drum brake (See Gr.35A)
17 Spacer

*a: Knuckle
P: Locating pin
⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
7, 10, 11, 12	Starting torque of wheel hub bearing (Tangential force at hub bolt position with oil seal fitted in)		1 to 3.5 N·m {0.7 to 2.6 ft.lbs, 0.10 to 0.35 kgf·m} (Tangential force:8.8 to 28.4 N {2.0 to 6.4 lbs, 0.9 to 2.9 kgf})	–	Adjust or replace
14	Brake drum	Inside diameter	320 {12.6}	322 {12.7}	Repair or replace
		Cylindricality	0.05 {0.0020}	0.05 {0.0079}	

These location numbers correspond with disassembly sequence numbers.

P58289N

"Wet" is indicated when part is to be tightened with oil or grease applied to its threaded part.

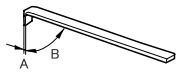
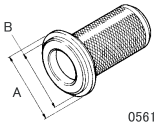
Tightening torque (unit: N·m {ft.lbs, kgf·m})

Mark	Part to be tightened	Tightening torque	Remarks
Ta	Brake force tightening	13 to 17 {9.6 to 13, 1.3 to 1.7}	–
Tb	Lock nut	113 ± 15 {83 ± 11, 11.5 ± 1.5}	Wet
Tc	Nut (brake drum and wheel hub mounting)	343 ± 39 {250 ± 29, 35 ± 4}	–
Td	Nut (front drum brake mounting)	118 ± 20 {87 ± 15, 12 ± 2}	–

Lubricant and/or sealant

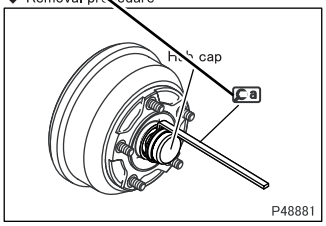
Mark	Point of application	Specified lubricant and/or sealant	Quantity
Sa	Between rolls of outer bearing inner race and inner bearing inner race	Mitsubishi wheel bearing grease	As required
	Inside wheel hub		395 ± 40 g {13.9 ± 1.41 oz}

Special tools (unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
Ca	Hub Cap Wrench A: 0.5°, B: 78°  P49261	MB999108	Removal of hub cap
Cb	Oil Seal Installer A: ϕ84 {3.31}, B: ϕ70 {2.76}  05619	MB999097	Installation of oil seal

Identification marks for special tools are the same as used in the text.

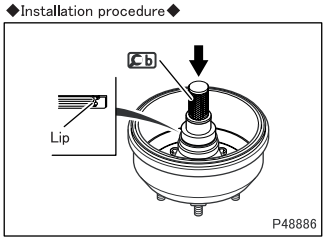
◆ Removal procedure



P48881

■Removal: Hub cap

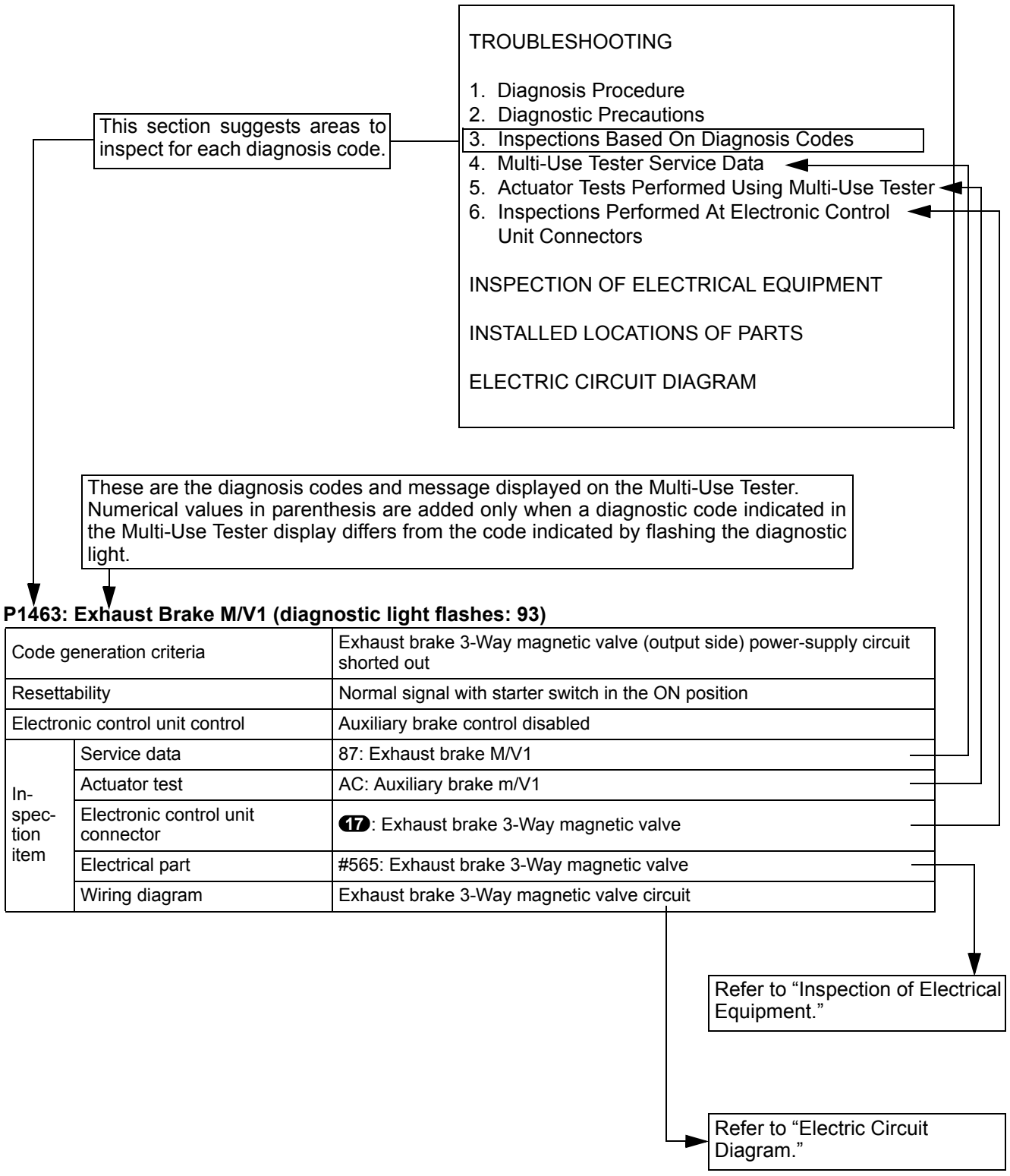
◆Installation procedure◆



P48886

■Installation: Oil seal
Apply grease to the lip of the oil seal, then fit the oil seal onto the wheel huh in the illustrated direction.

P58290N



P1463: Exhaust Brake M/V1 (diagnostic light flashes: 93)

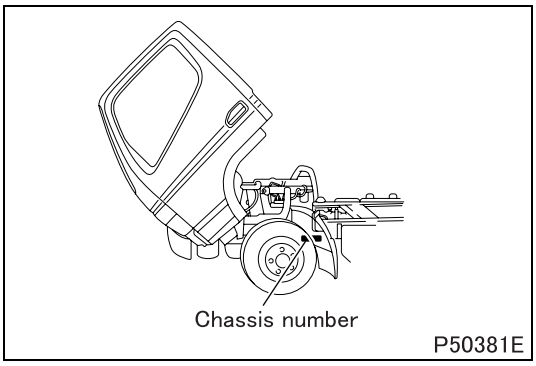
Code generation criteria		Exhaust brake 3-Way magnetic valve (output side) power-supply circuit shorted out
Resettability		Normal signal with starter switch in the ON position
Electronic control unit control		Auxiliary brake control disabled
In-spec-tion item	Service data	87: Exhaust brake M/V1
	Actuator test	AC: Auxiliary brake m/V1
	Electronic control unit connector	⓱: Exhaust brake 3-Way magnetic valve
	Electrical part	#565: Exhaust brake 3-Way magnetic valve
	Wiring diagram	Exhaust brake 3-Way magnetic valve circuit

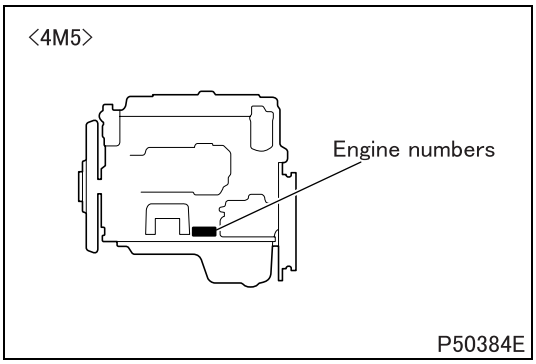
Refer to “Inspection of Electrical Equipment.”

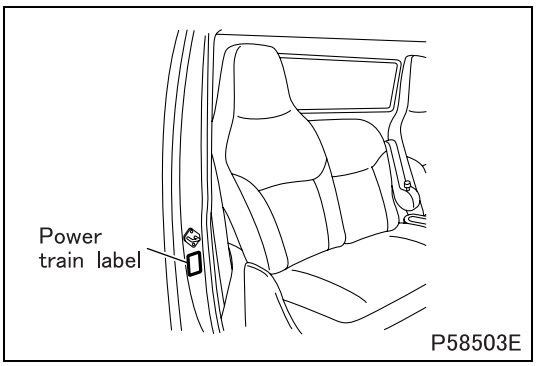
Refer to “Electric Circuit Diagram.”

CHASSIS NUMBER, ENGINE NUMBER, POWER TRAIN LABEL

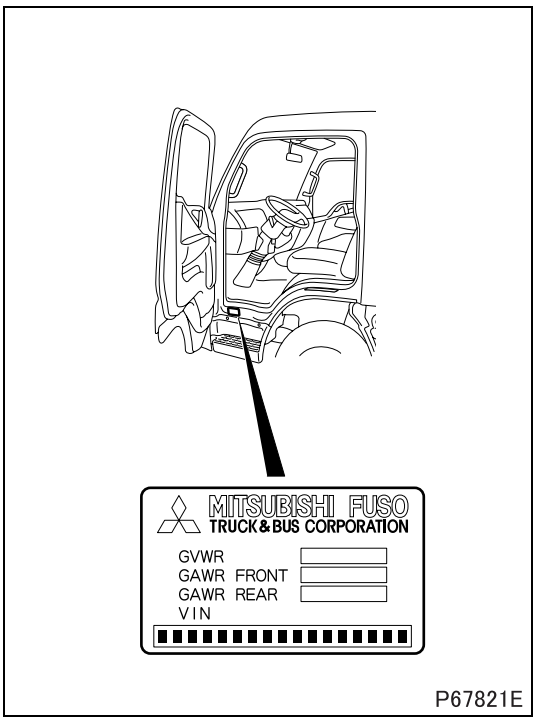
- Chassis and engine numbers are allocated to each vehicle and engine as they are produced. These numbers are required for registration.







- The power train label, located on the passenger door B-pillar, indicates the vehicle model, chassis number and the serial numbers of the vehicle's powertrain components.



- The vehicle identification number is punch-marked on the plate attached inside the driver's door, as shown in the illustration.
  The vehicle identification number consists of a 17-digit set of alphanumeric characters. Each digit represents the following specifications.

J	L	S	B	B	D	1	S	■	7	K	■■■■■■
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

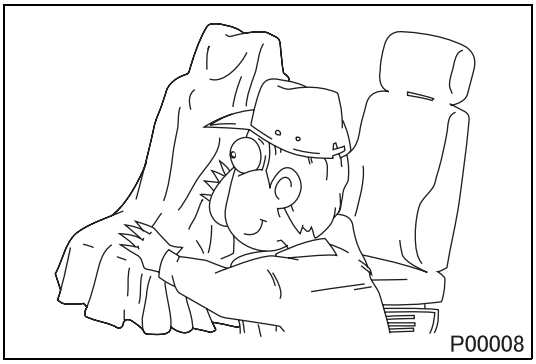
(1)	Country	J:	Japan
(2)	Make	L:	Mitsubishi Fuso
(3)	Type	S:	Sterling incomplete vehicle
(4)	Gross vehicle weight / Brake system		
		A:	10,001 to 14,000 lb / Hydraulic
		B:	14,001 to 16,000 lb / Hydraulic
		C:	16,001 to 19,500 lb / Hydraulic
(5)	Line	A:	Sterling 360 COE 30
		B:	Sterling 360 COE 45
		C:	Sterling 360 COE 50
(6)	Series (Wheel base)	D:	2.90 to 3.19 m (9.51 to 10.46 ft.)
		E:	3.20 to 3.49 m (10.49 to 11.44 ft.)
		G:	3.80 to 4.09 m (12.46 to 13.41 ft.)
		H:	4.10 to 4.39 m (13.45 to 14.40 ft.)
		J:	4.40 to 4.69 m (14.43 to 15.38 ft.)
		K:	4.7 to 4.99 m (15.41 to 16.37 ft.)
(7)	Cab chassis type	1:	COE 4X2 chassis cab
(8)	Engine	S:	Proprietary 4M50 4.9 L inline 4 Diesel
(9)	Check digit		
(10)	Model year	8:	2008
(11)	Plant	K:	Kawasaki
(12)	Plant sequential number		

PRECAUTIONS FOR MAINTENANCE OPERATION

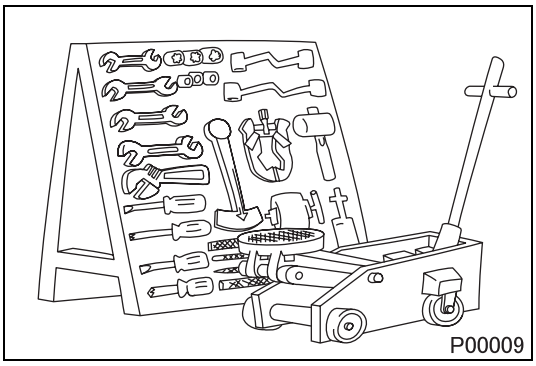
DANGER ⚠

This product contains or emits chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Before performing any service operations, inquire into the customer's complaints, determine the condition of the vehicle, check the distance traveled, look into the severity and type of service it has undergone, and note any other relevant factors. Assemble all the information needed to help you to service the vehicle efficiently.
- Check the location of the fault, and identify its cause. Based on your findings, determine whether parts must be removed or replaced. Follow the service procedures in this manual.


P00008

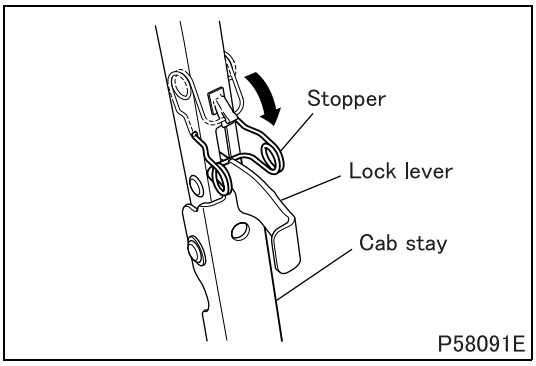
- Perform service operations on a level surface. Before starting, take the following preparatory steps:
  - To prevent soiling and damage, place covers over the seats, trim and floor in the cab and over the paint work of the body.


P00009

- Have ready all the tools necessary for the job, including special tools as required.

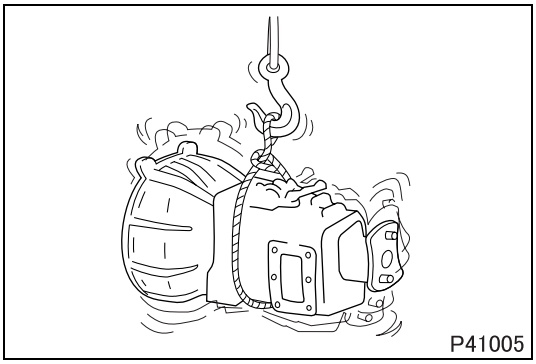
CAUTION ⚠

- **Special tools must be used whenever this manual requires them. Do not attempt to use other tools since they could cause injuries and/or vehicle damage.**

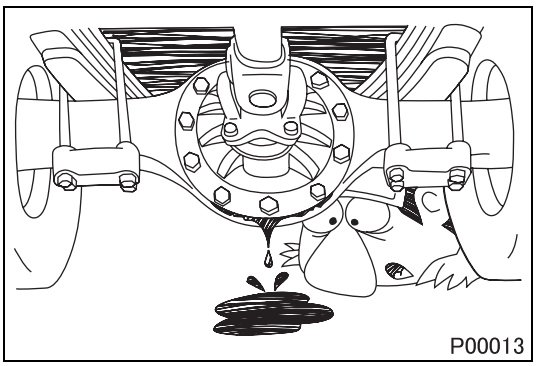


P58091E

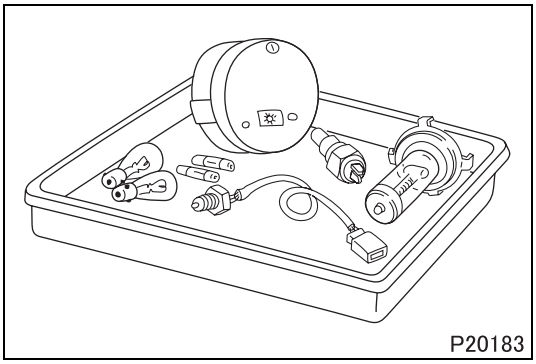
- When tilting the cab, be sure to engage the stopper (hold-down) with the lock lever. This will secure the cab stay and support the cab.
- Take extreme care when removing or installing heavy units such as the engine, transmission, or axle. When lifting heavy units using a cable etc., observe the following precautions.
- Know the weight of the unit being lifted. Use a lifting device and cable that is strong enough to support that weight.


P41005

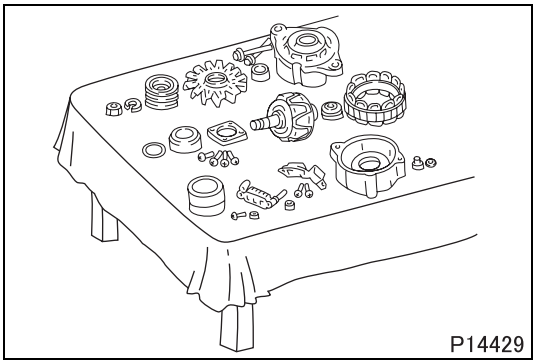
- If lifting eyes are not provided, tie a cable around the unit taking into account the unit's center of gravity.
- Do not allow anyone to walk or stand underneath a unit suspended on a lifting device.
- Never work in shoes with oily soles.
  When working with a partner or in a group, use pre-arranged signals and pay constant attention to safety. Be careful not to touch switches and levers unintentionally.


P00013

- Inspect for fluid leaks before washing the vehicle. Signs of fluid leaks may go unnoticed on a freshly-washed vehicle.


P20183

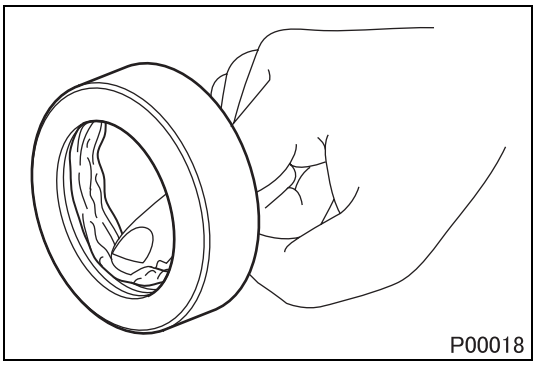
- Have replacement parts ready for installation.
- Oil seals, packings, O-rings and other rubber parts, gaskets, and split pins must be replaced with new ones after removal.
- When disassembling parts, visually check them for wear, cracks, damage, deformation, deterioration, rust, corrosion, defective rotation, fatigue, clogging and any other possible defect.


P14429

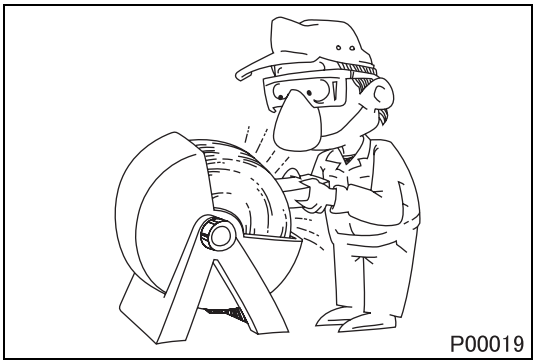
- To facilitate correct reassembly of parts, mark them with a paint pen before disassembly and arrange the disassembled parts neatly. Make alignment marks where they will not detract from parts' functionality and appearance.
- After removing parts from the vehicle, cover the area to keep it free of dust.

NOTE

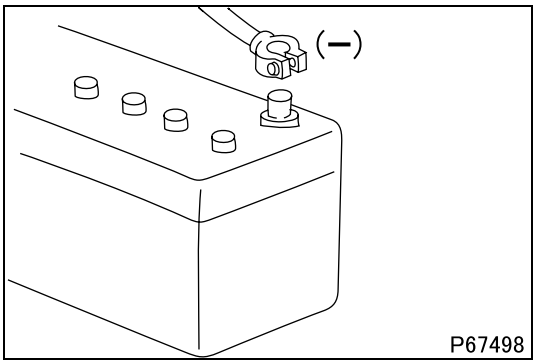
- **Be careful not to mix up identical parts, similar parts and parts that have left/right alignments.**
- **Keep new replacement parts and original (removed) parts separate.**


P00018

- Apply oil or grease as specified to O-rings, oil seals, dust seals and bearings before reassembly.
- Always use the required oils and greases when performing inspection or replacement. Immediately wipe away any excess oil or grease with a shop towel.


P00019

- Wear safety goggles when using power tools or equipment. Wear gloves when necessary, and watch out for sharp edges and other items that might injure your hands.

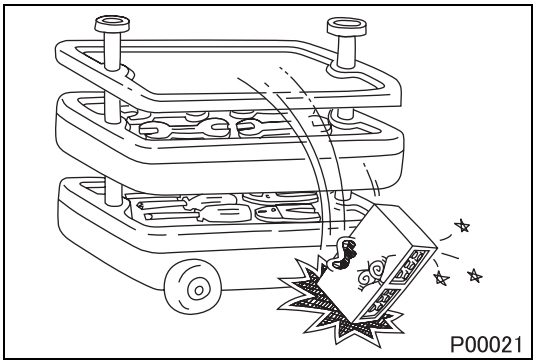


P67498

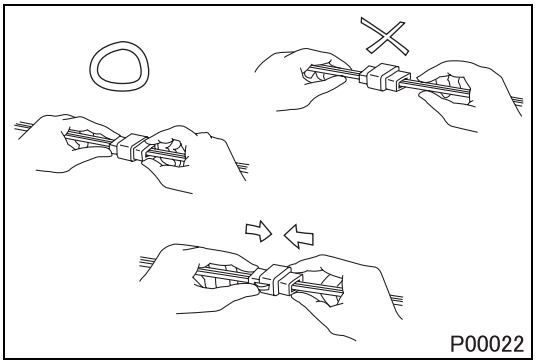
- Before working on the electrical system, disconnect the battery's (–) cable to prevent short circuits.

CAUTION ⚠

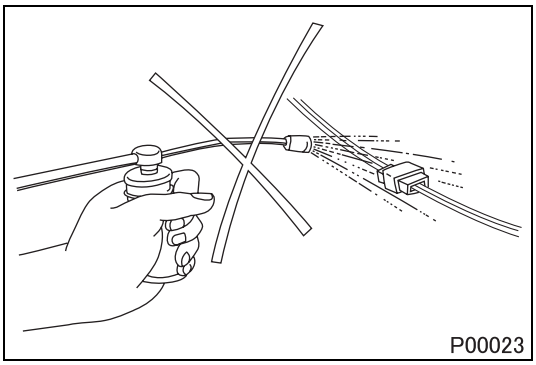
- **Make sure the ignition switch and all light switches are OFF before disconnecting or connecting battery cable. This will prevent damage to semiconductor components.**


P00021

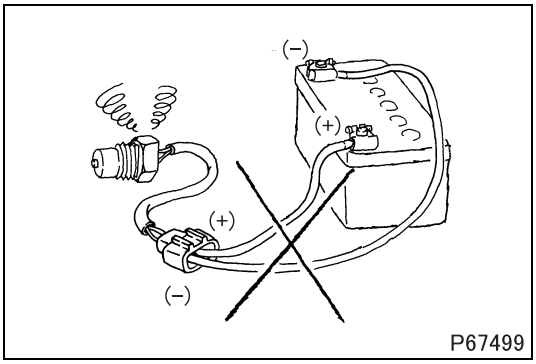
- Carefully handle sensors, relays, and other items that are sensitive to shock and heat. Do not remove or paint the cover of any control unit.


P00022

- When separating connectors, grasp the connectors themselves rather than the harnesses.
- To separate locking connectors, first push them in the direction of the arrows. To reconnect locking connectors, push them together until they click.

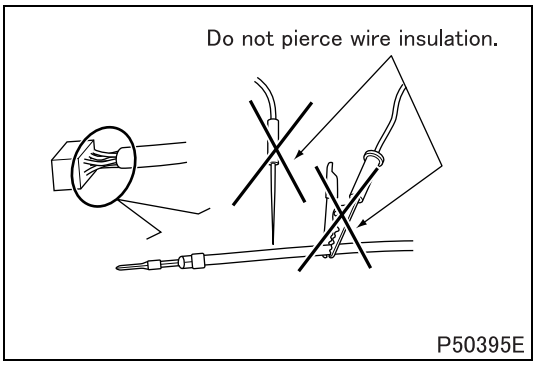

P00023

- Before washing the vehicle, cover all electrical parts to keep them dry. (Use plastic sheets or the like.) Keep water away from harness connectors and sensors and immediately wipe off any water that gets on them.



- When applying a voltage to a part for inspection purposes, check that the (+) and (–) cables are connected properly then gradually increase the voltage from zero. Do not exceed the specified voltage.
  Remember that control units and sensors do not necessarily operate on battery voltage.

1. Handling Precautions for Electric Circuits



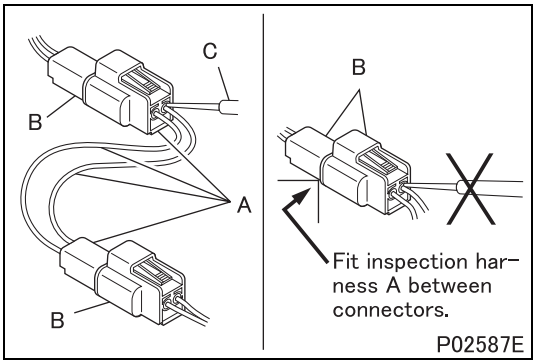
CAUTION ⚠

- **Do not pierce wire insulation with test probes or alligator clips when performing electrical inspections. Doing so can hasten corrosion, particularly with the chassis harness.**

1.1 Inspection of harnesses

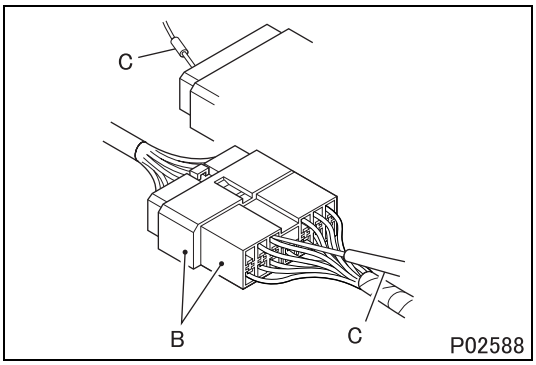
(1) Inspections with connectors fitted together

(1.1) Waterproof connectors

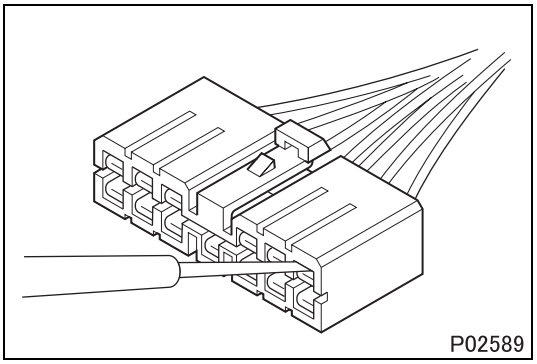


- Connect an inspection harness and connector **A** between the connectors **B** of the circuit to be inspected. Perform the inspection by applying a test probe **C** to the connectors of the inspection harness. Do not insert the test probe **C** into the wire-entry sides of the waterproof connectors since this would damage their waterproof seals and lead to rust.

(1.2) Non-waterproof connectors



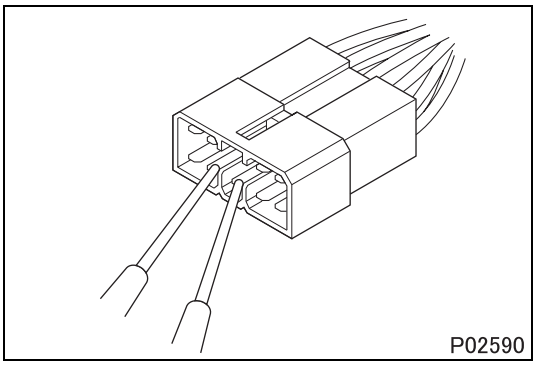
- Perform the inspection by inserting a test probe **C** into the wire-entry sides of the connectors. An extra-narrow probe is required for control unit connectors, which are smaller than other types of connector. Do not force a regular-size probe into control unit connectors since this would cause damage.


P02589

(2) Inspections with connectors separated

(2.1) Inspections on female terminals

- Perform the inspection by carefully inserting a test probe into the terminals. Do not force the test probe into the terminals since this could deform them and cause poor connections.

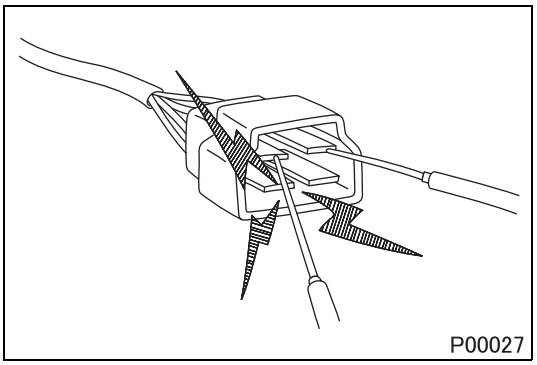

P02590

(2.2) Inspections on male terminals

- Perform the inspection by applying test probes directly to the pins.

CAUTION ⚠

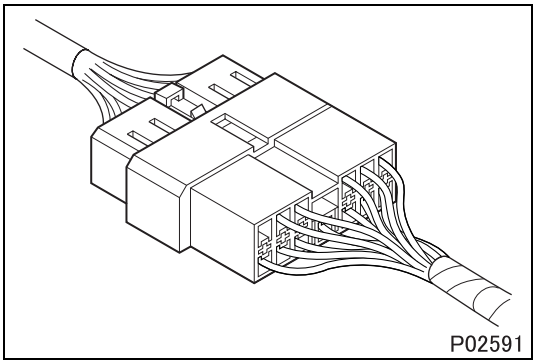
- **Be careful not to short-circuit pins through the test probes. If the pins of a control unit connector become short-circuited, this can cause damage to the control unit's internal circuitry.**


P00027

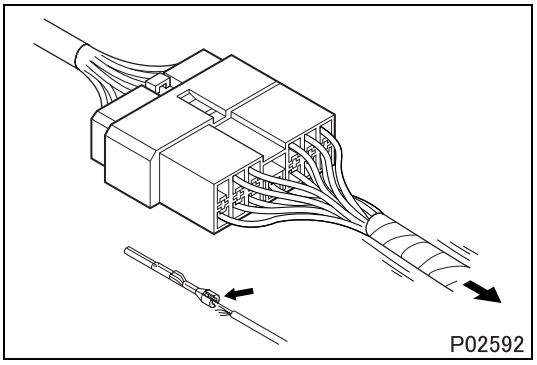
- When using a multimeter to check continuity, do not allow the test probes to touch the wrong terminals.

1.2 Inspection of connectors

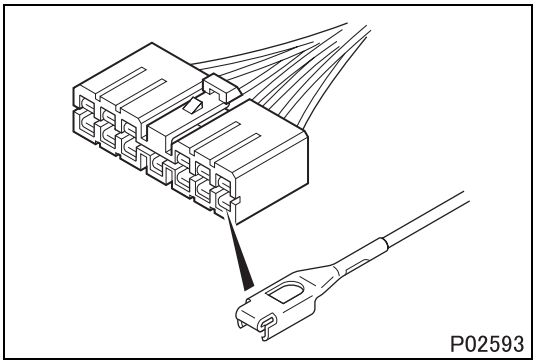
(1) Visual inspection


P02591

- Check that the connectors are fitted together securely.

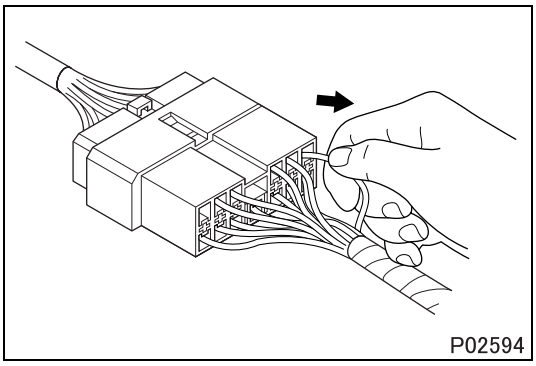

P02592

- Check for wires that have separated from their terminals due to pulling of the harness.


P02593

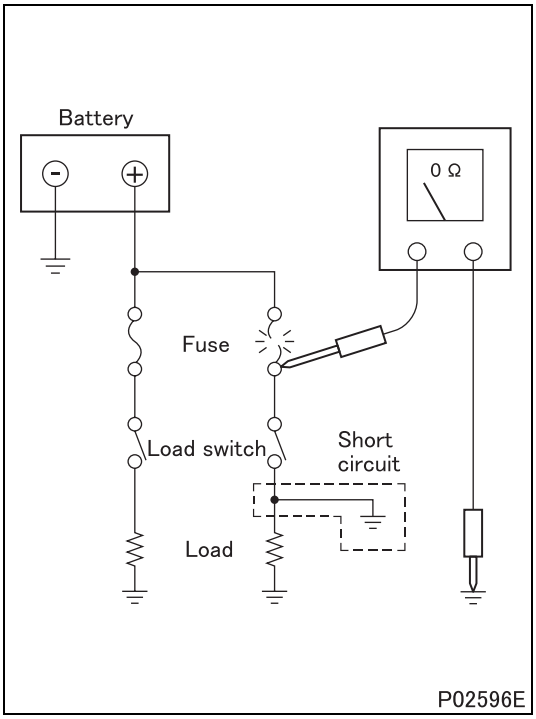
- Check that male and female terminals fit together tightly.

- Check for defective connections caused by loose terminals, by corrosion on terminals, or by contamination of terminals by foreign materials.


P02594

(2) Checking for loose terminals

- On a connector, if terminal retainers become damaged, male and female terminals may not mate with each other when the connector bodies are fitted together. To check for such terminals, gently tug on each wire and see whether any terminals slip out of their connector housings.

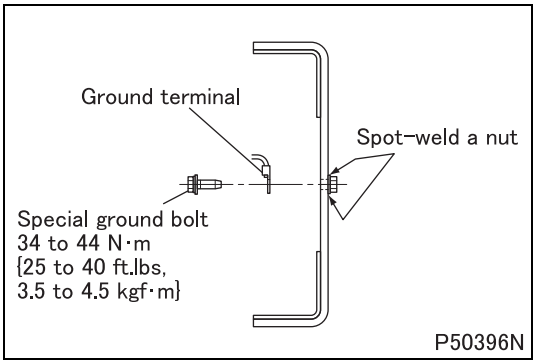


P02596E

1.3 Inspections when a fuse blows

- Remove the fuse, then measure the resistance between ground and the fuse's load side.
  Next, close the switch of each circuit connected to the fuse. If the resistance measurement between any switch and ground is zero, there is a short circuit between the switch and the load. If the resistance measurement is not zero, the circuit is not currently short-circuited; the fuse probably blew due to a momentary short circuit.

- The main causes of short circuits are as follows:
  - Harnesses trapped between chassis parts
  - Harness insulation damage due to friction or heat
  - Moisture in connectors or circuitry
  - Human error (accidental short-circuiting of components)



1.4 Inspection of chassis ground

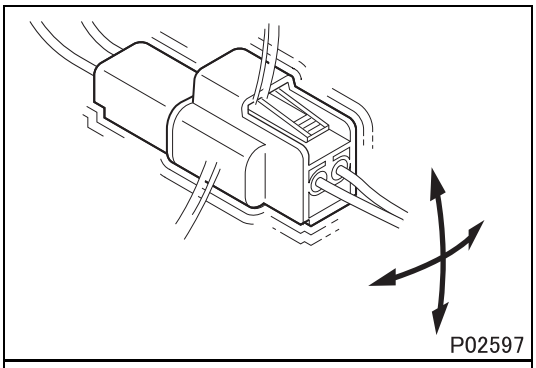
- A special ground bolt is used to tighten a ground terminal. When servicing the ground point, be sure to follow the procedures described below:
  - When reinstalling the ground bolt
    Tighten the ground bolt to the specified torque.
  - When relocating the ground point
    A special ground bolt must be used. Spot-weld a nut to a frame and tighten the ground bolt to the specified torque. Be sure to apply touch-up paint to the welded point.

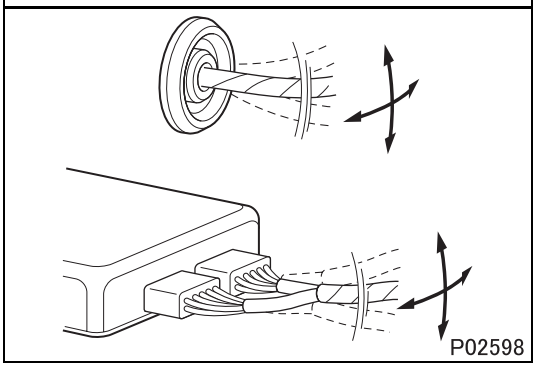
2. Service Precautions for Alternators

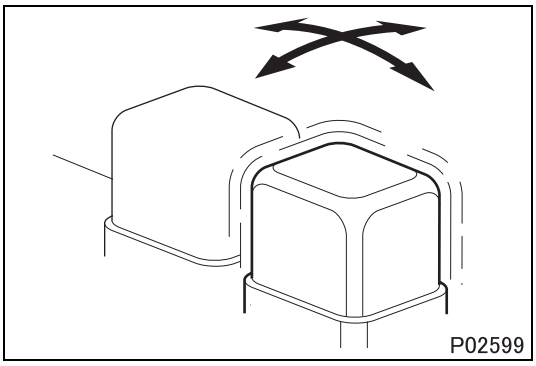
When servicing alternators, observe the following precautions:

- Never reverse the polarity of battery connections.
  If the polarity of the battery connections were to be reversed, a large current would flow from the battery to the alternator, damaging the diodes and regulator.
- Never disconnect the battery cables with the engine running.
  Disconnection of the battery cables during engine operation would cause a surge voltage, leading to damage to the diodes and regulator.
- Never perform inspections using a high-voltage multimeter.
  The use of a high-voltage multimeter could damage the diodes and regulator.
- Keep alternators dry.
  Water on alternators can cause internal short circuits and damage.
- Never operate an alternator with the B and L terminals short-circuited. Operation with the B and L terminals connected together would damage the diode trio.
- Disconnect the battery cables before quick-charging the battery with a quick charger.
  Unless the battery cables are disconnected, quick-charging can damage the diodes and regulator.

3. Intermittent Faults







- An intermittent fault typically occurs only under certain operating conditions. Once these conditions have been identified, the cause of the intermittent fault is easy to determine. First, ask the customer about the vehicle operating conditions and weather conditions under which the fault occurs. Also ask about the frequency with which the fault occurs and about the fault symptoms. Then reproduce the fault based on this information.
  Determine in this way if factors such as heat or vibration play a role in producing the fault. If vibration is a possible factor, try to reproduce the fault by doing the following:
  - Gently move connectors up and down and to left and right.
  - Gently move wiring harnesses up and down and to left and right.
  - Gently wiggle sensors and other devices by hand.
  - Gently wiggle wiring harnesses on suspension systems and other moving parts.

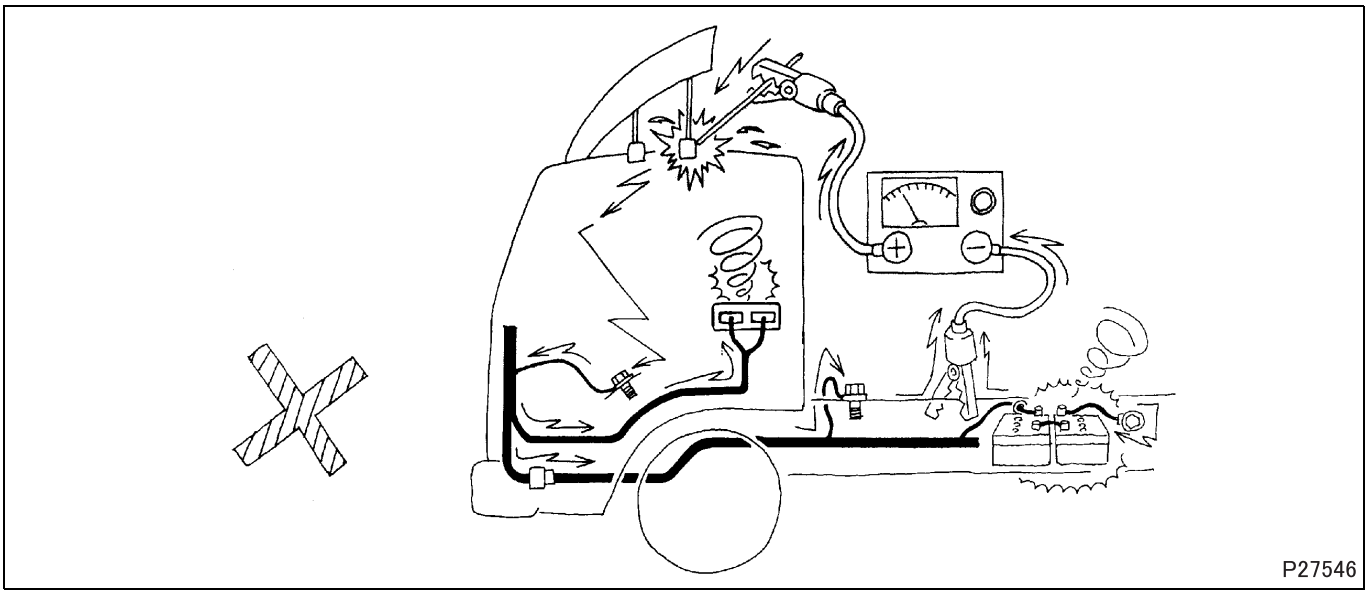
- To identify the connectors, harnesses, and other devices to be checked, consult the troubleshooting procedures for the affected system in this manual.

4. Precautions for Electric Welding

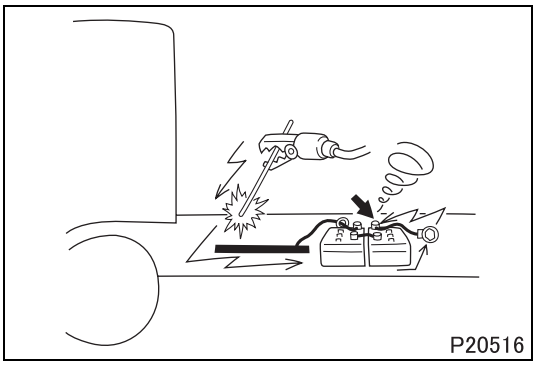
WARNING ⚠

- **Before performing any electric welding on a vehicle, disconnect the battery power and ground cable, and any electronic control units or similar devices installed on the vehicle. Electric currents produced during electric welding can damage various electrical components on the vehicle, which could result in malfunction of the components.**

Electric current from the welder flows to ground via the vehicle's metal parts. Unless appropriate steps are taken, this current can damage control units, other electrical devices and wiring harnesses.
Any electrical device near the point of attachment of the welding ground strap is especially liable to damage.



- Current flows backward as shown below.



4.1 From battery (–) cable

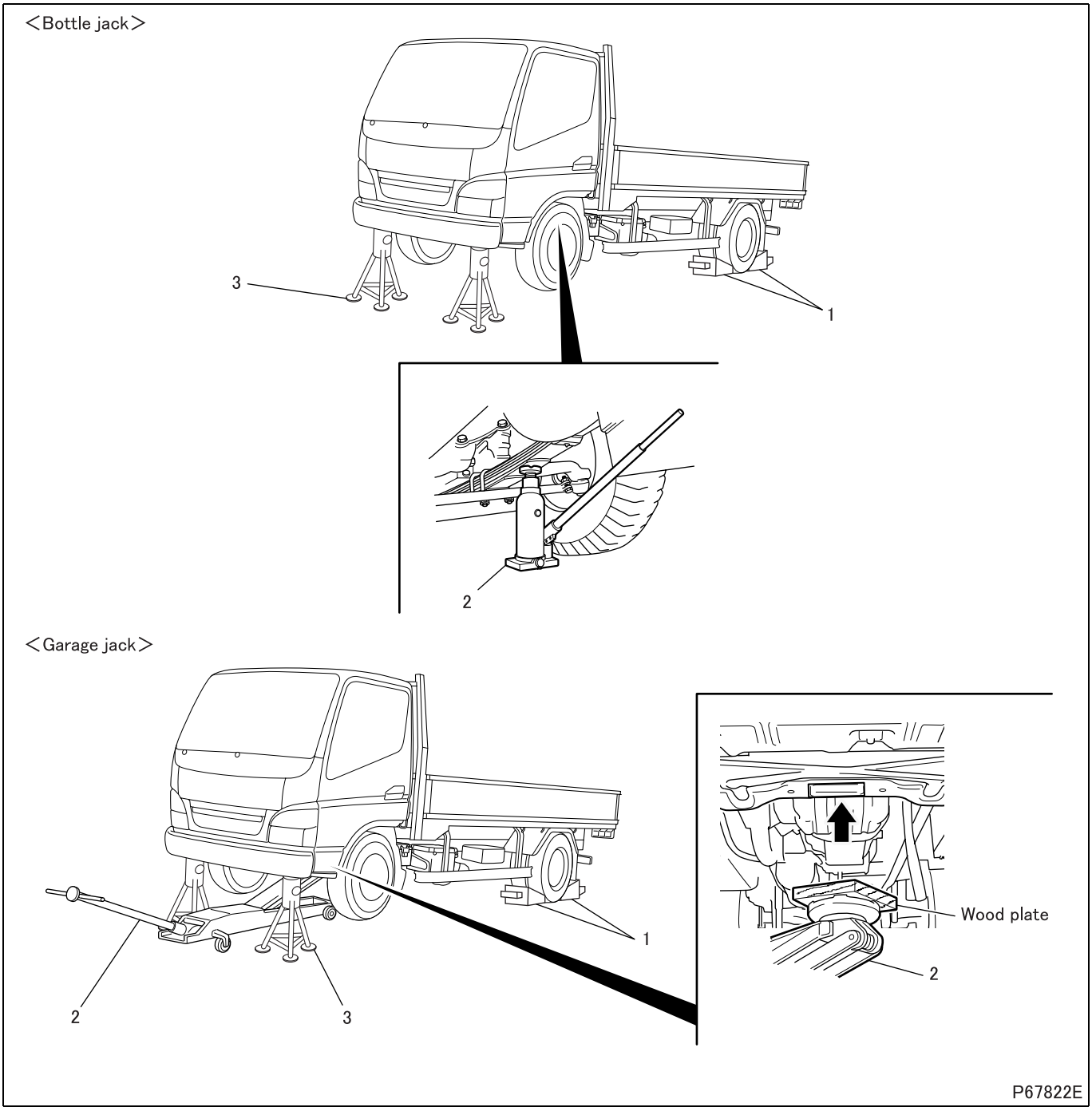
To prevent damage to the battery and to electrical devices that are connected directly to the battery, it is essential to disconnect the batteries.

4.2 Procedure

- Park the vehicle on a level surface. Shut down the engine and turn the ignition switch to LOCK.
- Set the parking brake and chock the front and rear tires.
- Disconnect the batteries.
- Attach the welding ground strap as close as possible to the work being done. If the frame is being welded, do not attach the welding ground strap to the cab. Similarly, If the cab is being welded, do not attach the welding ground strap to the frame.
- Cover all parts of the vehicle that may be damaged by welding sparks.
- Disconnect the engine, transmission, and ABS electronic control units.

M E M O

<Front of vehicle>



Jacking procedure

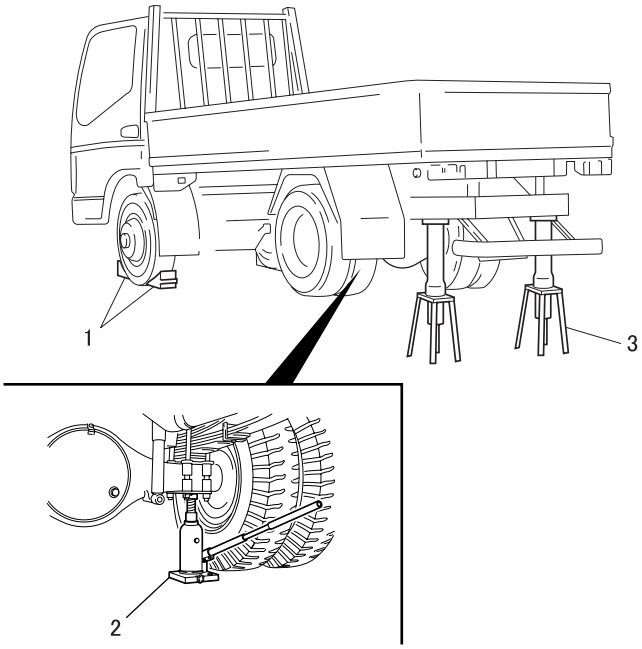
1 Chock the rear tires.
2 Using an axle or floor jack, raise the front of the vehicle.
3 Support the vehicle frame on safety stands.

WARNING ⚠

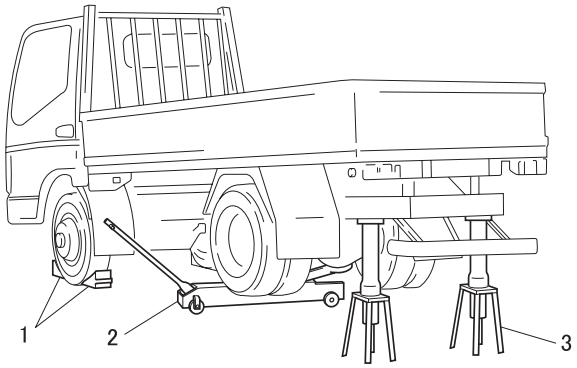
- **To prevent the vehicle from rolling, chock the tires firmly and do not remove the chocks until the operation is completed.**
- **Never work around or under a vehicle that is supported only by a jack. Always support the vehicle with safety stands. Jacks can slip, allowing the vehicle to fall, which could result in serious injury or death.**

<Rear of Vehicle>

＜Bottle jack＞



＜Garage jack＞



P58509E

Jacking up procedure

1 Chock the front tires.
2 Using an axle or floor jack, raise the front of the vehicle.
3 Support the vehicle frame on safety stands.

WARNING ⚠

- **To prevent the vehicle from rolling, chock the tires firmly and do not remove the chocks until the operation is completed.**
- **Never work around or under a vehicle that is supported only by a jack. Always support the vehicle with safety stands. Jacks can slip, allowing the vehicle to fall, which could result in serious injury or death.**

1. Diagnosis Codes

- Diagnosis codes indicate the faulty sections of the vehicle.
- A fault can be repaired by reading out the diagnosis code(s) stored in the control unit and performing the remedy for that code(s).
- Diagnosis codes can be displayed in the following two methods. Select either of them according to the system to be diagnosed.
  - Using a scanning tool (General Scanning Tool or Multi-Use Tester)
  - Using flashing of a warning lamp on meter cluster
- The table below indicates the systems for which diagnosis codes can be displayed and the methods usable for individual systems.

1.1 Systems and diagnosis code displaying methods

Warning lamp	System	Diagnosis codes displaying methods		Reference Gr
		Multi-Use Tester	Flashing of warning lamp	
CHECK ENGINE or	Common rail	O	O	13EA
	Exhaust gas recirculation			17
	Starter continuous energizing preventing function, Preheating system			54
	Vehicle speed limiting (SLD)	O	O	13EB
	Auto cruise			
	Automatic transmission	O	O	23
ABS or	Anti-lock brake system	O	O	35E

1.2 Types of diagnosis codes <Except Gr13EA and Gr23>

(1) System for which present and past codes are discriminately displayed

(1.1) Present diagnosis code

- Fault developed in the vehicle after the starter switch is set to ON is indicated by corresponding diagnosis code.
- The fault warning lamp is lit at the same time.

(1.2) Past diagnosis code

- Past fault developed in the vehicle is indicated by corresponding diagnosis code stored in the memory of the electronic control unit.
- With the vehicle restored to its normal condition or the starter switch turned from OFF to ON after inspection or repair against present diagnosis codes, the present diagnosis code is stored as past diagnosis codes in the memory of the electronic control unit.
- The warning lamp is not lit because the indicated fault is not present one.

1.3 Types of diagnosis codes <Gr13EA and Gr23>

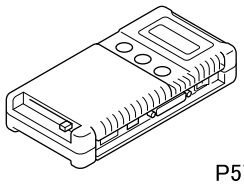
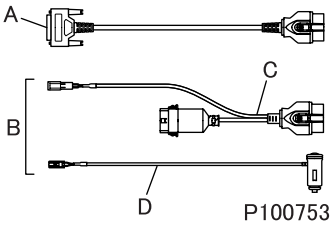
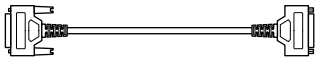
- The diagnosis codes has no distinction of present and past.
- If a fault occurs and an electronic control unit detects the fault, the electronic control unit will store a diagnosis code in memory after a diagnosing time predetermined for each fault content and turn on the warning lamp.
- When the fault has solved, the warning lamp goes off, but the diagnosis code still remains in the memory.
- The diagnosis codes can be erased by using the scanning tool (General Scanning Tool or Multi-Use Tester) or they will be erased automatically after a specified period.

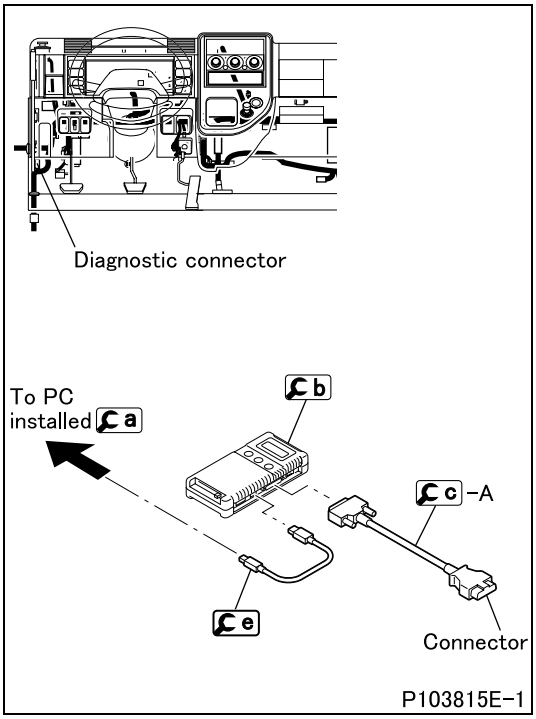
2. Reading and Erasing the Diagnosis Code

2.1 Using a Multi-Use Tester

(1) Connecting a Multi-Use Tester

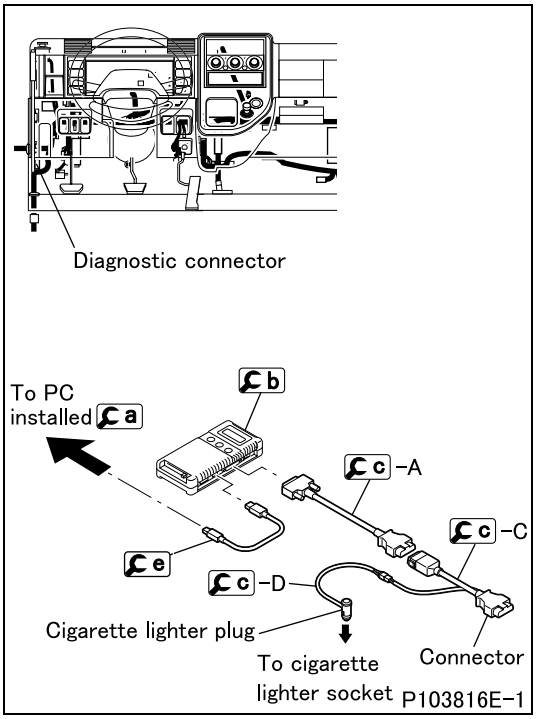
Special tools

Mark	Tool name and shape	Part No.	Application
a	PC P100236	SMS-E07-1* (Multi-Use Tester-III version)	Installation of the Muti-Use-Tester-III or version-up of the current version into Multi-Use Tester-III SOFTWARE DISC (Pub. No. SN0703C)
b	V.C.I.  P57296	MH062927	Data transmission between electronic control unit and PC
c	Multi-Use Tester test Harness E A: Harness for inspection and drive recorder B: Harness for drive recorder C: Drive recorder harness D: Cigarette lighter plug harness  P100753	MH063659 A: MH063661 B: MH063663 C: MH063665 D: MH063666	Power supply to V.C.I. and communication with electronic control unit
d	Multi-Use Tester test harness D (used for extension)  P57299	MH062951	Multi-Use Tester test harness B extension
e	USB cable P57300	MH063668	Communication between V.C.I. and PC



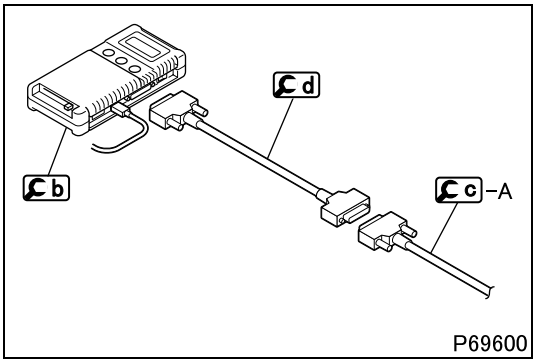
(1.1) To perform system inspection

- Move the starter switch to the LOCK position.
- Connect PC installed a, b, c-A and e as shown.
- Connect c-A connector to the diagnostic connector on the vehicle.



(1.2) To use drive recorder function

- Move the starter switch to the LOCK position.
- Connect PC installed a, b, c-A, c-C, c-D and e as shown.
- Connect c-C connector to the diagnostic connector on the vehicle.
- Connect the cigarette lighter plug of c-D to the cigarette lighter socket on the vehicle.



(1.3) To extend the Multi-Use Tester test harness

- Connect d to c-A to extend the test harness to use the Multi-Use Tester outside the vehicle.

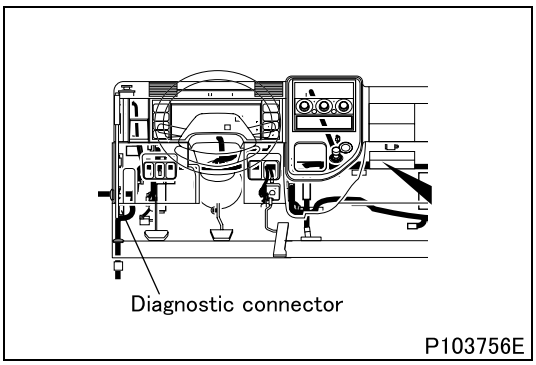
(2) Access of diagnosis code

- Set the starter switch to ON.
- Operate the Multi-Use Tester for a display of necessary diagnosis code stored in the memory of the electronic control unit and identify the location of the fault.

(3) Clearing of diagnosis code

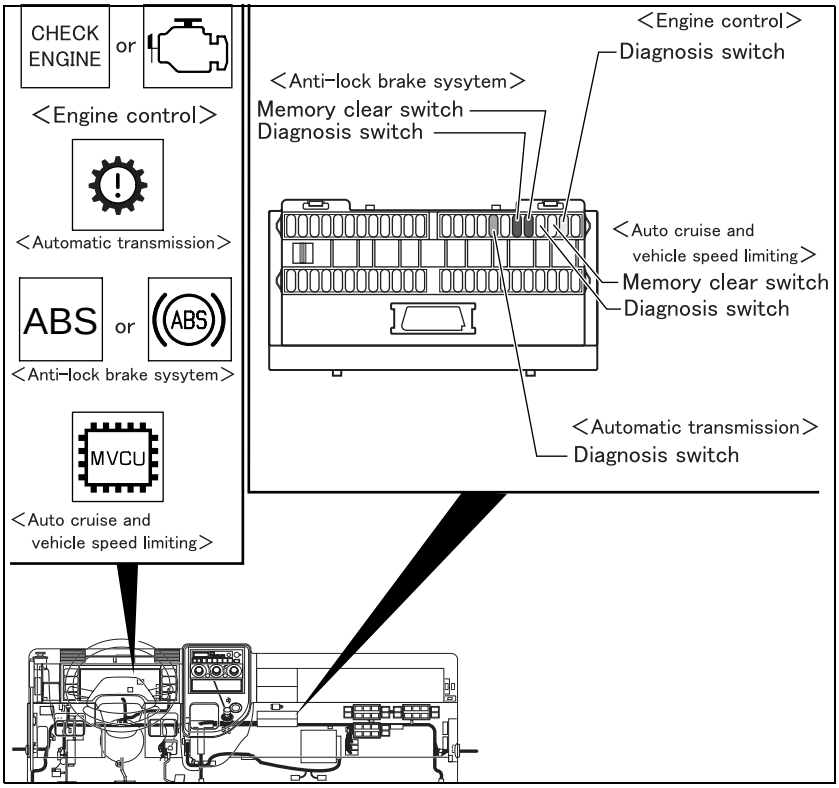
- Set the starter switch to ON (the engine not to be started).
- Operate the Multi-Use Tester to delete all the diagnosis codes stored in the memory of the electronic control unit.

2.2 Using a General Scanning Tool



- For the usage of a General Scanning Tool, refer to the instruction manual for that tool.

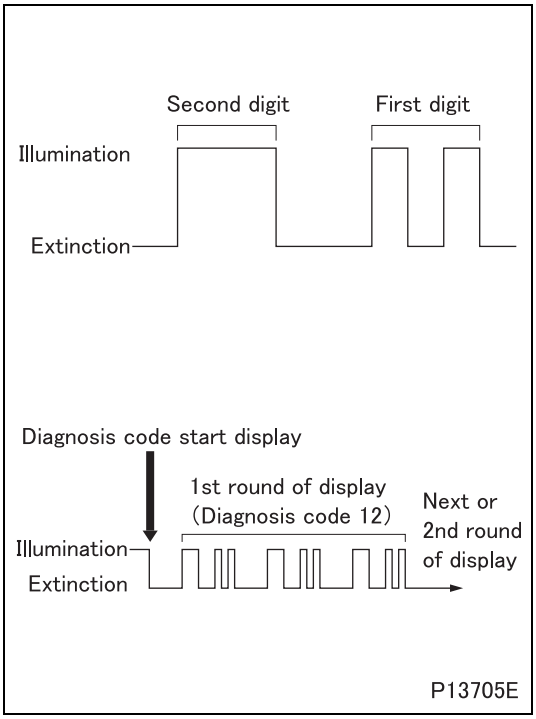
3. Retrieving Diagnosis Codes Using the Flashing Diagnostic Light



- Use the diagnosis and memory clear switches to display diagnosis codes.

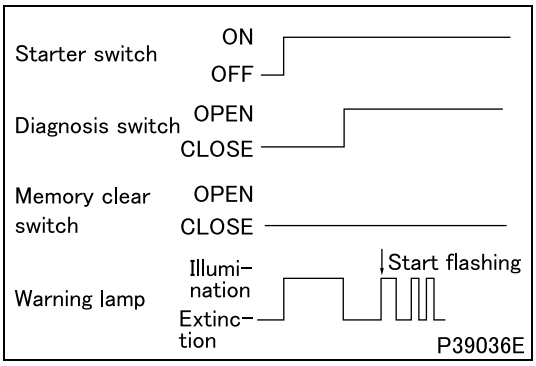
CAUTION ⚠

- **Disconnecting and connecting the memory clear switch can erase past diagnosis codes from memory. Before handling diagnosis codes, carefully follow the procedure described below to avoid erasing codes inadvertently. <Except Gr13EA and Gr23>**



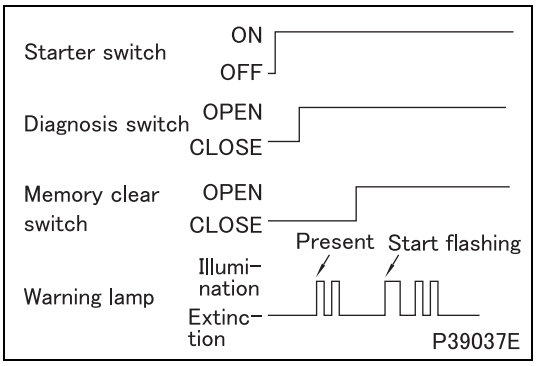
3.1 Reading diagnosis codes

- To read a diagnosis code, observe how may times the warning lamp flashes and how long each illumination lasts.
- The duration of illumination differs between the first and second digits.
  - Second digit: 1.2 sec.
  - First digit: 0.4 sec.
- A diagnosis code consists of the flashing of second digit and the flashing of first digit in that order. If a diagnosis code has “0” in the second digit, only the first digit will be displayed.
- The diagnosis code 01 will be displayed if the system is normal.
- The same diagnosis code will be displayed 3 times in a row before moving to the display of the next code.
- After the last diagnosis code is displayed, the first code will be displayed again 3 times in a row and then the subsequent codes. This will be repeated.



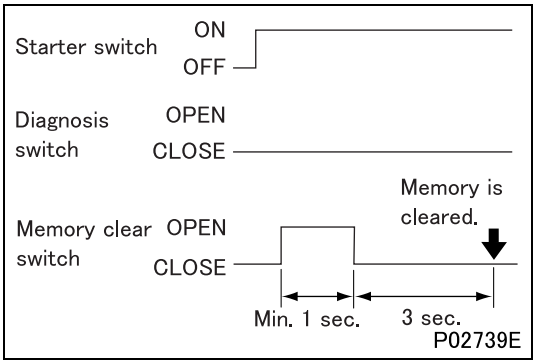
(4) Diagnosis codes <Gr13EA and Gr23>
Present diagnosis codes <Except Gr13EA and Gr23>

- Turn the starter switch ON.
- Remove the diagnosis switch.
- Present diagnosis codes will be displayed by flashing of the warning lamp.
- When the diagnosis switch is connected, electronic control unit will stop (terminate) displaying diagnosis codes.



(5) Present and past diagnosis codes <Except Gr13EA and Gr23>

- Turn the starter switch to the ON position.
- Open the diagnosis switch.
- Present diagnosis codes will be displayed by flashing of the warning lamp.
- Open the memory clear switch.
- Present and past diagnosis codes will be displayed by flashing of the warning lamp.
- Turn the starter switch to the OFF position and connect the memory clear switch and diagnosis switch to terminate the diagnosis code displaying mode.



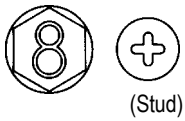
(6) Erasing diagnosis codes <Except Gr13EA and Gr23>

- Turn the starter switch to the ON position (do not start the engine).
- Open the memory clear switch and reconnect it; all diagnosis codes stored in electronic control unit memory will be erased.
  To cancel diagnosis code erasure after opening the memory clear switch, turn the starter switch to the OFF position and then reconnect the memory clear switch.

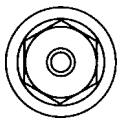
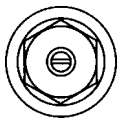
TABLE OF STANDARD TORQUE VALUES

- Use specified bolts and nuts. Tighten them to the torque values specified in this section unless otherwise stated.
- Threaded portions and bearing surfaces should be dry.
- When the nut is in a different strength class than the bolt (or stud), use the torque value for the bolt (or stud).

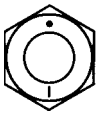
Hexagon Headed Bolt, Stud (Torque: N·m {lbf·ft, kgf·m})

Strength	4T		7T		8T	
Identification symbol Nominal diameter	(Stud)		(Stud)		 (Stud)	
M5	2 to 3 {1.5 to 2.2, 0.2 to 0.3}	–	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–	5 to 7 {3.7 to 5.2, 0.5 to 0.7}	–
M6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–	7 to 10 {5.2 to 7.4, 0.7 to 1.0}	–	8 to 12 {5.9 to 8.9, 0.8 to 1.2}	–
M8	9 to 13 {6.6 to 9.6, 0.9 to 1.3}	–	16 to 24 {12 to 18, 1.7 to 2.5}	–	19 to 28 {14 to 21, 2.0 to 2.9}	–
M10	18 to 27 {13 to 20, 1.8 to 2.7}	17 to 25 {13 to 18, 1.8 to 2.6}	34 to 50 {25 to 37, 3.5 to 5.1}	32 to 48 {24 to 35, 3.3 to 4.9}	45 to 60 {33 to 44, 4.5 to 6.0}	37 to 55 {27 to 41, 3.8 to 5.7}
M12	34 to 50 {25 to 37, 3.4 to 5.1}	31 to 45 {23 to 33, 3.1 to 4.6}	70 to 90 {52 to 66, 7.0 to 9.5}	65 to 85 {48 to 63, 6.5 to 8.5}	80 to 105 {59 to 77, 8.5 to 11}	75 to 95 {55 to 70, 7.5 to 10}
M14	60 to 80 {44 to 59, 6.0 to 8.0}	55 to 75 {41 to 55, 5.5 to 7.5}	110 to 150 {81 to 110, 11 to 15}	100 to 140 {74 to 105, 11 to 14}	130 to 170 {96 to 125, 13 to 17}	120 to 160 {89 to 120, 12 to 16}
M16	90 to 120 {66 to 89, 9 to 12}	90 to 110 {66 to 81, 9 to 11}	170 to 220 {125 to 160, 17 to 23}	160 to 210 {120 to 155, 16 to 21}	200 to 260 {145 to 190, 20 to 27}	190 to 240 {140 to 175, 19 to 25}
M18	130 to 170 {96 to 125, 14 to 18}	120 to 150 {89 to 110, 12 to 16}	250 to 330 {185 to 245, 25 to 33}	220 to 290 {160 to 215, 23 to 30}	290 to 380 {215 to 280, 30 to 39}	250 to 340 {185 to 250, 26 to 35}
M20	180 to 240 {130 to 175, 19 to 25}	170 to 220 {125 to 160, 17 to 22}	340 to 460 {250 to 340, 35 to 47}	310 to 410 {230 to 300, 32 to 42}	400 to 530 {295 to 390, 41 to 55}	360 to 480 {265 to 355, 37 to 49}
M22	250 to 330 {185 to 245, 25 to 33}	230 to 300 {170 to 220, 23 to 30}	460 to 620 {340 to 455, 47 to 63}	420 to 560 {310 to 415, 43 to 57}	540 to 720 {400 to 530, 55 to 73}	490 to 650 {360 to 480, 50 to 67}
M24	320 to 430 {235 to 315, 33 to 44}	290 to 380 {215 to 280, 29 to 39}	600 to 810 {440 to 595, 62 to 83}	540 to 720 {400 to 530, 55 to 73}	700 to 940 {515 to 695, 72 to 96}	620 to 830 {455 to 610, 63 to 85}

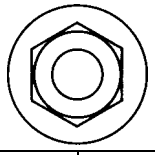
Hexagon Headed Flange Bolt (Torque: N·m {lbf·ft, kgf·m})

Strength	4T		7T		8T	
Identification symbol Nominal diameter						
M6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–	8 to 12 {5.9 to 8.9, 0.8 to 1.2}	–	10 to 14 {7.4 to 10, 1.0 to 1.4}	–
M8	10 to 15 {7.4 to 11, 1.0 to 1.5}	–	19 to 28 {14 to 21, 2.0 to 2.9}	–	22 to 33 {16 to 24, 2.3 to 3.3}	–
M10	21 to 31 {15 to 23, 2.1 to 3.1}	20 to 29 {15 to 21, 2.0 to 3.0}	45 to 55 {33 to 41, 4.5 to 5.5}	37 to 54 {27 to 40, 3.8 to 5.6}	50 to 65 {37 to 48, 5.0 to 6.5}	50 to 60 {37 to 44, 5.0 to 6.5}
M12	38 to 56 {28 to 41, 3.8 to 5.5}	35 to 51 {26 to 38, 3.5 to 5.2}	80 to 105 {59 to 77, 8.0 to 10.5}	70 to 95 {52 to 95, 7.5 to 9.5}	90 to 120 {66 to 89, 9 to 12}	85 to 110 {63 to 81, 8.5 to 11}

Hexagon Nuts (Torque: N·m {lbf·ft, kgf·m})

Strength	4T		6T	
Identification symbol				
Nominal diameter	Standard screw thread	Coarse screw thread	Standard screw thread	Coarse screw thread
M5	2 to 3 {1.5 to 2.2, 0.2 to 0.3}	–	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–
M6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–	7 to 10 {5.2 to 7.4, 0.7 to 1.0}	–
M8	9 to 13 {6.6 to 9.6, 0.9 to 1.3}	–	16 to 24 {12 to 18, 1.7 to 2.5}	–
M10	18 to 27 {13 to 20, 1.8 to 2.7}	17 to 25 {13 to 18, 1.8 to 2.6}	34 to 50 {25 to 37, 3.5 to 5.1}	32 to 48 {24 to 35, 3.3 to 4.9}
M12	34 to 50 {25 to 37, 3.4 to 5.1}	31 to 45 {23 to 33, 3.1 to 4.6}	70 to 90 {52 to 66, 7.0 to 9.5}	65 to 85 {48 to 63, 6.5 to 8.5}
M14	60 to 80 {44 to 59, 6.0 to 8.0}	55 to 75 {41 to 55, 5.5 to 7.5}	110 to 150 {81 to 110, 11 to 15}	100 to 140 {74 to 105, 11 to 14}
M16	90 to 120 {66 to 89, 9 to 12}	90 to 110 {66 to 81, 9 to 11}	170 to 220 {125 to 160, 17 to 23}	160 to 210 {120 to 155, 16 to 21}
M18	130 to 170 {96 to 125, 14 to 18}	120 to 150 {89 to 110, 12 to 16}	250 to 330 {185 to 245, 25 to 33}	220 to 290 {160 to 215, 23 to 30}
M20	180 to 240 {130 to 175, 19 to 25}	170 to 220 {125 to 160, 17 to 22}	340 to 460 {250 to 340, 35 to 47}	310 to 410 {230 to 300, 32 to 42}
M22	250 to 330 {185 to 245, 25 to 33}	230 to 300 {170 to 220, 23 to 30}	460 to 620 {340 to 455, 47 to 63}	420 to 560 {310 to 415, 43 to 57}
M24	320 to 430 {235 to 315, 33 to 44}	290 to 380 {215 to 280, 29 to 39}	600 to 810 {440 to 595, 62 to 83}	540 to 720 {400 to 530, 55 to 73}

Hexagon Flange Nuts (Torque: N·m {lbf·ft, kgf·m})

Strength	4T	
Identification symbol		
Nominal diameter	Standard screw thread	Coarse screw thread
M6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–
M8	10 to 15 {7.4 to 11, 1.0 to 1.5}	–
M10	21 to 31 {15 to 23, 2.1 to 3.1}	20 to 29 {15 to 21, 2.0 to 3.0}
M12	38 to 56 {28 to 41, 3.8 to 5.6}	35 to 51 {26 to 38, 3.5 to 5.2}

Torque Values for General-Purpose Flare Nut: N·m {lbf·ft, kgf·m}

Pipe diameter	ϕ4.76 mm {0.19 in.}	ϕ6.35 mm {0.25 in.}	ϕ8 mm {0.31 in.}	ϕ10 mm {0.39 in.}	ϕ12 mm {0.47 in.}	ϕ15 mm {0.59 in.}
Torque value	17 {13, 1.7}	25 {18, 2.6}	39 {29, 4.0}	59 {44, 6.0}	88 {65, 9.0}	98 {72, 10}

Torque Values for General-Purpose Air Piping Nylon Tube (DIN Type): N·m {lbf·ft, kgf·m}

Nominal diameter × wall thickness	6 × 1 mm {0.24 × 0.039 in.}	10 × 1.25 mm {0.39 × 0.049 in.}	12 × 1.5 mm {0.47 × 0.059 in.}	15 × 1.5 mm {0.59 × 0.059 in.}
Torque value	20^{+6}_{0} {$15^{+4.4}_{0}$ $2.0^{+0.6}_{0}$}	34^{+10}_{0} {$25^{+7.4}_{0}$ $3.5^{+1.0}_{0}$}	49^{+10}_{0} {$36^{+7.4}_{0}$ $5.0^{+1.0}_{0}$}	54^{+5}_{0} {$40^{+3.7}_{0}$ $5.5^{+0.5}_{0}$}

Torque Values for General-Purpose Air Piping Nylon Tube (SAE Type): N·m {lbf·ft, kgf·m}

Nominal diameter	1/4 in.	3/8 in.	1/2 in.	5/8 in.
Torque value	13^{+4}_{0} {$9.6^{+3.0}_{0}$ $1.3^{+0.4}_{0}$}	29^{+5}_{0} {$21^{+3.7}_{0}$ $3.0^{+0.5}_{0}$}	49^{+5}_{0} {$36^{+3.7}_{0}$ $5.0^{+0.5}_{0}$}	64^{+5}_{0} {$47^{+3.7}_{0}$ $6.5^{+0.5}_{0}$}

GROUP 01 INDEX

HOW TO READ THE MAINTENANCE SCHEDULE TABLES 01-2

MAINTENANCE SCHEDULE TABLES 01-4

MAINTENANCE OPERATIONS 01-8

LUBRICATION TABLES 01-14

LUBRICATION 01-15

HOW TO READ THE MAINTENANCE SCHEDULE TABLES

Example Table:

Ⓔ: Exhaust emission items.
Ⓝ: Noise control items.

Item (1)	Time of inspection and maintenance (2)									Working procedures (3)	Reference Gr (4)
			Inspection interval								
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles	Every 90,000 km/ 54,000 miles	Every 250,000 km/ 150 ,000 miles		
ENGINE											
Fuel, oil, or coolant leaks from engine	×									Check engine for fuel, oil and coolant leaks.	Gr11, 12 13A, 14
ⒺⓃ Engine conditions	×									Check the engine for smooth starting and quiet running.	Gr11, 13 15, 17, 54
Manifold bolts and nuts torque							×			Check inlet exhaust manifold dolts and nuts for looseness.	Gr15
Ⓔ Check and adjust valve clearance		×					×			Check valve clearance with thickness gauge.	Gr11
Ⓔ Oil filter replacement			Every 10,000 km/6,000 miles or 12 months							Replace oil filters	Gr12

(1) This column contains the maintenance and inspection items.

(2) The inspection and service intervals are based on the assumption that the vehicle will be driven approximately 60,000 kilometers (36,000 miles) per year.
Mandatory inspections are indicated by an "×" or by the appropriate period between servicing.

(3) This column (working procedures) provides a simplified explanation of the operational procedures involved for each inspection or maintenance item.

(4) This column (Reference group) refers to the "group number" in this manual where detailed procedures can be found.

M E M O

MAINTENANCE SCHEDULE TABLES

Ⓔ: Exhaust emission items.
Ⓝ: Noise control items.

Item	Time of inspection and maintenance									Working procedures	Reference Gr
			Inspection interval								
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles	Every 90,000 km/ 54,000 miles	Every 250,000 km/ 150,000 miles		
ENGINE											
Leakage of coolant, fuel and oil	×									Check the underneath of the vehicle for any sign of leakage.	Gr11, 12, 13A, 14
ⒺⓃ Engine conditions	×									Check the engine for smooth starting and quiet running.	Gr11, 13, 15, 17, 54
Manifold bolts and nuts torque							×			Check inlet exhaust manifold bolts and nuts for looseness.	Gr15
Ⓔ Check and adjust valve clearance		×					×			Check valve clearance with feeler gauge.	Gr11
Ⓔ Oil filter replacement			Every 10,000 km/6,000 miles or 12 months							Replace oil filters.	Gr12
Ⓔ Fuel filter replacement			Every 20,000 km/12,000 miles or 12 months							Replace fuel filter.	Gr13A
Ⓔ Fuel line			Every 20,000 km/12,000 miles or 12 months							Inspect the fuel tank, cap and lines for damage causing leakage.	Gr13A
ⒺⓃ Belts tension and damage	×		Every 10,000 km/6,000 miles or 12 months							Inspect belts for crack, wear and tension.	Gr14
Ⓔ Cooling system				×						Check radiator and pressure cap for sealing performance and mounting condition. Inspect hoses for looseness, deterioration, damage causing leakage. Remove dust and foreign matter deposit from radiator and intercooler front.	Gr14
Coolant level	×									Check that the coolant level is between the “FULL” and “LOW” marks on the reservoir tank.	Gr14
Coolant replacement			Every 24 months							Replace coolant.	Gr14
Ⓔ Turbocharger rotor play									×	Check turbocharger rotor play.	Gr15
Air cleaner element			Every 5,000 km/3,000 miles							Clean air cleaner element by blowing clean compressed air.	Gr15
ⒺⓃ Air cleaner element replacement						×				Replace air cleaner element.	Gr15
ⒺⓃ Exhaust system				×						Inspect the exhaust system for damage, corrosion and loose connection causing leakage.	Gr15

Item	Time of inspection and maintenance									Working procedures	Reference Gr
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval: Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles	Every 90,000 km/ 54,000 miles	Every 250,000 km/ 150,000 miles		
Ⓔ DPF			Every 10,000 km/6,000 miles or 12 months							Check DPF for blocking.	Gr15
			First 185,000 km/110,000 miles thereafter every 105,000 km/65,000 miles							DPF ash cleaning	
POWER TRAIN											
Clutch pedal play	×									Check the clutch pedal for play.	Gr21
Clutch pedal and clutch disc wear			×							Check the pedal for free play. Check clutch disc wear.	Gr21
Range selector lever	×		Every 30,000 km/18,000 miles or 6 months							Check the operate performance of range selector lever	Gr23
Propeller shaft flange torque and universal joint looseness		×	×							Check flange yoke bolts for looseness and universal joint for play.	Gr25
Propeller shaft center bearing							×			Check center bearing if trace of grease flowing out is evident. Check center bearing for wear, damage and play.	Gr25
FRONT AND REAR AXLE											
Wheel hub bearing					×					Check wheel hub bearing for play.	Gr26, 27
Wheel hub bearing hub seals replacement					×					When wheel hub bearing grease is replaced, also replace the wheel hub bearing hub seals.	Gr26, 27
Wheel and tire	×		×							Check disc wheel for corrosion, deformation and cracks. Measure inflation pressure with tire gauge. Check tire tread and side wall for cracks and damage. Measure tire tread groove depth to make sure it is deep enough. Check tire tread for uneven wear, stepped wear and other abnormal wear.	See later section.
			×							Rotate all tires.	
Retightening wheel nuts		×	×							Check wheel nuts for looseness. Check at the first 50 to 100 km/30 to 60 miles after changing a wheel.	See later section.
SUSPENSION SYSTEM											
Suspension springs	×									Check for broken springs and tilt of vehicle body toward either side.	Gr33, 34

Item	Time of inspection and maintenance									Working procedures	Reference Gr
			Inspection interval								
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles	Every 90,000 km/ 54,000 miles	Every 250,000 km/ 150,000 miles		
Retightening U-bolts		×		×						Check U-bolt nuts for looseness. Check at the first 1,000 km/600 miles after removing and retightening U-bolt nuts. Do not reuse the removed nuts.	Gr33, 34
BRAKING SYSTEM											
Service brake pedal	×									Check brake pedal play and stroke.	Gr35A
Brake performance	×									Press the brake pedal and check that the brakes work effectively and evenly on all wheels.	Gr35A
Disc brake pad and disc			×							Check disc brake pad and disc for damage and wear.	Gr35A
Brake lining			×							Check lining for wear through inspection hole.	Gr35A
Brake drum					×					Disassemble and check drum for wear, crack and damage.	
Parking brake lever stroke	×									Check parking brake lever stroke.	Gr36
Looseness, play and damage of brake system parts			×							Inspect brake lines and hoses looseness, play and damage. Inspect wheel cylinder and brake master cylinder for looseness, play and damage.	Gr35A
STEERING SYSTEM											
Steering wheel play	×									Turn steering wheel right and left to measure play at steering wheel rim. Measure while engine is running.	Gr37
Steering wheel operation	×									Check that the steering wheel does not vibrate or pull to one side and that it is not unduly heavy. Also make sure that the steering wheel returns to its neutral position smoothly.	Gr37
Steering system			×							Check steering system for looseness, steering wheel play and operating condition. Inspect for oil leaks, booster and oil pump function.	Gr37
Drag link ball joint dust cover					×					Check the dust cover for wear, cracks and other damage.	Gr37
CAB											
Defroster	×									Make sure that warm air blows properly onto the windshield.	Gr55

Item	Time of inspection and maintenance									Working procedures	Reference Gr
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval								
			Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles	Every 90,000 km/ 54,000 miles	Every 250,000 km/ 150,000 miles		
Rearview mirrors	×									Seated in the driver's seat, adjust the angles for clear views of the sides and rear. Make sure the mirrors are clean.	Gr51
License plate and reflector condition	×									Check the license plate and reflectors for loose installation, damage, and dirt.	–
Door locks	×									Push down the lock knob and verify that the door does not open even when the inner handle is operated.	Gr43
Seat belts	×									Confirm that the seat belt buckles function correctly when fastening and unfastening.	Gr52
ELECTRICAL SYSTEM											
Horn operation	×									Press the horn button to check that the horn is working properly.	Gr54
Windshield washer fluid level	×									Confirm that the windshield washer fluid level is above the bottom of the inspection window.	–
Windshield wiper and washer operation	×									Check the washer for proper fluid spray direction and the wipers for normal action.	Gr51, 54
Lighting system	×									Make sure that each lamp lights up or flashes properly. Check lamp lenses for dirt and damage.	Gr54
Gauge, warning/indicator lamp operation	×									Check that gauges, warning lamps and indicators are working properly.	Gr54

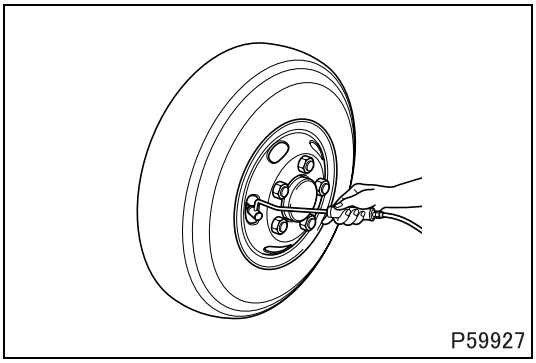
Tire

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
–	Depth of tire tread grooves	–	1.6 {0.063}	Replace

Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
–	Wheel nut	490 ± 49 {360 ± 36}	–


P59927

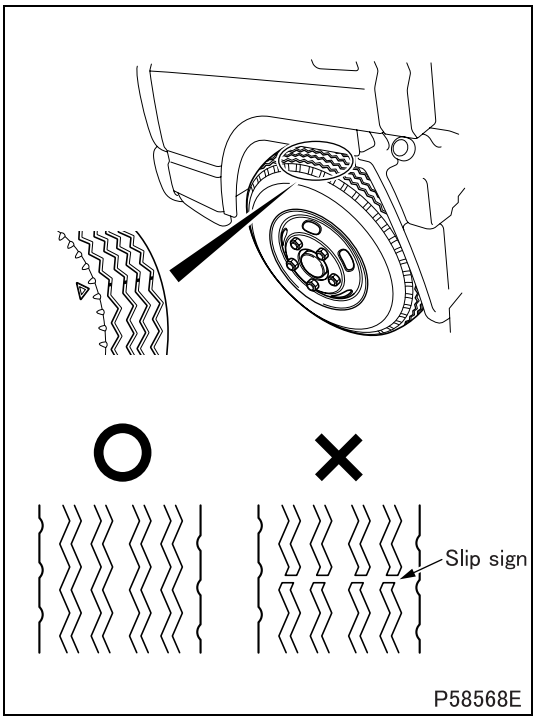
Check inflation pressure

Check air pressure before the vehicle is driven, while the tires are still cool.

Item / Vehicle model	Tire size	Air pressure kPa {psi}
COE 40/45	LT215/85R16-10PR (load range E)	550 {80, 5.5}
COE 50	215/75R17.5 124/123L (load range F)	690 {100, 7.0}

WARNING ⚠

Inflate tires to the standard inflation pressure. Tire underinflation or overinflation will damage wheels and tires and could result in a blowout, causing possible personal injury and property damage.



P58568E

CAUTION ⚠

- **Always install the valve caps after checking or adjusting air pressure. Unless the valve caps are in place, dirt and dust may stick in the valves and cause a flat tire.**

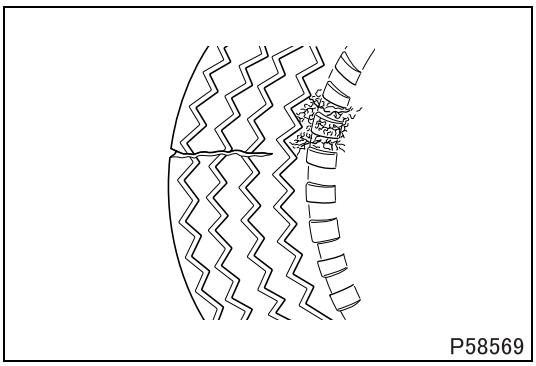
- Make sure the valve cap is securely fitted on each tire.
- It is not necessary to increase tire pressure before high-speed driving.
- On dual wheels, inflate both inner and outer tires to the same pressure.

Check tread depth

- Check all around each tire to make sure the remaining tread is deep enough.
- When the tread wears, slip signs (wear bars) appear across the tire at locations corresponding to the ⧋ marks.

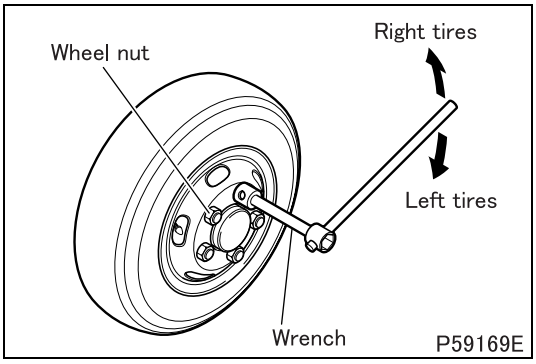
WARNING ⚠

To prevent an injury accident or loss of life, replace worn tires as soon as possible. Worn tires are more susceptible to punctures. They are also more likely to skid and/or hydroplane.


P58569

Check for cracks, damage, and objects embedded in the treads

- Check the tread surface and sidewalls of each tire for cracks, damage, and excessive or unusual wear.
- Check for metal pieces, nails, and stones embedded in the tread or caught between the tires (on dual-wheel axles).



Remove the wheel

- Set the parking brake and chock the front or rear tires, as applicable.
- Position a jack under the front or rear axle jacking point of the vehicle, as applicable. Raise the vehicle high enough to take weight off the wheel, but low enough that the tire still touches the ground.
- Loosen the wheel nuts slightly. The wheel nuts for right tires have right-hand threads "**R**", and the wheel nuts for left tires have left-hand threads "**L**".

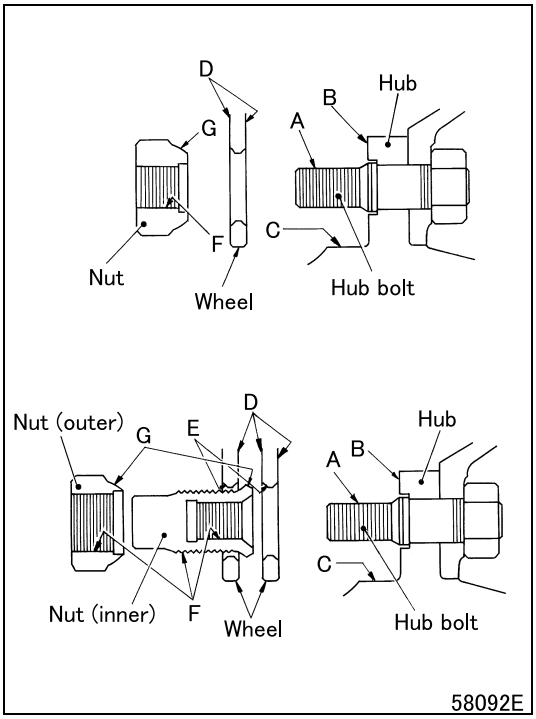
WARNING ⚠

Make certain that the socket is fully seated on the wheel nut. If not, the wrench could slip off the nut and cause a personal injury.

CAUTION ⚠

At this time, do not loosen the wheel nuts too much. You could damage the threads.

- Raise the vehicle until the tire is just clear of the ground. Remove the wheel nuts, and then remove the wheel and tire assembly.
- When working on dual-wheel axles, remove the outside wheel and tire assembly first. Then lower the vehicle and loosen the nuts on the inside tire. After doing this, raise the vehicle again and remove the wheel and tire assembly.



Mounting the wheel

Clean the following areas before mounting the wheel. Dirt or debris in these areas could cause the wheel nuts to become loose during operation.

- **A:** Hub bolt thread area
- **B:** Wheel mounting surface of hub
- **C:** Wheel alignment area of hub
- **D:** Disc wheel mating surface
- **E:** Disc wheel nut mounting surface
- **F:** Wheel nut thread area
- **G:** Wheel nut spherical area

- Even if only the outside tire is to be changed, do not mount it until the inner wheel nuts have been fastened at the specified torque.
- When installing dual wheels, make sure that the air valve on the inner tire is not lined up with the air valve on the outer tire.

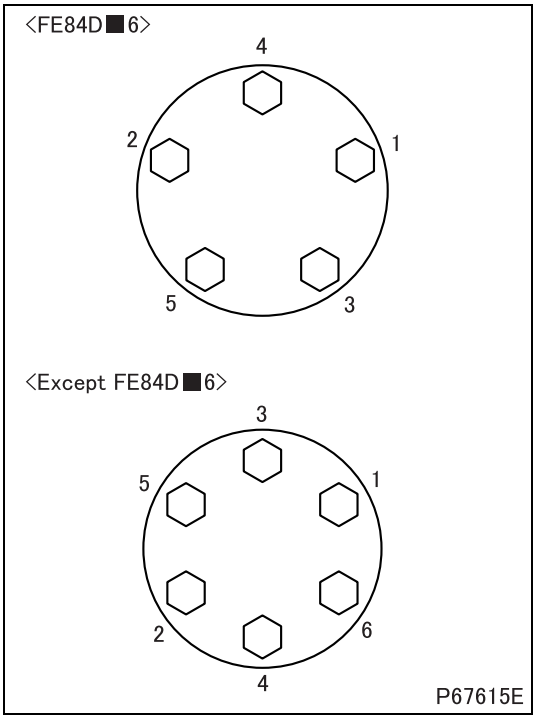
WARNING ⚠

If wheel studs or nut threads are damaged, or the disc wheel is cracked or otherwise damaged, replace the wheel. A damaged wheel could work loose and cause an injury accident.

CAUTION ⚠

Check hub bolt threads carefully for damage before putting the tire on.

- Mount the wheel on the hub. Install the wheel nuts tight enough to hold the wheel in position.
- If the wheel nut has a spherical end, direct the spherical end toward the wheel. Center the nuts on the wheel studs.
- Lower the vehicle until the tire makes contact with the ground.



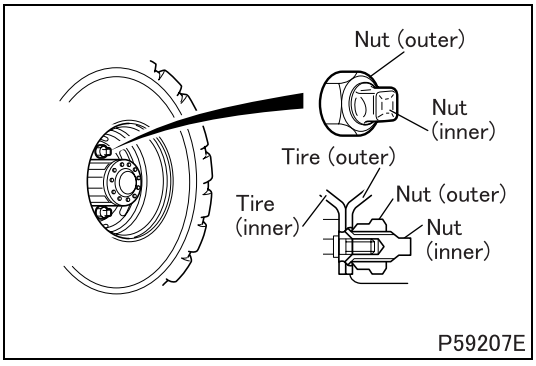
- Tighten the nuts in the order as illustrated, tightening each nut two or three times. To finish, tighten each nut at the specified torque.

WARNING ⚠

- **Tighten all wheel nuts to the required torque value. When replacing the outer wheel in a dual-wheel set, be sure to tighten the inner wheel nuts before tightening the outer wheel nuts. If the nuts are not tight, the wheel may work loose and cause an injury accident.**

CAUTION ⚠

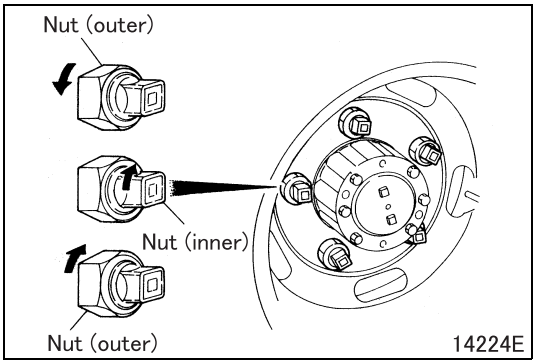
- **Do not coat the threads of the wheel nuts with grease. If the wheel nuts are over-tightened, they could be damaged.**



- On dual rear wheels, mount the outer wheel as described below.
  - When finished mounting the inner wheel and fully tightening the inner wheel nuts, raise the vehicle on the jack again.
  - Mount the outer wheel on the wheel hub, then tighten the wheel nuts to hold the wheel in position.
  - Tighten the wheel nuts in three stages, ending with the final torque shown in the table. Use the tightening sequence shown in the illustration.

Check the wheel nuts

The wheel nuts should be checked for looseness every 10 000 km (6000 miles). All nuts should be tightened to the specified torque value.



- On dual-wheel assemblies, check the wheel nuts as follows:

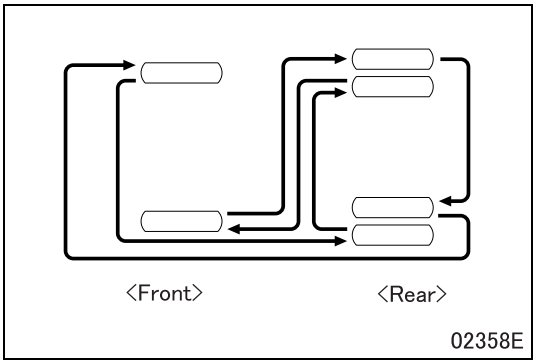
(1) Loosen the outer wheel nuts.
(2) Tighten the inner wheel nuts to the specified torque.
(3) Tighten the outer wheel nuts to the specified torque.

CAUTION ⚠

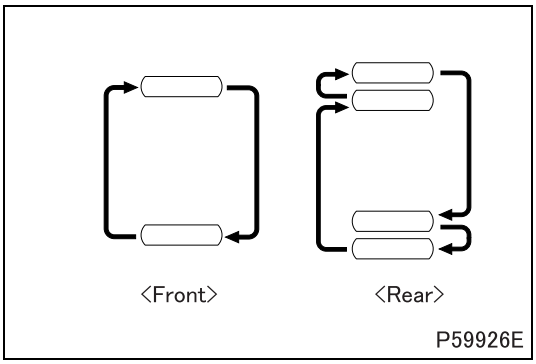
If the outer wheel nuts are tightened without first being loosened, it might not be possible to tighten them to the specified torque.

Tire rotation

The amount of wear on a tire depends on its position on the vehicle. To equalize wear and extend life as much as possible, rotate the tires every 10 000 km (6000 miles) in the rotation order shown below:



- When the tread pattern for all tires is identical:



- When the tread patterns are different for the front and rear tires:

NOTE

- *If using different tread patterns on the front and rear wheels, select tires with a ribbed tread for the front wheels and tires with a traction-type tread for the rear wheels.*

WARNING ⚠

- **After a wheel has been replaced, the wheel nuts will loosen somewhat as they wear in, creating a potential for an injury accident. Tighten the wheel nuts again after the vehicle has been driven 50 to 100 km (30 to 60 miles).**
- **Be sure to use tires of the approved type. Mixing bias-ply and radial tires on the same vehicle results in impaired steering and could cause an injury accident or loss of life.**

M E M O

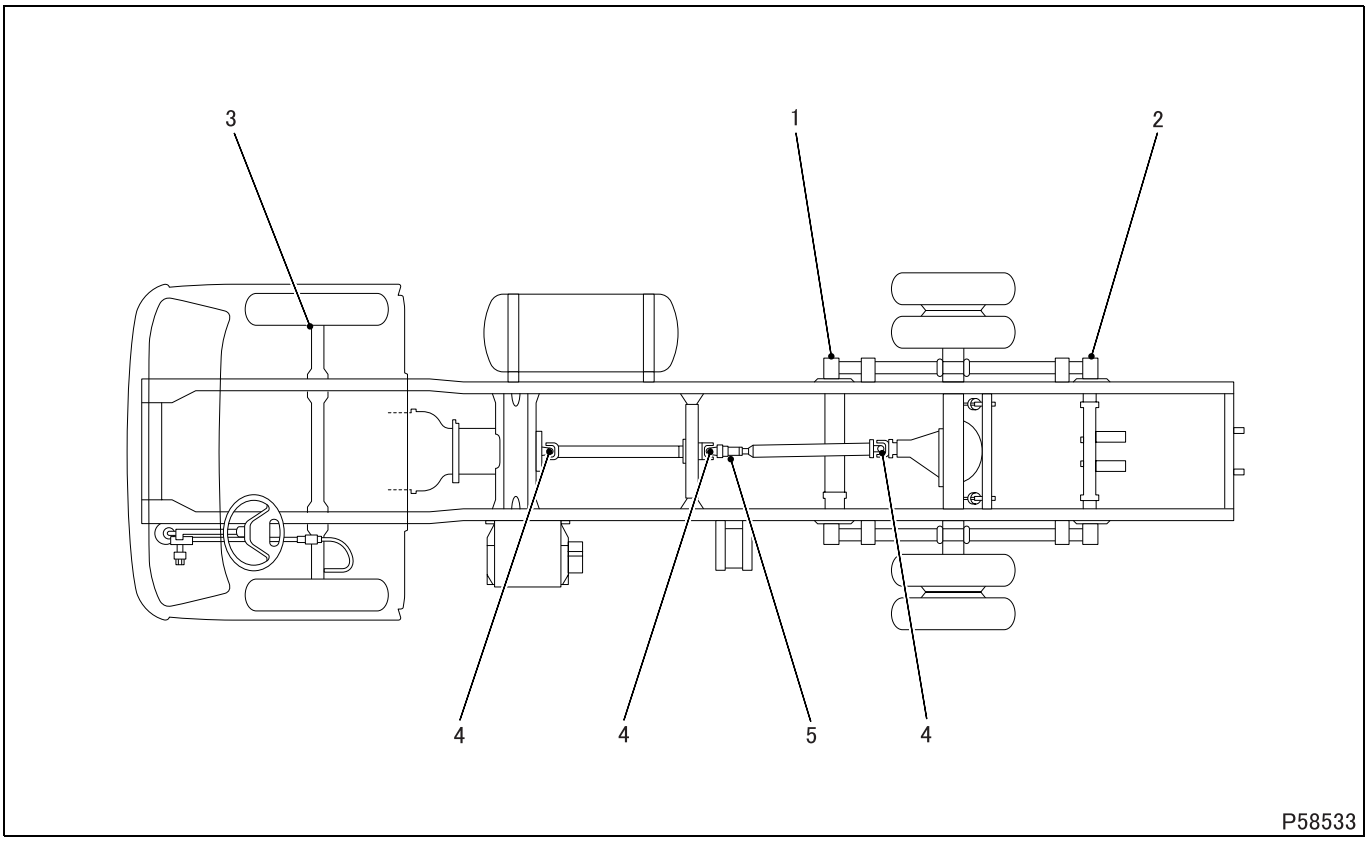
LUBRICATION TABLES

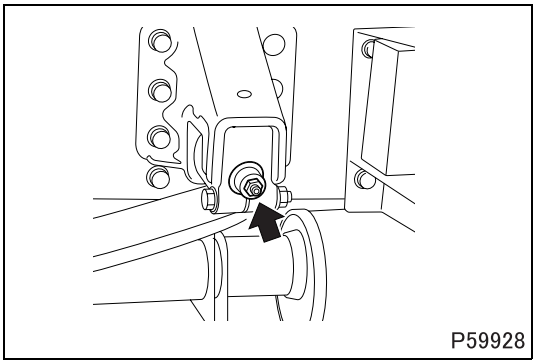
Ⓔ: Exhaust emission items.

Items	Time of inspection and maintenance							Lubricant specifications	Reference Gr
	Pre-operational checks	New vehicle at 4 000 km/ 2500 miles	Inspection interval: Every 10 000 km/ 6000 miles	Every 20 000 km/ 12,000 miles	Every 30 000 km/ 18,000 miles	Every 40 000 km/ 24,000 miles	Every 50 000 km/ 30,000 miles		
Ⓔ Engine oil level check	×							Engine oil API classification, CD, CD/SF, CE, CE/SF or CF-4 or JASO classification DH-1 Over 30°C {86°F} SAE 40 40 to –5°C {104 to 23°F} SAE 30 15 to –15°C {59 to 5°F} SAE 20W-20 Over –15°C {5°F} SAE 15W-40 Below 0°C {32°F} SAE 10W-30	Gr12
Ⓔ Engine oil change		×	×						
Manual transmission oil level			×					Gear oil API classification GL-3 SAE 80 (temperate climate) GL-3 SAE 90 (warm climate) GL-4 SAE 90 (tropical climate) Use engine oil when operating vehicle for long periods at high speeds API classification CC SAE 30 or SAE 40	Gr22
Manual transmission oil change		×			×				
Automatic transmission fluid (ATF) level check			×					Mobil ATF3309 manufactured by Exxon Mobil	Gr23
ATF change						×			
Rear axle oil level check			×					Gear oil API classification GL-5 Below 40°C {104°F} SAE 90 Over 40°C {104°F} SAE 140 Use SAE 140 when operating vehicle at high load, such as continuous ascent on slopes and when the outside temperature is 10°C {50°F} or more <Limited-slip differential only> Limited-slip differential oil API classification GL-5 SAE 90	Gr27
Rear axle oil change		×			×				
Hub bearing lubrication					×			Wheel bearing grease [NLGI No. 2 (Li soap)]	Gr26, 27
Brake fluid level check	×							Brake fluid <SAE J1703f or FMVSS No. 116 DOT3>	Gr35A
Brake fluid change							×		
Power steering fluid level check			×					Automatic transmission fluid <DEXRON, DEXRON II or DEXRON III>	Gr37
Power steering fluid change							×		
Lubrication of propeller shaft: Midship bearing							×	Bearing grease [NLGI No. 3 (Li soap)]	Gr25
Lubrication of propeller shaft: Universal joint, slip joint			×					Wheel bearing grease [NLGI No. 2 (Li soap)]	Gr11
Rear suspension spring pin lubrication			×					Chassis grease [NLGI No. 1 (Li soap)]	Gr11.
King pin bearing lubrication			×					Wheel bearing grease [NLGI No. 2 (Li soap)]	Gr11
Door hinge lubrication			×					Chassis grease [NLGI No. 1 (Li soap)]	Gr43
Anchor hook lubrication			×					Chassis grease [NLGI No. 1 (Li soap)]	Gr42

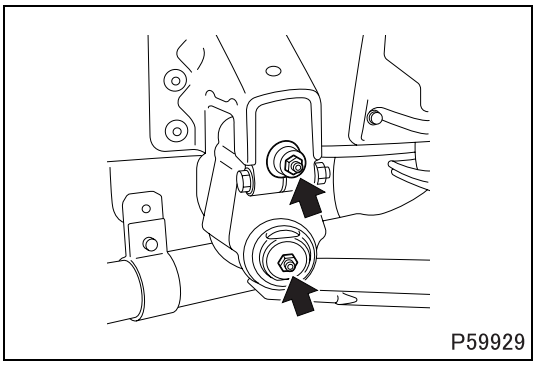
Chassis lubrication

Remove all dust and dirt from the grease fittings. Always use the recommended grease. The areas requiring grease are shown in the following illustration.

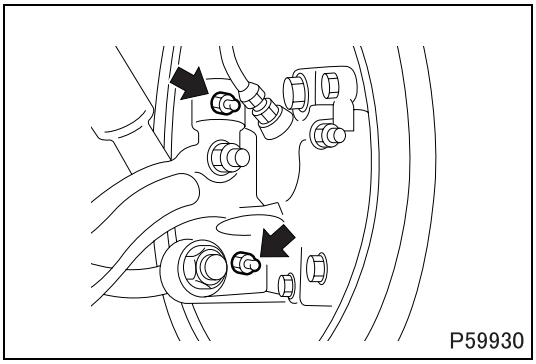




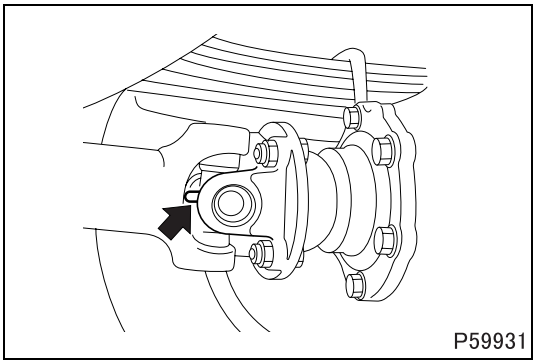
1. Rear spring pin, forward (2 points total, one on each side)



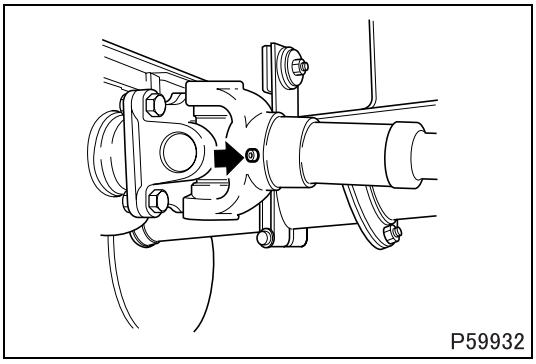
2. Rear spring pin, aft (4 points total, two on each side)



3. King pin bearing (4 points total, two on each side)



4. Propeller shaft (driveshaft) universal joint



5. Propeller shaft (driveshaft) slip joint

GROUP 11 INDEX

SPECIFICATIONS 11-2

STRUCTURE AND OPERATION
1. Exploded View 11-3
2. Cylinder Head, Cylinder Head Gasket, Camshaft, and Camshaft Frame 11-4
3. Valve Mechanism 11-5
4. Connecting Rod 11-6
5. Piston 11-6
6. Timing Gears 11-7
7. Flywheel 11-7
8. Balance Shafts 11-8
9. Crankcase and Main Bearings 11-9
10. Oil Seals 11-11

TROUBLESHOOTING 11-12

ON-VEHICLE INSPECTION AND ADJUSTMENT
1. Measuring Compression Pressure 11-14
2. Inspection and Adjustment of Valve Clearances 11-16

ENGINE REMOVAL AND INSTALLATION 11-20

ROCKER COVER 11-21

ROCKERS AND CAMSHAFTS 11-23

CYLINDER HEAD AND VALVE MECHANISM 11-34

PISTONS, CONNECTING ROD, AND CYLINDER LINERS 11-48

FLYWHEEL 11-60

FRONT CASE 11-64

TIMING GEARS AND BALANCE SHAFTS 11-68

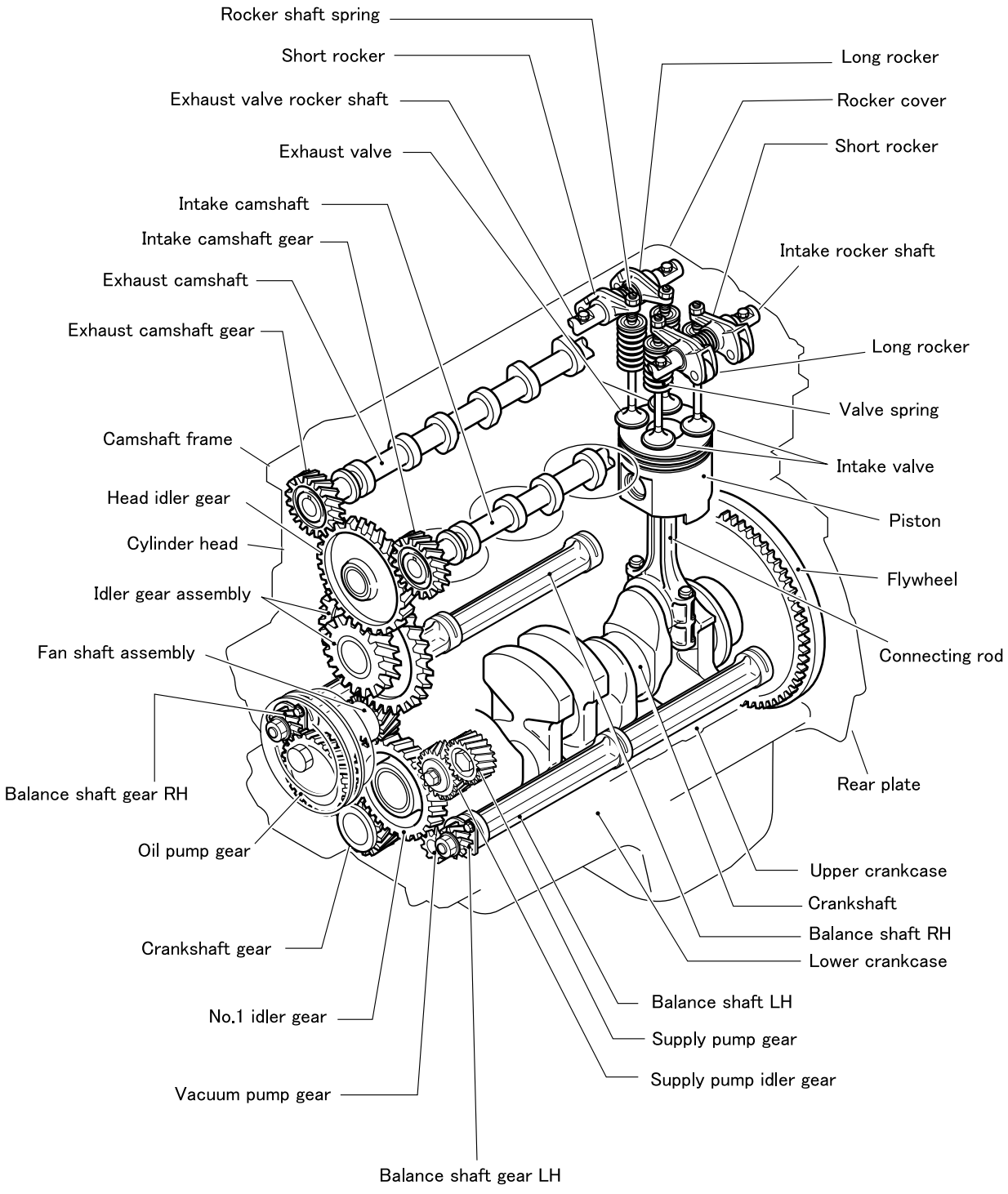
CRANKSHAFT AND CRANKCASE ... 11-76

BALANCE SHAFT BUSHINGS 11-85

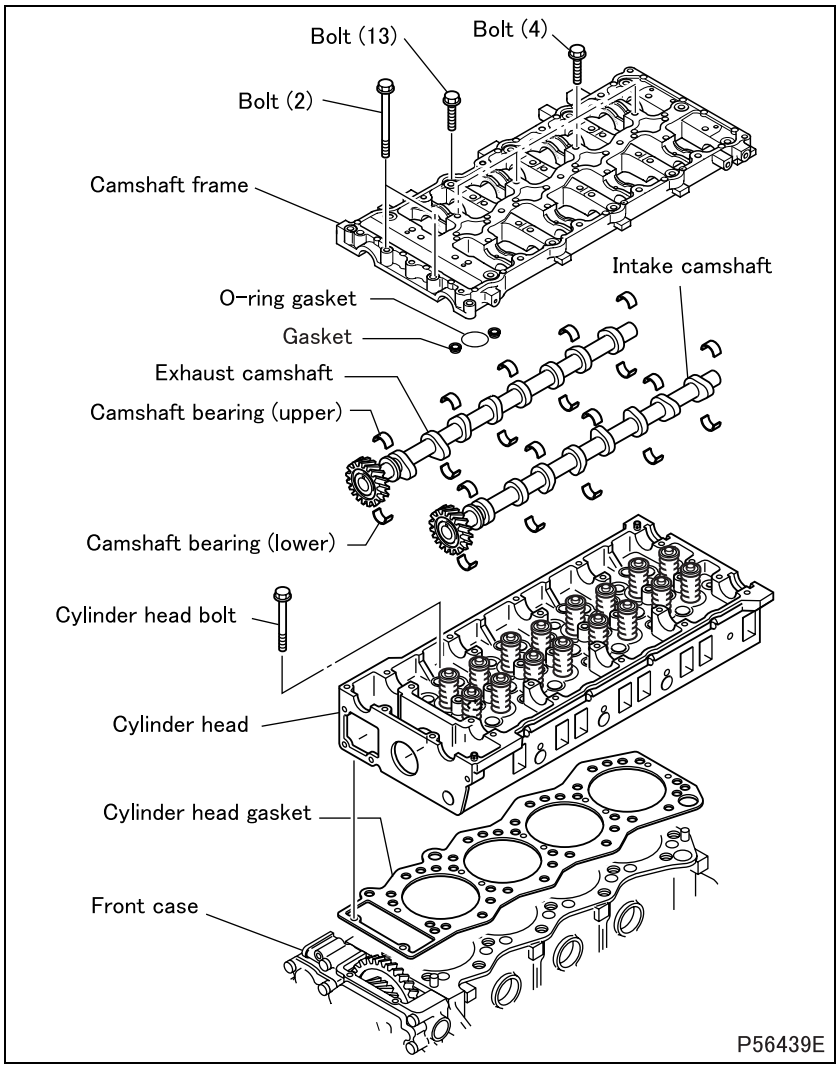
SPECIFICATIONS

Item		Specifications	
Engine model		4M50T7	4M50T8
Type		4-cylinder, in-line, water-cooled, 4-cycle diesel engine	
Combustion chamber		Direct injection type	
Valve mechanism		Double overhead camshaft (DOHC)	
Maximum output	HP / rpm	147 / 2700	175 / 2700
Maximum torque	ft.lbf / rpm	347 / 1600	391 / 1600
Bore × stroke	mm {in.}	ϕ114 × 120 {ϕ4.49 × 4.72}	
Total displacement	L {qts}	4.899 {4899}	
Compression ratio		17.5	

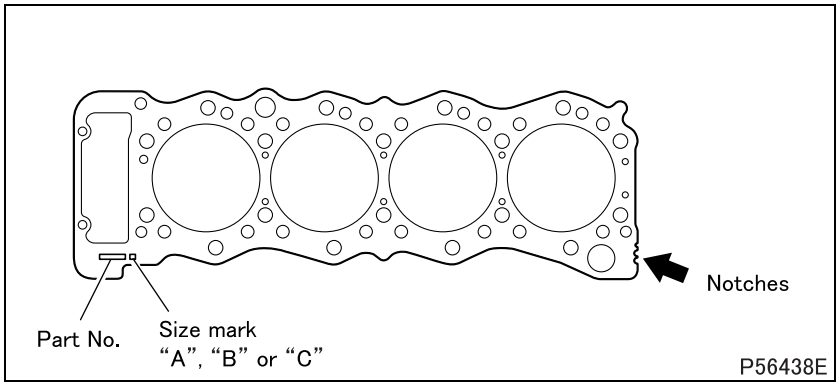
1. Exploded View



2. Cylinder Head, Cylinder Head Gasket, Camshaft, and Camshaft Frame



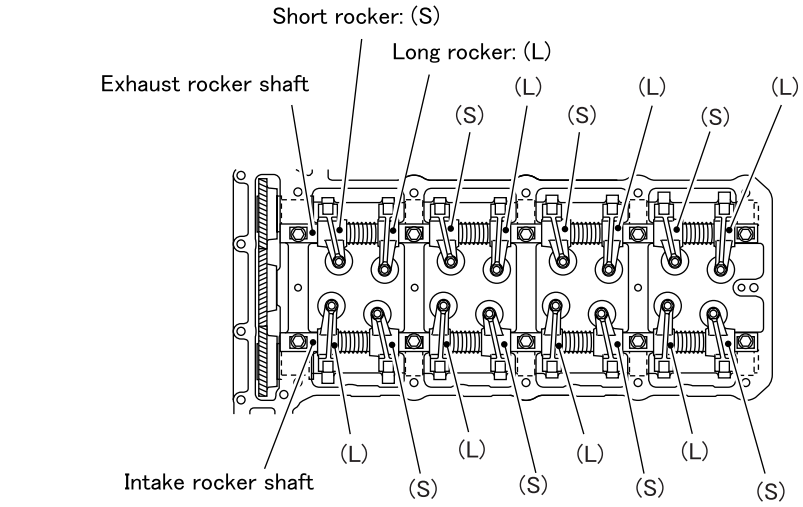
- The camshaft is supported at its journals from below by the cylinder head and retained from above by the camshaft frame.
- The upper and lower camshaft bearings are identical, but cannot be interchanged when they are reinstalled.
- The exhaust camshaft and the intake camshaft have identical gears but different cams.
- The thirteen shortest bolts and four shorter bolts fasten the camshaft frame onto the cylinder head.
- The two long bolts fasten the camshaft frame to the front case.

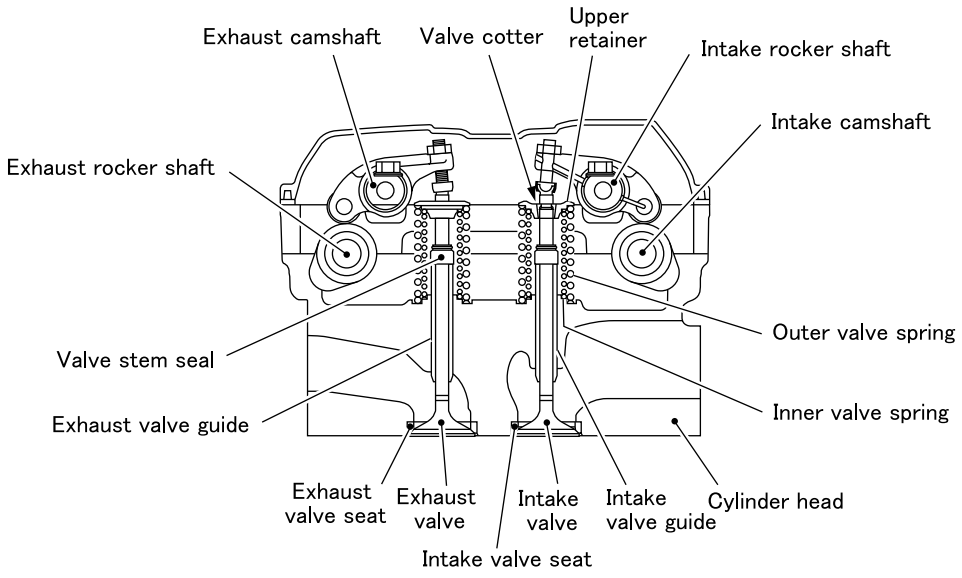


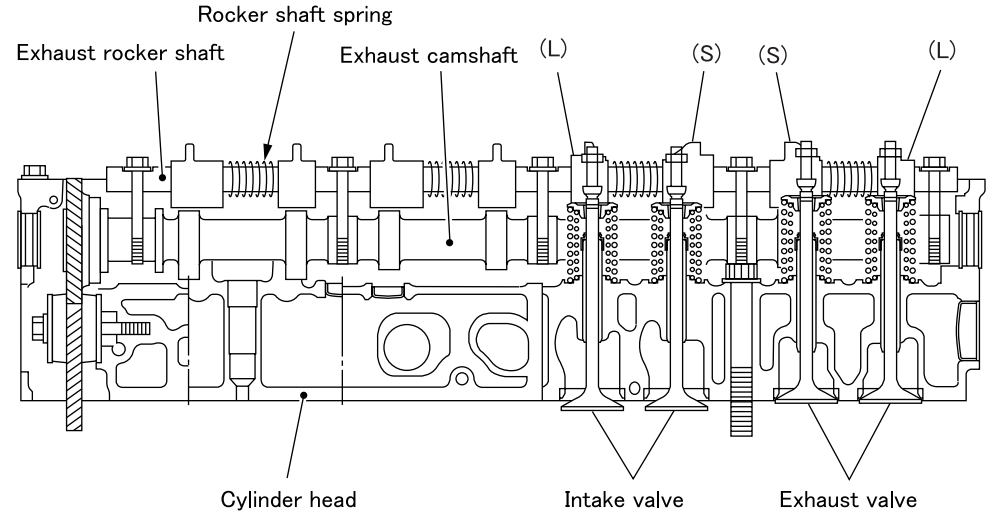
2.1 Cylinder head gasket

- Select and use a cylinder head gasket of a thickness that can accommodate the piston projection.
- The size (thickness) class of the gasket can be identified by the shape of the notches and size mark cut on the edge of each gasket.

3. Valve Mechanism



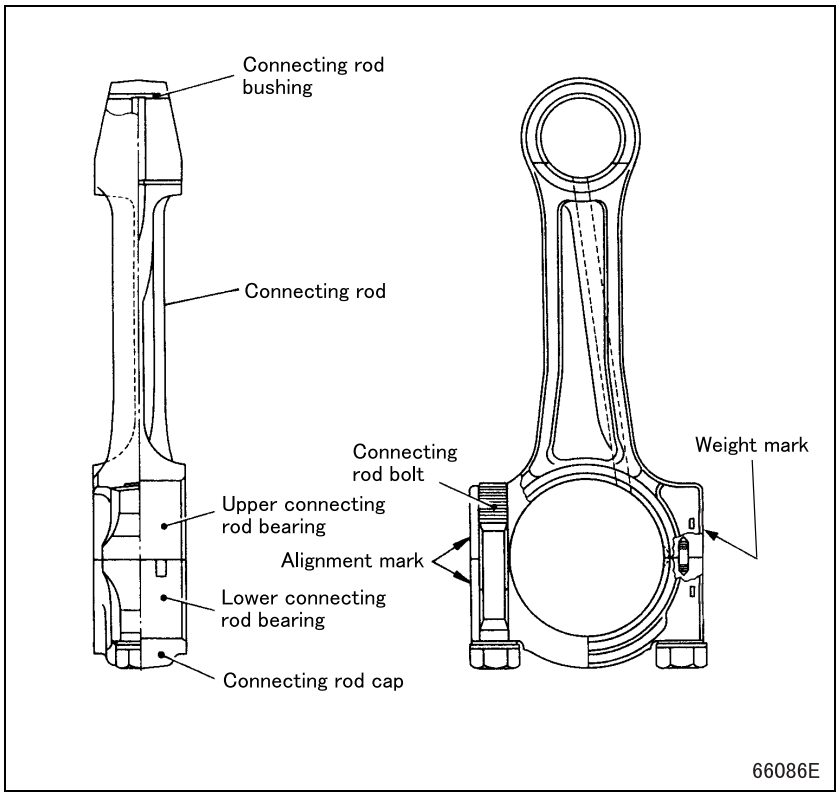




P49222E

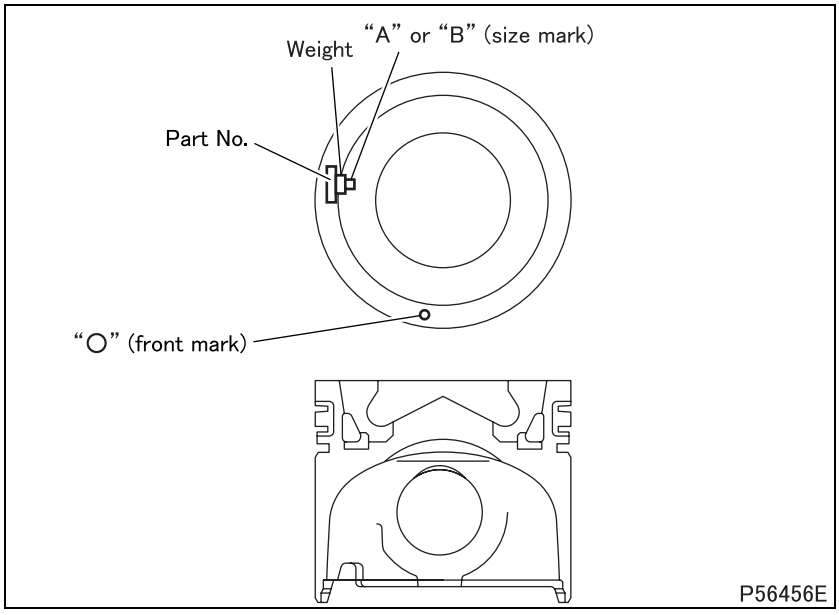
- The short rockers and the long rockers are installed differently, as shown in the illustration.
- Each valve has an inner valve spring and an outer valve spring.

4. Connecting Rod



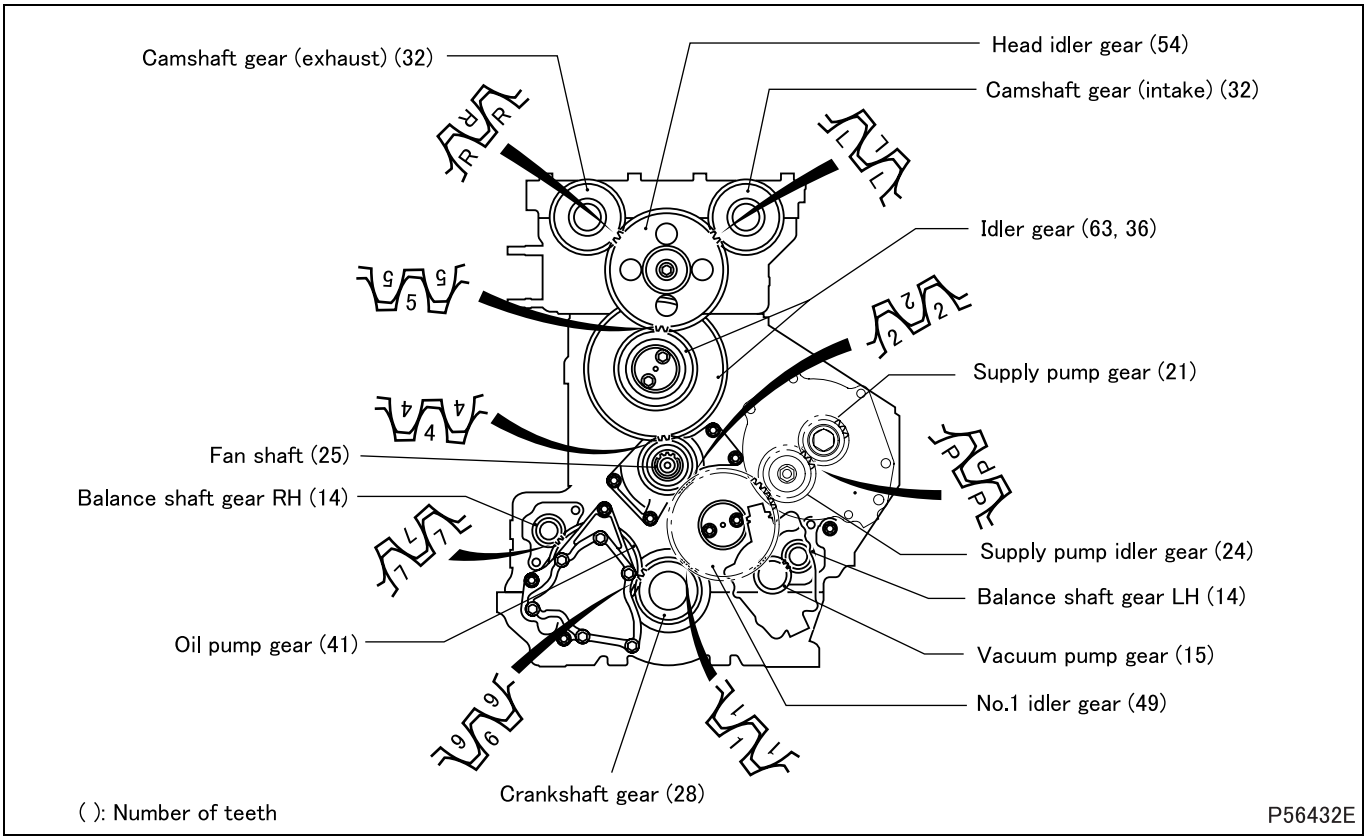
Weight mark:
"C" to **"G"**
(with **"G"** as the maximum)

5. Piston



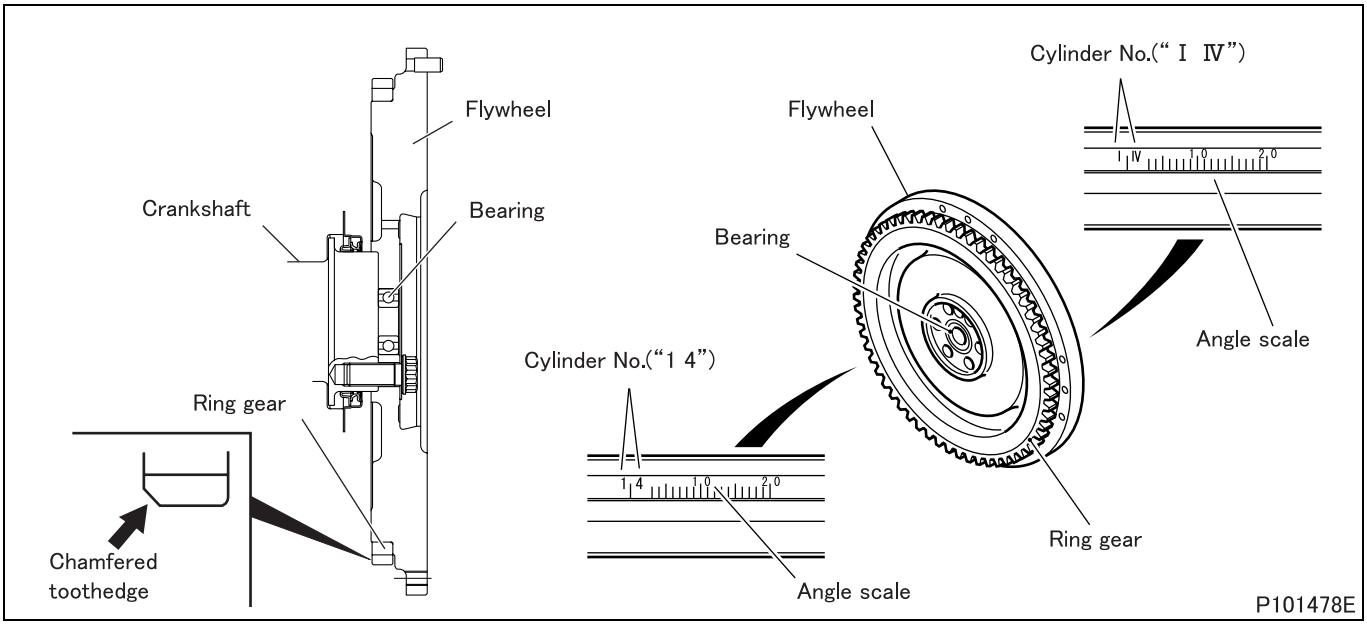
- Each piston must be mated with a cylinder in the upper crankcase that has the same size mark as the piston. The pistons are marked with either **"A"** or **"B"**, where **"B"** stands for the larger and **"A"** for the smaller of the two available diameters.
- The pistons have been made lightweight by use of a special aluminum alloy, as well as by the reduction of their height.

6. Timing Gears



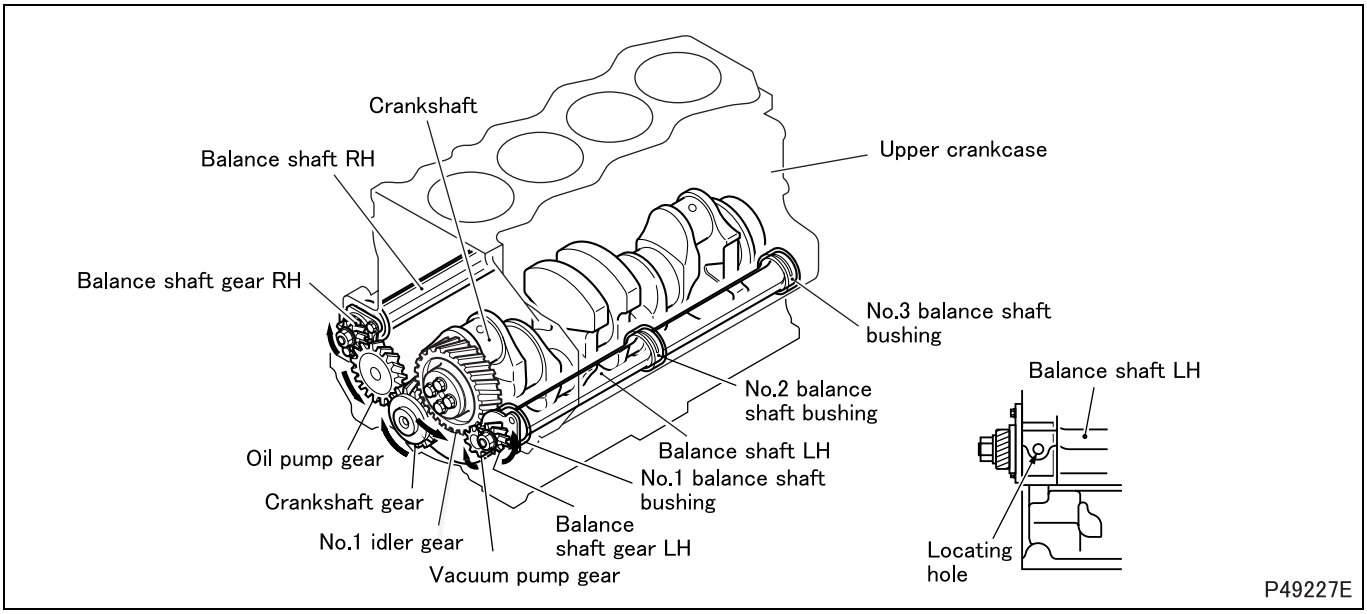
- All gears, except the vacuum pump gear, each has timing mark(s) to ensure correct engagement during assembly.

7. Flywheel

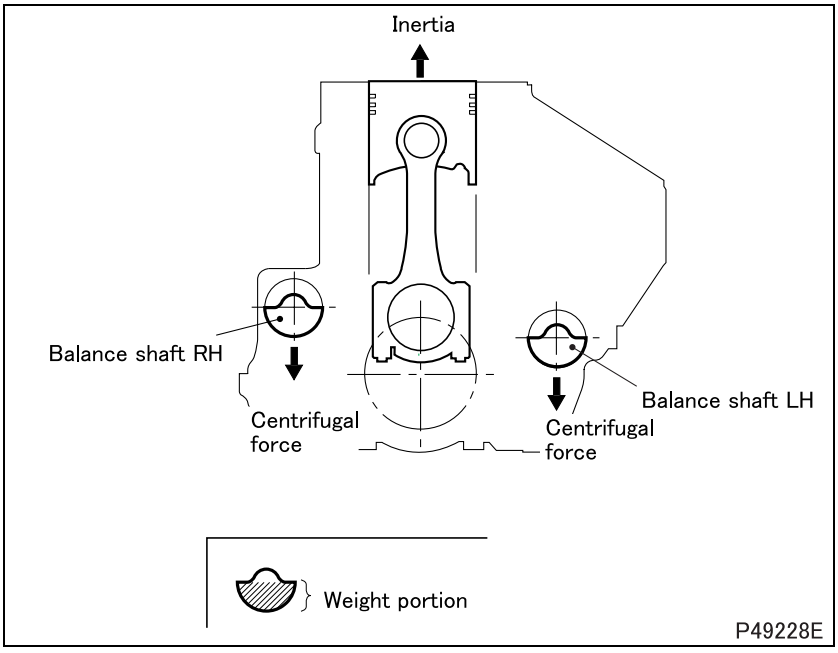


- One side of each flywheel ring gear tooth is chamfered to facilitate the engagement of the starter pinion.

8. Balance Shafts



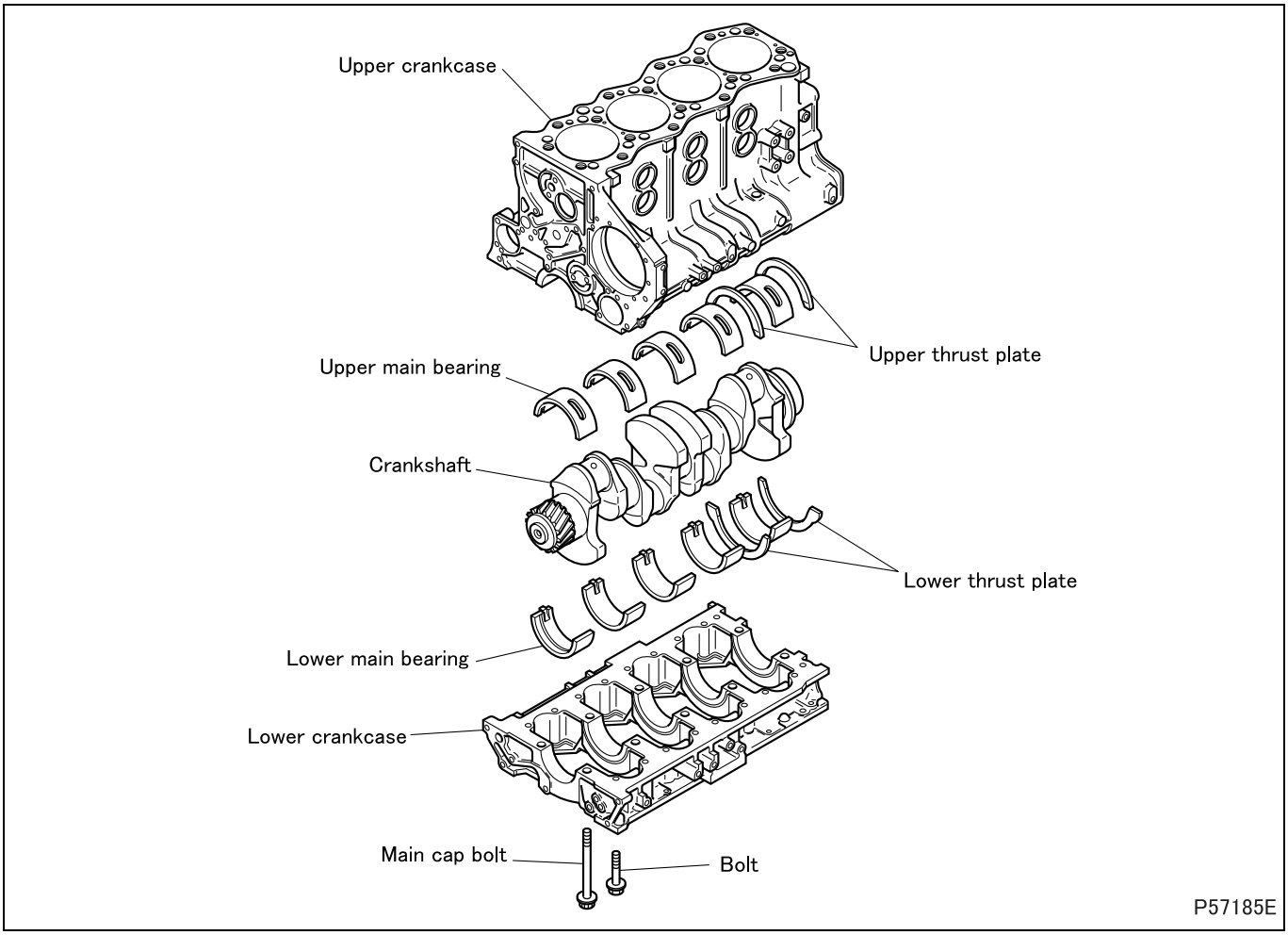
- The balance shaft RH and balance shaft LH are mounted in the upper crankcase on the right and left sides of the crankshaft. The balance shafts reduce the vibration of the engine caused by the rotation of the crankshaft.
- The balance shaft RH and balance shaft LH are both driven by timing gears. Each balance shaft is held in the upper crankcase by way of three balance shaft bushings.
- The balance shaft LH has a locating hole to enable correct installation.

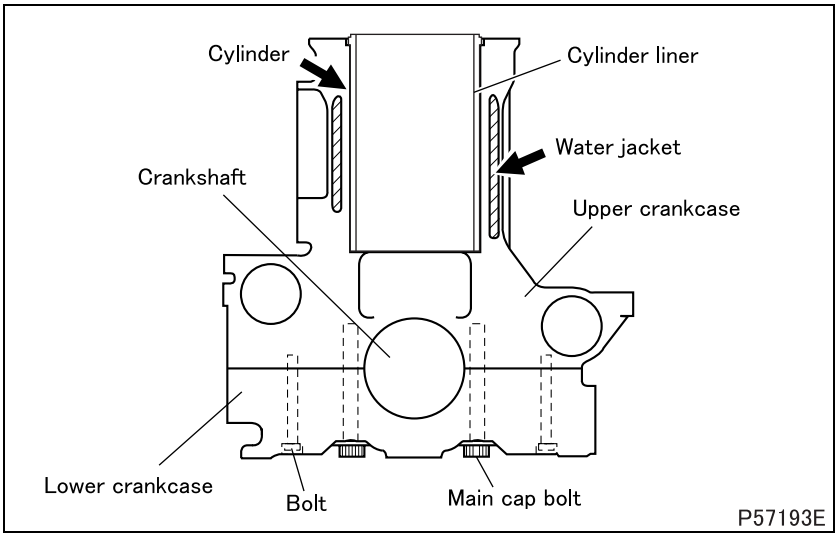


8.1 Reduction of vertical vibration (secondary vibration element)

- When the piston moves up and down, vertical vibrations are generated at the top dead center (TDC) and bottom dead center (BDC) due to inertia.
- The balance shaft LH and the balance shaft RH rotate so that their weight portions are at the bottom positions when a piston is at TDC and at the top positions when the piston is at BDC, i.e., the weight portions are always on the opposite side to the piston head.
- This creates centrifugal forces in the balance shaft RH and balance shaft LH, the total of which is equal in amount to the inertia force that the piston creates when it is at TDC or BDC. These centrifugal forces in the balance shafts cancel out the inertia forces resulting from piston's movements and reduce the amount of vertical vibration.
- The balance shafts also reduce the moment created around the crankshaft (which constitutes secondary vibration elements) when the engine is running in the middle-to-high speed range.

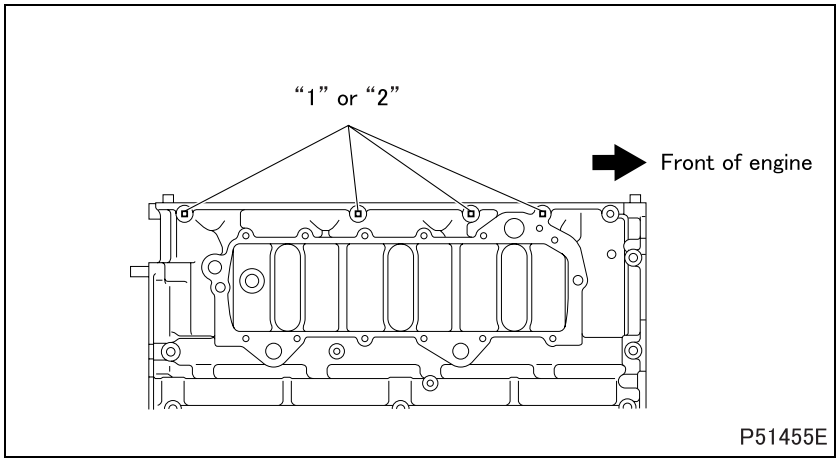
9. Crankcase and Main Bearings



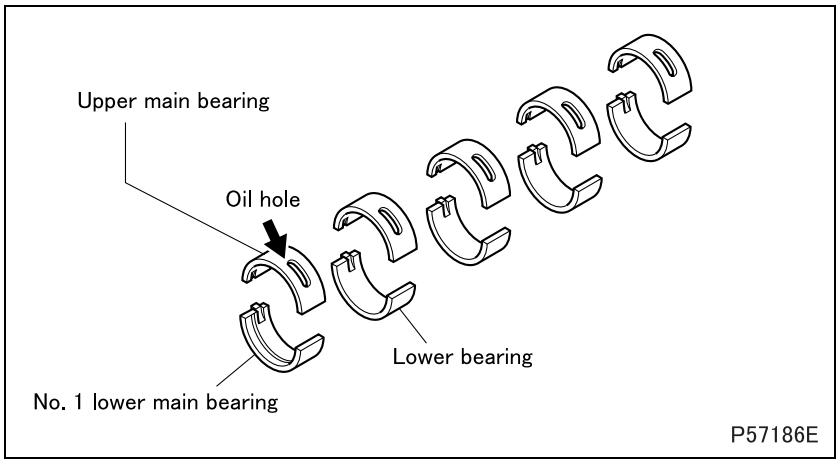


9.1 Crankcase

- The crankcase is a two-piece type consisting of an upper crankcase and a lower crankcase, which hold the crankshaft in between.
- Cylinder liners are inserted into the cylinder bores in the upper crankcase.
- An water jacket is formed in the walls of these cylinders to cool them down.
- The main cap bolts and the bolts that fasten the upper and lower crankcases together are tightened using a special method.

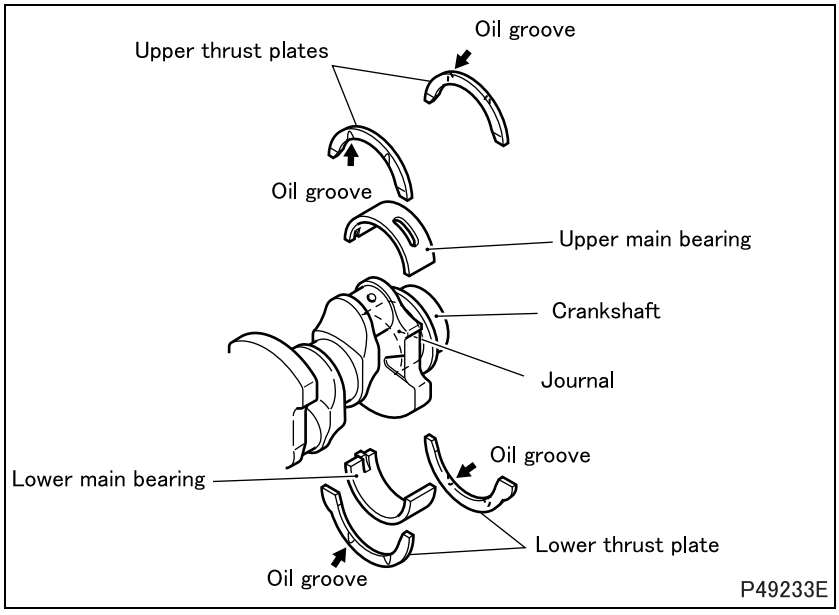


- The upper crankcase is marked with a size mark (**"1"** or **"2"**) to be used as a reference in selecting cylinder liners.
- The first to forth size marks from the front of the engine correspond to the No. 1 to No. 4 cylinders.



9.2 Main bearing

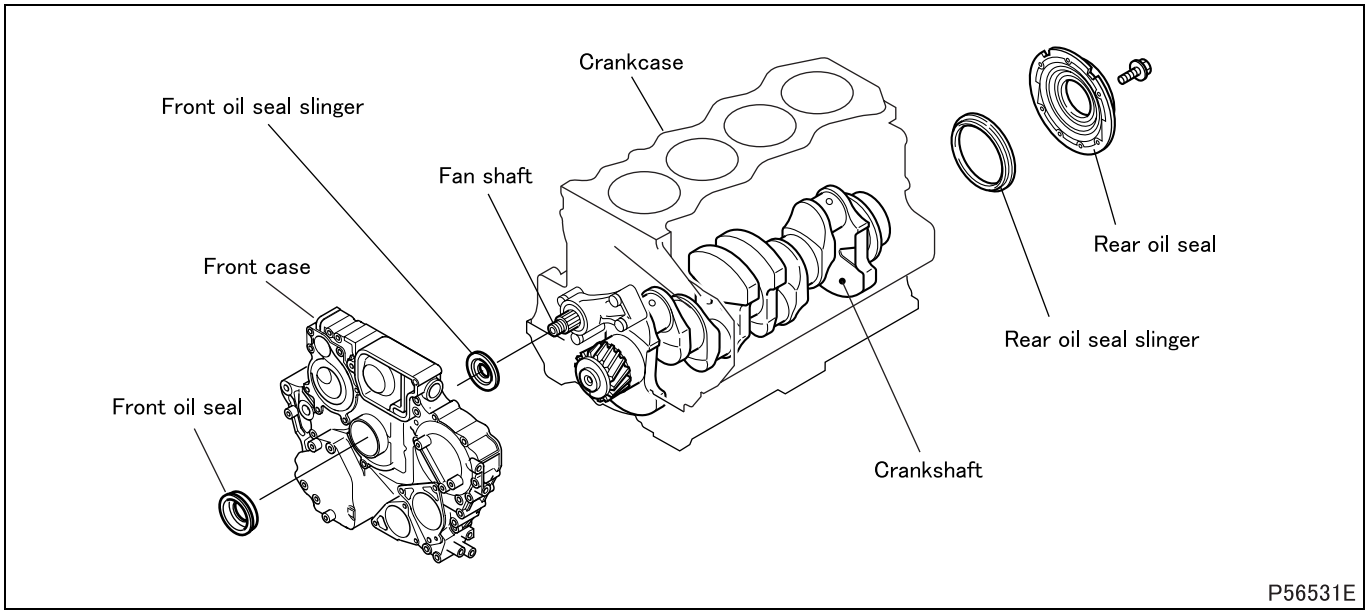
- The upper main bearings have oil holes through which engine oil is supplied to the crankshaft journals.
- An oil groove is provided in the No. 1 lower bearing.

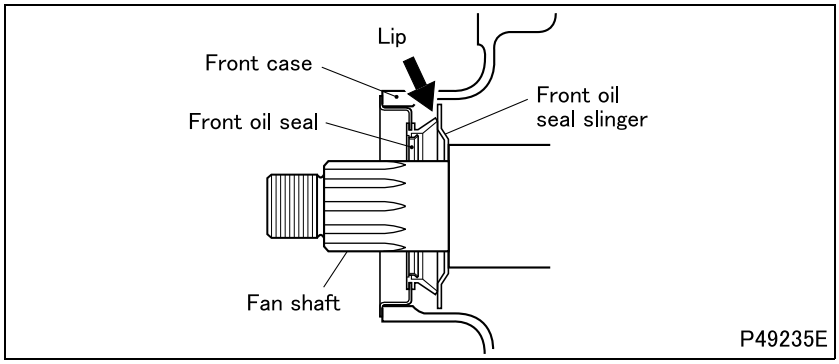


9.3 Thrust plates

- Two upper and lower thrust plate pairs are installed on both sides of the upper and lower main bearings at the rearmost journal of the crankshaft.
- Select the thrust plates of a thickness that can accommodate the crankshaft end play. The thrust plates each have two oil grooves, which assures their minimum friction against the crankshaft journal.

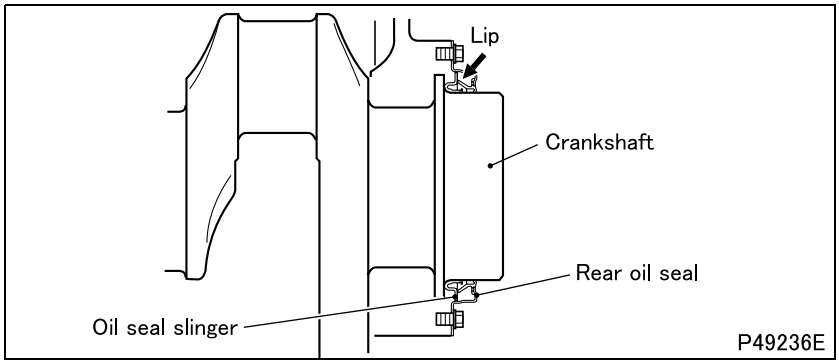
10. Oil Seals





10.1Front oil seal

- The front oil seal is fitted in the front case and prevents oil from leaking by contact of its lip with the front oil seal slinger.
- The front oil seal slinger is press-fitted onto the fan shaft.



10.2Rear oil seal

- The rear oil seal is fitted in the crankcase assembly and prevents oil from leaking by contact of its lip with the rear oil seal slinger.
- The rear oil seal slinger is press-fitted onto the rear end of the crankshaft.

Possible causes / Symptoms		Low power output	Abnormal engine noise	Reference Gr
Cylinder head and valve mechanism	Incorrect valve clearance	O	O	
	Defective cylinder head gasket	O	O	
	Worn valve and valve seat; carbon deposits	O	O	
	Weakened valve spring	O	O	
	Defective rocker shaft and camshaft frame		O	
	Poor lubrication of rocker shaft and camshaft frame		O	
Timing gears	Incorrect backlash in timing gears		O	
	Poor lubrication of timing gears and idler shaft		O	
Camshaft	Excessive end play in camshaft		O	
	Worn camshaft		O	
Pistons and connecting rods	Worn/damaged piston ring groove(s)	O	O	
	Worn/damaged piston ring(s)	O	O	
	Worn piston pin and connecting rod small end		O	
Crankshaft	Excessive end play in crankshaft		O	
	Incorrectly fitted crankshaft		O	
	Worn/damaged crankshaft pins and connecting rod bearings		O	
	Worn/damaged crankshaft journals and main bearings		O	
Fuel system	Defective supply pump	O	O	Gr13E
	Faulty fuel spray from injector	O	O	Gr13A
	Air trapped in fuel system	O		
Cooling system	Malfunctioning cooling system components	O		Gr14
	Loose/damaged V-belts		O	
Intake and exhaust system	Clogged air cleaner	O	O	Gr15
	Clogged muffler	O	O	
Incorrect oil viscosity		O		Gr12
Improper fuel		O		
Incorrectly fitted piping and hoses			O	
Defective/incorrectly fitted alternator and other auxiliaries			O	

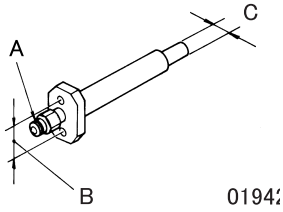
M E M O

1. Measuring Compression Pressure

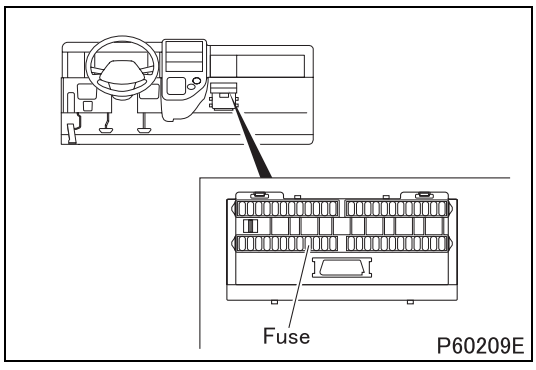
Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Compression pressure	Each cylinder (at 200 rpm)	2550 kPa {370 psi, 26 kgf/cm^2}	1960 kPa {285 psi, 20 kgf/cm^2}	Inspect
		Cylinder-to-cylinder pressure difference	–	390 kPa {57 psi, 4 kgf/cm^2} or less	Inspect

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
a	Compression gauge adapter A: M14 × 1.5 B: 58 {2.28} C: ϕ7.2 {ϕ0.28} 	MH063853	Measuring compression pressure

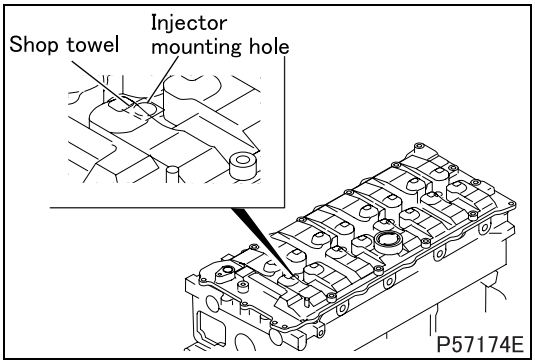
- A drop in compression pressure can be used as a guide to determine when the engine should be overhauled.
- Measure the compression pressure at regular intervals. Keeping track of its transitions can provide a useful tool for troubleshooting. On new vehicles and vehicles with newly replaced parts, the compression pressure will be somewhat higher depending on the break-in condition of piston rings, valve seats, etc., but this will return to normal as the parts wear down.
- Before the compression measurement, confirm that the engine oil, starter, and battery are in normal condition.
- Place the vehicle in the following conditions.
  - Warm up the engine until the coolant temperature reaches approximately 75 to 85°C {167 to 185°F}.
  - Turn off the lights and auxiliaries.
  - Place the transmission in neutral (in the parking range P for automatic transmissions).
  - Place the steering wheel in the straight-ahead position.



- Remove the fuse (M9) to prevent fuel from being injected when the engine is cranked by the starter.

CAUTION ⚠

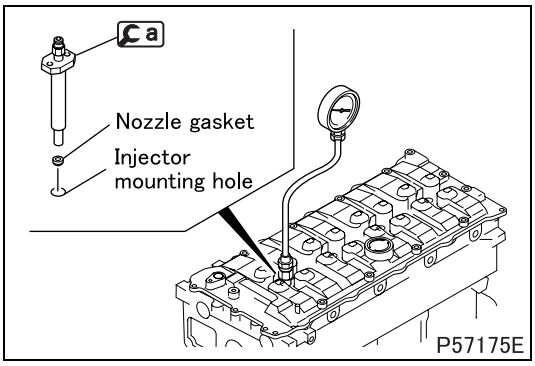
- **When cranking the engine, never shut off the power supplied to the engine electronic control unit by disconnecting the engine electronic control unit connector or other similar methods. If the engine is cranked with the power to the engine electronic control unit shut off, the supply pump will not be controlled by the electronic control unit, causing the supply pump to be malfunctioned.**



- Disconnect the injector connector and remove all injectors. (See Gr13A.)

[Inspection]

- Cover the injector mounting holes with shop towels. After cranking the engine by the starter, check that no foreign substances are deposited on the shop towels.
- If there are deposits (such as engine oil or coolant) on the shop towels, the following may be the cause:
  - Deposits of engine oil alone can mean a defective piston ring seal; the piston rings must be inspected.
  - Deposits of both engine oil and coolant can mean cracks in the cylinders; the crankcase must be replaced.



WARNING ⚠

- **When coolant and engine oil deposits are evident, cranking the engine could be dangerous as these substances, heated to high temperatures, will blow out from the injector mounting holes. Make sure to stay away from the injector mounting holes when the engine is being cranked.**

- Attach the gasket and Ca to one of the injector mounting holes. Then, connect a compression gauge to Ca.
- Crank the engine and measure the compression pressure for all the cylinders one after another. Determine the compression pressure difference between the cylinders.
- If the compression pressure is below the limit or the cylinder-to-cylinder pressure differences is not within the limit, pour a small amount of engine oil into the corresponding injector mounting hole and remeasure the compression pressure.
  - If the compression pressure increases, the piston rings and cylinder surfaces may be badly worn or otherwise damaged.
  - If the compression pressure remains unchanged, there may be seizure in the valves, the valves may be incorrectly seated or the cylinder head gasket may be defective.

[Installation]

- Install the injector. (See Gr13A.)
- Install the rocker cover and the gasket. (See later sections.)

2. Inspection and Adjustment of Valve Clearances

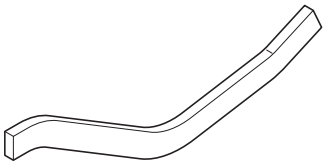
Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Valve clearance (when cold)	Intake valve	0.4 {0.016}	–	Adjust
		Exhaust valve	0.5 {0.020}	–	

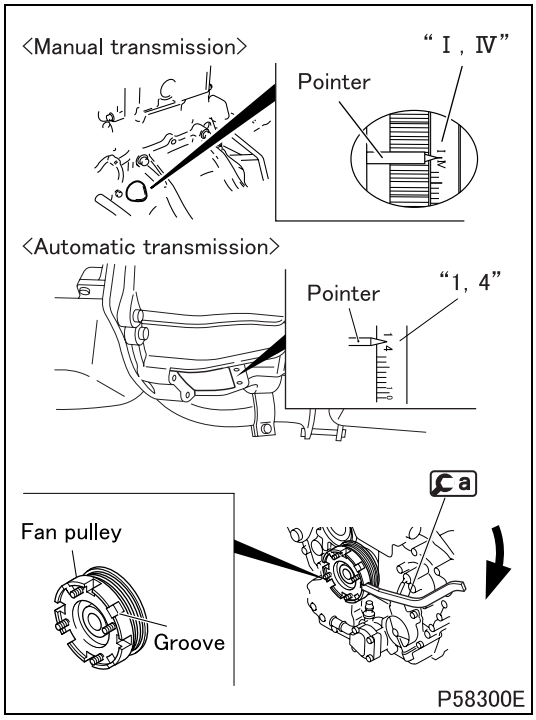
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Lock nut (adjusting screw stopping)	21 {15.5, 2.1}	–

Special tools

Mark	Tool name and shape	Part No.	Application
Ⓒa	Cranking handle (design may vary)  P58299	MH063704	Turning the fan pulley

- Valve clearances should be checked and adjusted as follows while the engine is still cold.

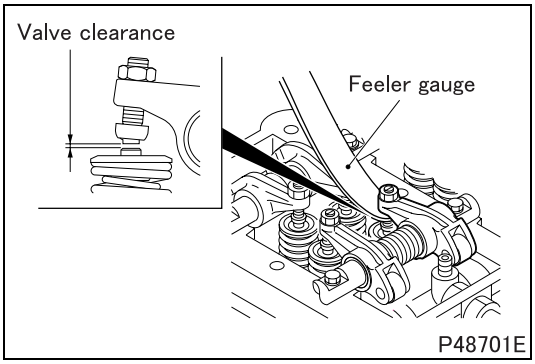


[Inspection]

CAUTION ⚠

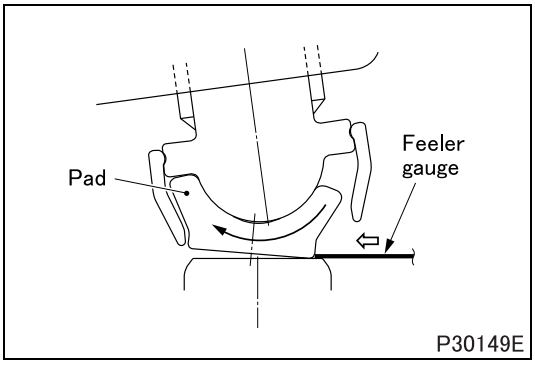
- **Never cut off the engine electronic control unit power supply when cranking the engine.**

- Remove the rocker cover.
- Disconnect the injector connector.
- Bring the No. 1 or No. 4 cylinder piston to the top dead center (TDC) on the compression stroke by the following procedure:
  - Hook Ⓒa onto the grooves in the fan pulley.
  - Turn the fan pulley in the illustrated direction to align the pointer with the **"Ⅰ, Ⅳ"** or **"1"** to **"4"** mark on the flywheel.
  - This will place either the No. 1 or No. 4 cylinder piston at TDC on the compression stroke. The cylinder in which the rocker arms for both the intake and exhaust valves can be pushed down by hand by the valve clearance amounts has its piston at TDC. Rotate the engine by one full turn to switch the TDCs of the No. 1 and No. 4 cylinder pistons.

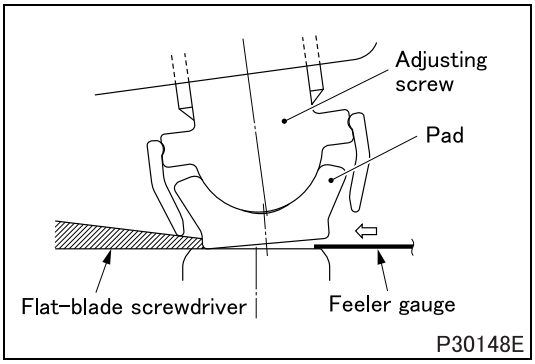


- With the No. 1 or No. 4 cylinder piston at TDC, measure the clearance of the valves marked with a circle in the table below.

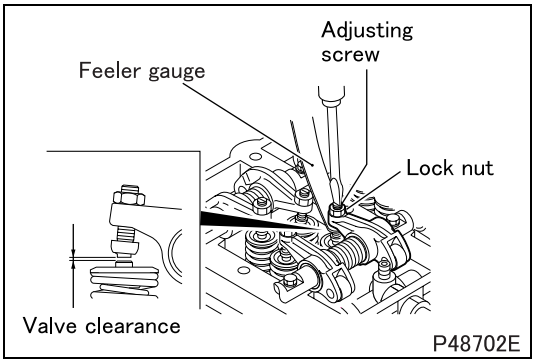
Cylinder No.	1		2		3		4	
Valve	IN	EX	IN	EX	IN	EX	IN	EX
No. 1 cylinder piston at TDC on compression stroke	O	O	O	–	–	O	–	–
No. 4 cylinder piston at TDC on compression stroke	–	–	–	O	O	–	O	O



- The feeler gauge cannot be inserted under the adjusting screw pad without carrying out the above step, as the pad will block the feeler gauge as shown in the illustration.

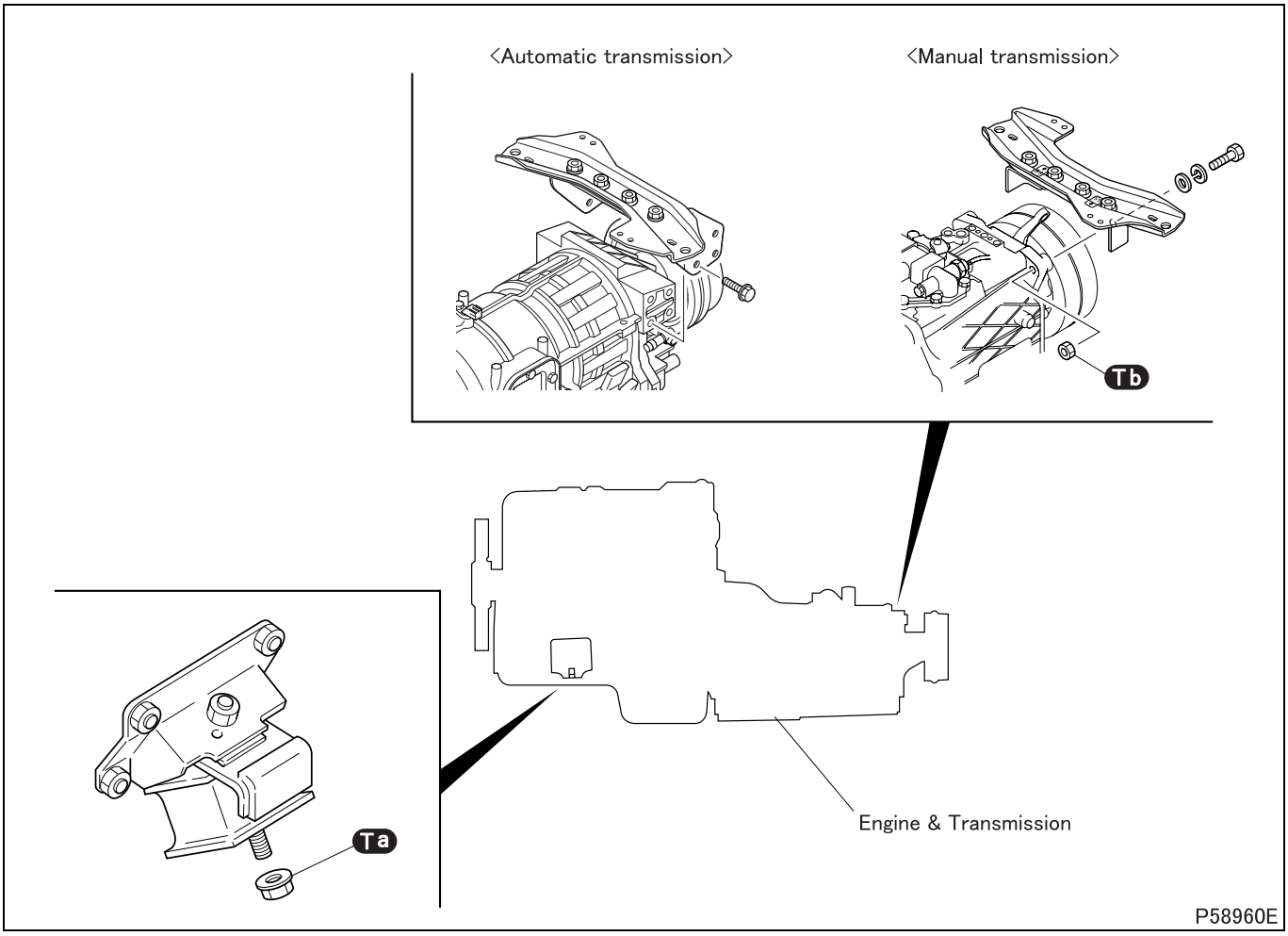


- To insert the feeler gauge under the adjusting screw pad, push the pad at the bottom on one side with a flat-blade screwdriver or a similar tool. Insert the feeler gauge into the small space created under the other side of the pad, as shown in the illustration.
- The feeler gauge must have a slight drag when taking measurements.
- If the feeler gauge can be moved without any resistance, the measurement will be incorrect.
- If the measurements are not within the standard value range, adjust the value clearance by the following procedures.



[Adjustment]

- Adjust the valve clearance by loosening the lock nut and rotating the adjusting screw so that the feeler gauge can only be moved with a slight drag.
- After the adjustment, hold the adjusting screw in position with a screwdriver and tighten the lock nut to the specified torque.
- Recheck the valve clearance with the feeler gauge, and readjust if the measurements are not within the specified value range.



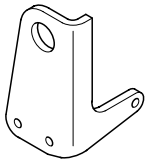
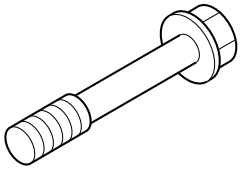
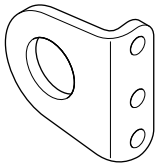
CAUTION ⚠

- **Only use hoisting equipment appropriate for the engine and transmission weight (approximately 600 kg {1320 lb}).**

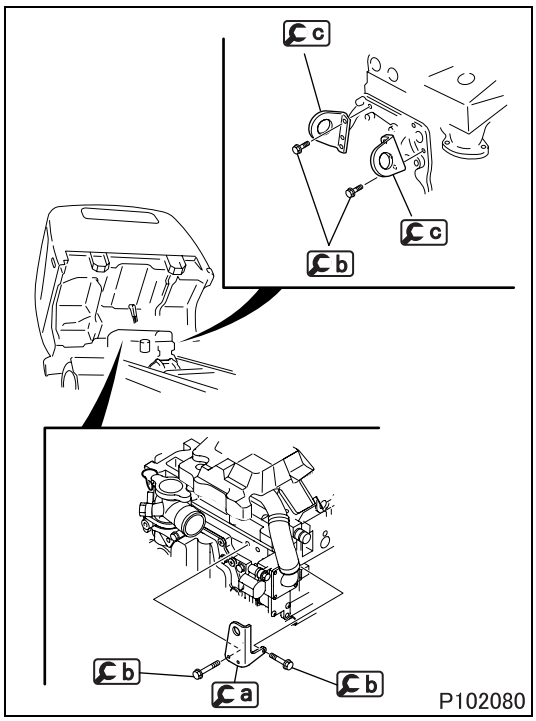
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (front mounting installation)	69 to 88 {51 to 65, 7 to 9}	–
Tb	Nut (rear mounting installation)	130 to 170 {96 to 125, 13 to 17}	–

Special tools

Mark	Tool name and shape	Part No.	Application
a	Engine front hanger  P57188	MH063636	Removal and installation of engine
b	Flange bolt  P29984	MF140429 MF140433 MF140421	Installation of engine front hanger
c	Engine rear hanger  P58957	MH063711	Removal and installation of engine

◆Work before removal◆

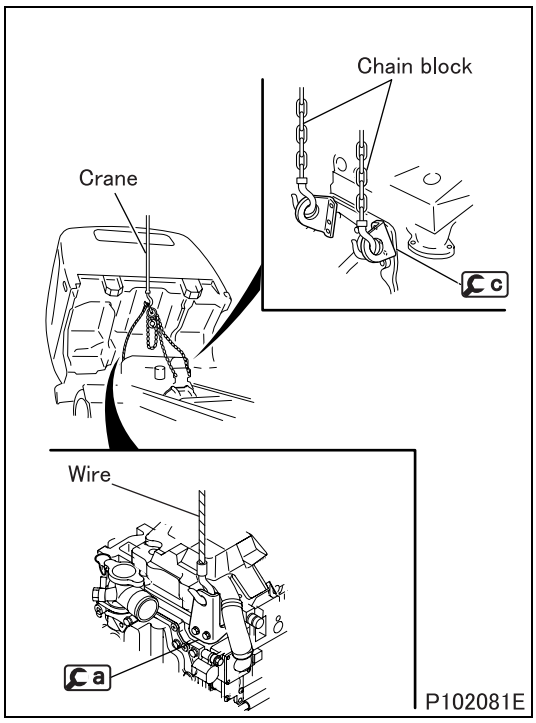


P102080

■ **Preparing for engine removal: Installation of engine front hanger and flange bolt**

- Install a, b and c on the engine.

◆Removal procedure◆

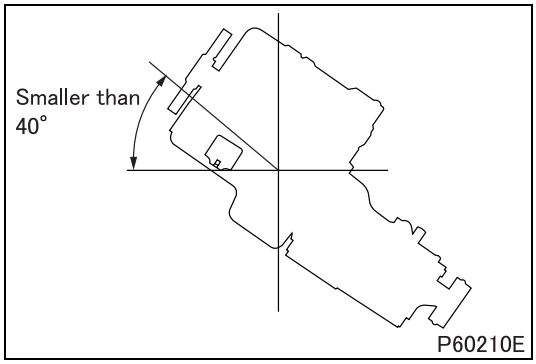


■ **Removal: Engine and transmission**

- Hook the wire rope on a and hitch the chain block to c. Then, pull all the slack out of the slings by a crane.

CAUTION ⚠

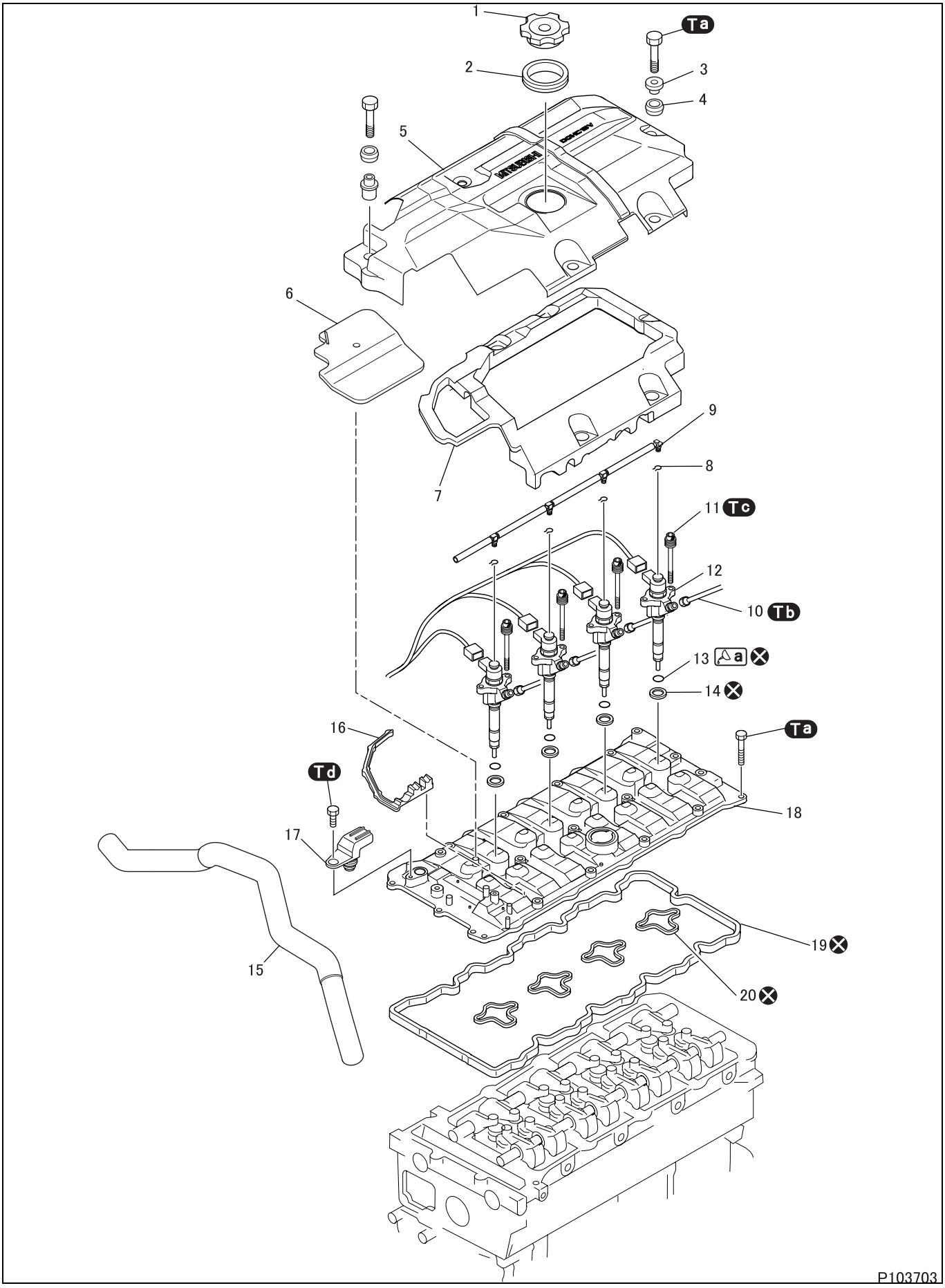
- **The slings must be strong enough to hang the engine and transmission assembly (weighing approximately 600 kg {1320 lb}).**
- **Be sure to keep the slings away from the exhaust gas recirculation pipes.**



- Make sure that all harnesses and pipes are disconnected.
- Lift the engine and transmission assembly slowing. Take care not to bump the assembly against the frame and cab.

CAUTION ⚠

- **When lifting the engine and transmission assembly, do not incline it more than 40°.**


1
2
3
4
5
6
7
8
9
10 Tb
11 Tc
12
13 a
14
15
16
17
18
19
20
Ta
Td
P103703

ROCKER COVER

● Disassembly sequence

1 Oil filler cap
2 Grommet
3 Spacer
4 Insulator
5 Cover
6 PCV hose spacer
7 Rocker cover rubber
8 Snap ring
9 Fuel return hose
10 Injection pipe
11 Bolt (with hexagonal hole)
12 Injector
13 O-ring
14 Tip gasket
15 PCV hose
16 Rubber seal
17 Cylinder sensor
18 Rocker cover
19 Rocker cover gasket A
20 Rocker cover gasket B

⊗: Non-reusable parts
PCV: Positive Crankcase Ventilation

● Assembly sequence

Follow the disassembly sequence in reverse.

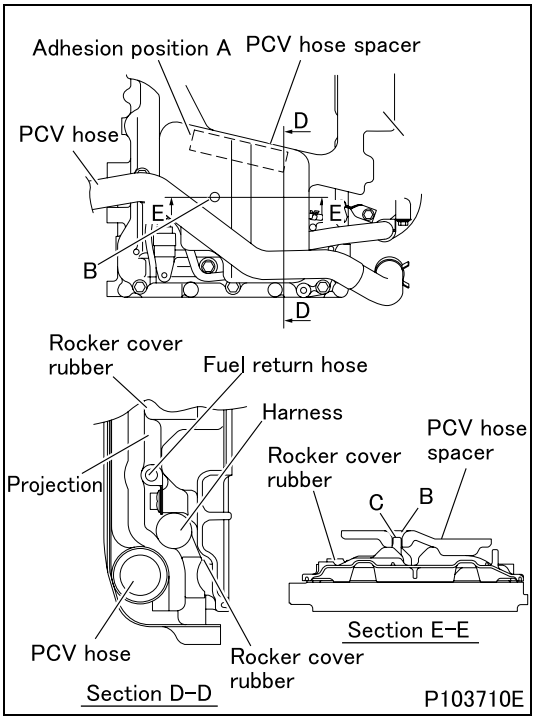
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (cover installation)	23.2 {17, 2.4}	–
	Bolt (rocker cover installation)		
	Bolt (PCV pipe installation)		
Tb	Injection pipe (union nut installation)	30.4 to 35 {22 to 26, 3.1 to 3.6}	–
Tc	Bolt (injector installation)	5.2 to 7.2 {3.8 to 5.3, 0.53 to 0.73}	–
Td	Bolt (cylinder sensor installation)	8 {5.9, 0.82}	–

Lubricant and/or sealant

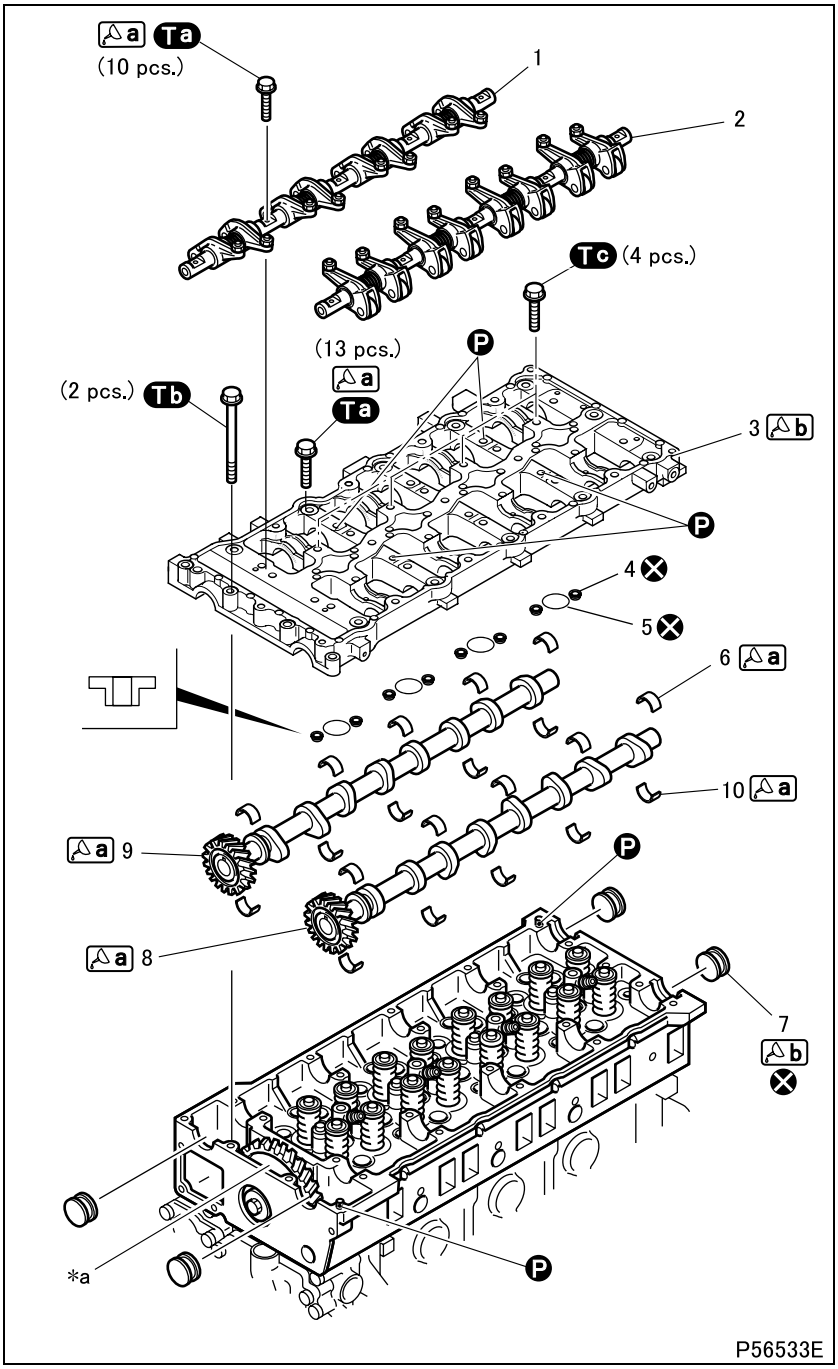
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

◆Installation procedure◆



■ Installation: PCV hose spacer

- Apply a sheet of double-sided adhesive tape at the adhesion position A on the PCV hose spacer.
- Install the PCV hose spacer while aligning the hole B in the spacer with the projection C on the rocker cover rubber. Be careful not to crush the fuel return hose with the projection on the PCV hose spacer.



● Disassembly sequence

1 Exhaust rocker shaft
(See later sections.)
2 Intake rocker shaft
(See later sections.)
3 Camshaft frame
4 Gasket
5 O-ring
6 Upper camshaft bearing
7 Packing
8 Intake camshaft
(See later sections.)
9 Exhaust camshaft
(See later sections.)
10 Lower camshaft bearing

***a**: Head idler gear
Ⓟ: Locating pin
⊗: Non-reusable parts

CAUTION ⚠

- **The camshaft frame and cylinder head are manufactured as a matched set. Never replace the camshaft frame or the cylinder head individually.**
- **Do not change the upper and lower camshaft bearing combinations. Do not interchange the position of an upper and lower camshaft bearing set with that of another.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

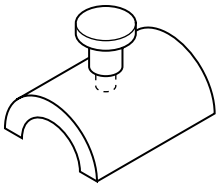
Location	Maintenance item		Standard value	Limit	Remedy
–	Backlash	Head idler gear-to-camshaft gear	0.080 to 0.126 {0.0031 to 0.0050}	0.3 {0.012}	Replace
–	End play	Camshaft	0.10 to 0.20 {0.0039 to 0.0079}	0.3 {0.012}	Replace
6, 8, 10	Camshaft bearing-to-intake camshaft clearance		0.07 to 0.12 {0.0028 to 0.0047}	0.16 {0.024}	Replace
6, 9, 10	Camshaft bearing-to-exhaust camshaft clearance		0.07 to 0.12 {0.0028 to 0.0047}	0.16 {0.024}	Replace
6, 10	Camshaft bearing span (when free)		–	35.5 {1.40}	Replace

Tightening torque (Unit: N·m {lbf·ft, kgf·m})

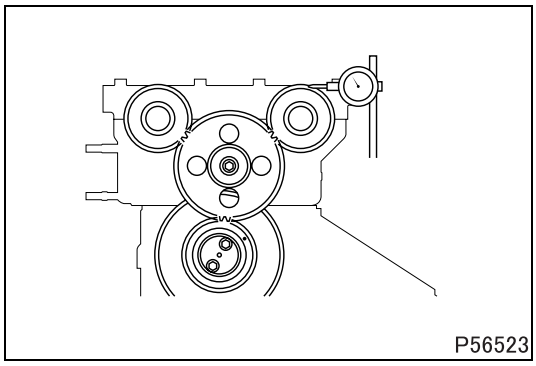
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (rocker shaft installation: 10 places)	27.5 {20, 2.8}	Wet
	Bolt (camshaft frame installation: 13 places)		
Tb	Bolt (camshaft installation: 2 places)	23.5 {17, 2.4}	–
Tc	Bolt (camshaft frame installation: 4 places)	23.2 {17, 2.4}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads and seat	Engine oil	As required
	Camshaft bearing inner surface		
	Camshaft journals and cams		
b	Cylinder head mounting surface of camshaft frame	ThreeBond 1217H	As required
	Entire periphery of packing		

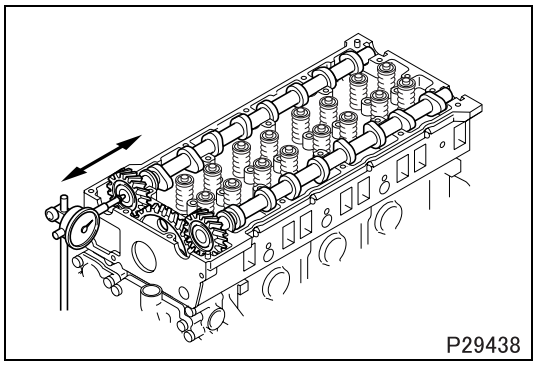
Mark	Tool name and shape	Part No.	Application
a	Rocker shaft set tool  P103819	MH063861	Installtion of rocker shaft

◆Work before removal◆


P56523

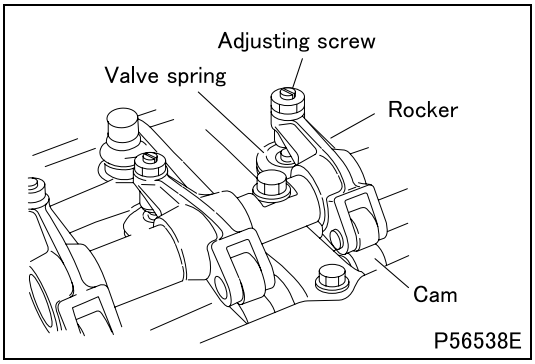
■ **Inspection: Backlash between gears**

- Measure the backlash at three or more locations for each pair of gears.
- If any of the measurements exceeds the specified limit, replace the defective part(s).


P29438

■ **Inspection: Camshaft end play**

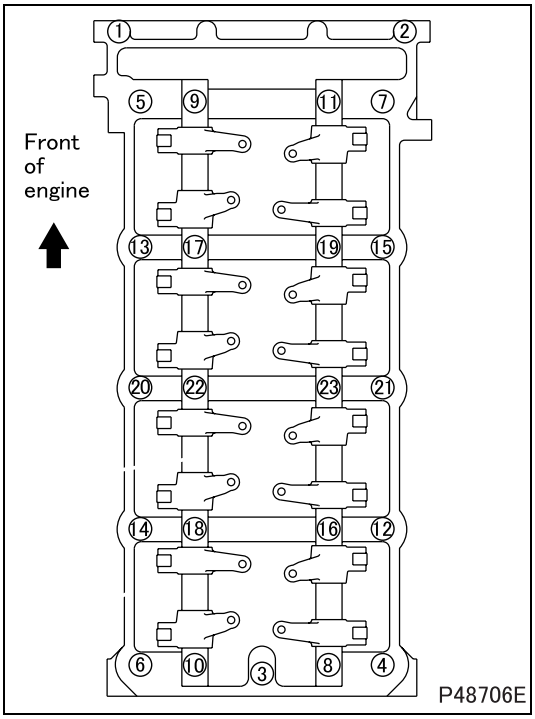
- If the end play exceeds the specified limit, replace the defective part(s).



■ Releasing valve spring tension

- Before removing the bolts in the next process, loosen the adjusting screws on the rockers whose valve springs are compressed (due to the cams lifting these rockers). This operation is necessary to release the tension in the valve springs, thus preventing other parts from undue forces when the bolts are removed.

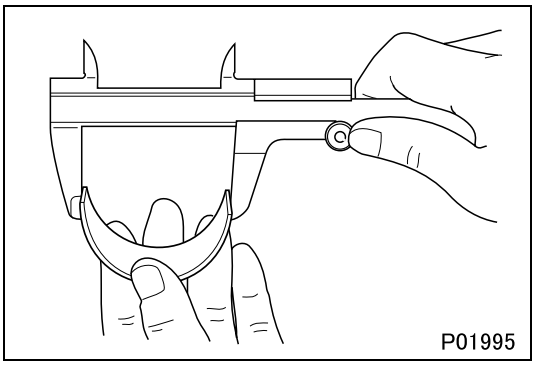
◆Removal procedure◆



■ Removal: Rocker shafts and camshaft frame

- Loosen the rocker shaft installation bolts (10 places) and the camshaft frame installation bolts (13 places) in several passes in the order indicated in the illustration (1 to 23). Then, remove the rocker shafts and the camshaft frame.

◆Inspection procedure◆

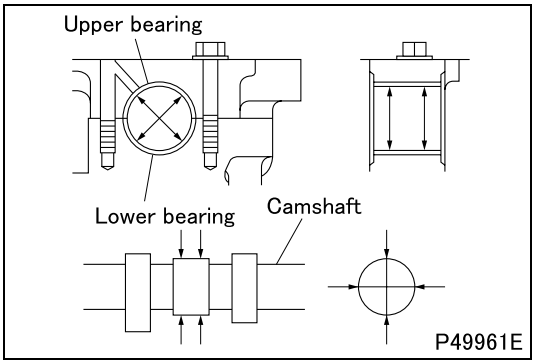


■ Inspection: Camshaft bearing free span

CAUTION ⚠

- **Do not force the bearings open.**

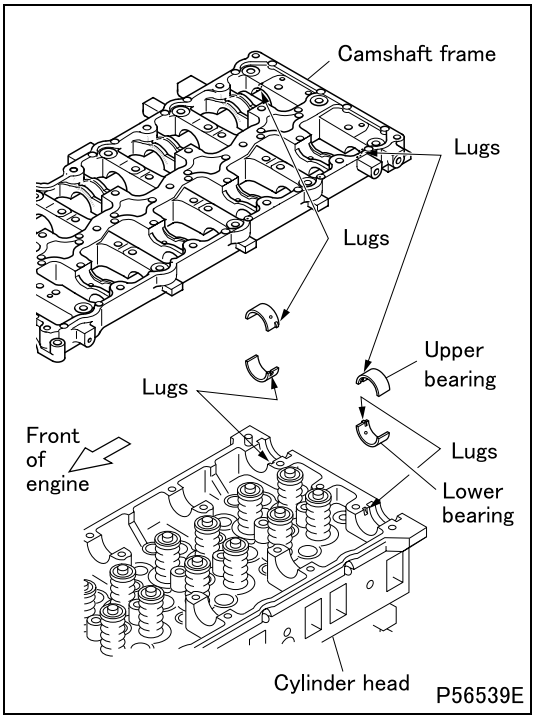
- If the measurement is less than the limit, replace upper and lower bearings as a set.



■**Inspection: Camshaft bearing-to-camshaft clearance**

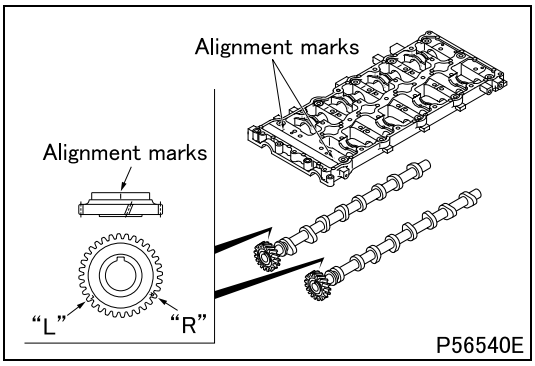
- If the measurement is not within the standard value range, replace the defective part(s).

◆Installation procedure◆



■ **Installation: Camshaft**

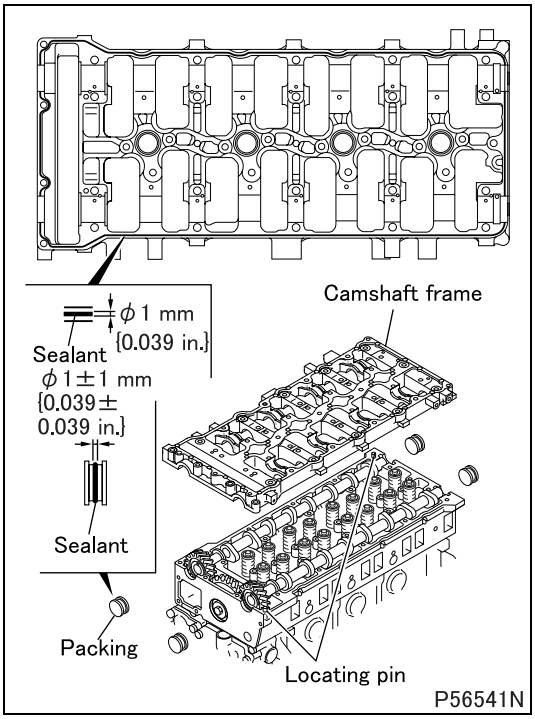
- Install the upper camshaft bearing on the camshaft frame and the lower camshaft bearing on the cylinder head by fitting their lugs into the notches in the camshaft frame and cylinder head.



- Place the No. 1 cylinder piston at the top dead center on the compression stroke.
- Align the mating marks on the camshaft gears with those on the camshaft frame when installing the camshafts.

NOTE

- **Each camshaft gear also has mating mark "L" or "R" for alignment with the head idler gear. This mark may not be exactly aligned with that on the head idler gear, as the position that the head idler gear takes when it is installed may make it impossible to align them. Such a misalignment does not lead to any undesirable consequences.**

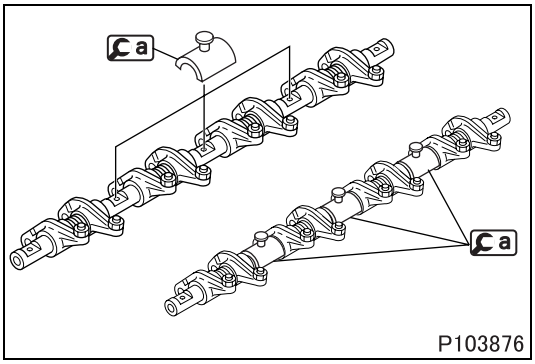


■ **Installation: Rocker shafts and camshaft frame**

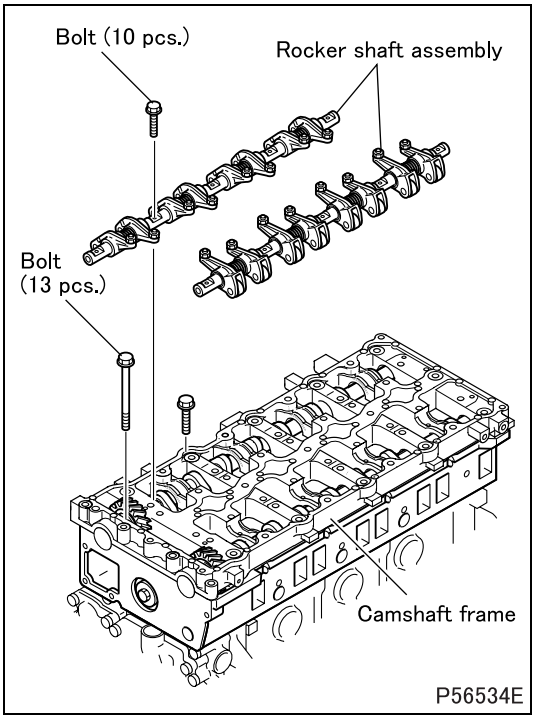
- Clean the sealant application surfaces on each part.
- Apply sealant to the entire periphery of the four packings evenly and without any breaks.
- Apply sealant to the camshaft frame evenly and without any breaks.
- Mount the camshaft frame and packing on the cylinder head within three minutes of applying the sealant, being careful not to dislodge the sealant in the process.

CAUTION ⚠

- **Do not run the engine within one hour of installing the rocker shafts and camshaft frame.**



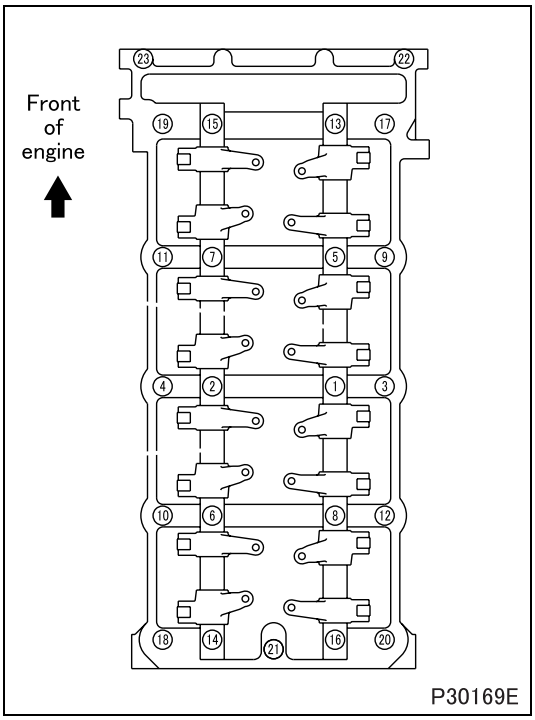
- Install a on the rocker shaft to prevent the rocker arms from moving away from each other.



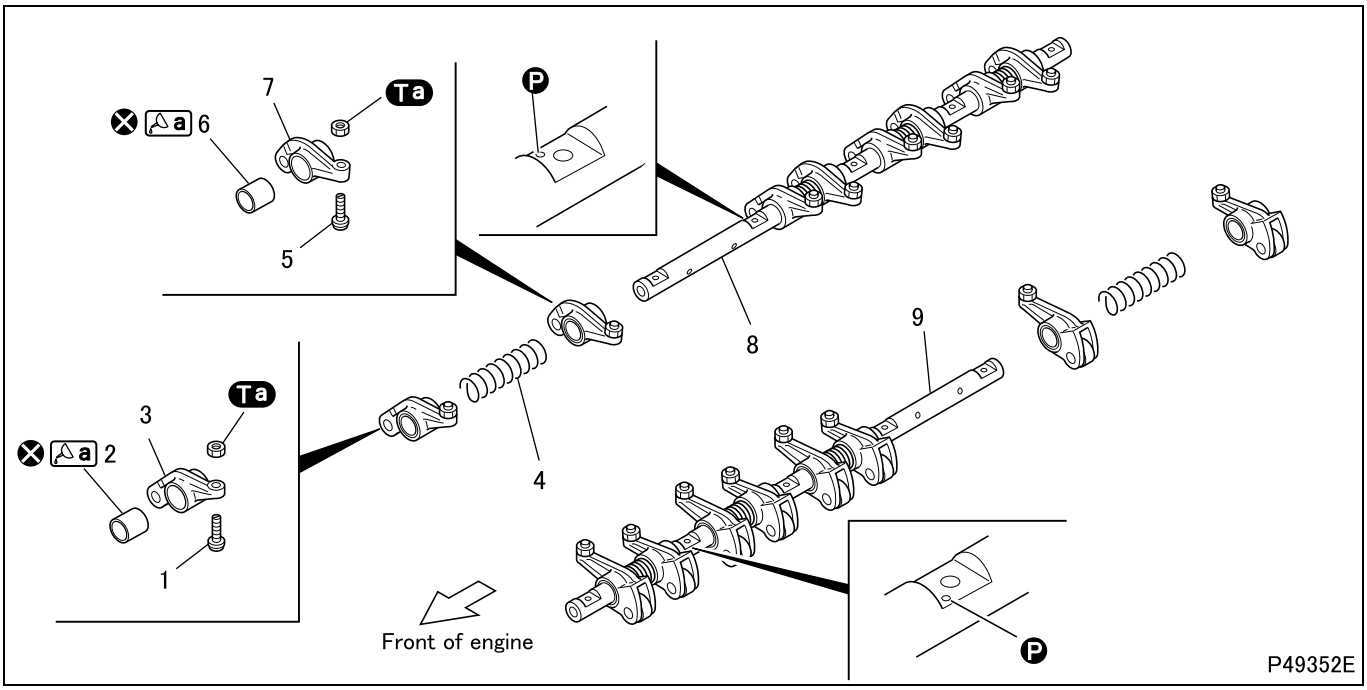
- When installing the camshaft frame on the cylinder head, also install the rocker shafts. Then, tighten the rocker shaft bolts (10 places) and the camshaft frame bolts (13 places) in the order indicated below.

CAUTION ⚠

- **Reapply sealant to the areas specified above if any of the bolts is loosened or removed after the rocker shafts and camshaft frame are installed.**



- Tighten the bolts (1 to 23) to the specified torque in the order indicated in the illustration.



● Disassembly sequence

1 Adjusting screw
2 Rocker bushing
3 Short rocker
4 Rocker shaft spring
5 Adjusting screw
6 Rocker bushing
7 Long rocker
8 Exhaust rocker shaft
9 Intake rocker shaft

Ⓟ: Hole for camshaft frame locating pin
⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **The short rockers and long rockers must be installed alternately. Be aware that the order of installation for the intake rockers is different from the order of installation for the exhaust rockers.**

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3, 7	Rocker (roller) radial play	0.038 to 0.100 {0.0015 to 0.0039}	–	Replace
2, 6, 8, 9	Rocker bushing-to-rocker shaft clearance	0.01 to 0.08 {0.00039 to 0.0031}	0.12 {0.0047}	Replace

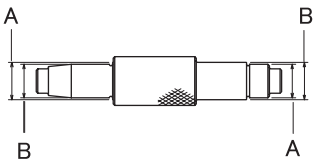
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (adjusting screw stopping)	21 {15.5, 2.1}	–

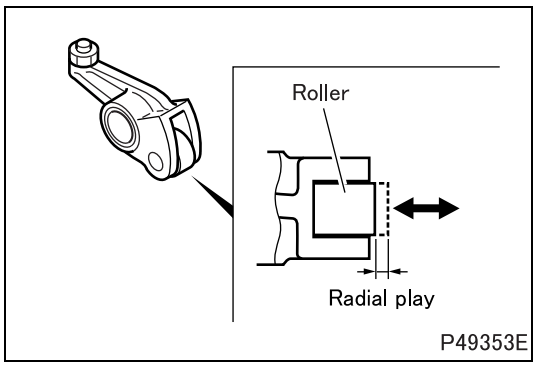
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Rocker bushing inner surface	Engine oil	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
Ca	Rocker bushing puller A: ϕ22 {ϕ0.87} B: ϕ24.5 {ϕ0.96}  P29932	MH062536	Removal and installation of rocker bushing

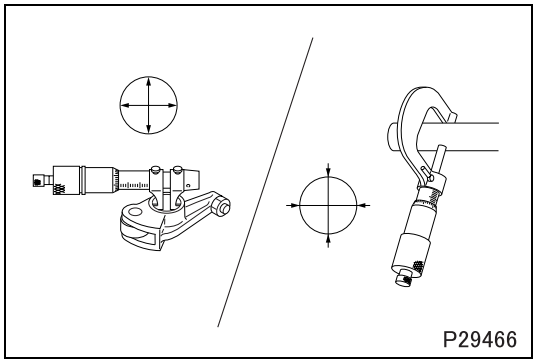
◆Inspection procedure◆



P49353E

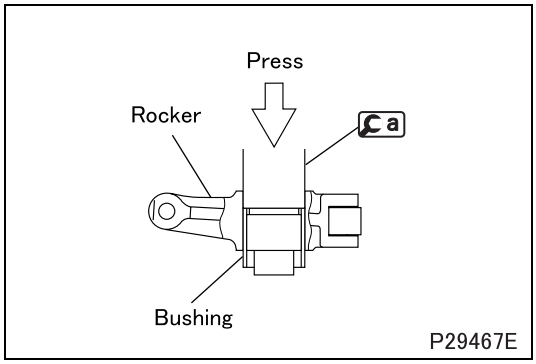
■ Inspection: Rocker (roller) radial clearance

- Replace the rocker if the radial play measurement is not within the standard value range.

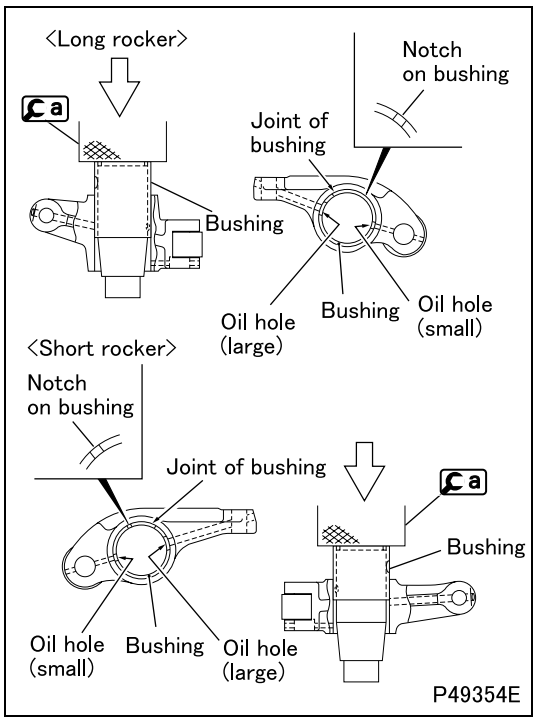

P29466

■ Inspection: Rocker bushing-to-rocker shaft clearance

- Replace the bushing if the measurement exceeds the specified limit.



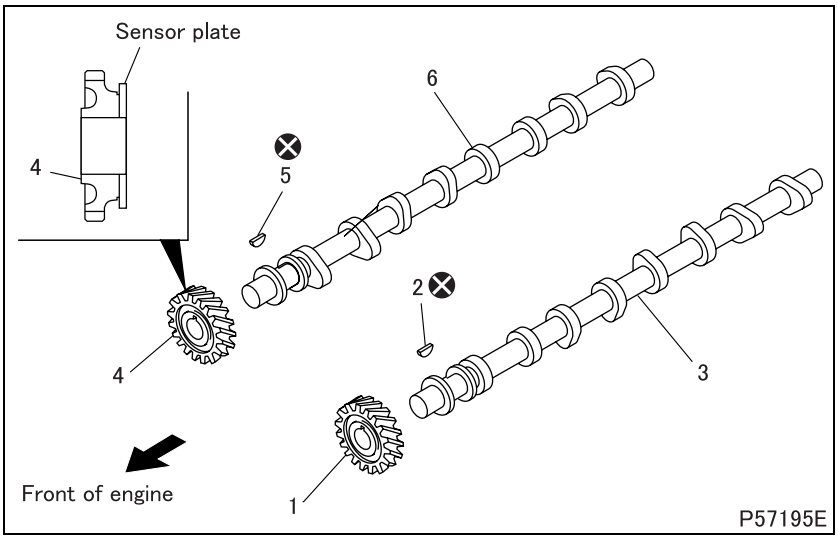
Replacement of rocker bushing
[Removal]



[Installation]

- Press-fit each rocker bushing in the rocker with its ends facing in the illustrated directions.

Camshafts



● Disassembly sequence

1 Intake camshaft gear
2 Key
3 Intake camshaft
4 Exhaust camshaft gear
5 Key
6 Exhaust camshaft

⊗: Non-reusable parts

NOTE

- **Do not remove the camshaft gears unless defects are evident.**

● Assembly sequence

Follow the disassembly sequence in reverse.

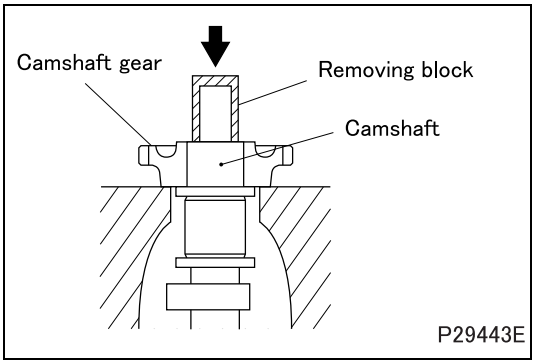
NOTE

- **The exhaust camshaft gear has the sensor plate. Do not mistake it for the intake camshaft gear. If the gears are incorrectly installed, engine malfunction will occur.**

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
1, 3, 4, 6	Camshaft gear-to-camshaft interference			0.007 to 0.041 {0.00028 to 0.0016}	–	Replace
3	Intake camshaft	Cam lift	Cams for long rockers	7.219 {0.284}	–	Replace
			Lobe height: 42.219 {1.66} Base circle diameter: 35 {1.38}			
			Cams for short rockers	9.281 {0.365}	–	
			Lobe height: 44.281 {1.74} Base circle diameter: 35 {1.38}			
		Bend		0.01 {0.00039}	0.03 {0.0012}	Replace
6	Exhaust camshaft	Cam lift	Cams for long rockers	7.111 {0.279}	–	Replace
			Lobe height: 42.279 {1.66} Base circle diameter: 35.168 {1.39}			
			Cams for short rockers	9.148 {0.36}	–	
			Lobe height: 44.359 {1.75} Base circle diameter: 35.211 {1.39}			
		Bend		0.01 {0.00039}	0.03 {0.0012}	Replace

◆Removal procedure◆



■ **Removal: Camshaft gears**

- Remove the camshaft gear by pushing on the camshaft using a press.

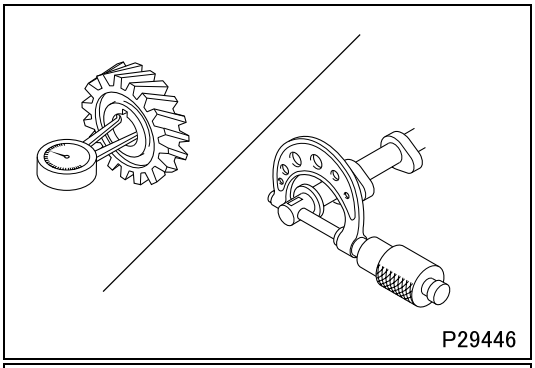
CAUTION ⚠

- **Do not use a hammer to remove the camshaft gear. Be sure to use a press for this purpose.**

◆Inspection procedure◆

■ **Inspection: Camshaft gear-to-camshaft interference**

- If the measurement is not within the standard value range, replace the defective part(s).



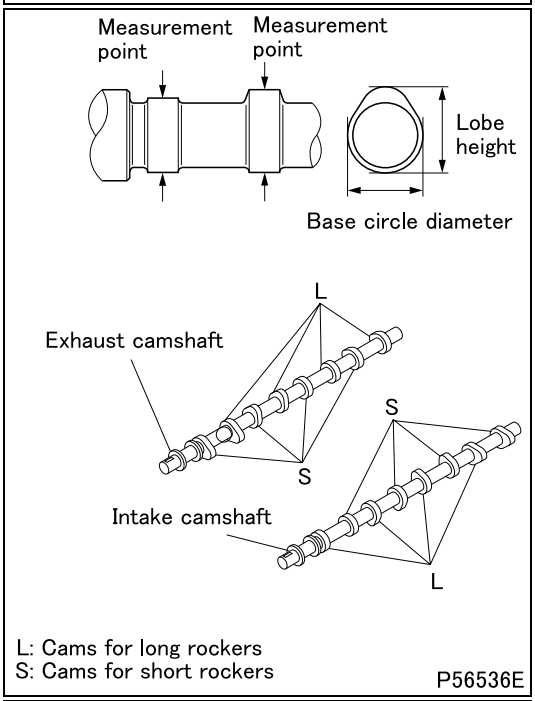
■ **Inspection: Camshaft**

(1) Cam lift

- Replace the camshaft if the difference between the cam lobe height and base circle diameter measurements is less than the specified limit.

NOTE

- **The cams for the long rockers (L) are different from the cams for the short rockers (S).**

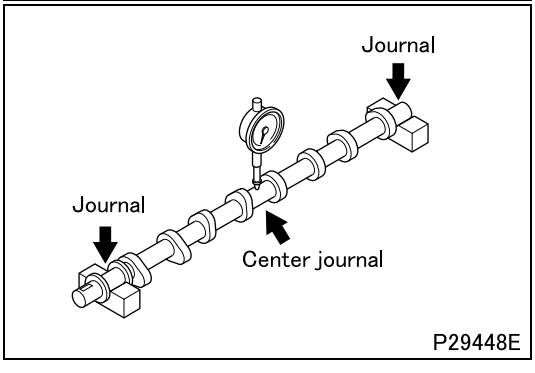


(2) Bend

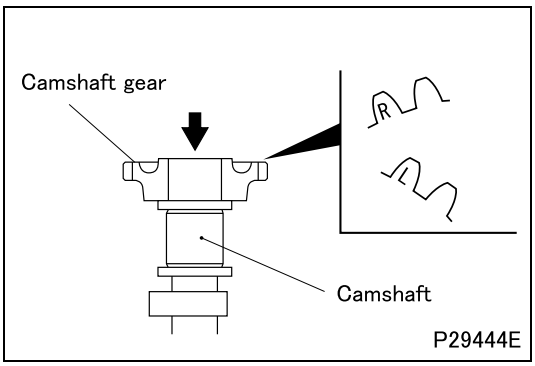
- Place supports under the journals at the ends of the camshaft and measure the bend of the camshaft at the central journal.
- If the measurement exceeds the specified limit, replace the camshaft.

NOTE

- **Turn the camshaft by one turn and read the dial gauge. Divide the reading by two to obtain the amount of camshaft bend.**



◆Installation procedure◆



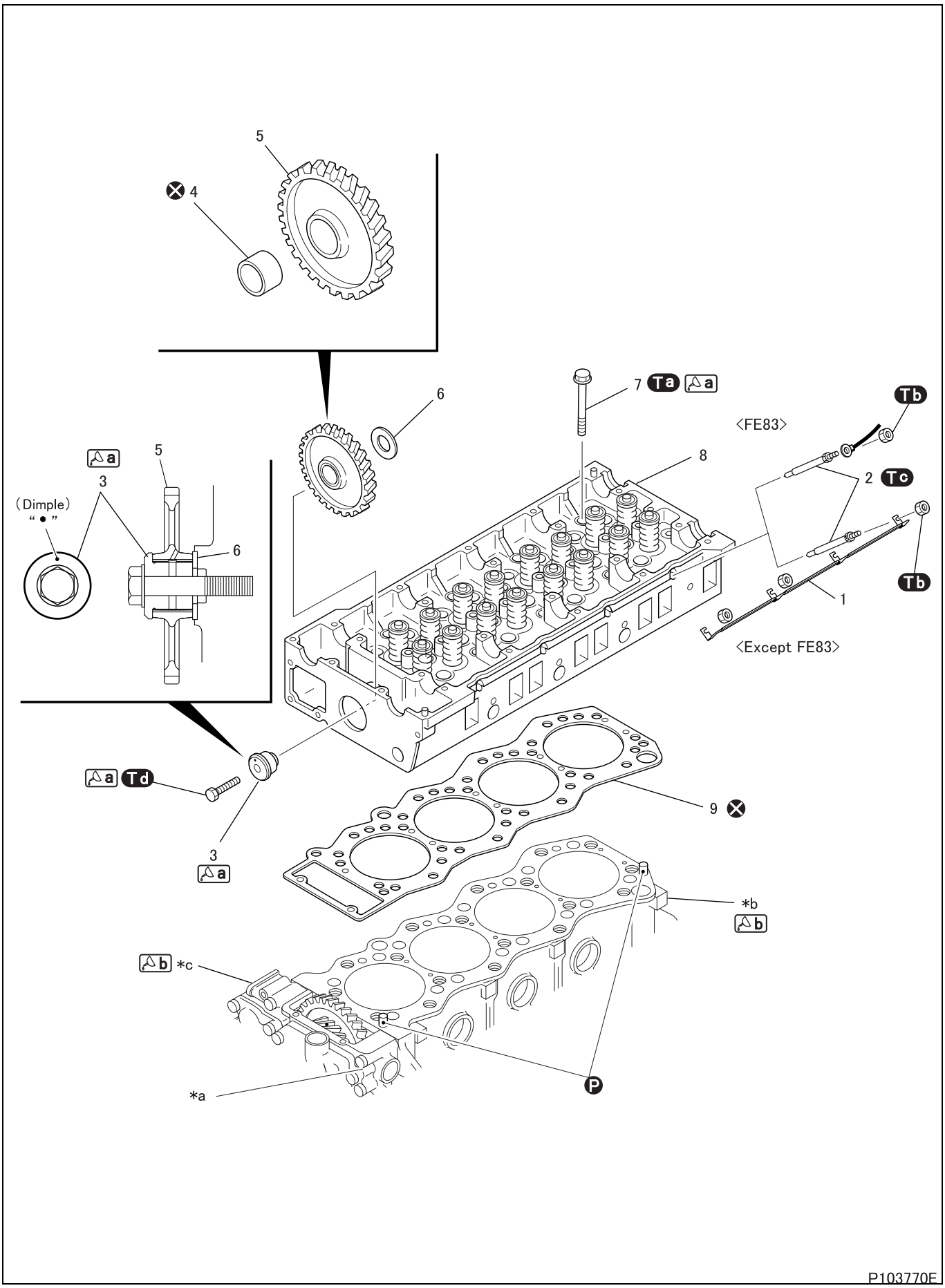
■ **Installation: Camshaft gears**

- Heat the camshaft gears to approximately 150°C {302°F} with a gas burner.

WARNING ⚠

- **You may burn yourself if you touch the heated gear.**

- Install the camshaft gear on the camshaft with a mating mark (“R” or “L”) facing in the illustrated direction.
- Press the gear until its end comes in close contact with the flange on the camshaft.


5
4
6
7 Ta a
Tb
<FE83>
8
2 Tc
a
3
5
(Dimple)
6
Tb
1
<Except FE83>
a Td
9
3
a
*b
b
b *c
*a
P
P103770E

● Disassembly sequence

1 Connection plates
2 Glow plug
3 Head idler shaft
4 Head idler gear bushing
5 Head idler gear
6 Thrust plate
7 Cylinder head bolt
8 Cylinder head
(See later sections.)
9 Cylinder head gasket
∗a: Idler gear
∗b: Upper crankcase
∗c: Front case
Ⓟ: Locating pin
⊗: Non-reusable parts

CAUTION ⚠

- **Be careful not to damage the glow plugs and injectors when placing the cylinder head on the worktable, as they are protruding out of the bottom of the cylinder head.**
- **The cylinder head bolts are tightened using the torque-turn method. Any cylinder head bolt that has three marks indicating that the bolt has been tightened three times already must be replaced with a new one.**

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **Do not forget to install the thrust plate.**

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Backlash between head idler gear and idler gear	0.103 to 0.158 {0.0041 to 0.0062}	0.3 {0.012}	Replace
–	Head idler gear end play	0.1 to 0.2 {0.0039 to 0.0079}	0.3 {0.012}	Replace
3, 4	Head idler shaft-to-head idler gear bushing clearance	0.01 to 0.05 {0.00039 to 0.0020}	0.1 {0.0039}	Replace

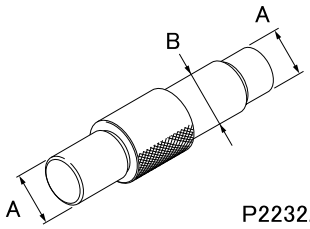
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Cylinder head bolt	147 {110, 15} + 90°	Wet
Tb	Nut (connection plate installation)	1.0 to 1.5 {0.7 to 1.1, 0.1 to 0.15}	–
Tc	Glow plug	19.6 to 24.5 {14 to 18, 2 to 2.5}	–
Td	Bolt (head idler shaft installation)	40.2 {30, 4.1}	Wet

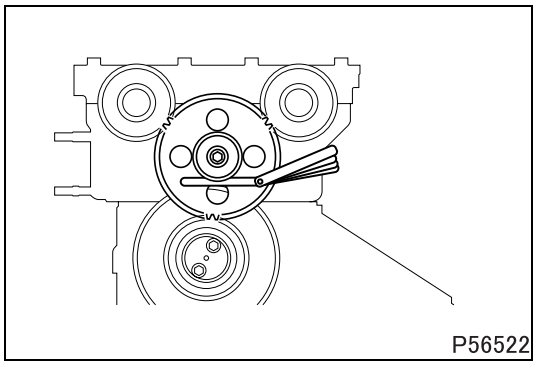
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required
	Bolt (head idler gear installation) threads and seating surface under head		
	Head idler shaft outer peripheral surface		
	Cylinder head bolt threads		
b	Top surfaces of joints between upper crankcase and front case	ThreeBond 1207C	As required

Special tools (Unit: mm {in.})

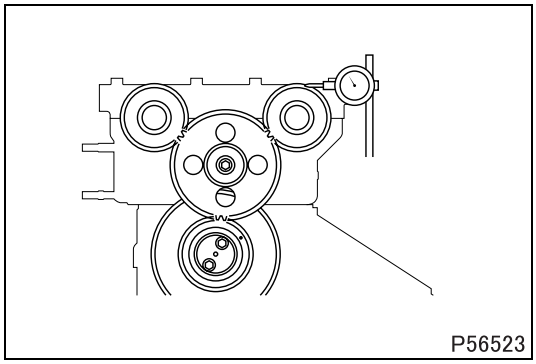
Mark	Tool name and shape	Part No.	Application
ⓒa	Idler gear bushing puller A: ϕ32 {ϕ1.26}, B: ϕ35 {ϕ1.38}  P22322	MH061779	Removal and installation of idler gear bushing

◆Inspection before removal◆


P56522

■ **Inspection: Head idler gear end play**

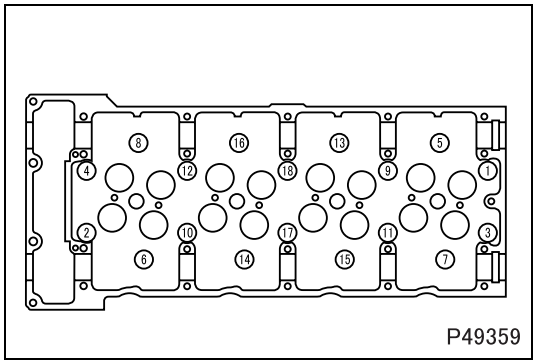
- If the measurement exceeds the specified limit, replace the defective part(s).


P56523

■ **Inspection: Backlash between gears**

- Measure the backlash at three or more locations for each pair of gears.
- If any of the measurements exceeds the specified limit, replace the defective part(s).

◆Removal procedure◆



P49359

■ **Removal: Cylinder head**

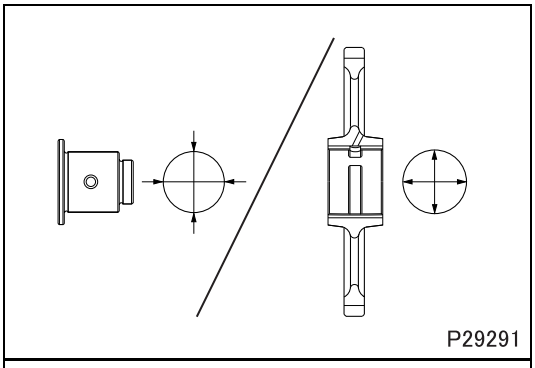
- Loosen the cylinder head bolts (1 to 18) in several passes in the order indicated in the illustration and remove the cylinder head.

■ **Removal: Cylinder head gasket**

CAUTION ⚠

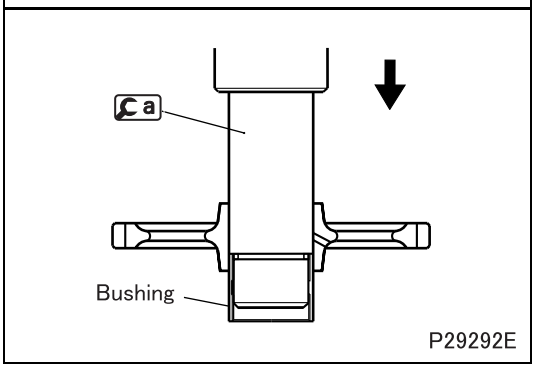
- **When removing the cylinder head gasket, be careful not to scratch the cylinder head, the upper crankcase and the front case.**

◆Inspection procedure◆


P29291

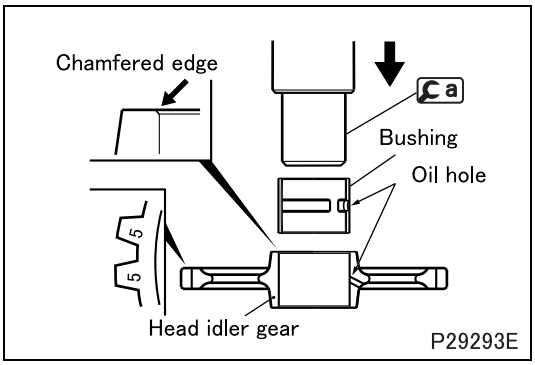
■**Inspection: Head idler shaft-to-head idler gear bushing clearance**

- Replace the bushing if the measurement exceeds the specified limit.



P29292E

Replacement of head idler gear bushing
[Removal]

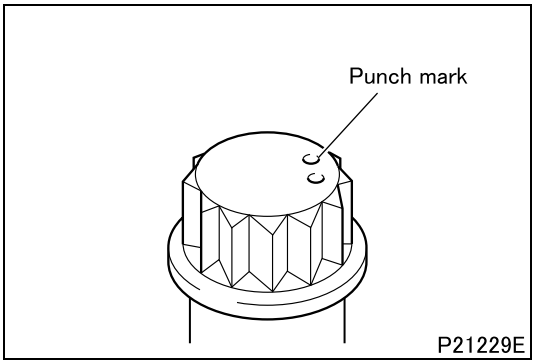


P29293E

[Installation]

- Position the bushing on the head idler gear with their ends facing the illustrated directions and their oil holes on the same line.
- Using a, press the bushing into the head idler gear until it is flush with the lower edge of the chamfer on the head idler gear.
- Remeasure the clearance between the bushing and head idler shaft.
- Ream the bushing if the measurement is less than the standard value.

◆Installation procedure◆

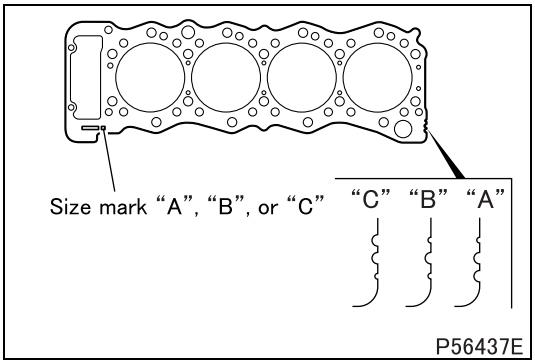


P21229E

■**Installation: Cylinder head**

CAUTION ⚠

- **Before fitting the cylinder head bolts, check the punch marks on each bolt's head. Do not use the bolt if there are three punch marks.**
- **The punch marks indicate the number of times each bolt has been tightened using the torque-turn tightening method. Any bolt that already has three punch marks must be replaced.**



- The cylinder head gasket comes in three sizes. Choose the gasket appropriate for the cylinder head by the following procedure.
  - Measure the amount of piston projection for every cylinder. (See the "**PISTONS, CONNECTING RODS AND CYLINDER LINERS**" section.)
  - Select a cylinder head gasket with the appropriate thickness for the average of the piston projection measurements from the table below.
  - If any of the piston projection measurements is more than 0.05 mm {0.0020 in.} larger than the average value, then use the gasket one class higher than that class (A→B, B→C).

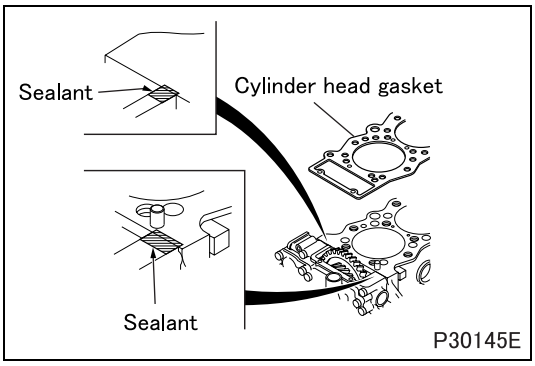
Unit: mm {in.}

Piston projection	Cylinder head gasket	
	Size	Thickness when tightened
–0.088 to –0.027 {–0.0035 to –0.0011}	"A"	0.75 ± 0.03 {0.030 ± 0.0012}
–0.027 to 0.033 {–0.0011 to 0.0013}	"B"	0.80 ± 0.03 {0.031 ± 0.0012}
0.033 to 0.094 {0.0013 to 0.0037}	"C"	0.85 ± 0.03 {0.033 ± 0.0012}

- The size class of the cylinder head gasket can be determined from the size mark or the shape of the notches cut on the gasket edge.

CAUTION ⚠

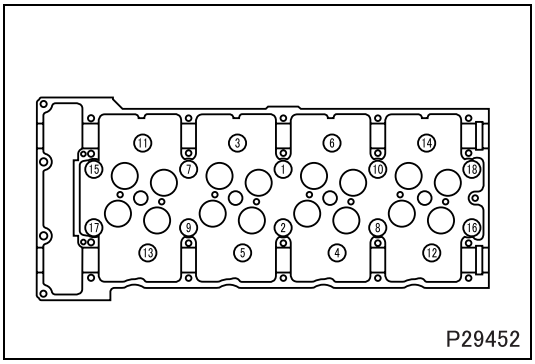
- **Replacement of the piston or connecting rod alters the piston projection. Always measure the amount of piston projection after either or both of them are replaced.**



- Clean the sealant application surfaces of each part.
- Apply sealant to the top surfaces of the joints between the upper crankcase and front case (at two places).
- Install the cylinder head and its gasket on the upper crankcase within three minutes of applying the sealant, being careful not to dislodge the sealant.

CAUTION ⚠

- **Do not run the engine within one hour of mounting the cylinderhead. If any cylinder head bolts are loosened or removed, be sure to reapply sealant to the surfaces specified above.**

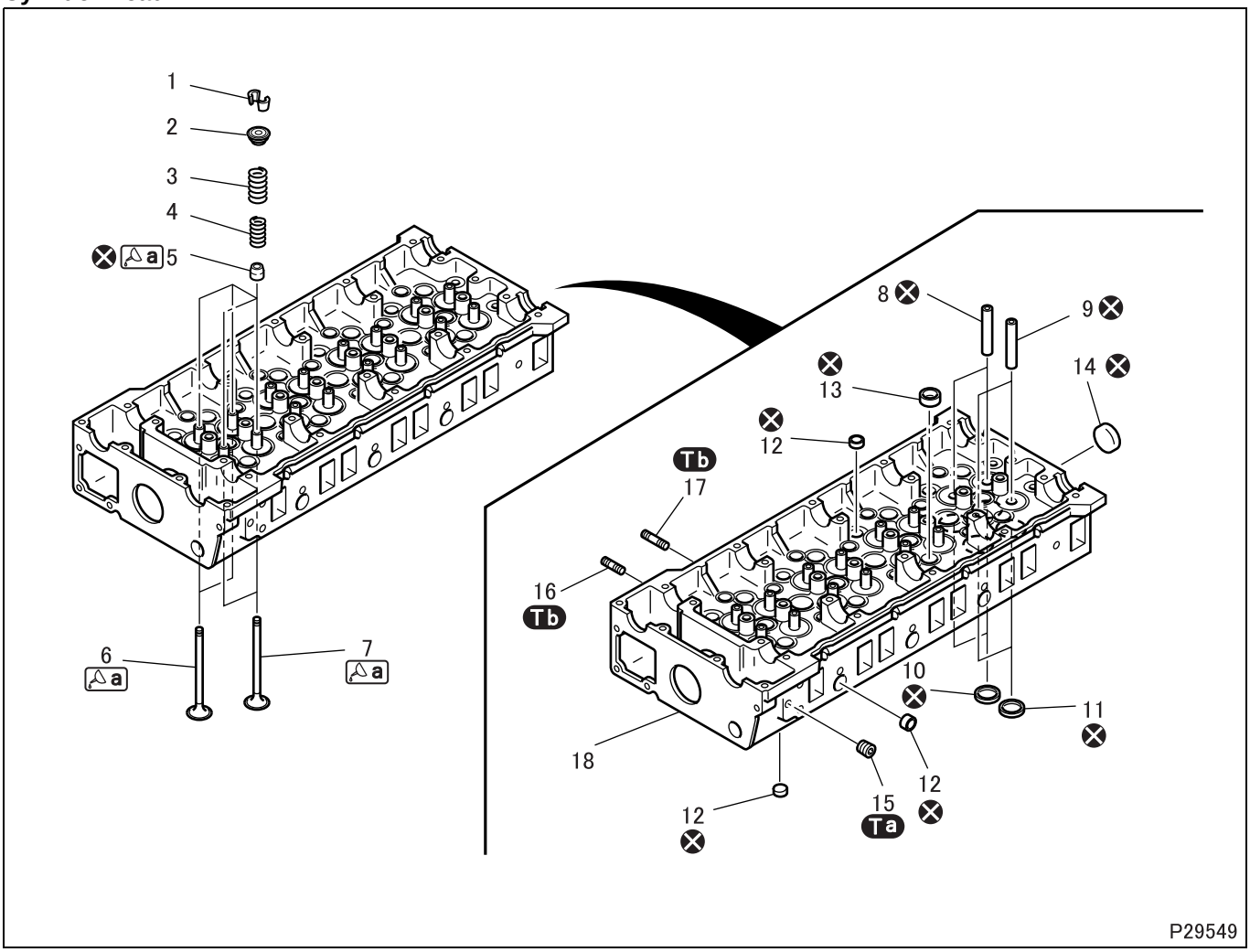


- Tighten the cylinder head bolts (1 to 18) to a torque of 147 N·m {110 lbf·ft, 15 kgf·m} (wet) in the order indicated in the illustration. Then, tighten them further by 90° in the same order.
- After tightening each bolt, make a punch mark on the head of the bolt to indicate the number of times that it has been used.

CAUTION ⚠

- **Cylinder head bolts that have been tightened using the torque-turn method must never be additionally tightened after the final angular tightening.**

Cylinder Head



● Disassembly sequence

1 Valve cotter
2 Upper retainer
3 Outer valve spring
4 Inner valve spring
5 Valve stem seal
6 Exhaust valve
7 Intake valve
8 Exhaust valve guide
9 Intake valve guide
10 Exhaust valve seat
11 Intake valve seat
12 Sealing cap (diameter: 22 mm {0.87 in.})
13 Sealing cap (diameter: 30 mm {1.18 in.})
14 Sealing cap (diameter: 40 mm {1.57 in.})
15 Taper plug
16 Stud (short)
17 Stud (long)
18 Cylinder head

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **When an intake valve or exhaust valve have been removed, make sure to replace the valve stem seal.**

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
3	Outer valve spring	Free length	87.8 {3.46}	83.4 {3.28}	Replace
		Installed load (57 {2.24} in installed length)	360 ± 18 N {81 ± 4.0 lbs, 36.7 ± 1.8 kgf}	–	
		Squareness	–	2.0 {0.079}	
4	Inner valve spring	Free length	78.8 {3.10}	74.9 {2.95}	Replace
		Installed load (52.3 {2.06} in installed length)	168 ± 8.4 N {38 ± 1.9 lbs, 17.1 ± 0.9 kgf}	–	
		Squareness	–	2.0 {0.079}	
6	Exhaust valve	Stem outside diameter	$\phi 8\ ^{-0.060}_{-0.075}$ {$\phi 0.31\ ^{-0.0024}_{-0.0030}$}	ϕ7.85 {ϕ0.31}	Replace
		Sinkage from cylinder head bottom surface	1.5 ± 0.25 {0.059 ± 0.0098}	2.0 {0.079}	Replace
		Valve margin	1.5 {0.059}	1.2 {0.047}	Replace
		Seat angle	45° ± 15'	–	Reface
6, 8	Exhaust valve stem-to-valve guide clearance		0.07 to 0.10 {0.0028 to 0.0039}	0.2 {0.0079}	Replace
7	Intake valve	Stem outside diameter	$\phi 8\ ^{-0.025}_{-0.040}$ {$\phi 0.31\ ^{-0.00098}_{-0.0016}$}	ϕ7.85 {ϕ0.31}	Replace
		Sinkage from cylinder head bottom surface	1.5 ± 0.25 {0.059 ± 0.0098}	2.0 {0.079}	Replace
		Valve margin	1.5 {0.059}	1.2 {0.047}	Replace
		Seat angle	45° ± 15'	–	Reface
7, 9	Intake valve stem-to-valve guide clearance		0.03 to 0.06 {0.0012 to 0.0024}	0.2 {0.0079}	Replace
10	Exhaust valve seat width		2.5 ± 0.2 {0.098 ± 0.0079}	3.5 {0.14}	Replace
11	Intake valve seat width		2 ± 0.2 {0.079 ± 0.0079}	2.8 {0.11}	Replace
16	Cylinder head	Bottom surface distortion	0.05 {0.0020}	0.2 {0.0079}	Correct or replace
		Height from top surface to bottom surface	107 ± 0.05 {4.21 ± 0.0020}	106.5 {4.19}	Replace
		Valve seat hole diameter	$\phi 38\ ^{+0.025}_{0}$ {$\phi 1.50\ ^{+0.0098}_{0}$}	–	Replace

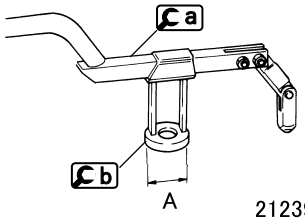
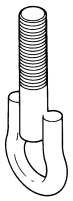
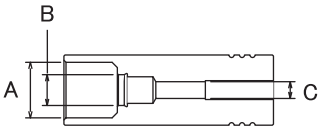
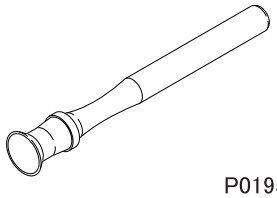
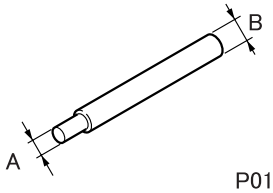
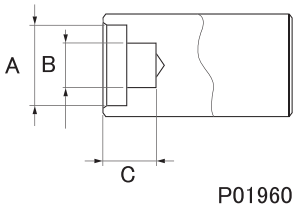
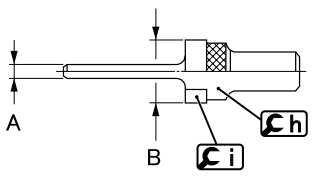
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Tapered plug	14 {10, 1.4}	–
Tb	Stud	20 {15, 2.0}	–

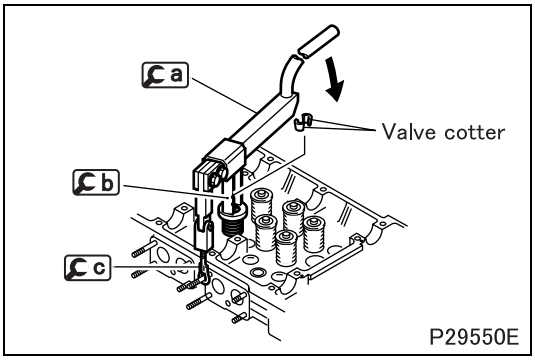
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Lip of valve stem seal	Engine oil	As required
	Valve stem and valve end		

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
a	Valve lifter  21239	MH061668	Removal and installation of valve cotters
b	Valve lifter seat A: ϕ38 {ϕ1.50}	MH061772	
c	Valve lifter hook  21240	MH061679	
d	Valve stem seal installer A: ϕ26.5 {ϕ1.04} B: ϕ14.7 {ϕ0.58} C: ϕ8 {ϕ0.31}  P29931	MH063607	Installation of valve stem seals
e	Valve lapper  P01958	30091-07500	Lapping valves and valve seats
f	Valve guide remover A: ϕ8 {ϕ0.31} B: ϕ12 {ϕ0.47}  P01959	31391-10500	Removal of valve guides
g	Valve guide installer A: ϕ25.5 {ϕ1.00} B: ϕ13 {ϕ0.51} C: 29 {1.14}  P01960	MH063604	Installation of valve guides
h	Caulking tool body A: ϕ8 {ϕ0.31}	31391-13100	Installation of valve seat
i	Installer ring B: ϕ38 {ϕ1.50}  P01961B	MH063605	

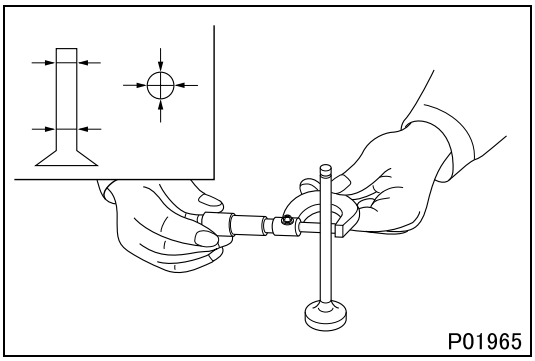
◆Removal procedure◆



■Removal: Valve cotters

- Remove the valve cotters by evenly compressing the valve springs.

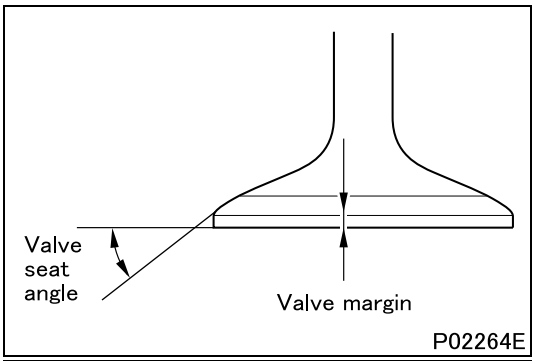
◆Inspection procedure◆



■Inspection: Intake valves and exhaust valves

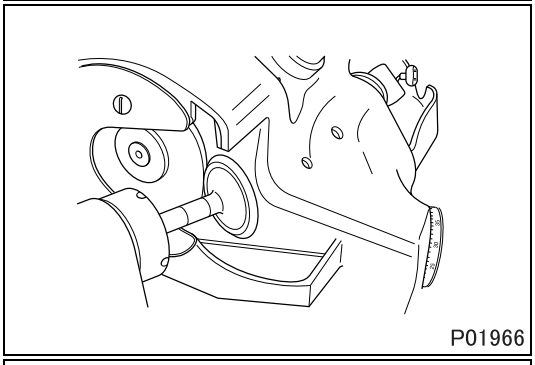
(1) Inspection of valve stem

- Replace the valve if the stem's outside diameter is below the limit or is severely worn.
- When the valve has been replaced with a new one, make sure to lap the valve and valve seat.



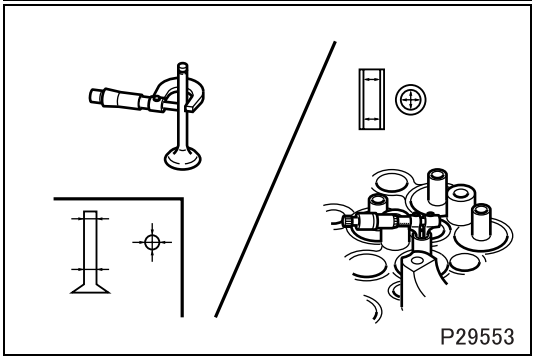
(2) Valve seat angle and valve margin

- Reface or replace the valve if the valve seat angle or valve margin exceeds the specified limits.



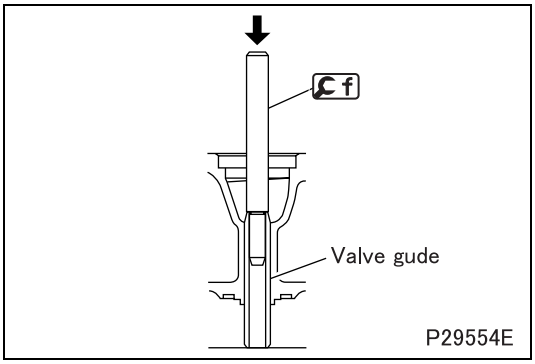
Refacing

- Limit grinding to a necessary minimum.
- If the valve margin is below the limit after grinding, replace the valve.
- After grinding, make sure to lap the valve and valve seat.

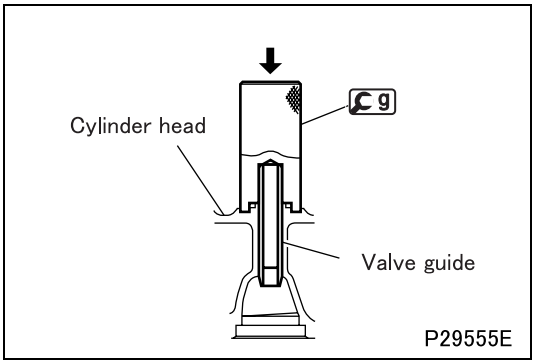


■Inspection: Valve-to-valve guide clearance

- If the clearance exceeds the specified limit, replace the defective part(s).



Replacement of valve guides
[Removal]

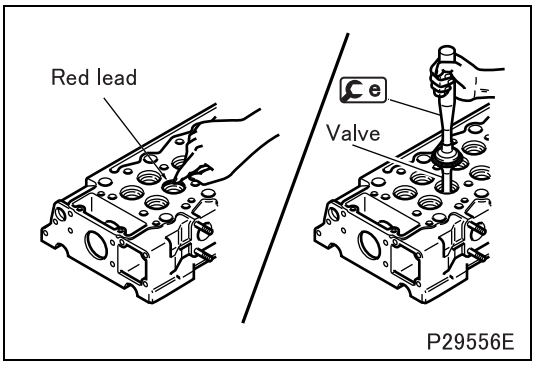


[Installation]

- Install the valve guide until g sits snugly on the cylinder head.

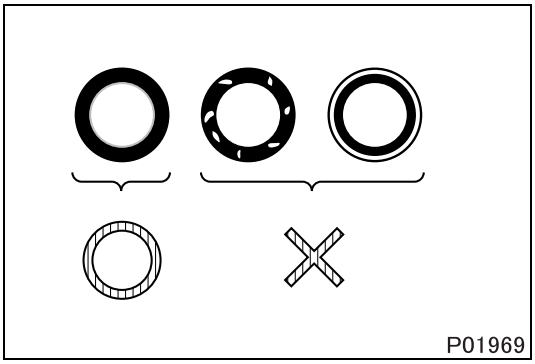
CAUTION ⚠

- **The valve guides must be pressed to the specified depth. Be sure to use g for this operation.**
- **Exhaust valve guides are longer than intake valve guides. Make sure to install the correct type of guide in each location.**



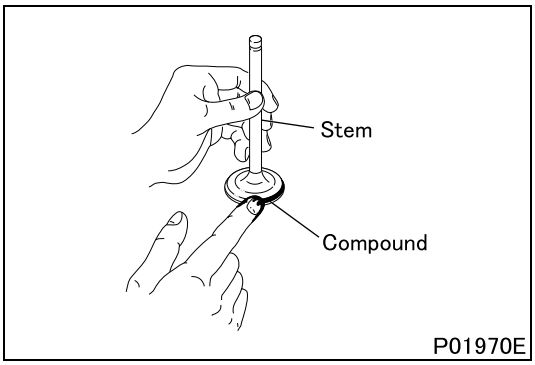
■ Inspection: Contact between valve and valve seat

- Before starting inspection, check that the valve and valve guide are intact.
- Apply an even coat of red lead to the valve contact surface of the valve seat.
- Strike the valve once against the valve seat. Do not rotate the valve during this operation.



- If the red lead deposited on the valve indicates a poor contact pattern, take either of the following corrective actions.

	Corrective action
Minor defect	Lapping
Serious defect	Reface or replace valve and valve seat

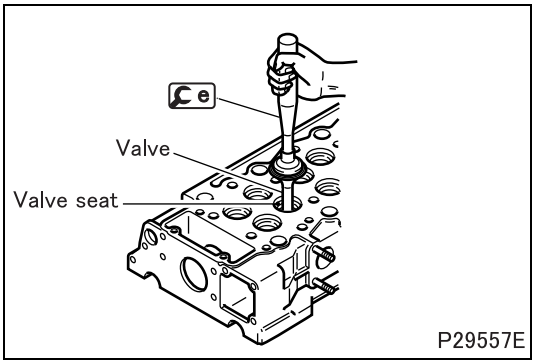


Lapping

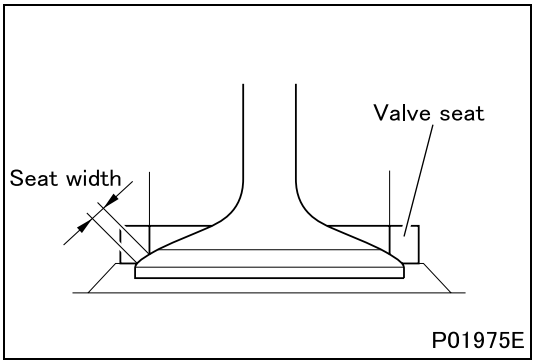
- Perform the valve lapping in the following procedure.
- Apply a thin coat of lapping compound to the seat contact surface of the valve.
- Start with an intermediate-grit compound (120 to 150 grit) and finish with a fine-grit compound (200 grit or more). Do not put any compound on the stem.
- Adding a small amount of engine oil to the lapping compound can facilitate even application.

CAUTION ⚠

- **Do not put any compound on the stem.**



- Strike the valve several times against the valve seat while rotating the valve a little at a time.
- Wash away the compound with diesel fuel.
- Apply engine oil to the valve contact surface of the valve seat and rub in the valve and seat well.
- Inspect the contact pattern of the valve and valve seat again.
- If the contact pattern is still defective, replace the valve seat.



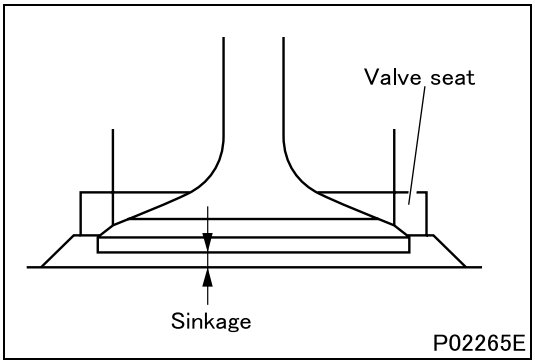
■ Inspection: Valve seats

(1) Valve seat width

- If the measurement exceeds the limit, reface or replace the valve seat.

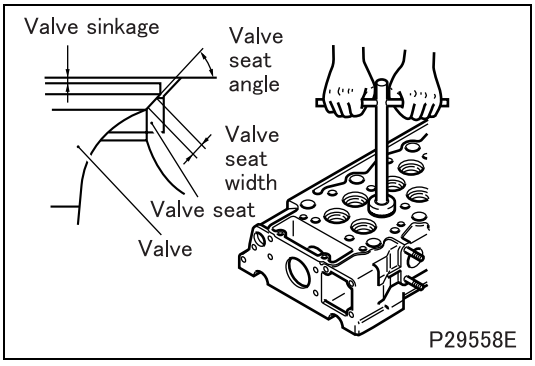
CAUTION ⚠

- **After refacing or replacing the valve seat, make sure to lap the valve seat and valve.**



(2) Valve sinkage from cylinder head bottom surface

- Make sure that the valve and valve seat are pressed together tightly when measuring the sinkage.
- If the measurement exceeds the limit, reface or replace the defective part(s).



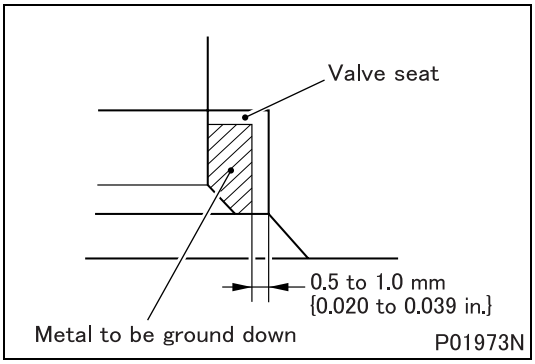
Refacing the valve seat

- Grind the valve seat using a valve seat cutter or valve seat grinder.
- Place a sandpaper of around #400 between the cutter and valve seat and grind the valve seat lightly.
- Use a 15° or 75° cutter to cut the valve seat to a width within the standard range. If the valve seat cannot be refaced to a width within the standard range, replace it.

CAUTION ⚠

- **Make sure that the valve seat refacing does not cause the valve sinkage to exceed the specified limit.**

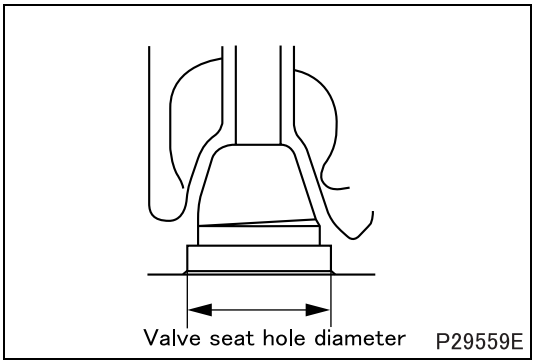
- Lap the valve and valve seat.



Replacement of valve seat

[Removal]

- The valve seats are installed by expansion fitting. To remove a valve seat, grind inside the metal stock to reduce the wall thickness, then remove the valve seat at room temperature.

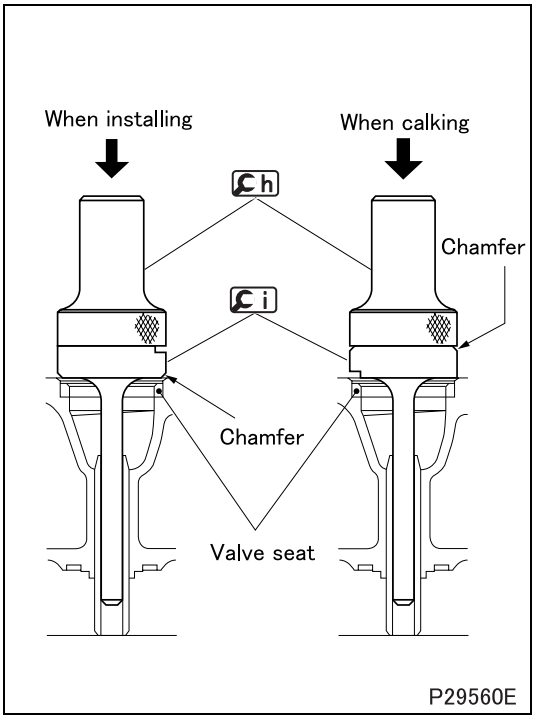


[Installation]

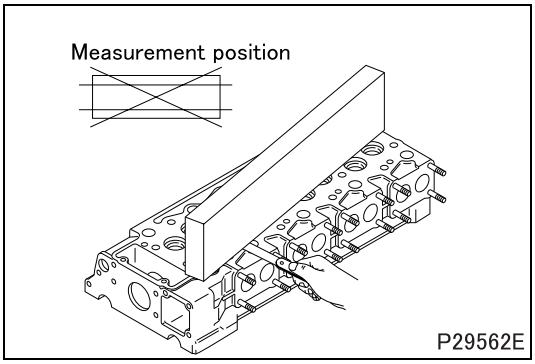
- Check that the diameter of the valve seat hole in the cylinder head conform with the value shown below.

Valve seat hole diameter	$\phi 38\ ^{+0.025}_{0}$ mm {$\phi 1.50\ ^{+0.00098}_{0}$ in.}

- Replace the cylinder head if the measurement deviates from specification.



- Chill the valve seat thoroughly by immersing in it in liquid nitrogen.
- Install the valve seat in the cylinder head using h and i, with the chamfered edge of i toward the valve seat.
- Turn i over so that its chamfered edge is toward h, and calk the valve seat.
- Lap the valve seat and valve.



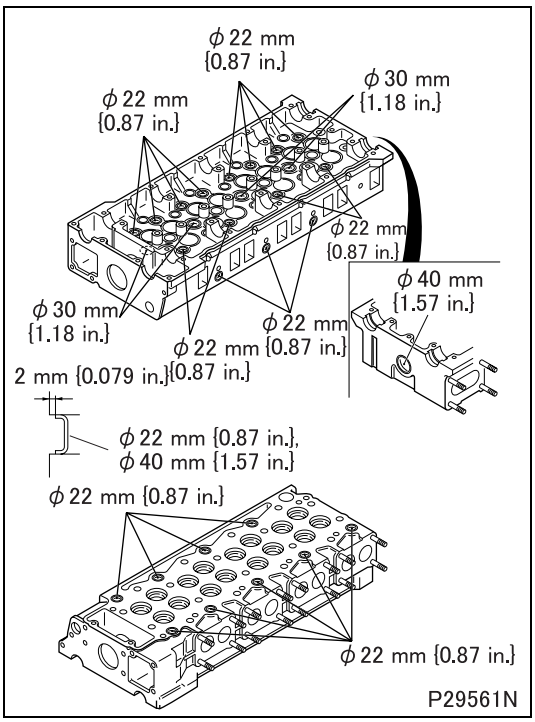
■ Inspection: Cylinder head bottom surface distortion

- If the distortion exceeds the specified limit, rectify it using a surface grinder.

CAUTION ⚠

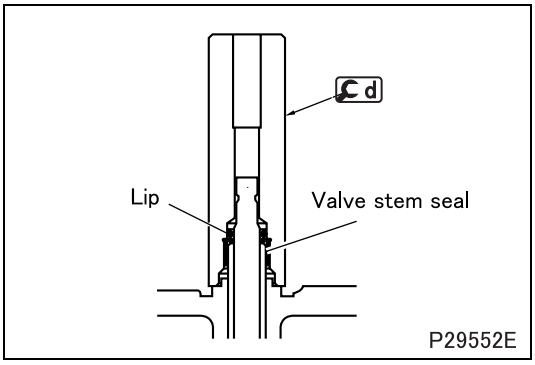
- **When grinding the cylinder head bottom surface, make sure that the height of the cylinder head (from the top surface to the bottom surface) is not reduced to a value below the specified limit.**

◆Installation procedure◆



■Installation: Sealing caps

- Drive the sealing caps into the cylinder head to the specified depth.



■Installation: Valve stem seal

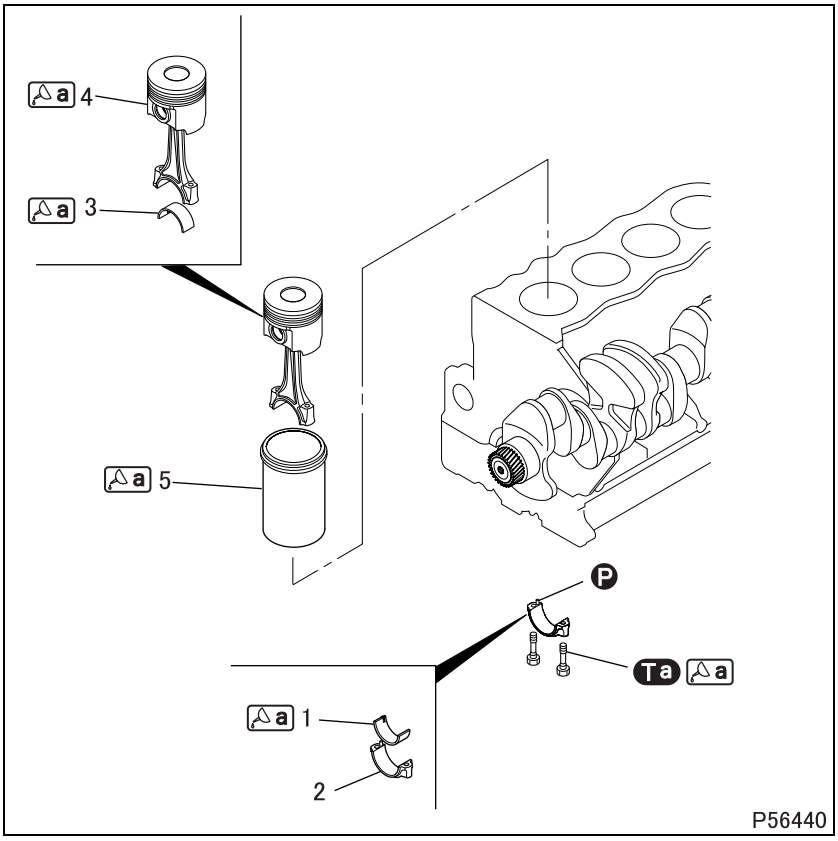
- Apply engine oil to the lip of the valve stem seal.
- Install the valve stem seal until d sits snugly on the cylinder head.

CAUTION ⚠

- **After installing the valve stem seal, check that its spring is not deformed or damaged.**

■Installation: Valve cotter

- To install the valve cotter, follow the removal procedure. (See **"■ Removal: Valve cotter"**.)



● **Disassembly sequence**

1 Lower connecting rod bearing
2 Connecting rod cap
3 Upper connecting rod bearing
4 Piston and connecting rod assembly (See later sections.)
5 Cylinder liner

Ⓟ: Locating pin

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Piston projection from crankcase top surface (average value)		–0.088 to 0.094 {–0.0035 to 0.037}	–	Inspect
–	Connecting rod end play		0.15 to 0.45 {0.0059 to 0.018}	0.6 {0.024}	Inspect
1, 3	Connecting rod bearing	Span when free	–	Less than 69.5 {2.74}	Replace
		Oil clearance	0.034 to 0.093 {0.0013 to 0.0037}	0.2 {0.0079}	
4, 5	Piston-to-cylinder liner clearance		0.181 to 0.201 {0.0071 to 0.0079}	–	Replace

PISTONS, CONNECTING ROD, AND CYLINDER LINERS

Location	Maintenance item		Standard value	Limit	Remedy
5	Cylinder liner	Flange projection above crankcase top surface	0.01 to 0.07 {0.00039 to 0.0028}	–	Replace
		Bore diameter	ϕ114 to 114.02 {ϕ4.4881 to 4.4889}	ϕ114.25 {ϕ4.50}	
		Out-of-roundness	0.08 {0.0031} or less	–	
		Taper	0.03 {0.0012} or less	–	
		Difference in flange projection from neighboring cylinder liner	0.04 {0.0016} or less	–	

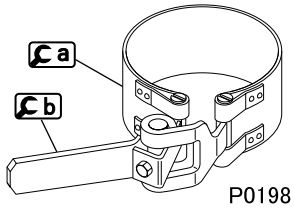
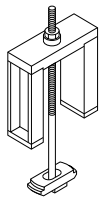
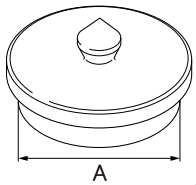
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

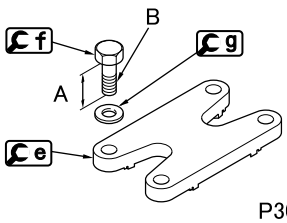
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (connecting rod cap installation)	29 {21, 3.0} + 90° ± 5°	Wet

Lubricant and/or sealant

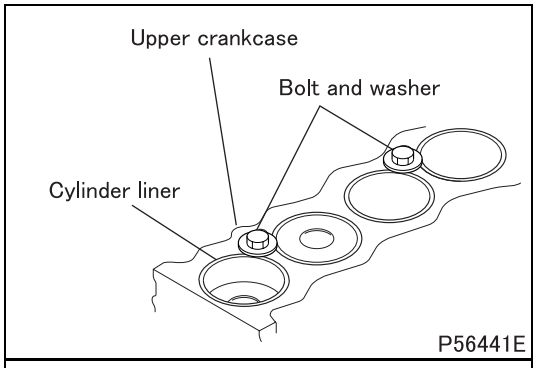
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads	Engine oil	As required
	Connecting rod bearing inside surface		
	Upper crankcase contact surface of cylinder liner		
	Piston outside surface		
	Cylinder liner wall surface		

Special tools (Unit: mm {in.})

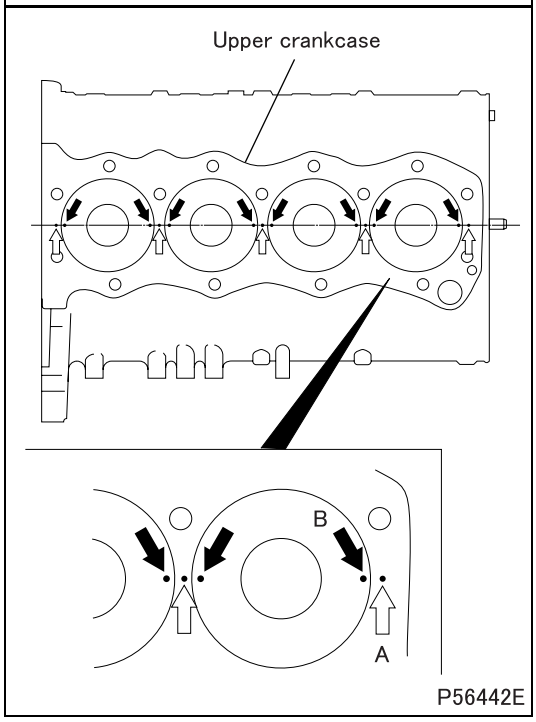
Mark	Tool name and shape		Part No.	Application
a	Piston guide clamp	 P01981	MH064332	Installation of piston and connecting rod assembly
b	Piston guide lever		MH061658	
c	Cylinder liner extractor	 P30008	MH062537	Removal of cylinder liner
d	Cylinder liner installer A: ϕ113.5 {ϕ4.47}	 A P30010	MH063606	Installation of cylinder liner

e	Adapter	 P30009	MH063433	Measurement of cylinder liner flange projection above upper crankcase top surface and difference in flange projection between neighboring cylinder liners
f	Bolt A: 40 {1.57}, B: M14 × 2		MF130625	
g	Washer		MH005012	

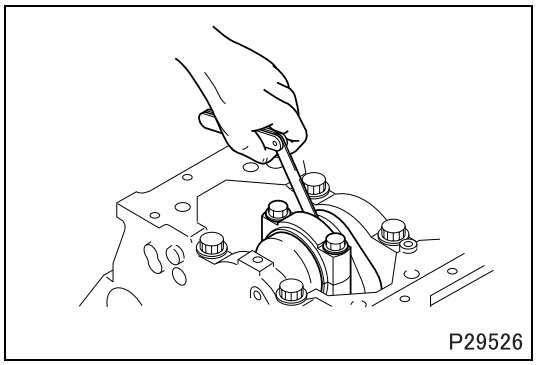
◆Inspection before removal◆



P56441E



P56442E


P29526

■Retaining cylinder liners

- The cylinder liners slips out of the upper crankcase easily when the upper crankcase is turned over or the crankshaft is rotated with pistons inside liners. To prevent this from happening, retain the flange of each cylinder liner in position with a bolt and washer.

■Inspection: Piston projection from upper crankcase top surface

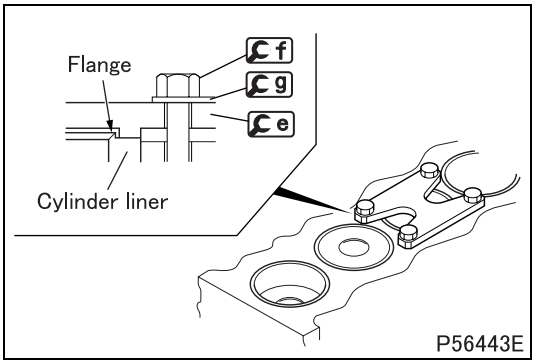
CAUTION ⚠

- **The amount of piston projection affects engine performance and must therefore be inspected without fail.**

- Set the piston at the top dead center.
- Mark reference points **A** (five points in total) on the top surface of the upper crankcase as shown in the illustration. Using each of the marks as a zero point, measure the amount of piston projection relative to the zero point (height of measurement point **B** – height of reference point **A**).
- Make the measurements at the two measurement points **B** for each cylinder (eight points in total) using the reference point **A** nearest to each measurement point, and calculate the average value of all the measurements.
- If the average value is out of the standard value range, check the clearances between all relevant parts.
- Select and use a cylinder head gasket that can accommodate the average piston projection (average value of the eight measurements).

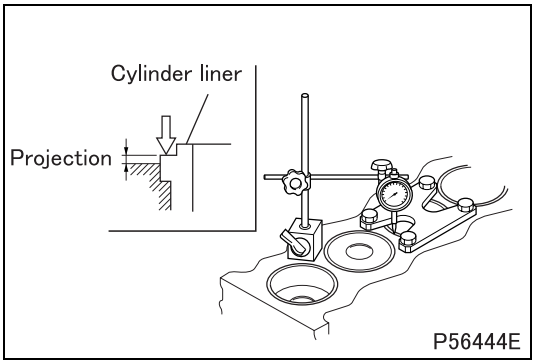
■Inspection: Connecting rod end play

- Measure the end play for every connecting rod.
- If any measurement exceeds the specified limit, replace the defective part(s).



■ **Inspection: Difference in flange projection between neighboring cylinder liners**

- Install e on the upper crankcase so that it is not lying on top of any part of the flanges. Tighten f to a torque of 49 N·m {36 lbf·ft, 5 kgf·m}.

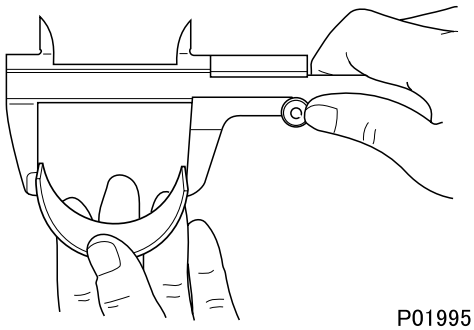


- Measure the amount of projection of the cylinder liner flange above the upper crankcase top surface.
- If the measurement is not within the standard value range, inspect the state of installation of the cylinder liner and then replace the defective part(s).

CAUTION ⚠

- **Insufficient projection of the flange can lead to a reduced pressure around the bore of the cylinder head gasket, causing gas leakage.**

◆Inspection procedure◆

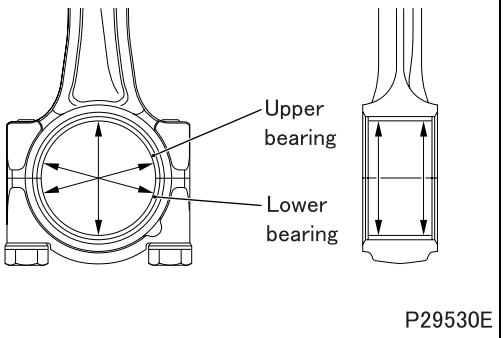

P01995

■ Inspection: Connecting rod bearing span when free

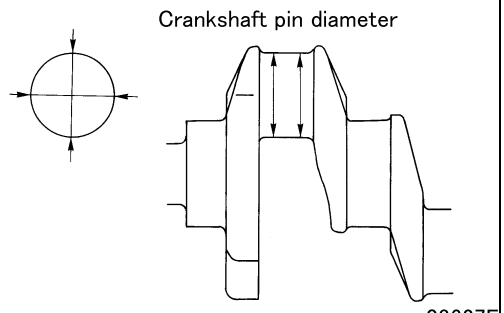
CAUTION ⚠

- **Do not attempt to manually expand the bearings.**
- **The upper and lower connecting rod bearings must be replaced as a set.**

- If the span is less than the specified limit, replace both the upper and lower bearings.



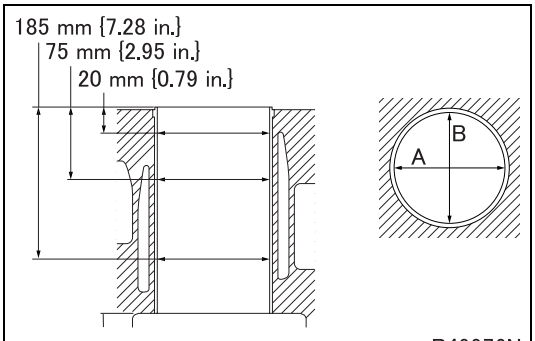
P29530E



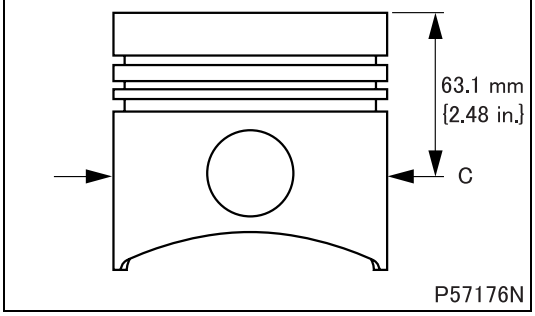
03627E

■ Inspection: Connecting rod bearing-to-crankshaft clearance (oil clearance)

- Fit the lower bearing to the connecting rod cap and the upper bearing to the connecting rod, then tighten the bolts to a torque of 30 N·m {22 lbf·ft, 3.1 kgf·m}.
- Measure the inside diameter of the bearing and the diameter of the crankshaft pin.
- If the clearance exceeds the limit, replace the defective part(s).
- If a bearing has to be replaced with an undersized one, machine the crankshaft pin to the specified undersize diameter.



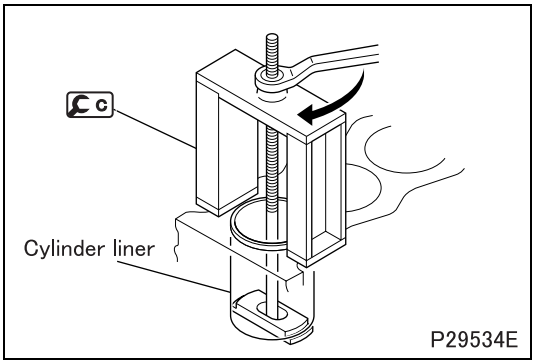
P49976N



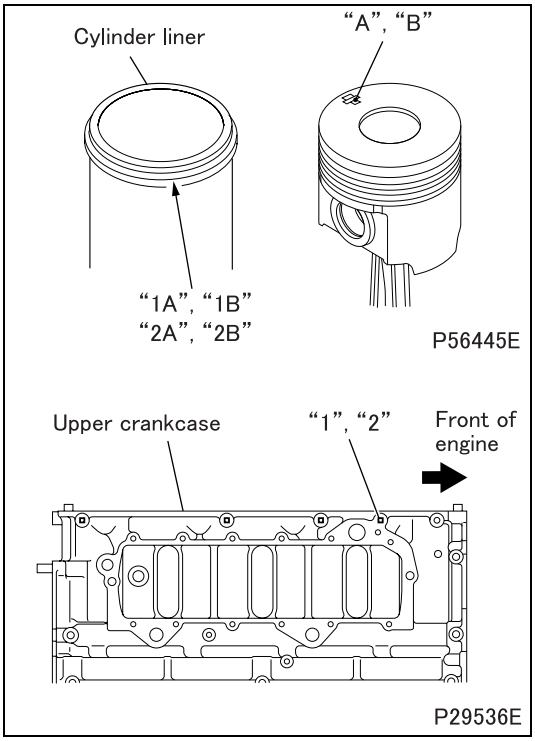
P57176N

■ Inspection: Piston-to-cylinder liner clearance

- If the measurement is not within the standard value range, replace the defective part(s).
  - **A:** Cylinder bore measurement (in direction of crankshaft axis)
  - **B:** Cylinder bore measurement (in direction perpendicular to crankshaft axis)
  - **C:** Piston diameter measurement (in direction perpendicular to piston pin hole)

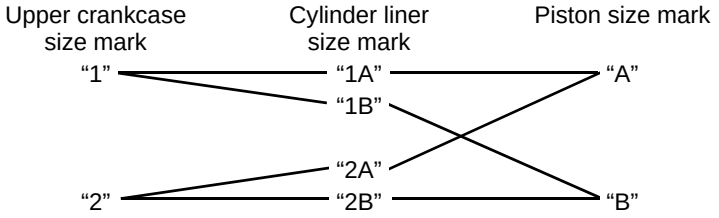


Replacement of cylinder liner
[Removal]



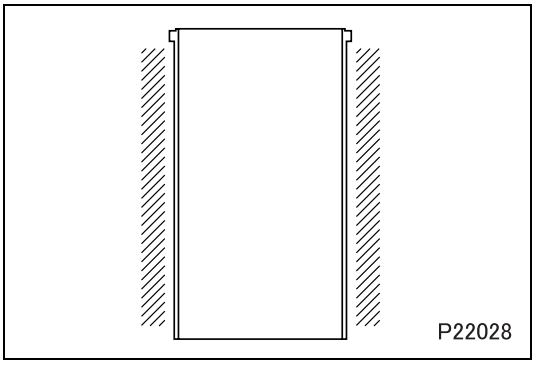
[Installation]

- Select cylinder liners with the same size marks as those on the upper crankcase and the pistons.
- The size marks on the upper crankcase are marked in the order of No. 1 cylinder, No. 2 cylinder, No. 3 cylinder and No. 4 cylinder starting with the front of the engine.

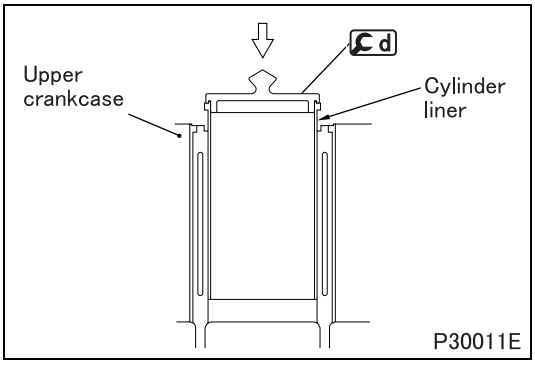


CAUTION ⚠

- **Make sure to use pistons and cylinder liners of the same size. Failure to do so may result in seizures it the engine.**



- Apply a thin coat of engine oil to the surfaces surrounding the cylinder liner of the upper crankcase (the shaded areas in the illustration).

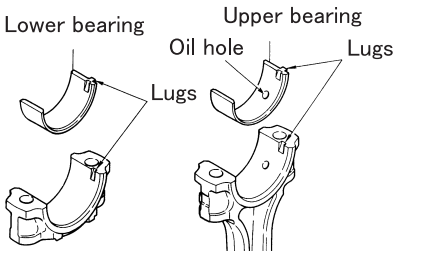


- Insert the cylinder liner into the upper crankcase by pushing down on d by hand slowly and evenly.

CAUTION ⚠

- **Handle the cylinder liner extremely carefully, as its wall is relatively thin and can be easily damaged.**

◆Installation procedure◆

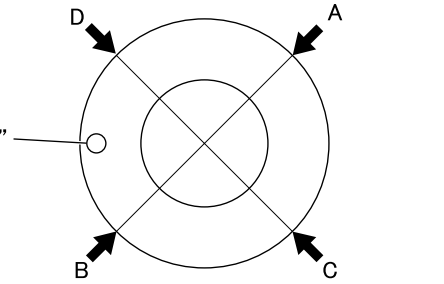


49975E

■ Installation: Connecting rod bearings

CAUTION ⚠

- **Do not reverse the positions of the lower bearing and the upper bearing (with oil hole) when installing, as this may cause seizure in the engine.**

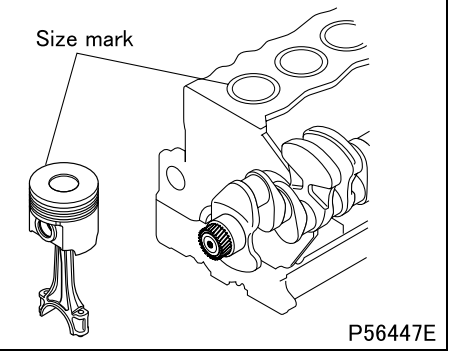


P56446

■ Installation: Piston and connecting rod assembly

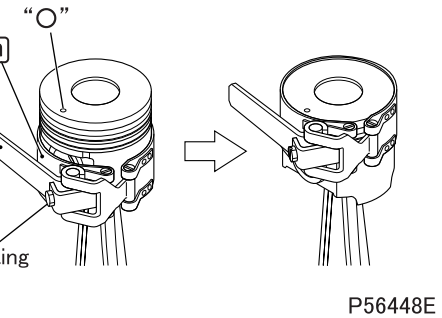
- Check that the piston ring end gaps are in their correct positions.
  - **A:** 1st compression ring gap
  - **B:** 2nd compression ring gap
  - **C:** Oil ring gap
  - **D:** Oil ring expander spring gap

"○": Front mark on piston

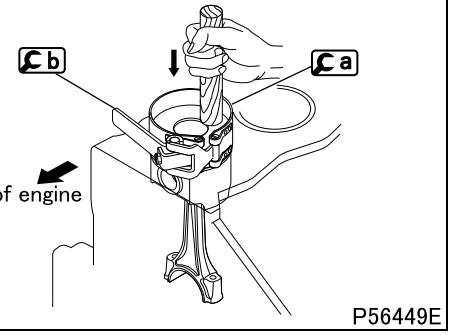


P56447E

- Check that the pistons and the cylinder liners have identical size marks (**"A"** or **"B"**).
- Install the pistons in the cylinder liners. Be careful not to scratch the inner surface of the liner and the crankshaft pins.

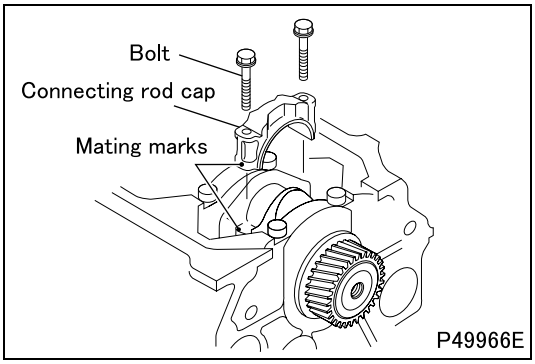


P56448E



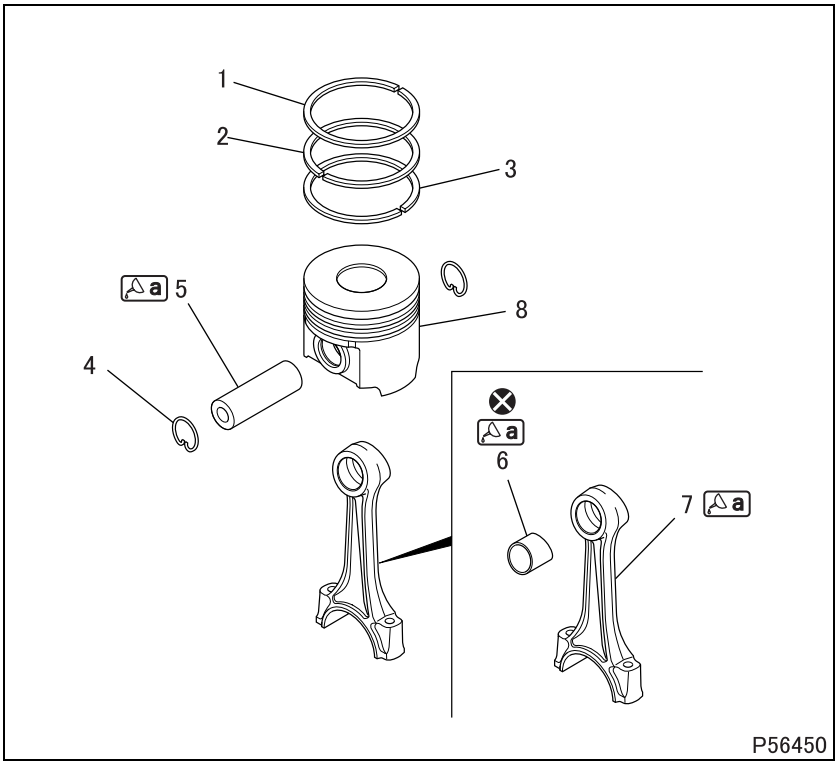
P56449E

- Face the front mark "○" of the piston toward the front of the engine.
- Using the adjusting bolt of b, adjust the inside diameter of a such that it matches the piston's skirt diameter.
- Remove the tools from the piston and apply engine oil to the following parts before reinstalling the tools around the piston rings:
  - Outside surface of piston
  - Inside surface of a
  - Inside surface of cylinder liner



- After installing the piston and connecting rod assembly, align the mating marks on the connecting rod and connecting rod cap and tighten the bolts alternately in the following manner.
  - First tighten the bolt to a torque of 29 N·m {21 lbf·ft, 3.0 kgf·m}.
  - Tighten the bolt further by turning it clockwise by 90° ± 5°.

Piston and Connecting Rod



● **Disassembly sequence**

1 1st compression ring
2 2nd compression ring
3 Oil ring
4 Snap ring
5 Piston pin
6 Connecting rod bushing
7 Connecting rod
8 Piston

⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

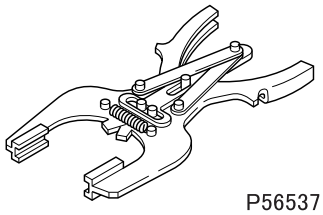
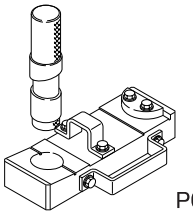
Location	Maintenance item		Standard value	Limit	Remedy
1 to 3	Piston ring end gap	1st compression ring	0.3 to 0.45 {0.012 to 0.018}	1.5 {0.059}	Replace
		2nd compression ring	0.4 to 0.55 {0.016 to 0.022}		
		Oil ring	0.3 to 0.5 {0.012 to 0.020}		
1 to 3, 8	Piston ring side clearance in piston groove	1st compression ring	0.129 to 0.178 {0.0051 to 0.0070}	0.2 {0.0079}	Replace
		2nd compression ring	0.065 to 0.105 {0.0026 to 0.0041}	0.15 {0.0059}	
		Oil ring	0.025 to 0.065 {0.00098 to 0.0026}		
4, 6	Piston pin-to-connecting rod bushing clearance		0.020 to 0.055 {0.00079 to 0.0022}	0.1 {0.0039}	Replace
4, 8	Piston pin-to-piston clearance		0.004 to 0.022 {0.00016 to 0.00087}	0.05 {0.0020}	Replace
7	Connecting rod	Bend	–	0.05 {0.0020}	Replace
		Twist	–	0.1 {0.0039}	

Lubricant and/or sealant

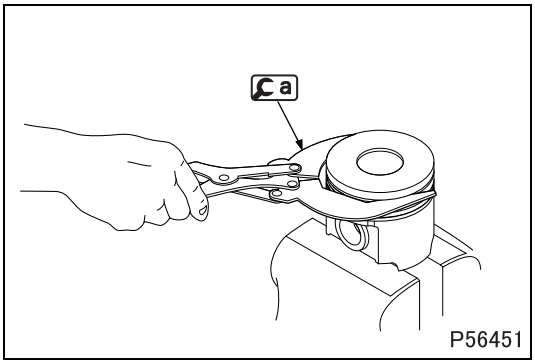
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Piston pin outside surface	Engine oil	As required
	Connecting rod bushing outside surface		
	Connecting rod bushing fitting surface of connecting rod		

PISTONS, CONNECTING ROD AND CYLINDER LINERS

Special tools

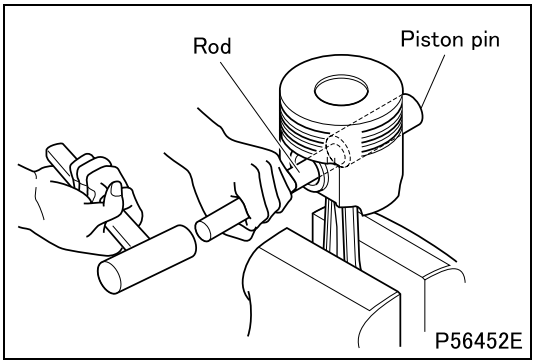
Mark	Tool name and shape	Part No.	Application
Ca	Piston ring tool  P56537	MH060014	Removal and installation of piston rings
Cb	Connecting rod bushing puller kit  P02015	MH062225	Removal and installation of connecting rod bushings

◆Removal procedure◆



P56451

■ **Removal: Piston ring**

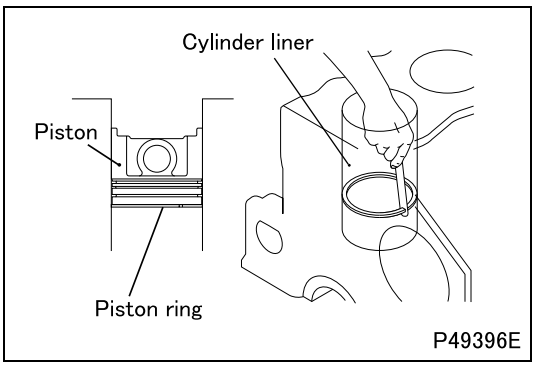


P56452E

■ **Removal: Piston pin**

- Remove the piston pin by striking it with a rod and hammer.
- If the piston pin is difficult to remove, first heat the piston in hot water or with a piston heater.

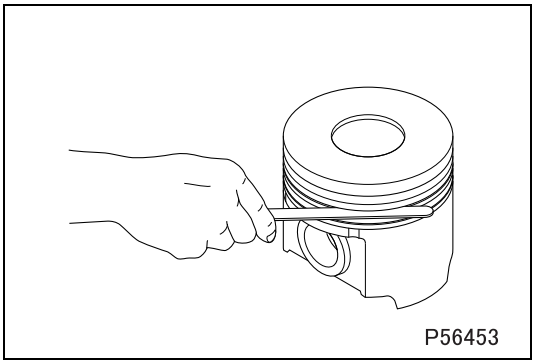
◆Inspection procedure◆



P49396E

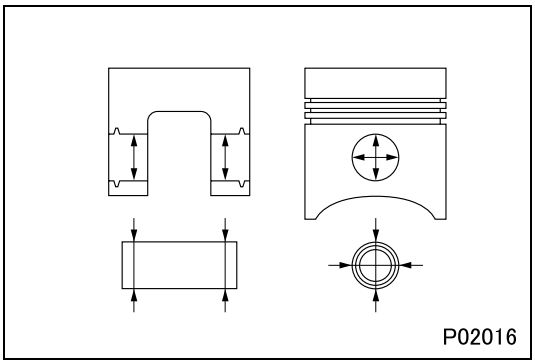
■ **Inspection: Piston ring end gap**

- Using the crown of a piston, push the piston ring horizontally into a cylinder in the cylinder liner until it reaches the lower part of the cylinder liner, where there is relatively small wear.
- Taking care not to move the piston ring, measure the end gap.
- If any of the rings has a gap exceeding the specified limit, replace all the piston rings as a set.



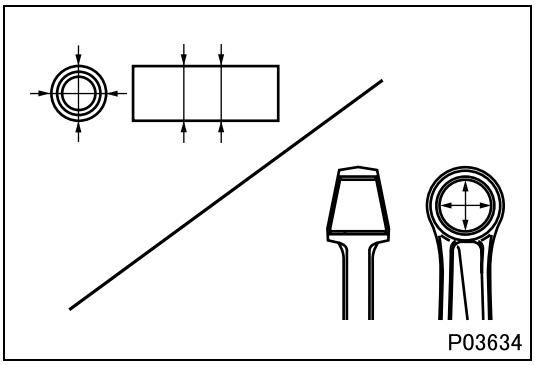
■ **Inspection: Piston ring side clearance in piston groove**

- Remove any carbon deposits from the ring groove in the piston.
- Measure the side clearance of each ring around the piston's entire periphery.
- If any of the measurements exceeds the specified limit, replace the defective part(s). If any of the piston rings is defective, replace all the rings on the piston as a set.



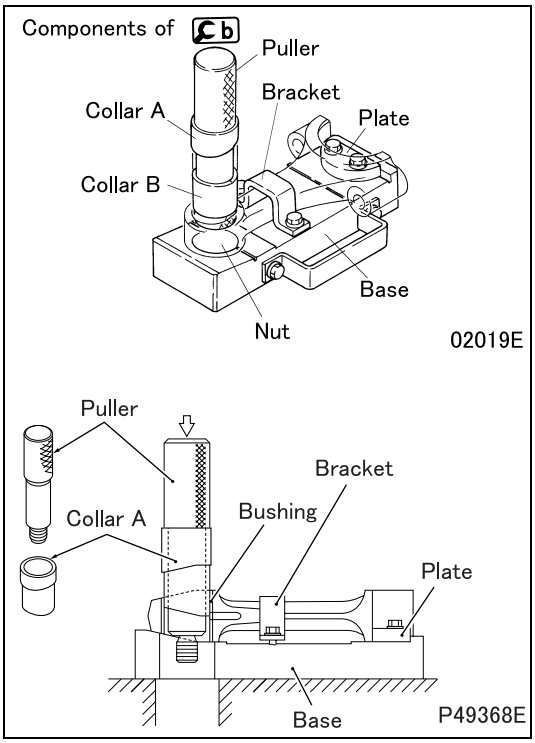
■ **Inspection: Piston pin-to-piston clearance**

- If the measurement exceeds the specified limit, replace the defective part(s).



■ **Inspection: Piston pin-to-connecting rod bushing clearance**

- If any of the measurements exceeds the specified limit, replace the bushing.

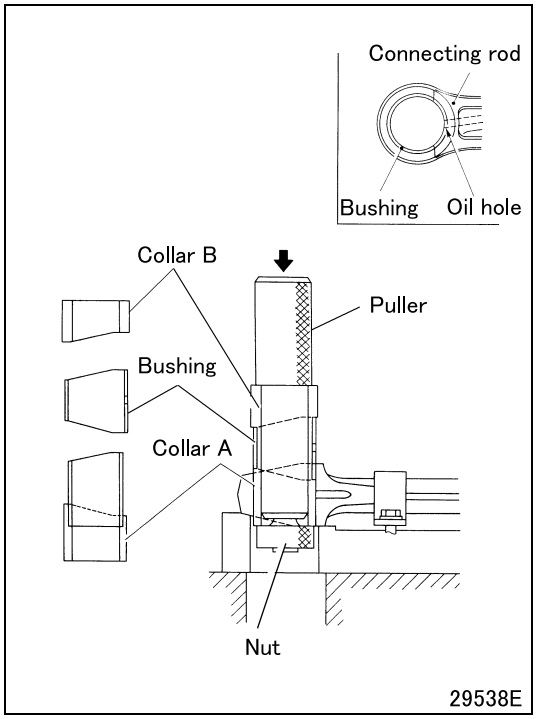


Replacement of connecting rod bushing

- Replace the connecting rod bushing using b.

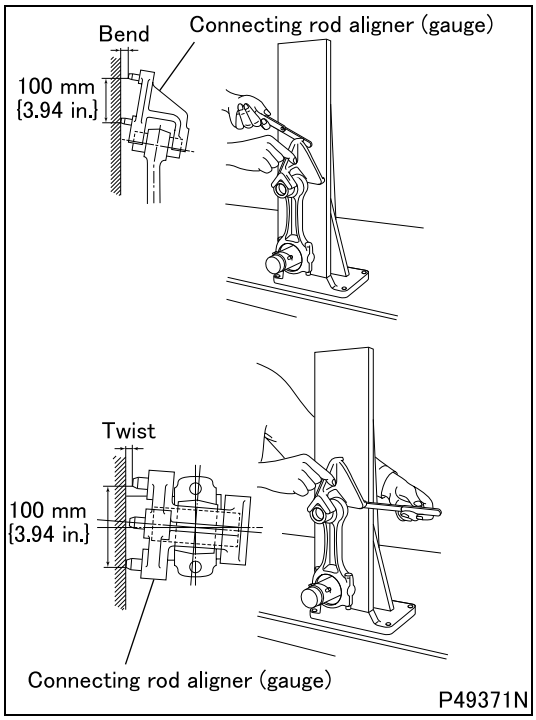
[Removal]

- Remove the upper bearing (if fitted) from the big end of the connecting rod.
- Mount the connecting rod on the base and lock it in position with the bracket and plate.
- Fit collar A over the puller with its ends facing in the illustrated directions. Then, slowly apply a pressure of approximately 49 kN {11020 lbs, 5000 kgf} to the puller with a press to force out the connecting rod bushing.



[Installation]

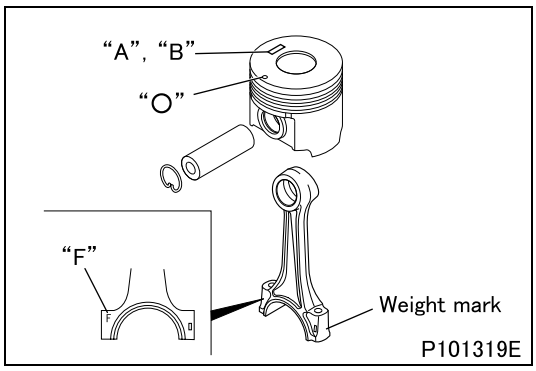
- Apply engine oil to the outside surface of the connecting rod bushing and the bushing fitting surface of the connecting rod.
- Fit collar B, the bushing, and collar A over the puller in the illustrated directions and lock this arrangement together with the nut.
- Align the oil holes in the connecting rod bushing and the connecting rod. Then, use a press to slowly apply a pressure of approximately 49 kN {11020 lbs, 5000 kgf} to the puller until the bushing is forced into place.
- After press-fitting the connecting rod bushing, measure the clearance between the piston pin and connecting rod bushing.
- If the measurement is less than the standard clearance range, ream the bushing.



■Inspection: Connecting rod bend and twist

- Mount the connecting rod on the connecting rod aligner. Also mount the connecting rod bearings, piston pin, and connecting rod cap to create the same conditions as are expected when the connecting rod is mounted on a crankshaft. Tighten the bolts of the connecting rod bearing cap to a torque of 30 N·m {22 lbf·ft, 3.1 kgf·m}.
- Measure the extent of bend and twist in the connecting rod.
- If either measurement exceeds the specified limit, replace the connecting rod.

◆Installation procedure◆

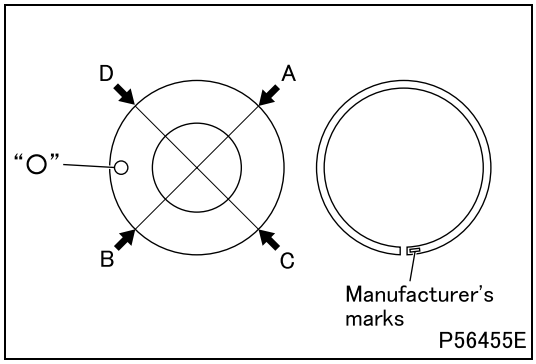


■ Installation: Piston and connecting rod

- Install pistons and connecting rods as follows when replacing them.
- All connnecting rods used in the same engine must be of the same weight size mark.
  Weight mark: "C" to "G"
- Apply engine oil to the piston pin, and assemble the piston and connecting rod with their marks facing in the illustrated directions.

"○": Front mark on piston
"F": Front mark on connecting rod

- If the piston pin is difficult to insert, heat the piston in hot water or with a piston heater.



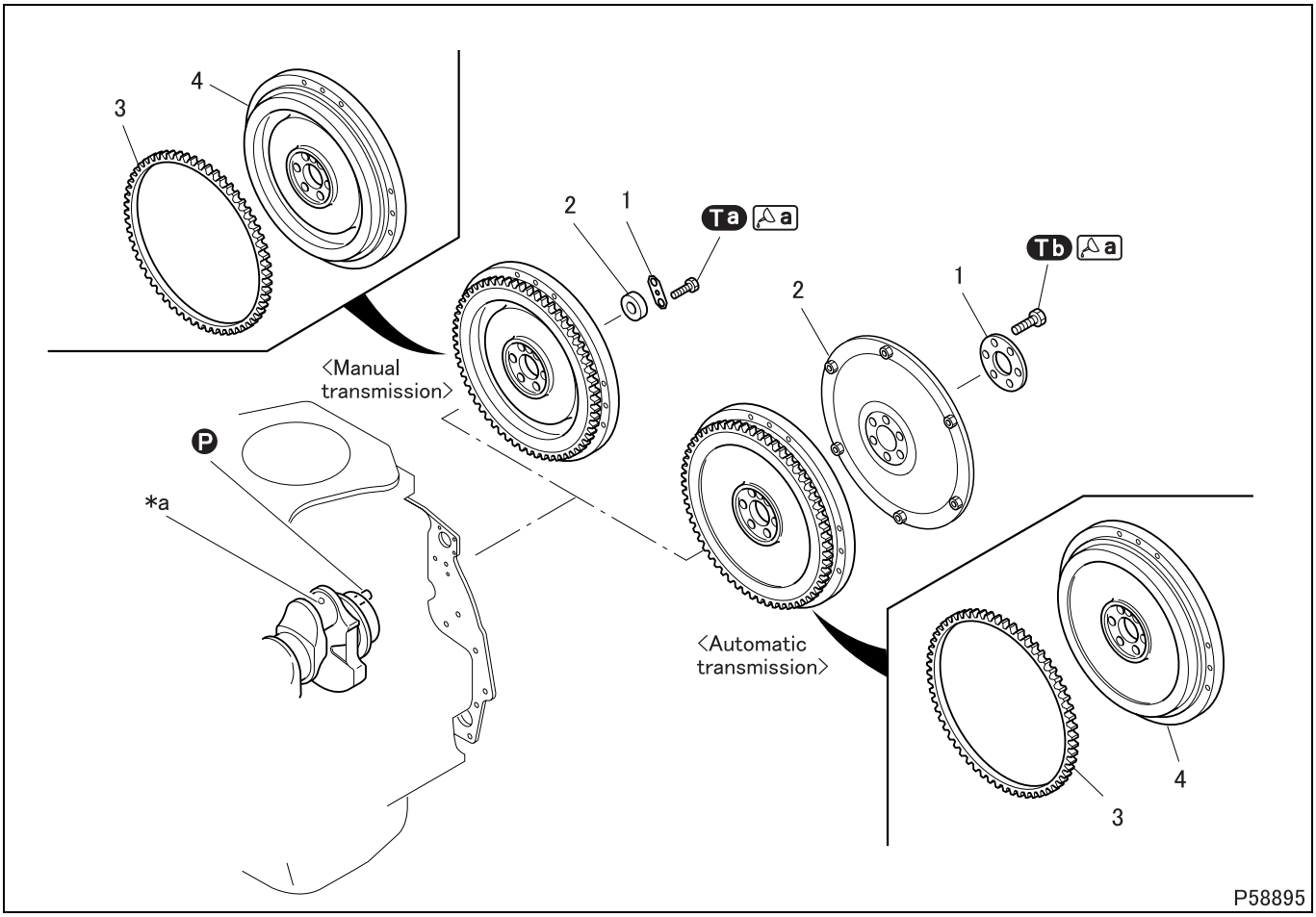
■ Installation: Piston rings

- With the manufacturer's marks (found near the piston ring end gaps) facing up, install the piston rings so that the end gap of each ring is positioned as illustrated.
  A: 1st compression ring end gap
  B: 2nd compression ring end gap
  C: Oil ring end gap
  D: Oil ring's expander spring end gap

"○": Front mark on piston

The manufacturer's marks are present only on the 1st and 2nd compression rings.

FLYWHEEL



● Disassembly sequence

1 Plate <Manual transmission>
Wear plate <Automatic transmission>
2 Bearing <Manual transmission>
Drive plate <Automatic transmission>
3 Ring gear
4 Flywheel assembly

***a**: Crankshaft
P: Locating pin

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
4	Flywheel <Manual transmission>	Friction surface runout (when fitted)	–	0.2 {0.0079}	Rectify or replace
		Friction surface height	19.5 {0.77}	18.5 {0.73}	
		Friction surface distortion	0.05 {0.0020} or less	0.2 {0.0079}	
		Friction surface parallelism	0.1 {0.0039} or less	–	

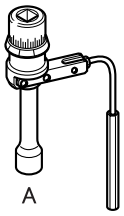
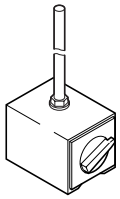
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (flywheel assembly installation)	39 {44, 6.0} + 40°	Wet
Tb	Bolt (flywheel assembly installation)	118 {87, 12} + 90°	Wet

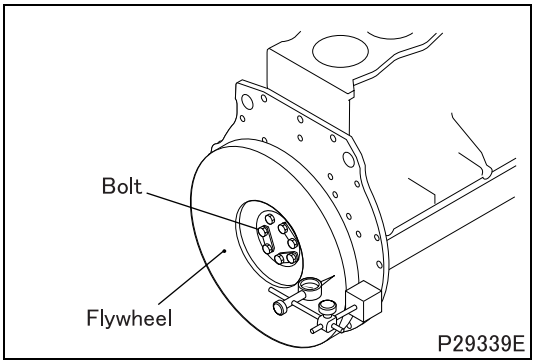
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads	Engine oil	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
a	Socket wrench A: Bolt head width across flats: 22 {0.87}  P01984	MH062183	Installation of flywheel assembly
b	Magnet base  P00471	MH062356	

◆Inspection before removal◆



■Inspection: Flywheel runout <Manual transmission>

- If the runout exceeds the specified limit, check that the bolts are tightened correctly and that there are no abnormalities on the crankshaft mounting surface. If the runout is still excessive even after necessary steps have been taken according to the check results, rectify or replace the flywheel assembly.

◆Removal procedure◆

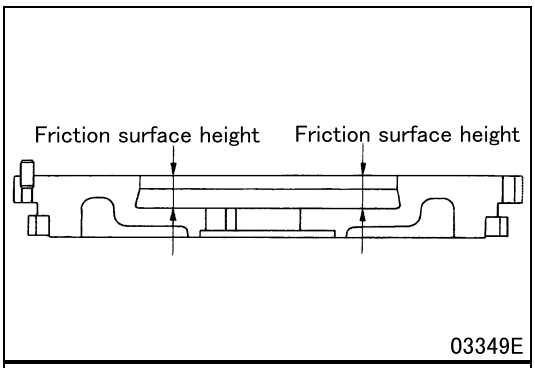
■Removal: Ring gear

- Heat the ring gear evenly with a gas burner or the like until it reaches approximately 200°C {390°F}, then remove it from the flywheel assembly.

WARNING ⚠

- **You could get burnt if you touch the heated ring gear.**

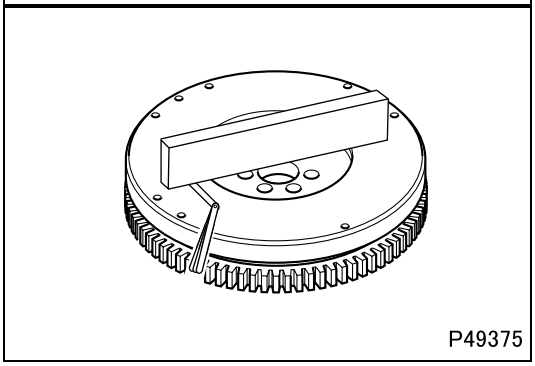
◆Inspection procedure◆



■ **Inspection: Flywheel assembly <Manual transmission>**

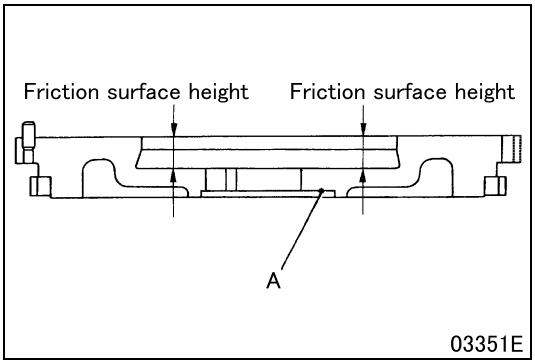
(1) Friction surface height

- If the height is below the specified limit, rectify or replace the flywheel assembly.



(2) Friction surface distortion

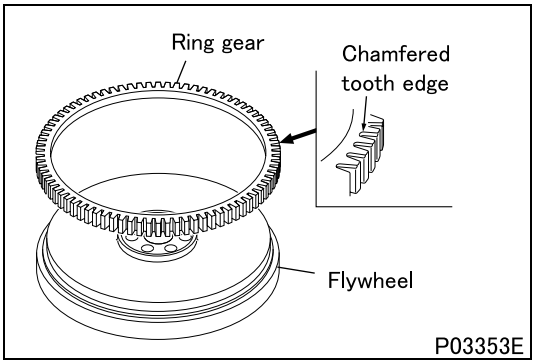
- If the measured amount of distortion is above the specified limit, rectify or replace the flywheel assembly.



Rectification of friction surface

- Rectify the friction surface so that its height is not below the specified limit, and it is parallel with surface **A** with an error not exceeding 0.1 mm {0.0039 in.}.

◆Installation procedure◆



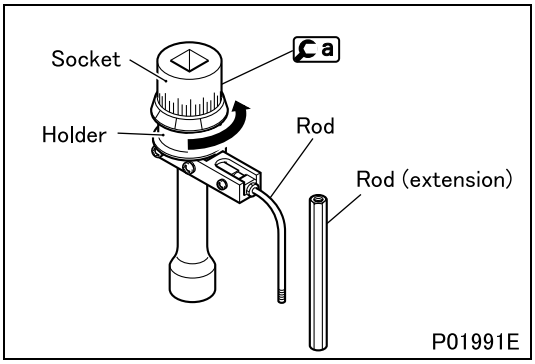
■ **Installation: Ring gear**

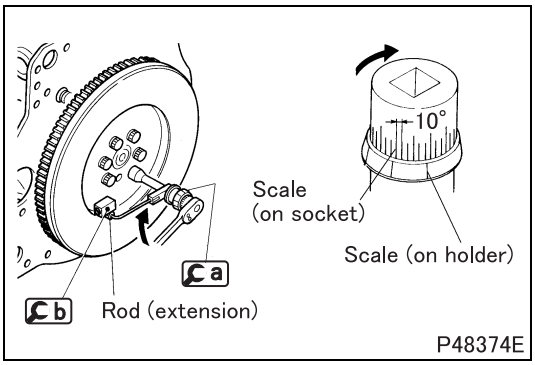
- Heat the ring gear evenly with a gas burner or the like until it reaches approximately 200°C {390°F}.

WARNING ⚠

- **You could get burnt if you touch the heated ring gear.**

- Fit the ring gear with the side having non-chamfered tooth edges toward the flywheel.

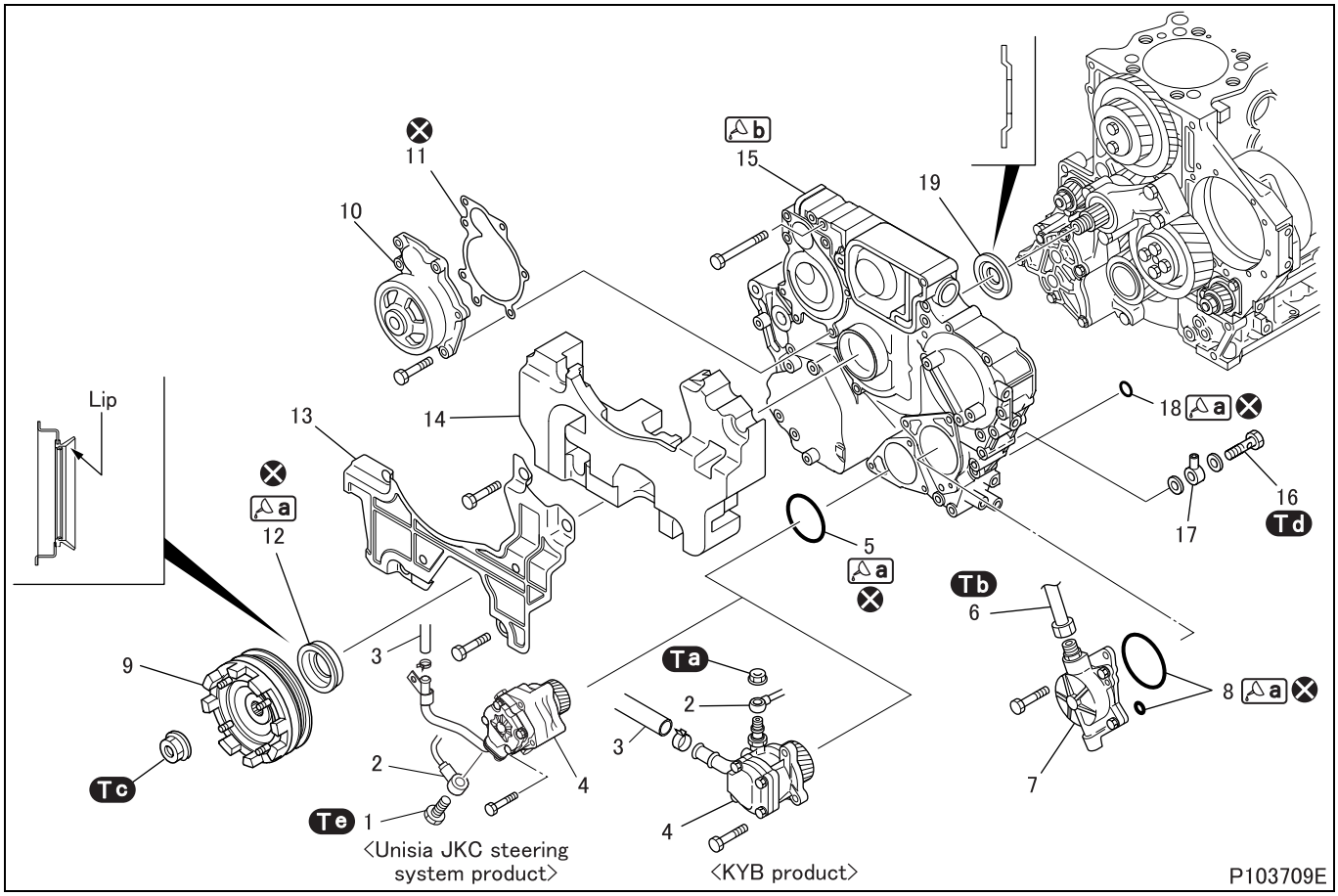




■ **Installation: Flywheel <Manual transmission>**

- Tighten all the bolts to 59 N·m {44 lbf·ft, 6.0 kgf·m} and then additionally tighten them by the following procedure.
- Rotate the holder of a counterclockwise to pretension the internal spring.
- Fit a on the bolt and set b so that the rod (extension) is held pressed against it by the spring force.
- Align a scale mark on the socket with a scale mark on the holder. (This point will be the point of reference, or the 0° point.)
- Starting with this point of reference, turn the socket clockwise with a wrench by 40° ± 5° (one graduation on the socket scale represents 10°).

FRONT CASE



● **Disassembly sequence**

1 Eyebolt <Unisia JKC steering system type>
2 Power steering pipe
3 Power steering hose
4 Power steering oil pump (See Gr37.)
5 O-ring
6 Vacuum pipe
7 Vacuum pump (See Gr35A.)
8 O-ring
9 Fan pulley
10 Water pump (See Gr14.)
11 Gasket
12 Front oil seal
13 Front case cover
14 Front case rubber
15 Front case
16 Eyebolt
17 Oil jet
18 O-ring
19 Front oil seal slinger

⊗: Non-reusable parts

● **Assembly sequence**

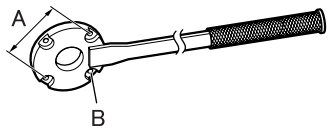
Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {lbf·ft, kgf·m})

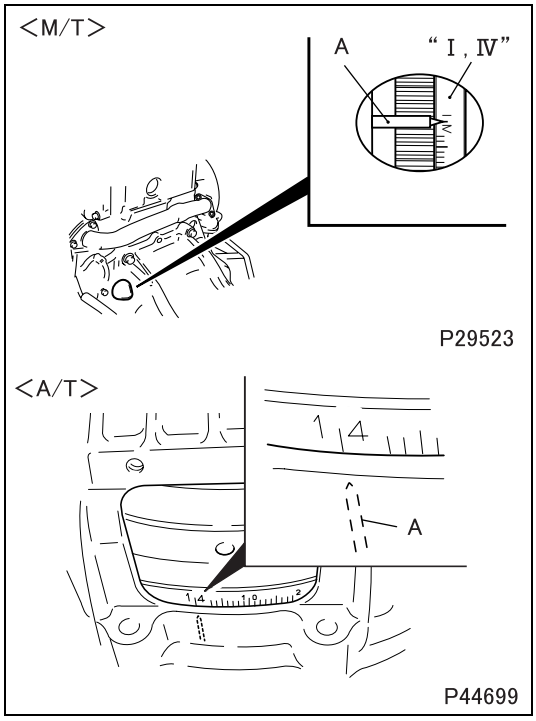
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (power steering pipe installation)	29.4 to 39.2 {22 to 29, 3 to 4}	–
Tb	Vacuum pipe	29.4 {22, 3.0}	–
Tc	Nut (fan pulley installation)	370 {270, 38}	–
Td	Eyebolt (oil jet installation)	10 {7.4, 1.0}	–
Te	Eyebolt (power steering pipe installation)	49.0 to 63.7 {36 to 47, 5.0 to 6.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required
	Front oil seal lip		
b	Front case installation surfaces	ThreeBond 1207C or D	As required

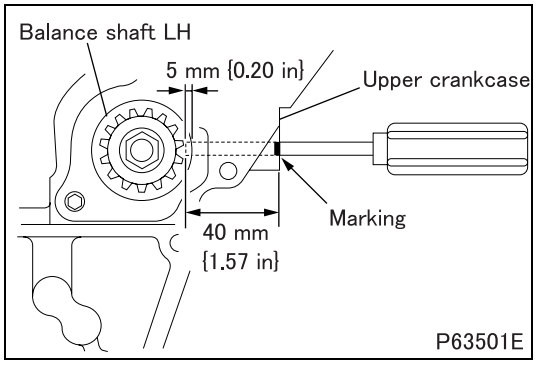
Mark	Tool name and shape	Part No.	Application
ⓐ	Holding bar A: 114 {4.49} B: ϕ9 {ϕ0.35}  P69433	MH062970	Holding of fan pulley

◆Removal procedure◆



■ Removal: Vacuum pump

- The vacuum pump also serves for positioning the balance shaft LH. Therefore, before removing the vacuum pump, hold the balance shaft in position by the following procedure.
- Align the pointer A to between the inscribed lines (**Ⅰ** and **Ⅳ** or **1** and **4**) on the flywheel. (Place No.1 cylinder piston at the top dead center on compression stroke.)

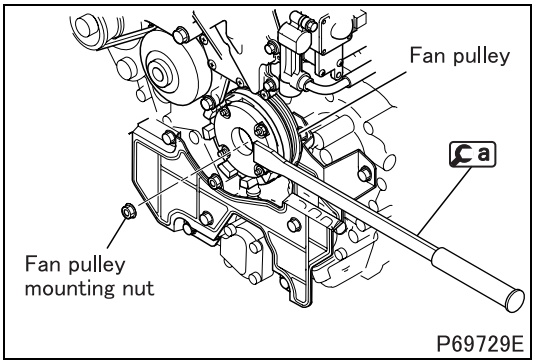


- Remove the upper crankcase plug.
- Mark a screwdriver or the like (ϕ4.5 mm {0.18 in} or less) at a point 40 mm {1.57 in} apart from its tip.
- Insert the screwdriver or the like (ϕ4.5 mm {0.18 in} or less) into the plug hole until it lightly touches the balance shaft LH.

CAUTION ⚠

- **Do not press the screwdriver hard against the balance shaft LH, as this may damage No.1 journal of the balance shaft.**

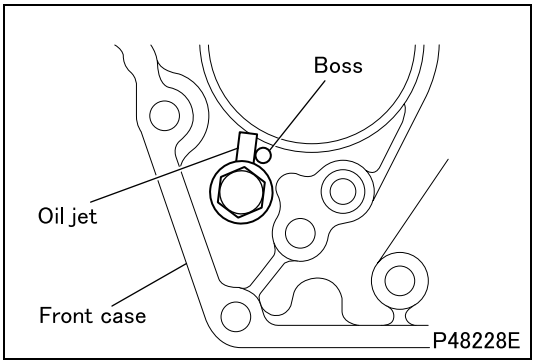
- Put the tip of the screwdriver or the like into the shaft supporting hole at No.1 journal of the balance shaft.
- This insertion depth of the screwdriver or the like into the shaft supporting hole should be 5 mm {0.20 in}.
- Remove the vacuum pump with the screwdriver or the like inserted in the hole.



■ **Removal: Fan pulley**

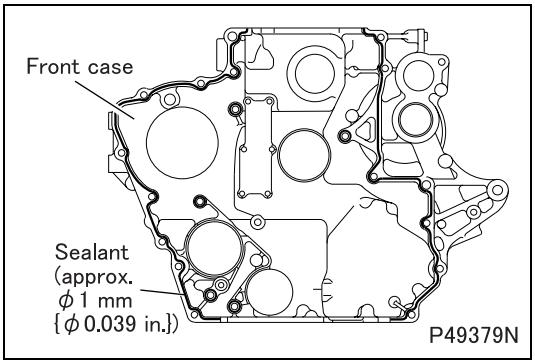
- Put Ca in position on the studs of the fan pulley and fix the tool by using nuts.
- While holding Ca, loosen the fan pulley mounting nut.

◆Installation procedure◆



■ **Installation: Oil jet**

- When installed, the oil jet must be in contact with the front case and its nozzle must face in the illustrated direction.

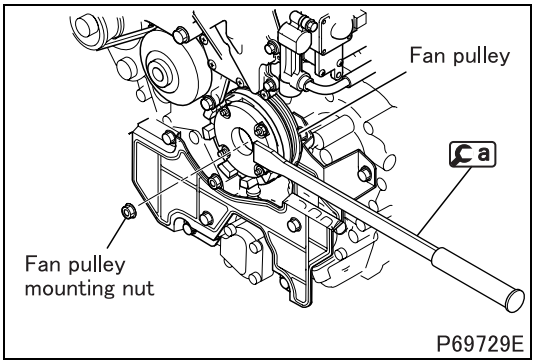


■ **Installation: Front case**

- Clean the sealant application surfaces of each part.
- Apply evenly thick beads of sealant to the upper crankcase mounting surface of the front case without any breaks.
- Mount the front case within three minutes of applying the sealant, being careful not to dislodge the sealant.

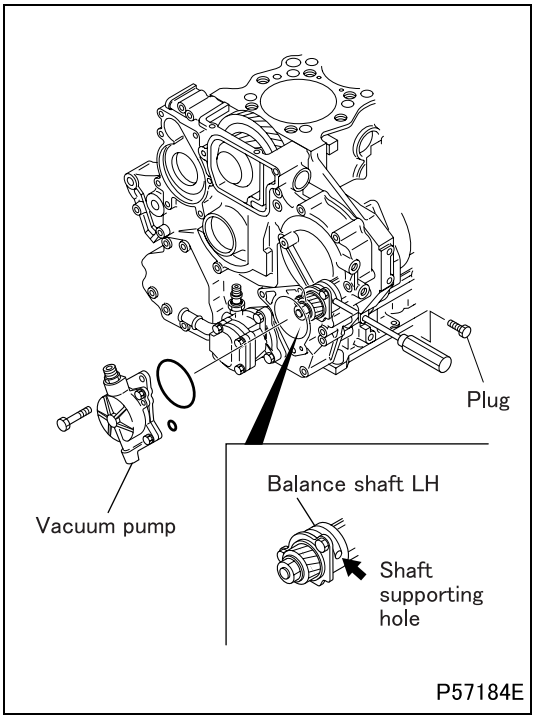
CAUTION ⚠

- **Do not run the engine within one hour of installing the front case.**
- **If the front case mounting bolts are loosened or removed, be sure to reapply sealant to the front case.**



■ **Installation: Fan pulley**

- Put Ca in position on the studs of the fan pulley and fix the tool by using nuts.
- Tighten the fan pulley mounting nut to the specified torque while holding Ca.



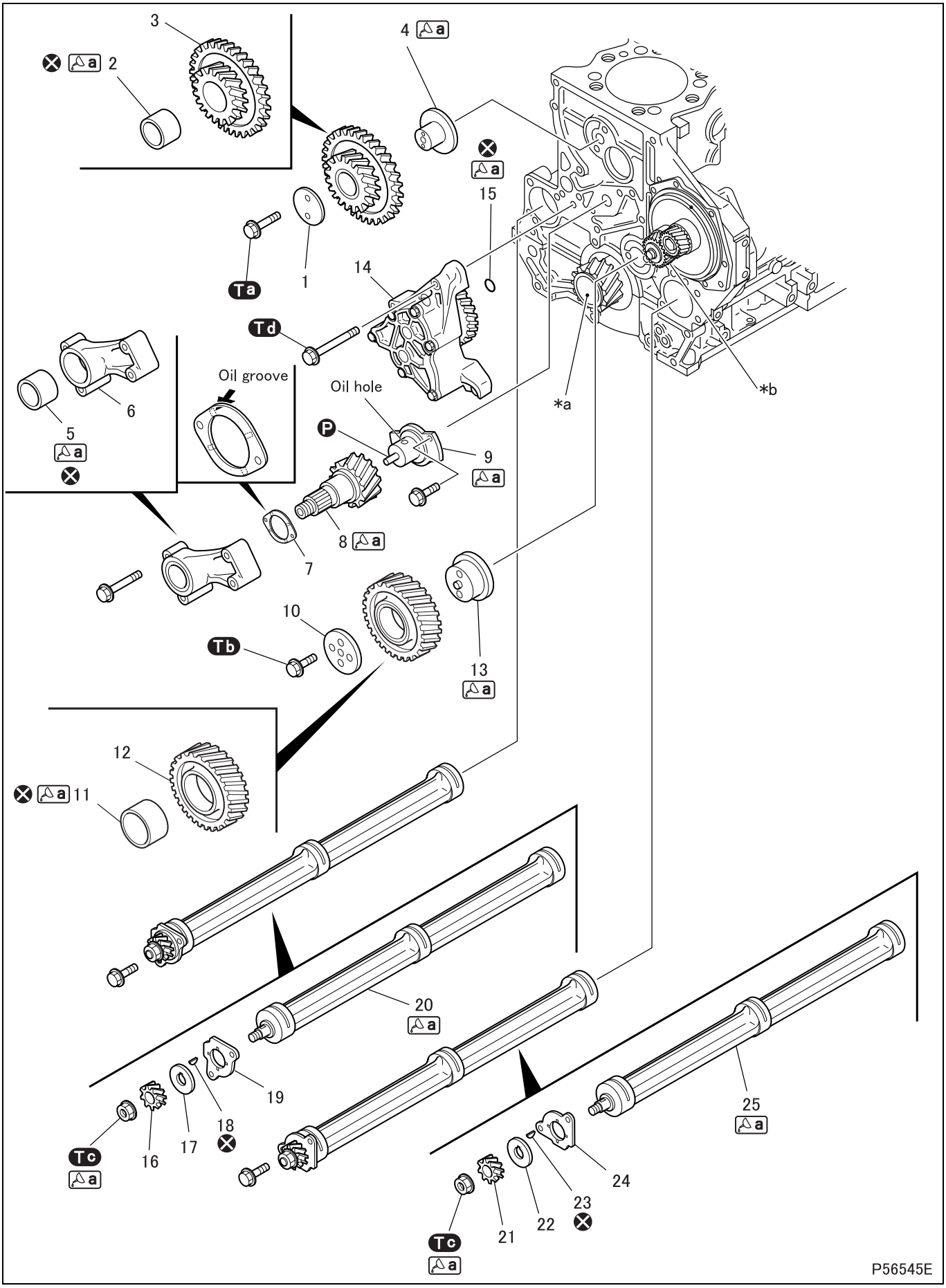
■ **Installation: Vacuum pump**

- The vacuum pump also serves as an element holding the balance shaft LH in place. Therefore, before installing the vacuum pump, hold the balance shaft LH in the correct position by the following procedure.
  - Place the No. 1 cylinder piston at the top dead center on compression stroke.
  - Remove the upper crankcase plug.
  - Insert a screwdriver or a similar tool into the plug hole until it lightly touches the balance shaft LH.

CAUTION ⚠

- **Do not press the screwdriver strongly against the balance shaft LH, as this may damage the No. 1 journal of the balance shaft.**

  - Turn the balance shaft LH slowly until the screwdriver aligns with the shaft support hole at the No. 1 journal and insert the screwdriver into the hole.
- Install the vacuum pump.
- After installing the vacuum pump, remove the screwdriver and reinstall the plug.


3
2
4
15
1
Ta
14
Td
Oil groove
Oil hole
6
5
9
8
7
*a
*b
10
Tb
13
12
11
20
19
18
17
16
Tc
25
24
23
22
21
Tc
P56545E

● Disassembly sequence

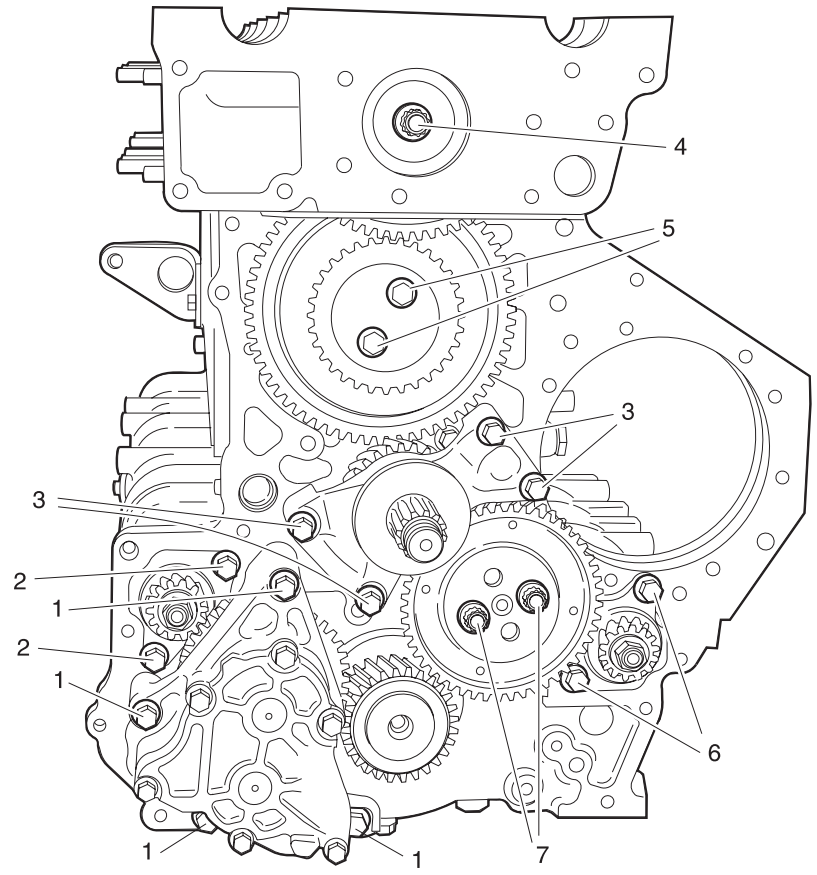
1 Thrust plate
2 Idler gear bushing
3 Idler gear
4 Idler shaft
5 Fan shaft case bushing
6 Fan shaft case
7 Thrust plate
8 Fan shaft
9 Fan gear shaft
10 Thrust plate
11 No. 1 idler gear bushing
12 No. 1 idler gear
13 No. 1 idler shaft
14 Oil pump (See Gr12)
15 O-ring
16 Balance shaft gear RH
17 Thrust spacer
18 Key
19 Thrust plate
20 Balance shaft RH
21 Balance shaft gear LH
22 Thrust spacer
23 Key
24 Thrust plate
25 Balance shaft LH

***a**: Crankshaft gear
***b**: Supply pump idler gear

Ⓟ: Locating pin
⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.



02/23/2006 f012119

1 Oil pump bolts Td
2 Right balance shaft thrust plate bolts Tf
3 Fan shaft case bolts Te
4 Head idler bolt Tg
5 Idler shaft bolts Ta
6 Left balance shaft thrust plate bolts Tf
7 No. 1 idler shaft bolts Tb

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Backlash between gears	Idler gear and fan shaft	0.09 to 0.14 {0.0035 to 0.0055}	0.3 {0.012}	Replace
		Fan shaft and No. 1 idler gear	0.06 to 0.10 {0.0024 to 0.0039}	0.3 {0.012}	
		No. 1 idler gear and crankshaft gear	0.11 to 0.13 {0.0043 to 0.0051}	0.3 {0.012}	
		No. 1 idler gear and supply pump idler gear	0.12 to 0.15 {0.0047 to 0.0059}	0.3 {0.012}	
		Oil pump gear and crankshaft gear	0.12 to 0.15 {0.0047 to 0.0059}	0.3 {0.012}	
		Oil pump gear and balance shaft gear RH	0.19 to 0.22 {0.0075 to 0.0087}	0.3 {0.012}	
–	End play of gears and shafts	Idler gear	0.10 to 0.20 {0.0039 to 0.0079}	0.3 {0.012}	Replace
		Fan shaft	0.07 to 0.19 {0.0028 to 0.0075}	0.3 {0.012}	
		No. 1 idler gear	0.15 to 0.25 {0.0059 to 0.0098}	0.3 {0.012}	
		Balance shaft RH	0.1 to 0.2 {0.0039 to 0.0079}	0.3 {0.012}	
		Balance shaft LH	0.1 to 0.2 {0.0039 to 0.0079}	0.3 {0.012}	
2, 4	Idler gear bushing-to-idler shaft clearance		0.02 to 0.06 {0.00079 to 0.0024}	0.1 {0.0039}	Replace
5, 8	Fan shaft case bushing-to-fan shaft clearance		0.03 to 0.07 {0.0012 to 0.0028}	0.1 {0.0039}	Replace
8, 9	Fan shaft-to-fan gear shaft clearance		0.01 to 0.05 {0.00039 to 0.0020}	0.1 {0.0039}	Replace
11, 13	No. 1 idler gear bushing-to-No. 1 idler shaft clearance		0.03 to 0.07 {0.0012 to 0.0028}	0.1 {0.0039}	Replace
20	Balance shaft RH bend		0.025 {0.00098}	0.05 {0.0020}	Replace
25	Balance shaft LH bend		0.025 {0.00098}	0.05 {0.0020}	Replace

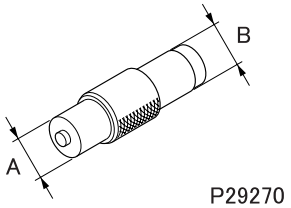
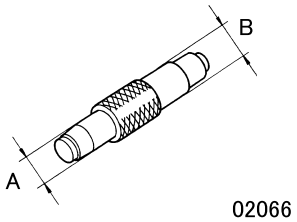
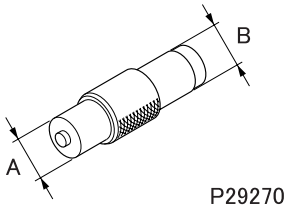
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (idler shaft installation)	32.3 {24, 3.3}	–
Tb	Bolt (No. 1 idler shaft installation)	53.9 {40, 5.5}	–
Tc	Nut (balance shaft gear installation)	96.1 {71, 9.8}	Wet
Td	Bolt (oil pump installation)	28 {21, 2.9}	–
Te	Bolt (fan shaft case)	29 {21, 3.0}	–
Tf	Bolt (balance shaft thrust plate)	29 {21, 3.0}	–
Tg	Bolt (head idler shaft installation)	40.2 {30, 4.1}	Wet

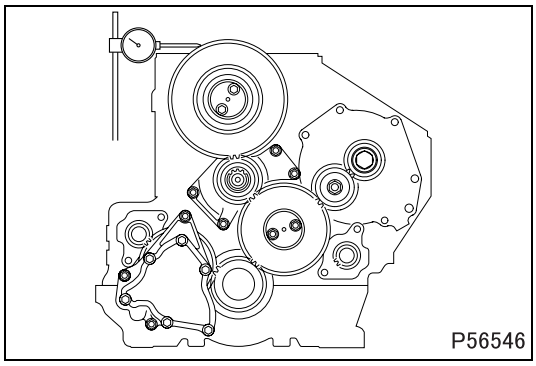
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Inner surface of every bushing	Engine oil	As required
	Outside surface of every shaft		
	O-rings		
	Nut threads		
	Balance shaft journals		

Special tools (Unit: mm {in.})

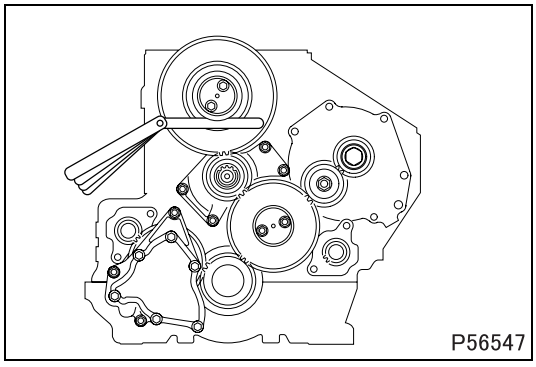
Mark	Tool name and shape	Part No.	Application
a	Idler gear bushing puller A: ϕ46.5 {ϕ1.83}, B: ϕ50 {ϕ1.97}  P29270	MH062540	Removal and installation of idler gear bushing
b	Idler gear bushing puller A: ϕ37 {ϕ1.46}, B: ϕ40 {ϕ1.57}  02066	MH062601	Removal and installation of fan shaft case bushing
c	Idler gear bushing puller A: ϕ54.5 {ϕ2.15}, B: ϕ58 {ϕ2.28}  P29270	MH062541	Removal and installation of No. 1 idler gear bushing

◆Inspection before removal◆


P56546

■ **Inspection: Backlash between gears**

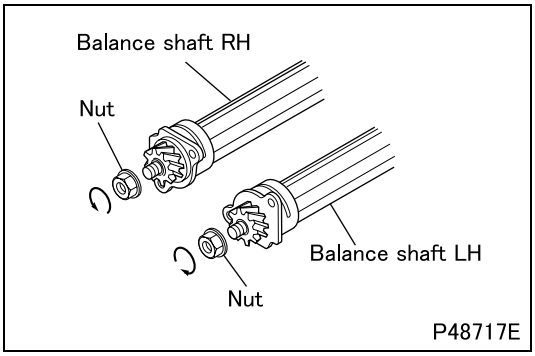
- For each pair of gears, measure the backlash at more than three teeth.
- If any of the measurements exceeds the specified limit, replace the defective part(s).


P56547

■ **Inspection: End play of each gear and shaft**

- If the measurement exceeds the specified limit, replace the defective part(s).

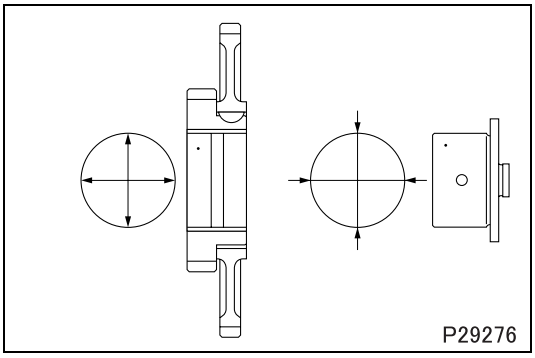
◆Removal procedure◆



■Removal: Balance shaft

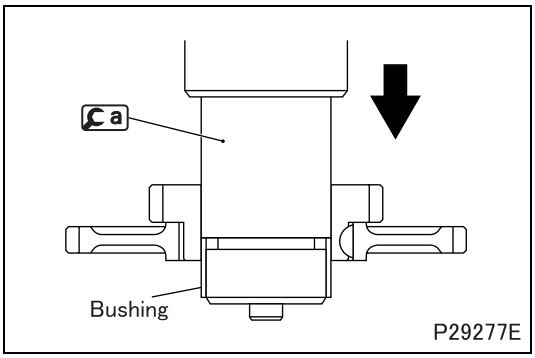
- Remove the balance shaft RH by turning its nut counterclockwise, and the balance shaft LH by turning its nut clockwise.

◆Inspection procedure◆

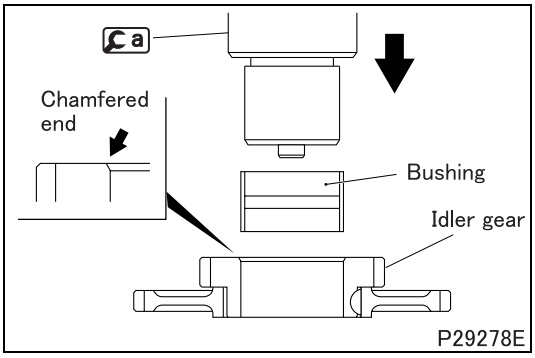


■Inspection: Idler gear bushing-to-idler shaft clearance

- If the measurement exceeds the specified limit, replace the bushing.

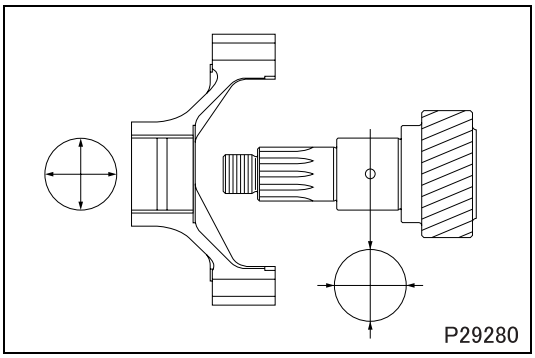


Replacement of idler gear bushing
[Removal]



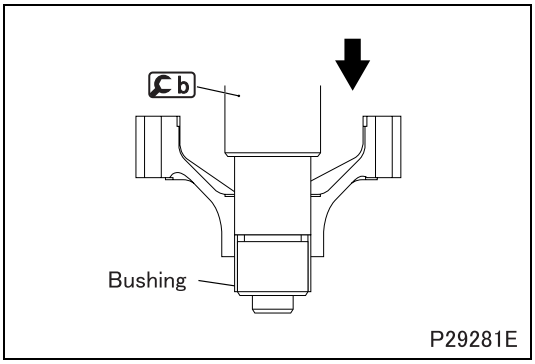
[Installation]

- Place the idler gear with its ends facing as illustrated.
- Press-fit the idler gear bushing until a sits snugly on the chamfered end of the idler gear.
- After press-fitting the bushing, measure the clearance.
- If the measurement is less than the minimum of the standard value range, ream the idler gear bushing until the clearance falls within the standard value range.

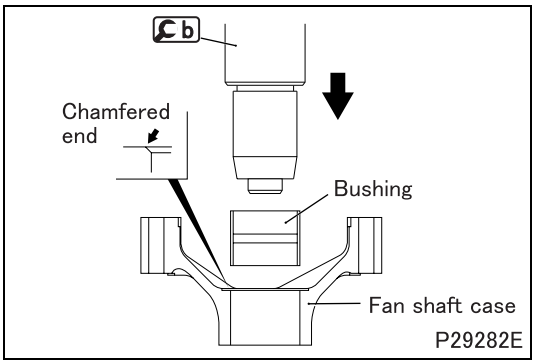


■Inspection: Fan shaft case bushing-to-fan shaft clearance

- Replace the fan shaft case bushing if the measurement exceeds the specified limit.

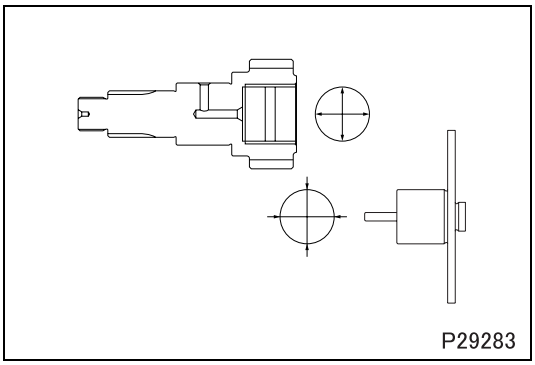


Replacement of fan shaft case bushing
[Removal]



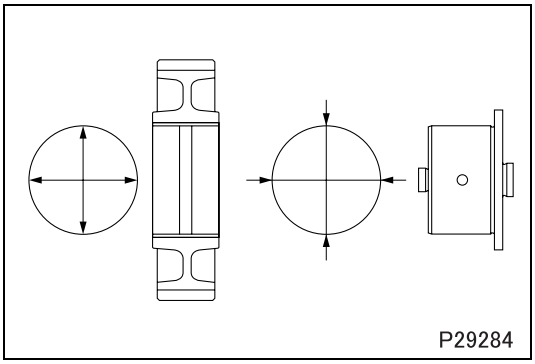
[Installation]

- Position the fan shaft case with its ends facing in the illustrated directions.
- Press in the bushing until b rests snugly on the chamfered end of the fan shaft case.
- After press-fitting the bushing, remeasure the clearance between it and the fan shaft.
- Ream the bushing if the measurement is below the standard value range.



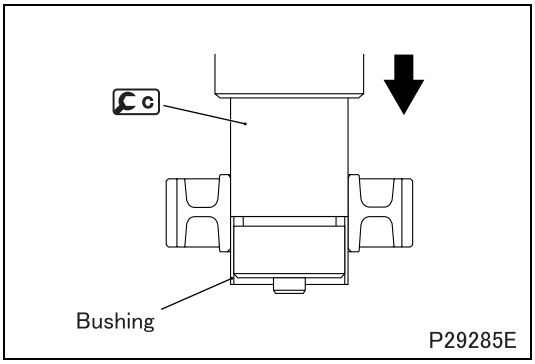
■ Inspection: Fan shaft-to-fan gear shaft clearance

- Replace the fan shaft if the measurement exceeds the specified limit.

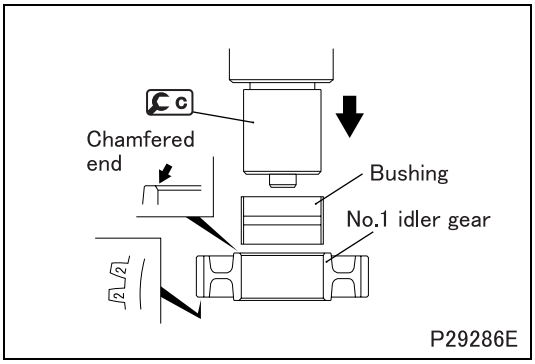


■ Inspection: No. 1 idler gear bushing-to-No. 1 idler shaft clearance

- Replace the bushing if the measurement exceeds the specified limit.

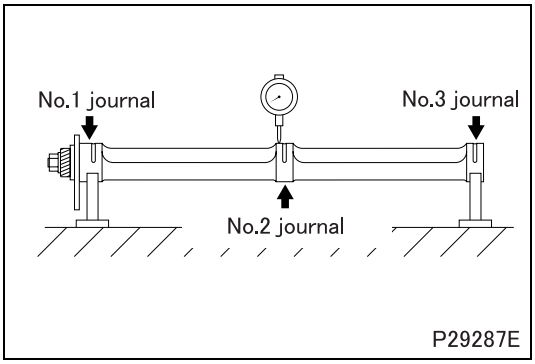


Replacement of No. 1 idler gear bushing
[Removal]



[Installation]

- Position the No. 1 idler gear with its ends facing in the illustrated directions.
- Press in the gear bushing until C sits snugly on the chamfered end of the No. 1 idler gear.
- After press-fitting the bushing, remeasure the clearance between it and the No. 1 idler shaft.
- Ream the busing if the measurement is below the standard value range.



■ Inspection: Balance shaft bend

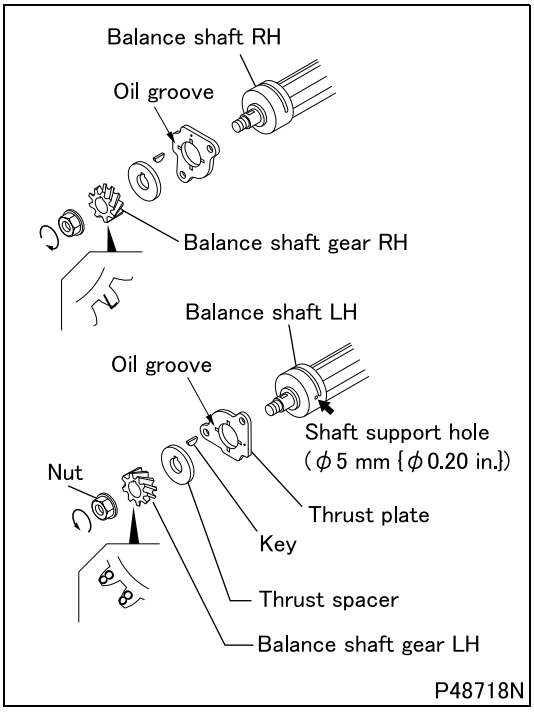
- Place supports under the No. 1 and No. 3 journals of the balance shaft and measure the bend of the balance shaft at the No. 2 journal.

NOTE

- **Turn the balance shaft by one turn and read the dial gauge. Divide the reading by two to obtain the balance shaft bend.**

- If the measurement exceeds the specified limit, replace the balance shaft.

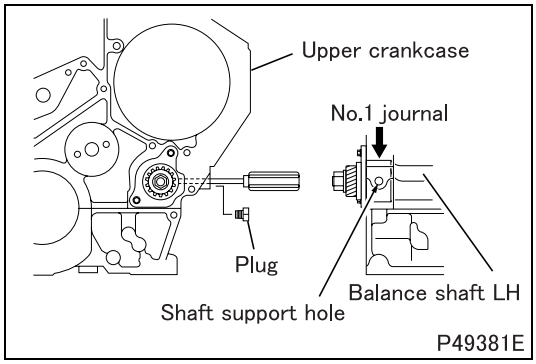
◆Installation procedure◆



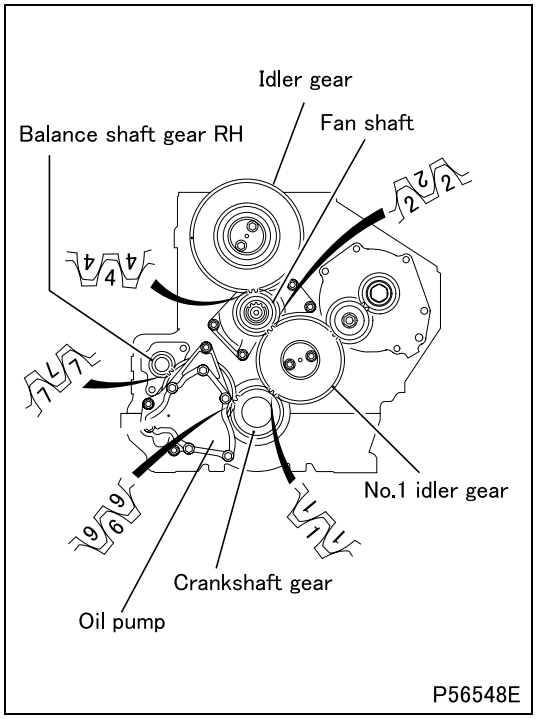
■ Installation: Balance shafts

- Install all the indicated parts on each balance shaft with their ends facing in the illustrated directions.
- Install the balance shaft RH by turning its nut clockwise, and the balance shaft LH by turning its nut counterclockwise.

- Install the balance shaft RH assembly and the balance shaft LH assembly into the crankcase according to the following procedures, which include different instructions between the two balance shafts.
  - The balance shaft RH can be installed in the crankcase without following any special procedure. (The positioning of the gear of the balance shaft RH will be finally determined by installing the oil pump.)

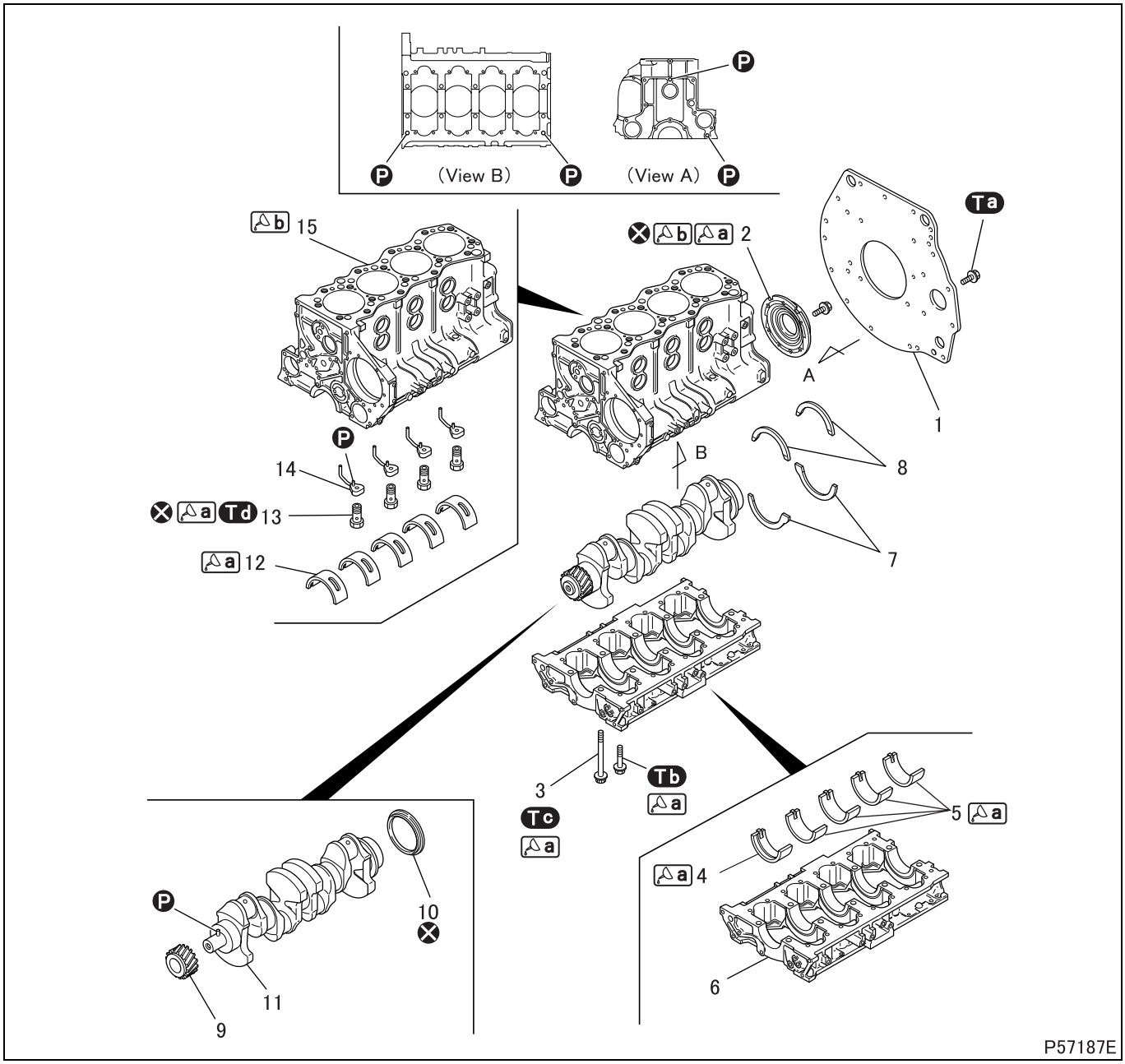


- The gear of the balance shaft LH can be engaged with other gears only after the front case is installed and then the vacuum pump is installed on the crankcase. This necessitates performing the following steps before installing the front case and vacuum pump. (The balance shaft LH cannot be rotated to adjust the gear position after the front case is installed on the crankcase.)
- Remove the plug on the upper crankcase.
- Insert a screwdriver through the plug hole and into the shaft support hole (diameter: 5 mm {0.20 in.}) on the No. 1 journal of the balance shaft LH to hold the shaft against rotation.
- Align the mating marks on each timing gear.
- This positions the balance shaft LH correctly. Leave the balance shaft in this state until installation of the front case and vacuum pump is completed.



■ Installation: Timing gears

- Place the No. 1 cylinder piston at top dead center to position the crankshaft gear.
- Install the oil pump gear by aligning mating mark **"6"** with that on the crankshaft gear, and mating mark **"7"** with that on the balance shaft gear RH.
- Install the No. 1 idler gear by aligning mating mark **"1"** with that on the crankshaft gear.
- Install the fan shaft by aligning mating mark **"2"** with that on the No. 1 idler gear.
- Install the idler gear by aligning mating mark **"4"** with that on the fan shaft.



● **Disassembly sequence**

1 Rear plate
2 Rear oil seal
3 Main bearing cap bolt
4 No.1 Lower bearing
5 Lower main bearing
6 Lower crankcase
7 Lower thrust plate
8 Upper thrust plate
9 Crankshaft gear
10 Rear oil seal slinger
11 Crankshaft
12 Upper main bearing
13 Check valve
14 Oil jet
15 Upper crankcase

Ⓟ: Locating pin
⊗: Non-reusable parts

NOTE

- **The lower crankcase and the upper crankcase are machined as a matched set, and cannot be replaced individually.**

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **The main bearing cap bolts are tightened using the torque-turn tightening method. Any bolt that has three punch marks must be replaced.**
- **Do not overtighten the check valve. If it is tightened to a torque exceeding the specification, the check valve may malfunction, resulting in seizures in the engine.**
- **The No. 1 lower bearing has a oil groove. Be sure to install it in the correct position, otherwise a crankshaft seizure may result.**

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
–	Crankshaft end play			0.10 to 0.28 {0.0039 to 0.011}	0.4 {0.016}	Replace thrust plate
4, 5, 12	Main bearing	Oil clearance	All except No. 3	0.038 to 0.1 {0.0015 to 0.0039}	0.15 {0.0059}	Replace
			No. 3	0.058 to 0.12 {0.0023 to 0.0047}		
		Span when free		–	Less than 91.5 {3.60}	
11	Crankshaft	Bend		0.02 {0.00079} or less	0.05 {0.0020}	Replace
		Pins and journals	Out-of-roundness	0.01 {0.00039} or less	0.03 {0.0012}	Rectify or replace
			Taper	0.006 {0.00024} or less	–	
		Center-to-center distance between the journal and pin		60 ± 0.05 {2.36 ± 0.002}	–	
		Journal width	No. 1	33.5 {1.32}		
			No. 2 to 4	35 {1.38}		
			No. 5	$35\ ^{+0.039}_{0}$ {$1.38\ ^{+0.0015}_{0}$}	–	
		Pin width		$41\ ^{+0.12}_{0}$ {$1.61\ ^{+0.0047}_{0}$}	–	
		Fillet		R4	–	
15	Upper crankcase	Distortion of upper crankcase top surface		0.07 {0.0028} or less	0.2 {0.0079}	Rectify or replace
		Cylinder block	Out-of-roundness	0.005 or less {0.0002 or less}	–	Replace
			Taper	0.015 or less {0.00059 or less}	–	

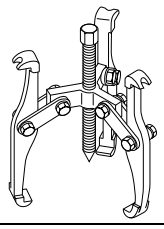
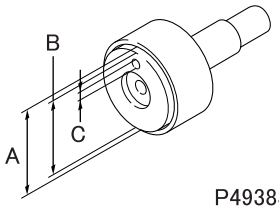
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (rear plate installation)	63.7 {47, 6.5}	–
Tb	Bolt (lower crankcase installation)	23.5 {17, 2.4}	Wet
Tc	Main cap bolt (lower crankcase installation)	49 {36, 5.0} +90°	Wet Reusable up to 3 times
Td	Check valve	29.4 {22, 3.0}	Wet

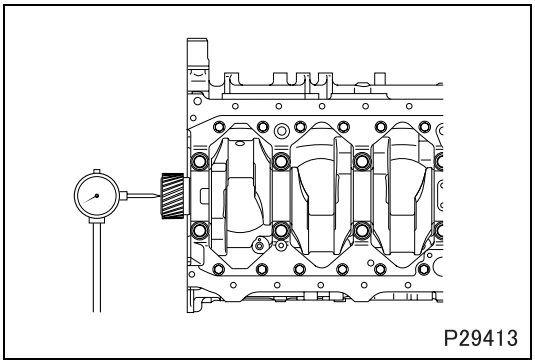
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Rear oil seal lip	Engine oil	As required
	Bolt and main bearing cap bolt threads and seating surface of head		
	Main bearing inside surface		
	Check valve threads		
b	Upper and lower crankcase mating surface of rear oil seal	ThreeBond 1207C or D	As required
	Lower crankcase mounting surface of upper crankcase		

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
ⓒa	Gear puller  P02065	MH061326	Removal of crankshaft gear
ⓒb	Rear oil seal slinger installer A: φ103 {φ4.06}, B: φ100 {φ3.94}, C: φ15 {φ0.59}  P49383	MH062677	Installation of rear oil seal slinger

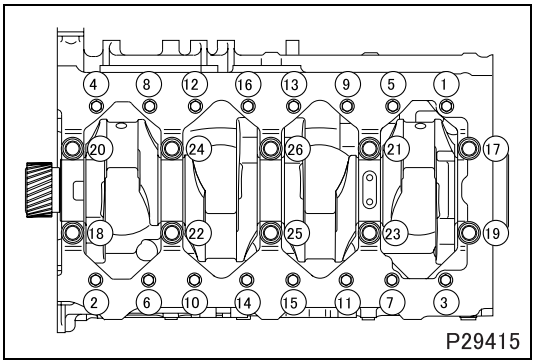
◆Inspection before removal◆


P29413

■ **Inspection: Crankshaft end play**

- If the measurement exceeds the specified limit, replace the thrust plates with oversize ones.
- Available oversizes:
  +0.15 mm, +0.30 mm, +0.45 mm {0.0059, 0.012, 0.018 in.}
- Replace the crankshaft if the end play is too large to adjust using oversize thrust plates.

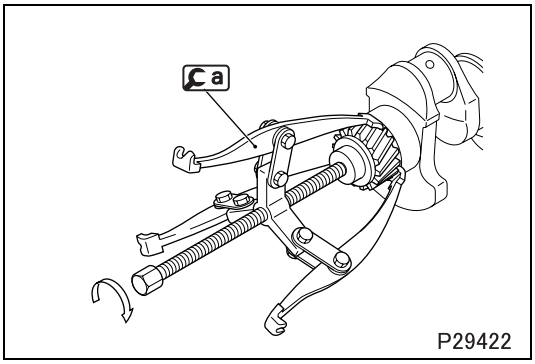
◆Removal procedure◆



P29415

■ **Removal: Lower crankcase**

- Loosen the bolts little by little in the order indicated in the illustration (1 to 16).
- After loosening the bolts, loosen the main cap bolts little by little in the order indicated in the illustration (17 to 26), then remove the main cap bolts.



P29422

■ **Removal: Crankshaft gear**

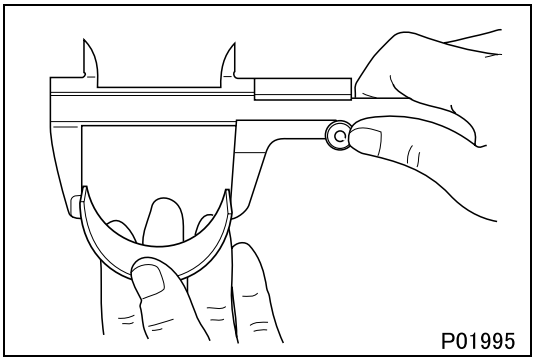
CAUTION ⚠

- **Do not tap off the crankshaft gear as this can damage it.**

■ **Removal: Rear oil seal slinger**

- Taking care not to damage the crankshaft, split the rear oil seal slinger using a chisel or a similar tool.

◆Inspection procedure◆

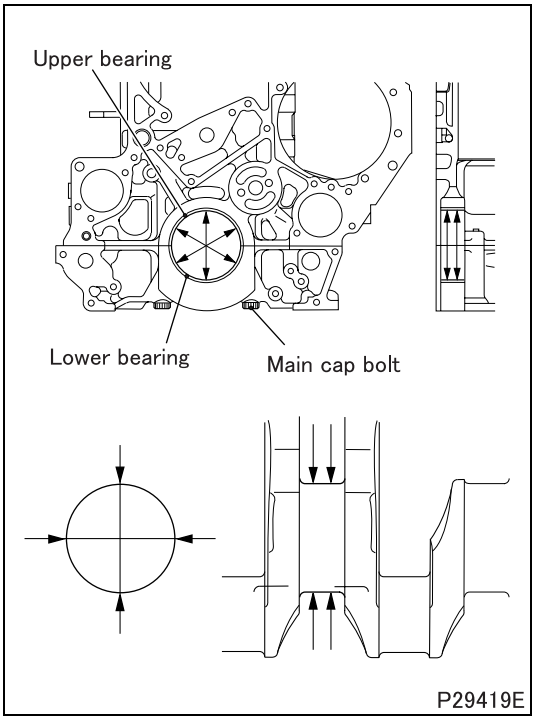


■ **Inspection: Main bearing span when free**

CAUTION ⚠

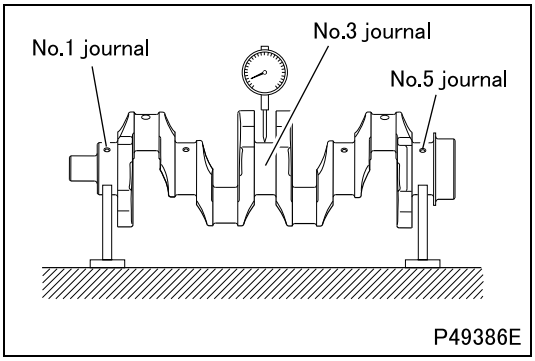
- **Do not attempt to manually expand the bearings.**
- **Always replace the upper and lower bearings as a set.**

- If the measurement exceeds the specified limit, replace the bearing.



■ **Inspection: Main bearing-to-crankshaft clearance**

- Fit the upper bearing into the upper crankcase and the lower bearing into the lower crankcase.
- Tighten the main bearing cap bolts to a torque of 49 N·m {36 lbf·ft, 5.0 kgf·m}.
- Measure the inside diameter of the main bearing and the diameter of the corresponding crankshaft journal.
- If the difference between the measurements exceeds the specified limit, machine the crankshaft journal to one of the specified undersize dimensions indicated on the next page.



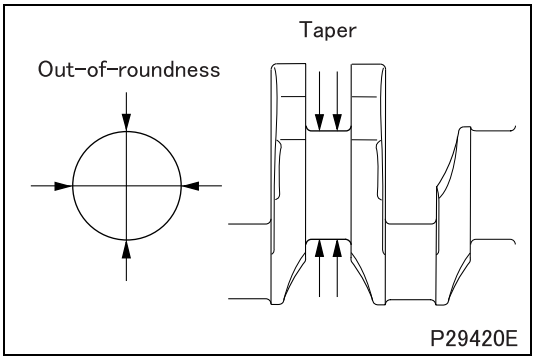
■ **Inspection: Crankshaft**

(1) Bend

- Support the crankshaft at its No. 1 journal and No. 5 journal. Measure the extent of bending in the crankshaft at the center of the No. 3 journal.
- If the measurement exceeds the specified limit, replace the crankshaft.

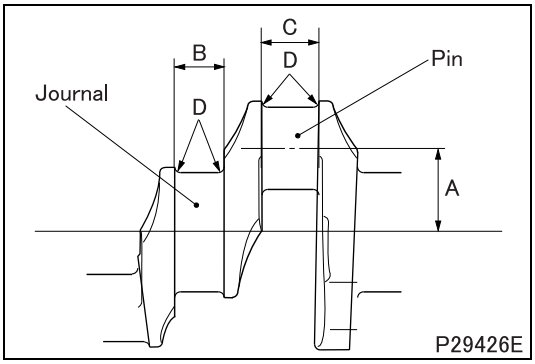
NOTE

- **Turn the crankshaft through one revolution. One-half of the dial indicator reading represents the extent of bending.**



(2) Out-of-roundness and taper of crankshaft journals and pins

- If any of the measurements exceeds the specified limits, grind the crankshaft journal(s) and/or pin(s) to undersize(s) or replace the crankshaft.



Grinding of crankshaft

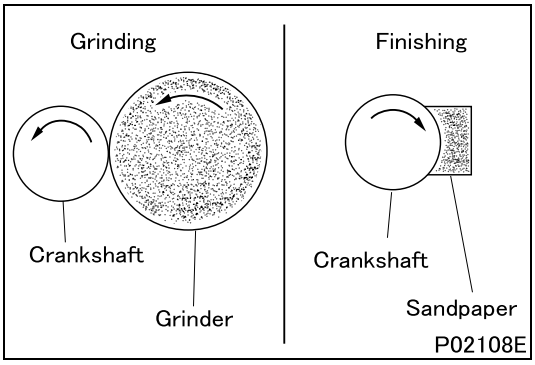
CAUTION ⚠

- **If the crankshaft is ground to an undersize, the main bearings must be replaced with the undersize ones of the corresponding undersize.**

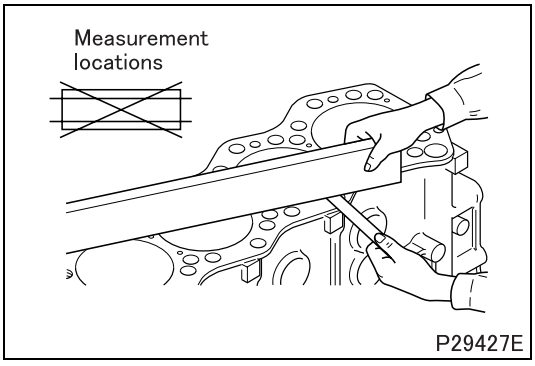
- Do not change the center-to-center distance **A** between the journal and pin.
  A: 60 ± 0.05 mm {2.36 ± 0.0020 in.}
- Do not change the journal width **B** and the pin width **C**.
  B: 33.5 mm {1.32 in.} (No. 1 journal)
  35 mm {1.38 in.} (No. 2 to No. 4 journals)
  $35\ ^{+0.039}_{0}$ mm {$1.38\ ^{+0.0015}_{0}$ in.} (No. 5 journal)
  C: $41\ ^{+0.2}_{0}$ mm {$1.61\ ^{+0.0079}_{0}$ in.} (No. 5 journal)
- Finish the fillets **D** smoothly.
  D: R4 mm {R0.16 in.}
- Carry out a magnetic inspection to check for cracks possibly caused by grinding. Also, check that the harness of the surface has not dropped below Shore hardness number (Hs) 75.
- Replace the crankshaft if defects are evident.

Crankshaft undersize dimensions (Unit: mm {in.})

		Undersizes			
		0.25 {0.0098}	0.50 {0.020}	0.75 {0.030}	1.00 {0.039}
Finished journal diameter	No. 1, 2, 4, 5	85.68 to 85.70 {3.37 to 3.37}	85.43 to 85.45 {3.36 to 3.36}	85.18 to 85.20 {3.35 to 3.35}	84.93 to 84.95 {3.34 to 3.34}
	No. 3	85.66 to 85.68 {3.37 to 3.37}	85.41 to 85.43 {3.36 to 3.36}	85.16 to 85.18 {3.35 to 3.35}	84.91 to 84.93 {3.34 to 3.34}
Finished pin diameter		64.69 to 64.71 {2.55 to 2.55}	64.44 to 64.46 {2.54 to 2.54}	64.19 to 64.21 {2.53 to 2.53}	63.94 to 63.96 {2.52 to 2.52}
Out-of-roundness		0.01 {0.00039} or less			
Taper		0.006 {0.00024} or less			



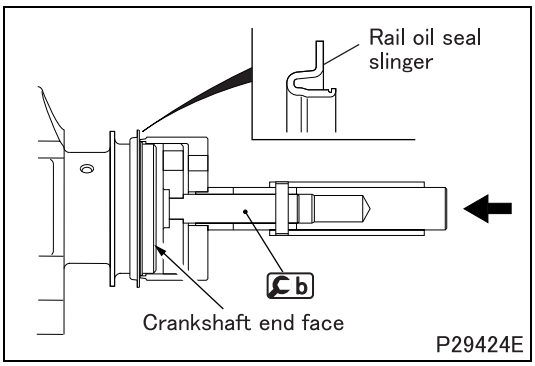
- When grinding, turn both the crankshaft and the grinder counterclockwise as viewed from the crankshaft front end.
- When finishing the crankshaft with whetstone or sandpaper, rotate the crankshaft clockwise.



■ Inspection: Distortion of upper crankcase top surface

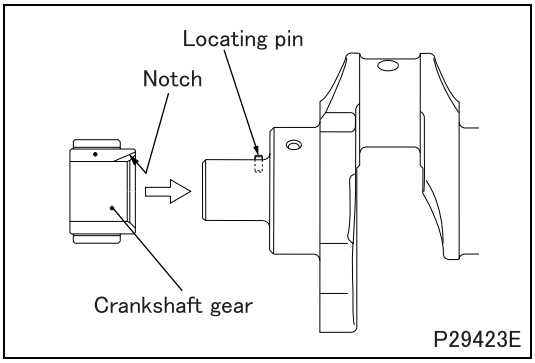
- If the measurement exceeds the specified limit, grind the crankcase top surface with a surface grinder.
- Limit the amount of removed metal to make sure that the amount of piston projection above the crankcase top surface stays within the standard value range. (See the PISTONS, CONNECTING ROD AND CYLINDER LINERS section.)

◆Installation procedure◆



■ **Installation: Rear oil seal slinger**

- Press in the rear oil seal slinger until Cb sits snugly on the crankshaft end surface.



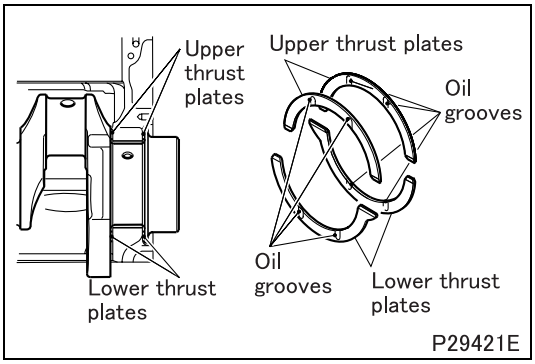
■ **Installation: Crankshaft gear**

- Heat the crankshaft gear to approximately 150°C {300°F} with a gas burner or the like.

CAUTION ⚠

- **Be careful not to get burned.**

- Align the locating pin in the crankshaft with the slot in the crankshaft gear. Drive the gear into position by lightly striking its end face with a plastic hammer.



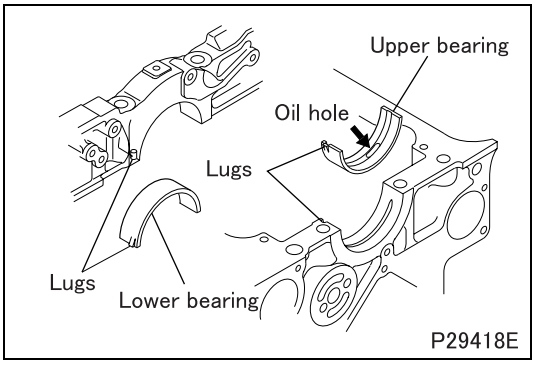
■ **Installation: Thrust plate**

- Install the thrust plates on both sides of the rearmost main bearing with the oil grooves on the inner plates facing inward and those on the outer plates outward as shown in the illustration.

CAUTION ⚠

- **Be sure to orient the oil grooves as indicated above, otherwise seizures may occur in the engine.**

- Use oversize thrust plates when adjusting the crankshaft end play. The upper and lower thrust plates on the same side must be of the same size. The thrust plates on one side may differ in size from those on the other side.

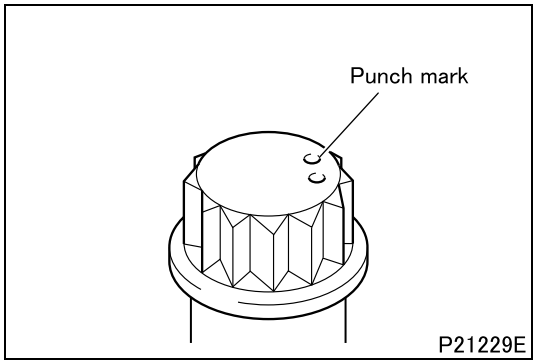


■ **Installation: Main bearings**

- Install the main bearings with their lugs aligned as shown in the illustration. When the crankshaft journals have been ground to an undersize, use undersize main bearings.
  Available main bearing undersizes:
  0.25 mm {0.0098 in.}, 0.50 mm {0.020 in.}, 0.75 mm {0.030 in.}, 1.00 mm {0.039 in.}

CAUTION ⚠

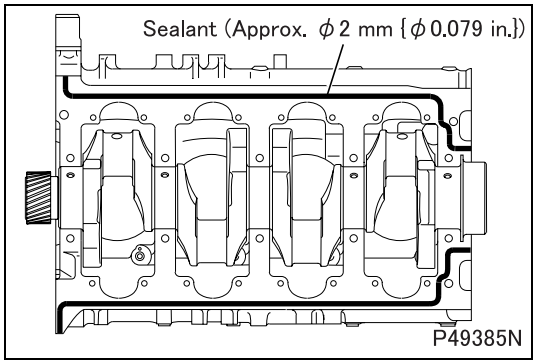
- **The upper main bearing has an oil hole. The lower main bearing has no oil hole. Do not confuse the upper and lower bearings, as this can cause seizure in the engine.**



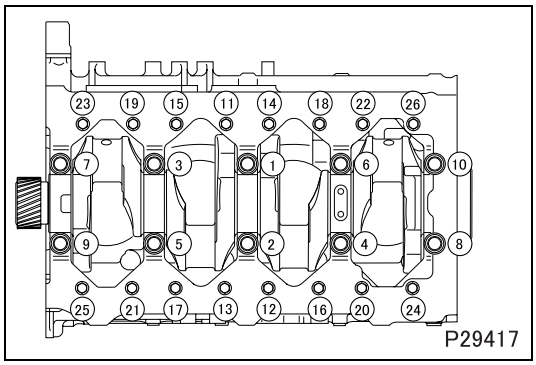
■ **Installation: Lower crankcase**

CAUTION ⚠

- **Before installing the main bearing cap bolts, check the number of punch marks on the head of each bolt. (A bolt with two or less marks is reusable.)**
- **The number of punch marks corresponds with the number of times the main cap bolt has been tightened using the torque-turn tightening method. Any bolt that has three marks (i.e. that has been used three times) must be replaced.**



- Clean all sealant application surfaces.
- Apply evenly thick beads of sealant to the upper crankcase without any breaks as shown in the illustration.
- Install the lower crankcase within three minutes of applying the sealant, being careful not to dislodge the sealant.



- Apply engine oil to the main cap bolt threads and seating surfaces of the bolt heads, then tighten them to a torque of 49 N·m {36 lbf·ft, 5.0 kgf·m} in the order indicated in the illustration (1 to 10).
- Tighten each main cap bolt further by 90° in the same order.
- Finally, tighten each bolt to the specified torque in the order indicated in the illustration (11 to 26).

CAUTION ⚠

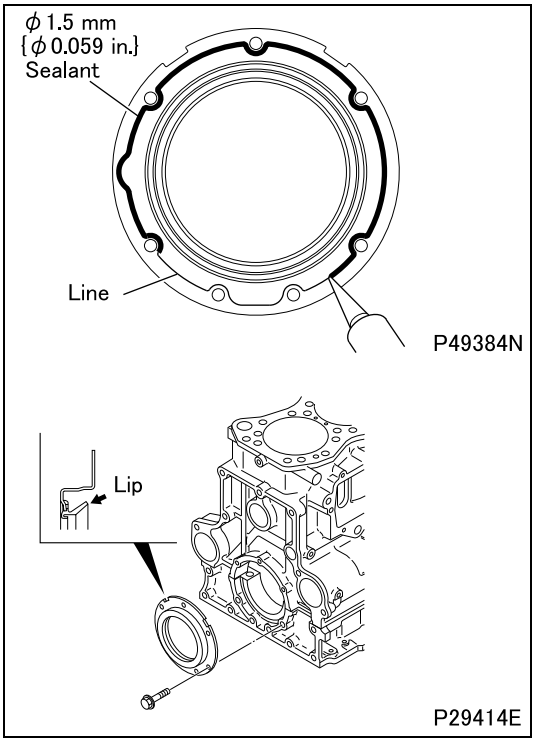
- **After installing the bolts, wait at least an hour before starting the engine.**
- **Apply new beads of sealant whenever the main cap bolts have been loosened or removed.**

- After tightening the bolts using the above torque-turn tightening method, make a punch mark on the head of each bolt to indicate the number of times that it has been used.

CAUTION ⚠

- **The bolts that have been tightened using the torque-turn method must never be additionally tightened after the final angular tightening.**

- After installing the main bearing caps, rotate the crankshaft by hand. If it cannot be rotated smoothly, inspect the main bearing caps for correct installation.

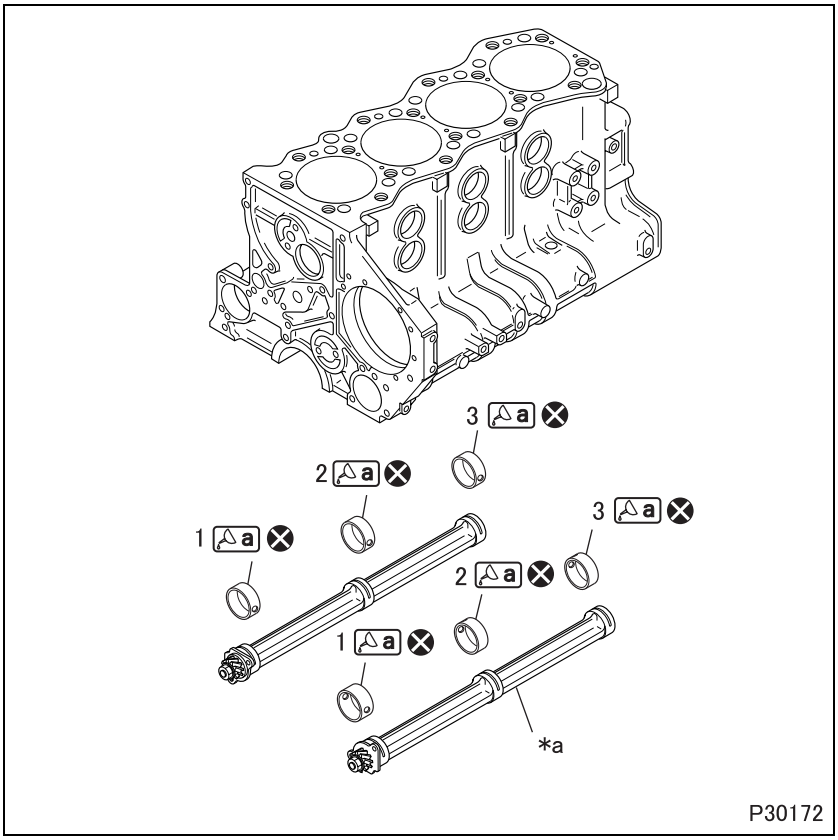


■ **Installation: Rear oil seal**

- Apply engine oil to the lip of the rear oil seal.
- Clean the seal surface of the crankshaft.
- Apply a bead of sealant along the line on the rear oil seal evenly without any breaks.
- Install the rear oil seal within three minutes after applying the sealant. Be careful not to let the applied sealant slip out of place during installation.

CAUTION ⚠

- **After fitting the rear oil seal, wait at least an hour before starting the engine.**
- **Apply a new bead of sealant whenever the mounting bolts of the rear oil seal have been loosened.**



● **Disassembly sequence**

1 No. 1 balance shaft bushing
2 No. 2 balance shaft bushing
3 No. 3 balance shaft bushing

***a**: Balance shaft
⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

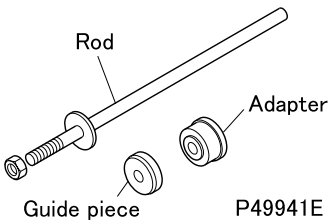
Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
1 to 3, *a	Balance shaft journal-to-balance shaft bushing clearance	No. 1	0.055 to 0.099 {0.0022 to 0.0039}	0.15 {0.0059}	Replace
		No. 2	0.075 to 0.119 {0.030 to 0.0047}		
		No. 3	0.055 to 0.099 {0.0022 to 0.0039}		

Lubricant and/or sealant

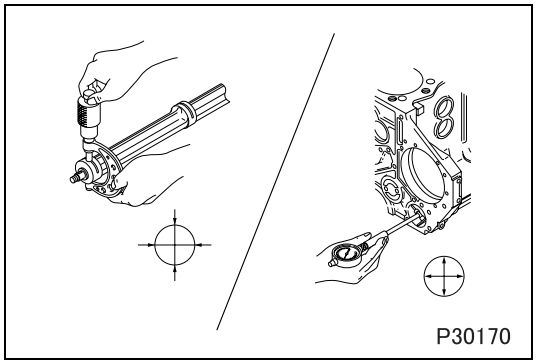
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Balance shaft bushing inner surface	Engine oil	As required

Special tools

Mark	Tool name and shape	Part No.	Application
a	Balance shaft bushing installer and extractor 	MH062782	Removal and installation of balance shaft bushing

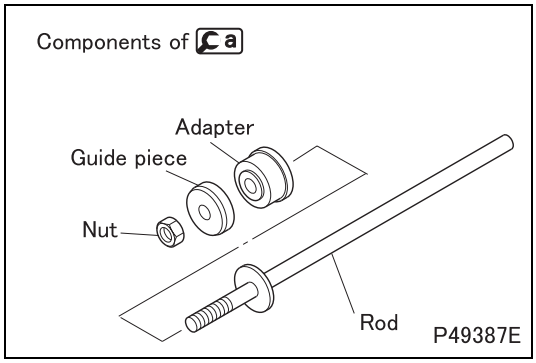
BALANCE SHAFT BUSHINGS

◆Inspection procedure◆



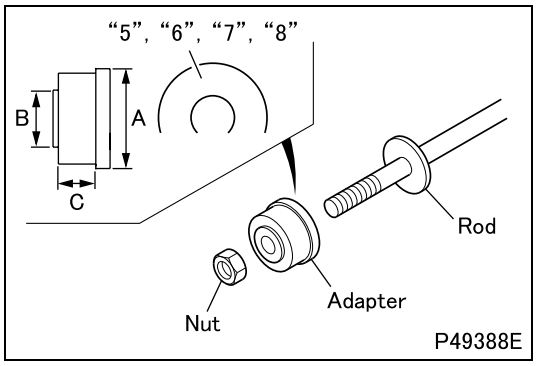
■ **Inspection: Balance shaft-to-balance shaft bushing clearance**

- Replace the bushing if the measurement exceeds the specified limit.



Replacement of balance shaft bushing

- Replace the bushing using a.

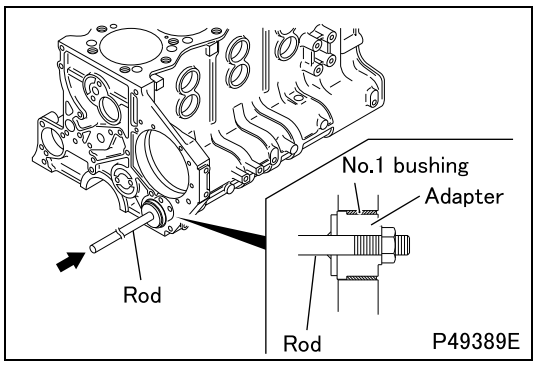


[Removal]

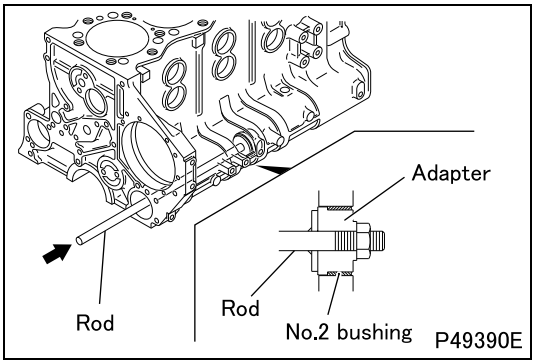
- To remove the bushings, use the rod fitted with an adapter corresponding to the size of each bushing.

Unit: mm {in.}

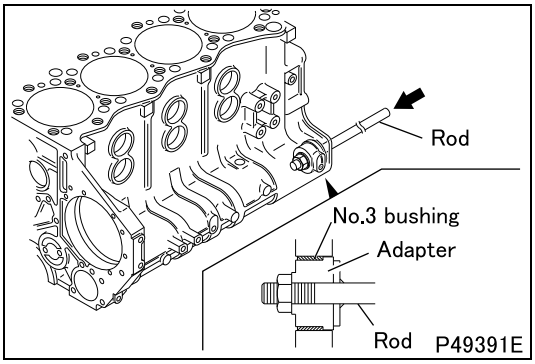
Bushing		Adapter			
		Identification mark	**A**	**B**	**C**
No. 1	Left	**"5"**	ϕ55.25 {ϕ2.18}	ϕ 51.5 {ϕ2.03}	26.5 {1.04}
	Right	**"6"**			21.5 {0.85}
No. 2		**"7"**	ϕ 55 {ϕ2.17}	ϕ 51 {ϕ2.01}	
No. 3		**"8"**	ϕ 54.75 {ϕ2.16}	ϕ 50.5 {ϕ1.99}	



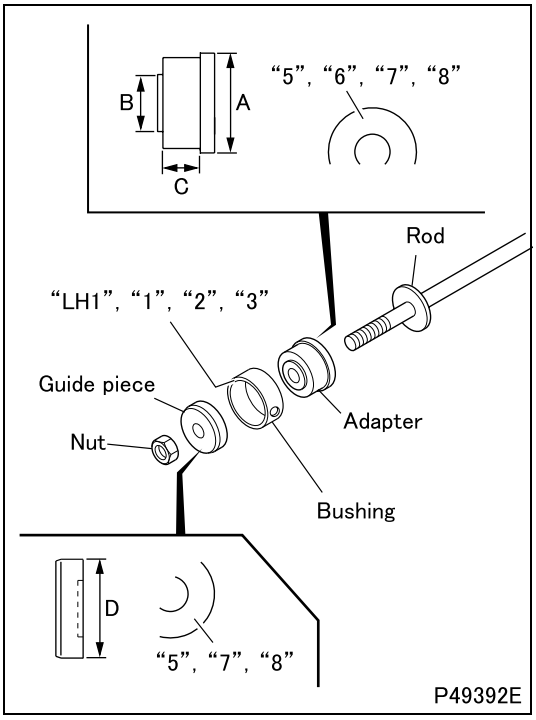
- Remove the No. 1 bushing by tapping on the rod from the front of the engine.



- Remove the No. 2 bushing by tapping on the rod from the front of the engine.



- Remove the No. 3 bushing by tapping on the rod from the back of the engine.



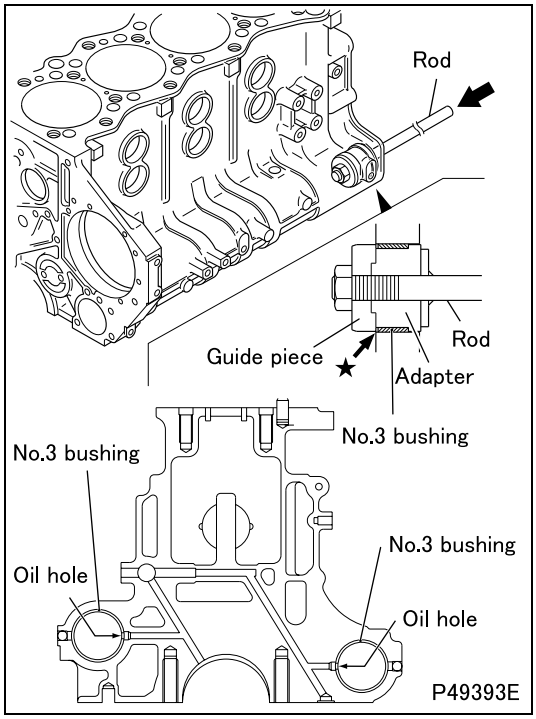
[Installation]

- To install the bushings, use the rod fitted with an adapter corresponding to the size of each bushing. Each bushing has an identification mark. These identification marks are used to distinguish between the No. 1, No. 2 and No. 3 bushings. If the identification mark is not clear, measure the outside diameter of the bushing and use the measurement as a means of identification.

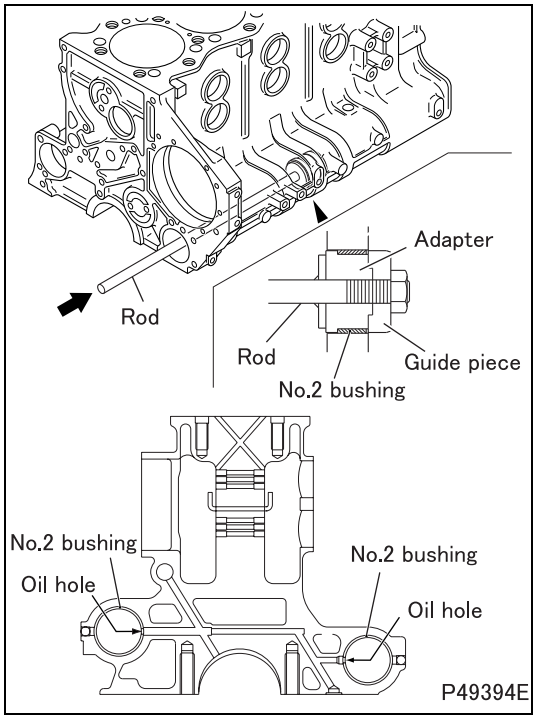
Unit: mm {in.}

Bushing				Adapter				Guide piece	
		Identification mark	Outside diameter	Identification mark	**A**	**B**	**C**	Identification mark	**D**
No. 1	Left	**"LH1"**	ϕ 55.25 {ϕ2.18}	**"5"**	ϕ 55.25 {ϕ2.18}	ϕ 51.5 {ϕ2.03}	26.5 {1.04}	**"5"**	ϕ 55.25 {ϕ2.18}
	Right	**"1"**	ϕ 55.25 {ϕ2.18}	**"6"**			21.5 {0.85}	**"6"**	
No. 2		**"2"**	ϕ55 {ϕ2.17}	**"7"**	ϕ55 {ϕ2.17}	ϕ51 {ϕ2.01}		**"7"**	ϕ55 {ϕ2.17}
No. 3		**"3"**	ϕ 54.75 {ϕ2.16}	**"8"**	ϕ 54.75 {ϕ2.16}	ϕ 50.5 {ϕ1.99}		**"8"**	ϕ 54.75 {ϕ2.16}

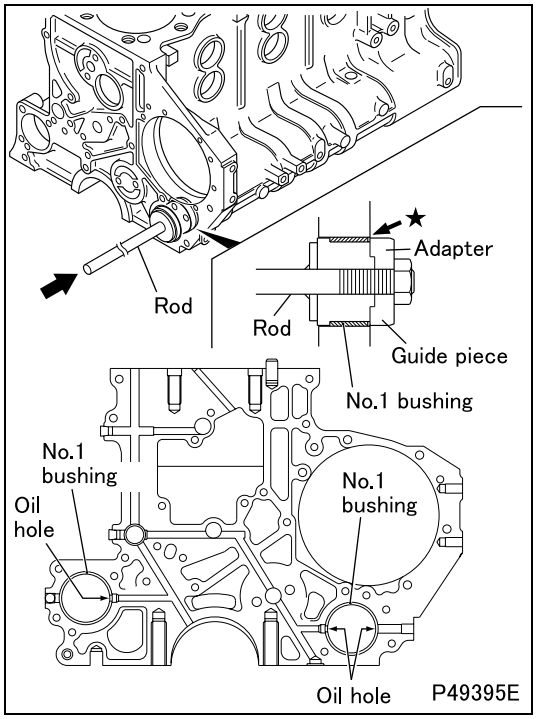
BALANCE SHAFT BUSHINGS



- Align the oil hole in the No. 3 bushing with the oil hole in the upper crankcase.
- Force the No. 3 bushing into the upper crankcase as deep as the ★ mark in the illustration by tapping on the rod from the rear of the engine.



- Align the oil hole in the No. 2 bushing with the oil hole in the upper crankcase.
- Force the No. 2 bushing into the upper crankcase to the illustrated position by tapping on the rod from the front of the engine.



- Align the oil hole(s) in the No. 1 bushing with the oil hole(s) in the upper crankcase.
- Force the No. 1 bushing into the upper crankcase as deep as the ★ mark in the illustration by tapping on the rod from the front of the engine.

CAUTION ⚠

- **The left and right No. 1 bushings are different from each other, and should not be installed in reverse positions.**
- **The left No. 1 bushing has two oil holes, whereas the right No. 1 bushing has only one oil hole.**

INDEX

SPECIFICATIONS 12-2

STRUCTURE AND OPERATION

1. **Lubrication System 12-3**
2. **Oil Pump 12-4**
3. **Oil Cooler 12-5**
4. **Oil Filter 12-6**
5. **Lubrication of Engine Components 12-7**

TROUBLESHOOTING 12-10

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. **Oil Filter Replacement 12-12**
2. **Engine Oil Replacement 12-14**
3. **Engine Oil Level Inspection 12-14**
4. **Oil Pressure Measurement 12-14**

OIL PAN, OIL STRAINER AND OIL JETS 12-16

OIL PUMP 12-18

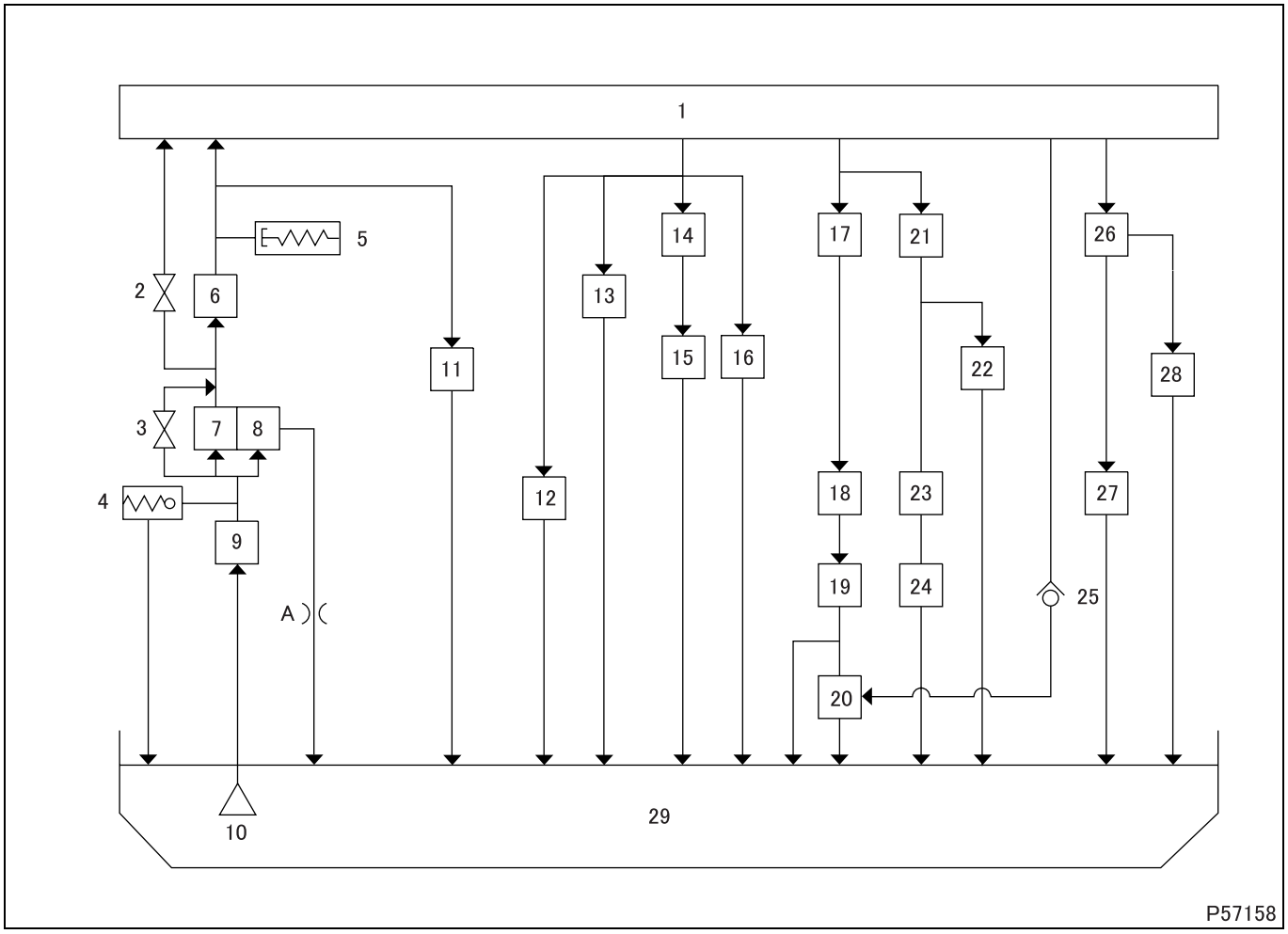
OIL FILTER 12-22

OIL COOLER 12-24

SPECIFICATIONS

Item			Specifications
Method of lubrication			Forced lubrication by oil pump
Oil filter			Spin-on filter paper type
Oil cooler			Shell and plate type (multiple-plate type)
Engine oil	Grade		API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1
	Quantity L (qts)	Oil pan	Approx. 9
		Oil filter	Approx. 1
Regulator valve opening pressure		kPa {psi, kgf/cm^2}	600 $^{+100}_{0}$ {87 $^{+15}_{0}$, 6 $^{+1}_{0}$ }
Bypass valve opening pressure		kPa {psi, kgf/cm^2}	390 ± 29 {57 ± 4.2, 4.0 ± 0.3}

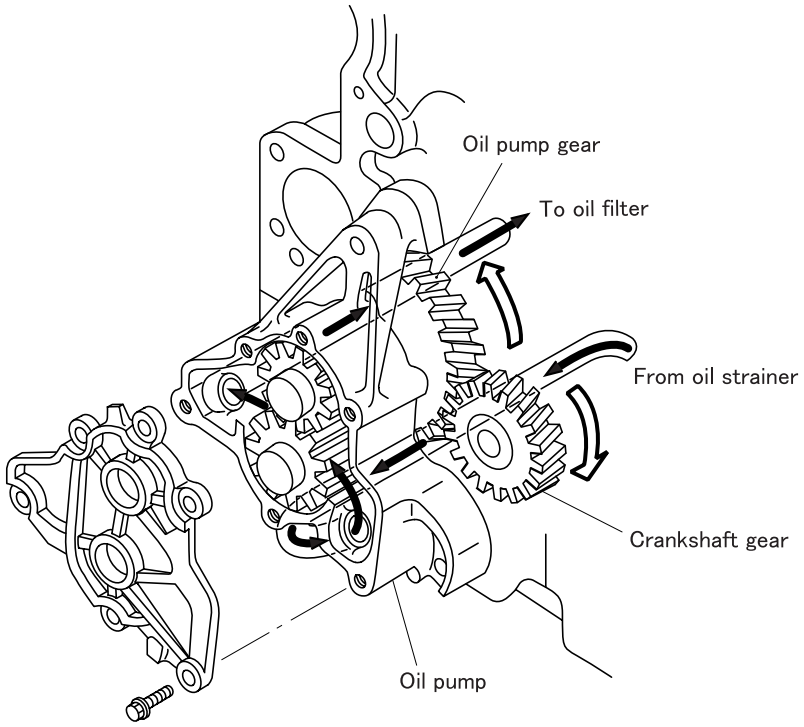
1. Lubrication System



1 Main oil gallery
2 Bypass valve
3 Bypass valve
4 Regulator valve
5 Engine oil pressure switch
6 Oil cooler
7 Full-flow filter element
8 Bypass filter element
9 Oil pump
10 Oil strainer
11 Turbo charger
12 Oil jet for gear
13 Vacuum pump
14 Idler bushing
15 Timing gear
16 Balance shaft bushing LH
17 Crankshaft main bearing
18 Connecting rod bearing
19 Connecting rod bushing
20 Piston
21 Balance shaft bushing RH
22 Supply pump gear bushing
23 Supply pump idler gear bushing
24 Supply pump idler gear shaft
25 Check valve for oil jet
26 Rocker bushing
27 Camshaft bushing
28 Rocker roller
29 Oil pan

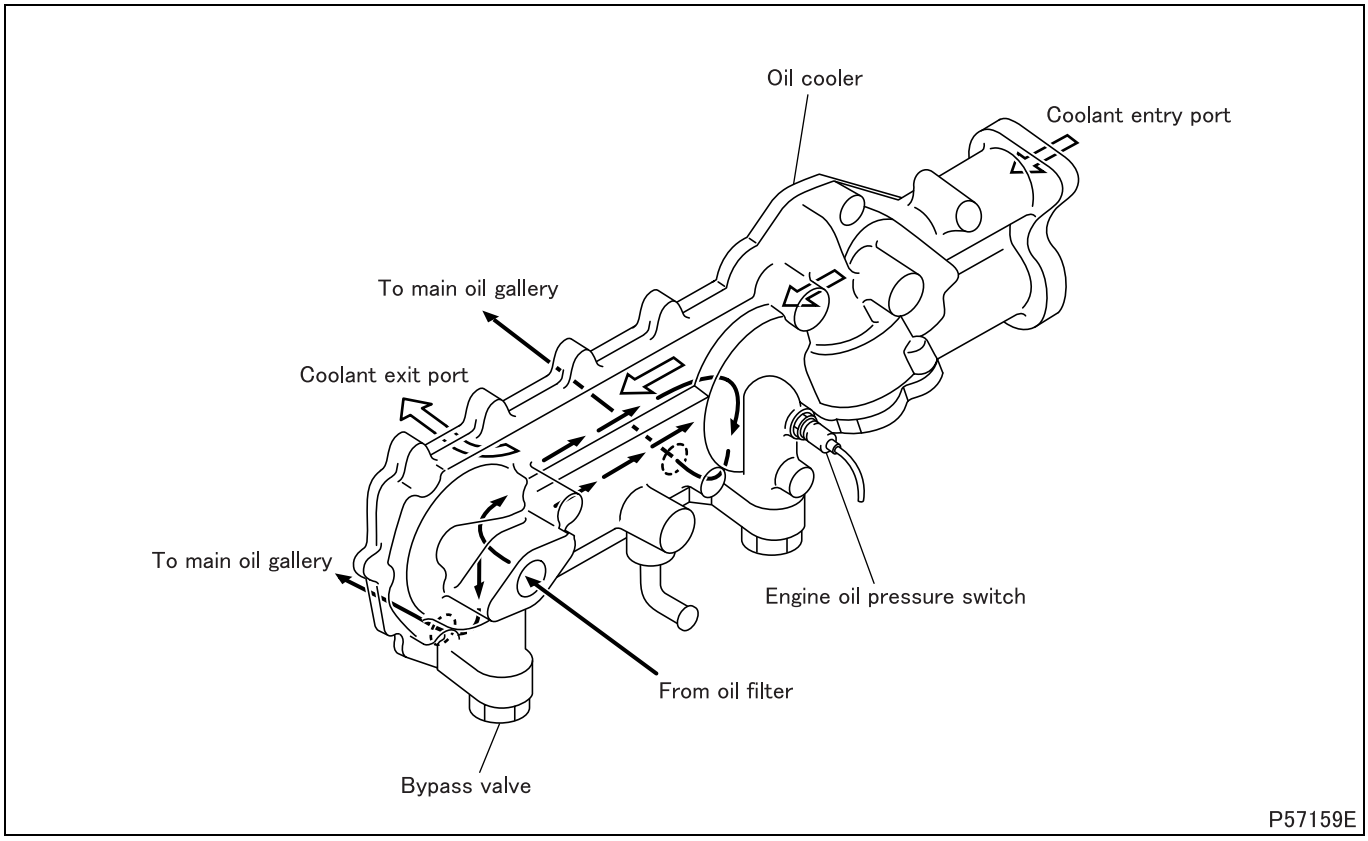
A: Orifice

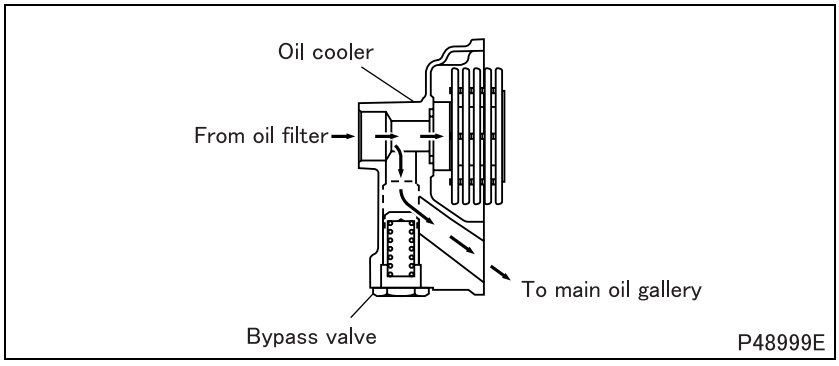
2. Oil Pump



- This engine uses a gear-type oil pump driven by the rotation of the crankshaft transmitted through the engagement of the crankshaft gear and the oil pump gear.

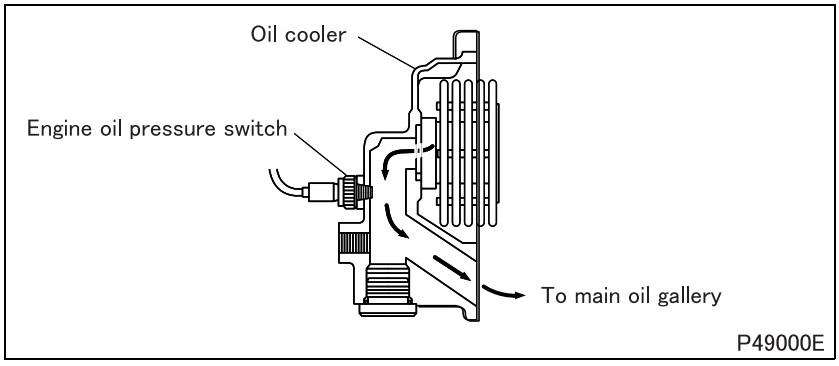
3. Oil Cooler





3.1 Bypass valve

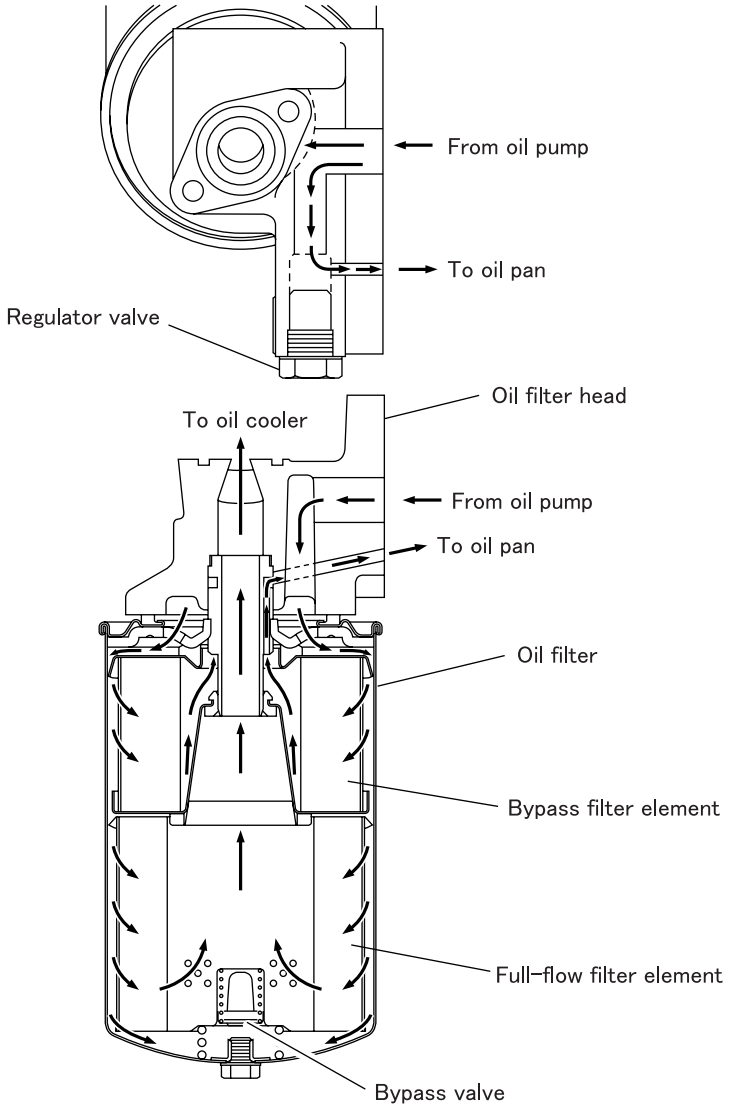
- When the engine oil is cool and its viscosity is high, or when the oil cooler element becomes clogged and restricts the flow of the engine oil, the bypass valve opens to let the engine oil bypass the oil cooler and flow directly to the main oil gallery.



3.2 Engine oil pressure switch

- When the pressure of the engine oil to the main oil gallery drops below the specified level, an electrical contact inside the engine oil pressure switch closes.
- This causes a warning lamp on the meter cluster to illuminate and notify the operator of the excessive pressure drop.

4. Oil Filter

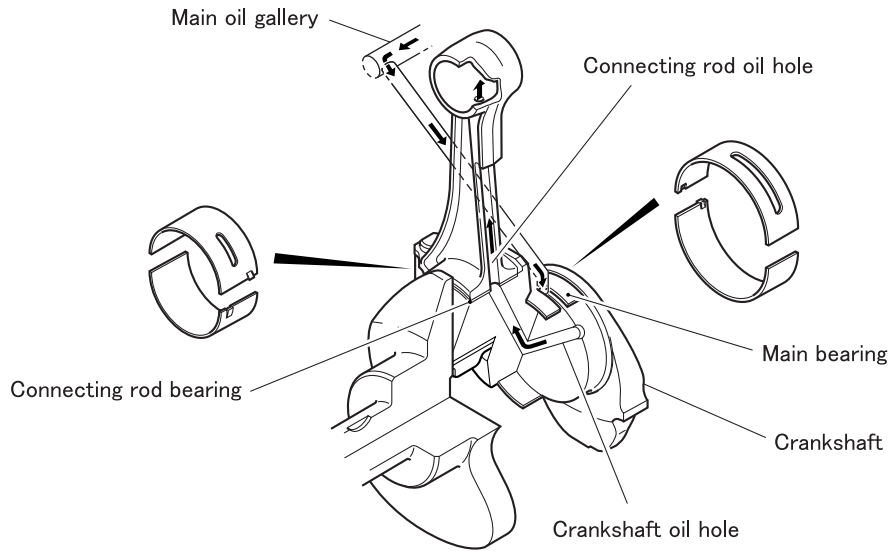


- The oil filter used in this engine is a spin-on, paper-filter type that incorporates both a bypass filter and a full-flow filter.
- A bypass valve is installed in the lower part of the oil filter. When the filter elements are clogged, this valve opens to let the engine oil bypass the filter elements and flow directly to the oil cooler, thereby preventing seizures in the engine.
- A regulator valve is installed on the oil filter head. When the oil pressure in the main oil gallery exceeds the specified level, the regulator valve opens to adjust the oil pressure by returning part of the engine oil to the oil pan.

5. Lubrication of Engine Components

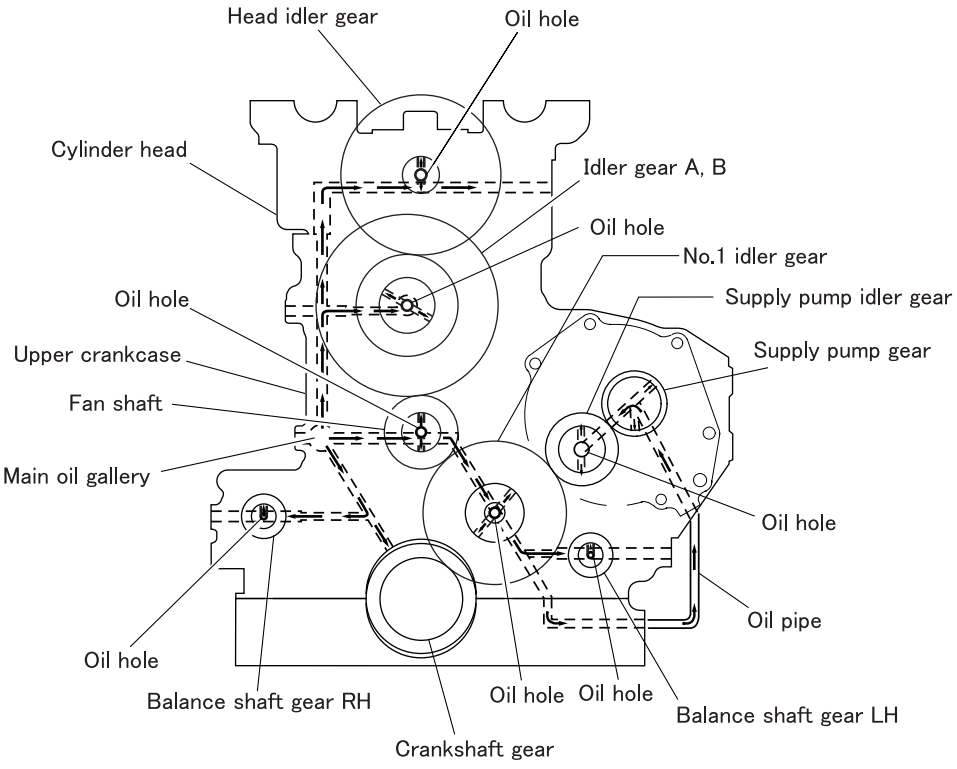
- The engine oil in the main oil gallery lubricates the engine components in the following ways.

5.1 Main bearing and connecting rod bearing

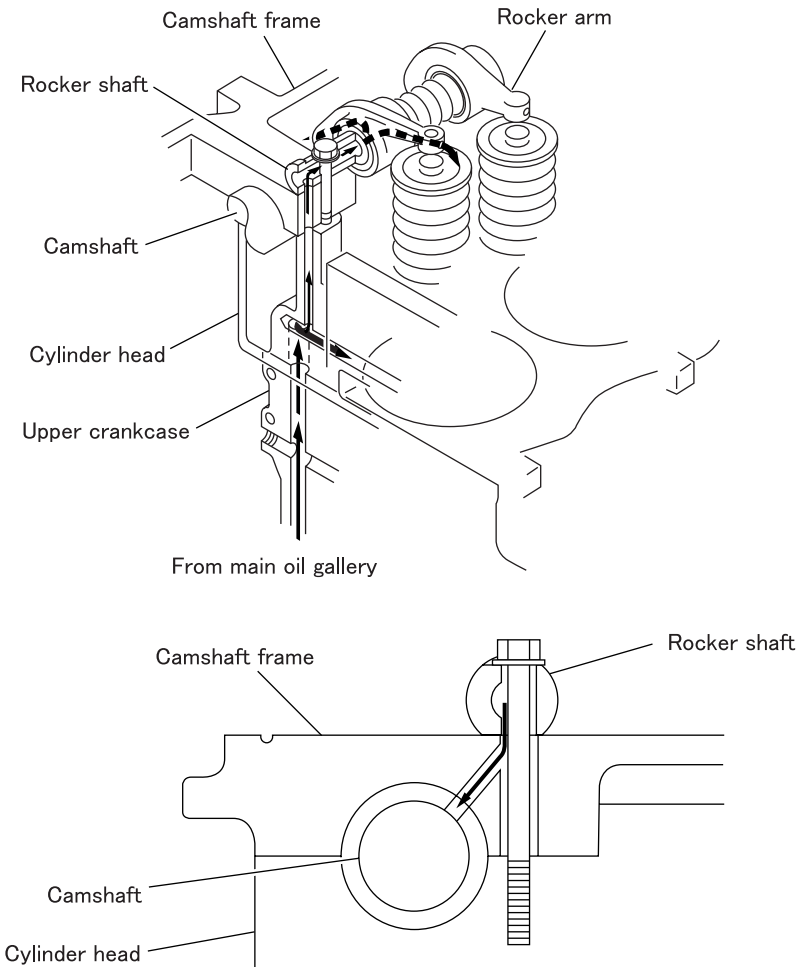


- Engine oil supplied through an oil passage in the crankshaft lubricates the big end (connecting rod bearing) of each connecting rod. Simultaneously, engine oil supplied through an oil passage in the connecting rod lubricates the connecting rod's small end.

5.2 Timing gears

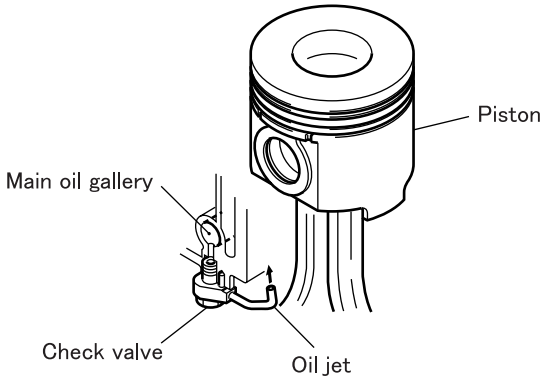


5.3 Valve mechanism



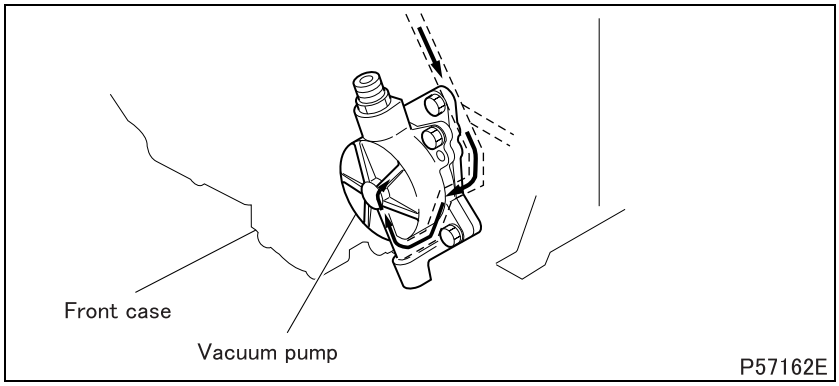
- The engine oil flows from the main oil gallery to the rocker shaft through the oil passages in the upper crankcase, cylinder head, and camshaft frame.
- The engine oil in the rocker shaft lubricates the rocker arms and camshaft, then returns to the oil pan.

5.4 Check valves and oil jets

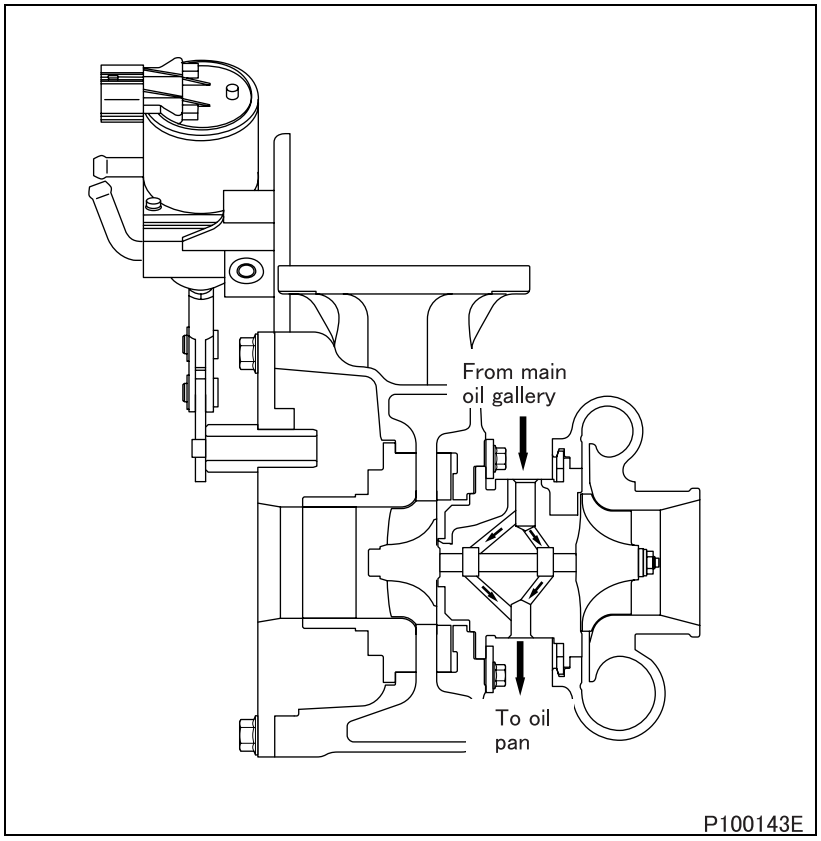


- An oil jet is fitted in the lower part of the main oil gallery for each cylinder.
- Engine oil is sprayed out of the oil jet into the piston to cool the piston.
- Each oil jet is fitted with a check valve that opens and closes at predetermined oil pressure levels. At low engine speeds, the check valve closes to maintain the required volume of oil in the lubrication system and prevent reductions in oil pressure.

5.5 Vacuum pump



- Engine oil flows through the oil passages in the front case to the vacuum pump.
- The oil in the pump lubricates the vanes, and then is discharged into the front case from the air discharge port of the vacuum pump along with air, and returns to the oil pan.



5.6Turbocharger

- Engine oil flows from the main oil gallery through the oil pipes to the turbocharger bearing housing and lubricates the inner surfaces of the bearing housing.
- The piston rings mounted on both sides of the turbine wheel shaft act as oil seals.

Possible causes		Engine is difficult to start	Overheating	Low oil pressure	Excessive oil consumption (oil leakage)	Reference Gr
Oil cooler	Incorrectly mounted element		O	O	O	
	Defective gasket		O	O	O	
	Defective O-ring		O	O	O	
	Clogged element		O	O		
	Damaged element		O	O	O	
	Weakened bypass valve spring		O			
Oil pump	Malfunctioning oil pump		O	O		
	Interference between oil pump gear and oil pump case and/or cover	O		O		
Oil filter	Incorrect installation				O	
	Clogged element		O	O		
	Defective gasket			O		
Weakened regulator valve spring				O		
Incorrectly mounted and/or clogged oil strainer			O	O		
Defective fan shaft front oil seal					O	Gr11
Defective crankshaft rear oil seal					O	
Incorrectly mounted front case					O	
Defective piston cooling oil jet(s)			O	O		
Incorrectly mounted gear lubrication oil jet				O		
Oil working its way up into combustion chamber(s) through piston rings					O	
Oil working its way down into combustion chamber(s) through valves					O	
Too high oil viscosity		O				
Poor oil quality			O			
Deterioration of oil			O			
Fuel mixed with oil			O			

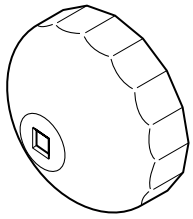
M E M O

1. Oil Filter Replacement

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Oil filter	Engine oil (CJ-4)	Approx. 1 L {1.1 qts}

Special tools

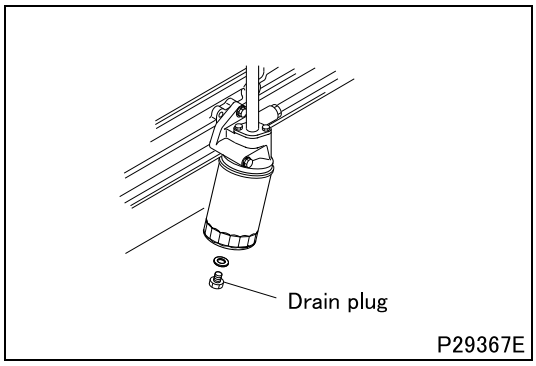
Mark	Tool name and shape	Part No.	Application
a	Oil filter element socket  P08550	MH061566	Removal of oil filter

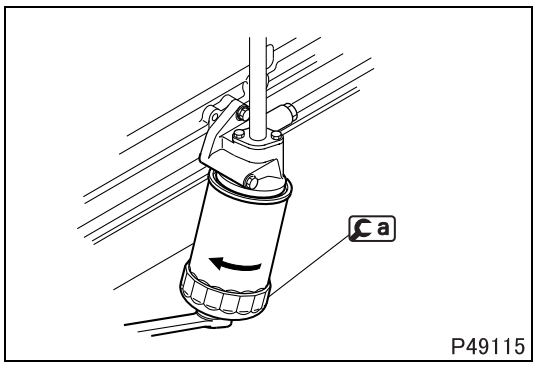
WARNING ⚠

- **Wipe up any spilled engine oil, as it can cause fires.**

CAUTION ⚠

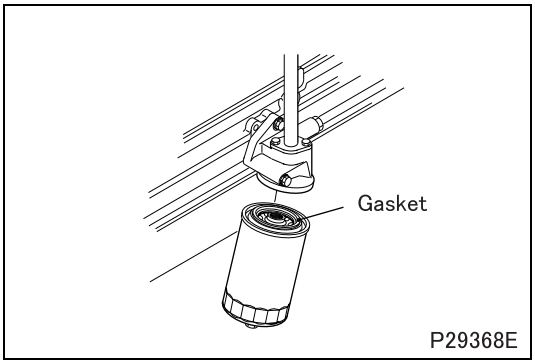
- **Make sure not to put any engine oil on the V-belt when working on the oil filter. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.**





[Removal]

- Remove the drain plug and drain the oil out of the oil filter.



[Installation]

- Clean the oil filter mounting surfaces of the oil filter head.
- Apply a thin coat of engine oil on the oil filter gasket.
- Screw in the oil filter by hand until the gasket touches the oil filter head. Then, tighten the filter by turning it further by three quarters (3/4) of a turn.
- After installing the oil filter, start the engine and check that there are no oil leaks.
- Remove and reinstall the oil filter if it is leaky.
- Stop the engine and check the engine oil level.
- Add engine oil if necessary.

2. Engine Oil Replacement

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug (oil filter)	9.8 ± 1.96 {7.2 ± 1.4, 1.0 ± 0.2}	–
–	Drain plug (oil pan)	34.3 to 43.1 {25 to 32, 3.5 to 4.4}	–

Lubricant and/or sealant

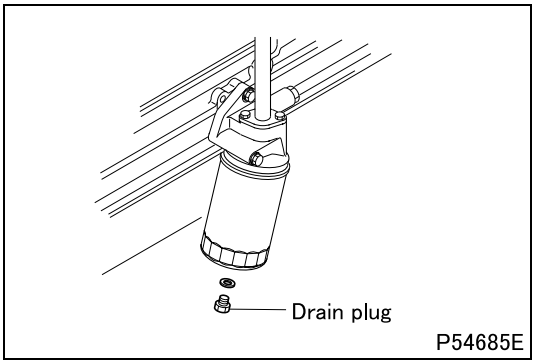
Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Oil filter	Engine oil (CJ-4)	Approx. 1 L {1.1 qts}
	Oil pan		Approx. 9 L {9.5 qts}

WARNING ⚠

- **Wipe up any spilled engine oil, as it can cause fires.**

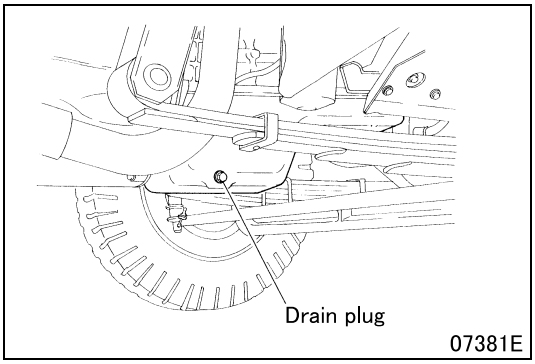
CAUTION ⚠

- **Make sure not to put any engine oil on the V-belt during engine oil replacement. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.**



[Draining]

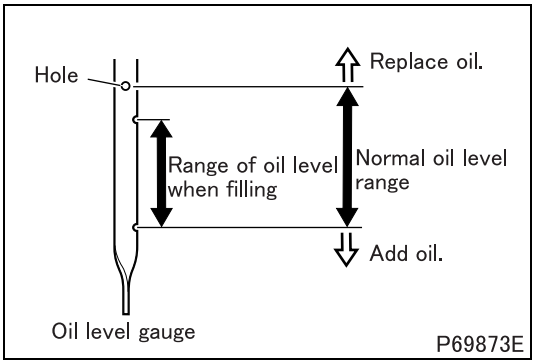
- Remove the filler cap.
- Remove the drain plugs of the oil filter and oil pan to drain out the engine oil.



[Refilling]

- Tighten the drain plug to the specified torque, then pour a specified amount of new engine oil into the engine.
- Stop the engine and check the engine oil level.
- Add engine oil if necessary.

3. Engine Oil Level Inspection



- When regenerating the DPF (diesel particulate filter), a part of the injected fuel may mix into the engine oil and may increase the quantity of oil.
- If the oil level is out of the normal range, add or replace the engine oil.

CAUTION ⚠

- **If the engine oil level exceeds the hole on the oil level gauge, replace the engine oil immediately as the oil has deteriorated and may cause seizure.**

- If remarkable increase of the engine oil is observed, check the following even the oil level is within the normal range.
  - Seizure of piston ring and piston
  - Excessive clearance between piston and cylinder liner

4. Oil Pressure Measurement

Service standards

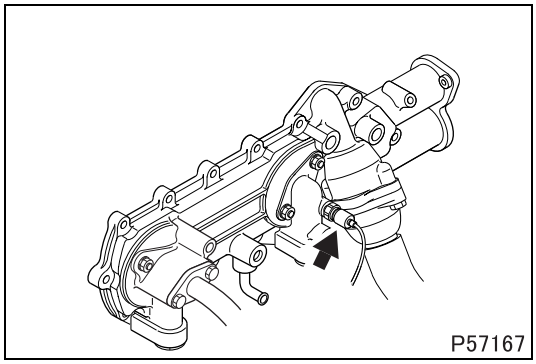
Location	Maintenance item		Standard value	Limit	Remedy
–	Oil pressure (oil temperature at 70 to 90°C {158 to 195°F})	No-load minimum speed	195 kPa {28 psi, 2.0 kgf/cm^2}	98 kPa {14 psi, 1.0 kgf/cm^2}	Inspect
		No-load maximum speed	295 to 490 kPa {43 to 71 psi, 3 to 5 kgf/cm^2}	195 kPa {28 psi, 2.0 kgf/cm^2}	

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

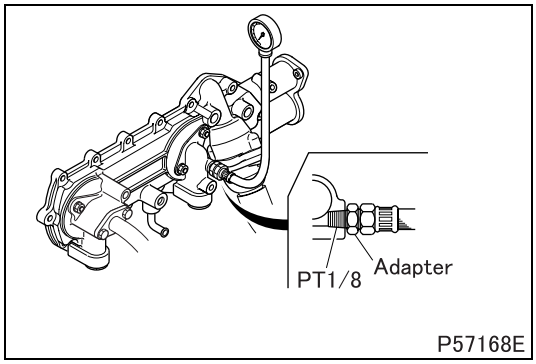
Mark	Parts to be tightened	Tightening torque	Remarks
–	Engine oil pressure switch	7.8 to 14.7 {5.8 to 11, 0.8 to 1.5}	Sealant With cold engine

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Engine oil pressure switch threads	ThreeBond 1215	As required


P57167

- Remove the engine oil pressure switch.



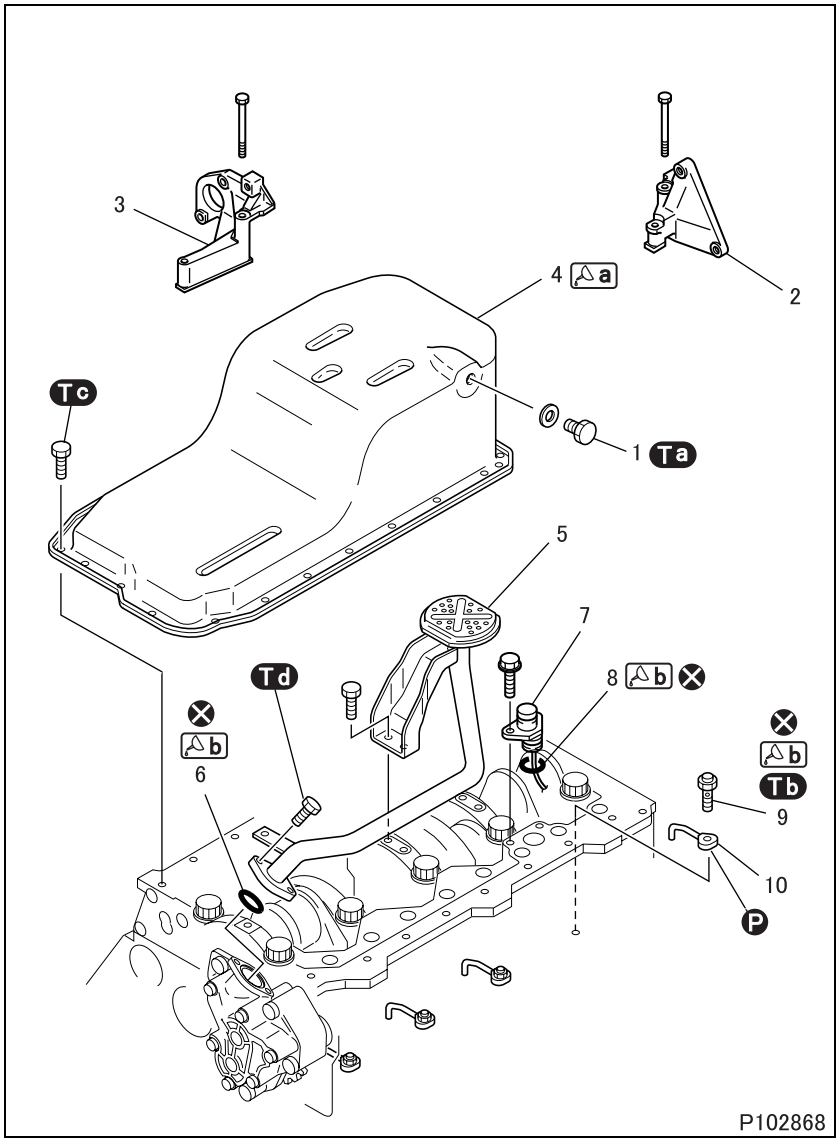
P57168E

- Using an adapter, connect an oil pressure gauge to the engine oil pressure switch mounting hole.
- Warm up the engine until the oil temperature reaches 70 to 90°C {158 to 195°F}.
- Measure the oil pressure while running the engine at a minimum speed and then at maximum speed, both under no load.
- If the measurements are below the specified limits, overhaul the lubrication system.
- After taking the measurements, apply sealant to the threads of the oil pressure switch and tighten the switch to the specified torque.

CAUTION ⚠

- **Reinstall the oil pressure switch only when the engine is cold.**

OIL PAN, OIL STRAINER AND OIL JETS



● Disassembly sequence

1 Drain plug
2 Stiffner RH
3 Stiffner LH
4 Oil pan
5 Oil strainer
6 O-ring
7 Engine oil level sensor
8 O-ring
9 Check valve
10 Oil jet

Ⓟ: Locating pin
⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **Make sure to tighten the check valve only to the specified torque. Overtightening it can cause defective operation, resulting in engine seizure.**

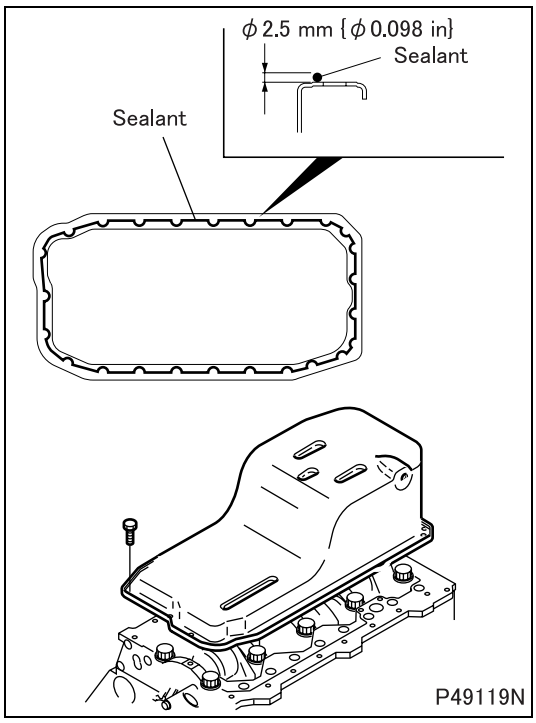
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	34.3 to 43.1 {25 to 32, 3.5 to 4.4}	–
Tb	Check valve	29.4 {22, 3.0}	Wet
Tc	Bolt (oil pan mounting)	23.5 {17, 2.4}	–
Td	Bolt (oil strainer mounting)	23.2 {17, 2.4}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Crankcase mounting surface of oil pan	ThreeBond 1207C	As required
b	O-ring	Engine oil	As required
	Check valve threads		

◆Installation procedure◆



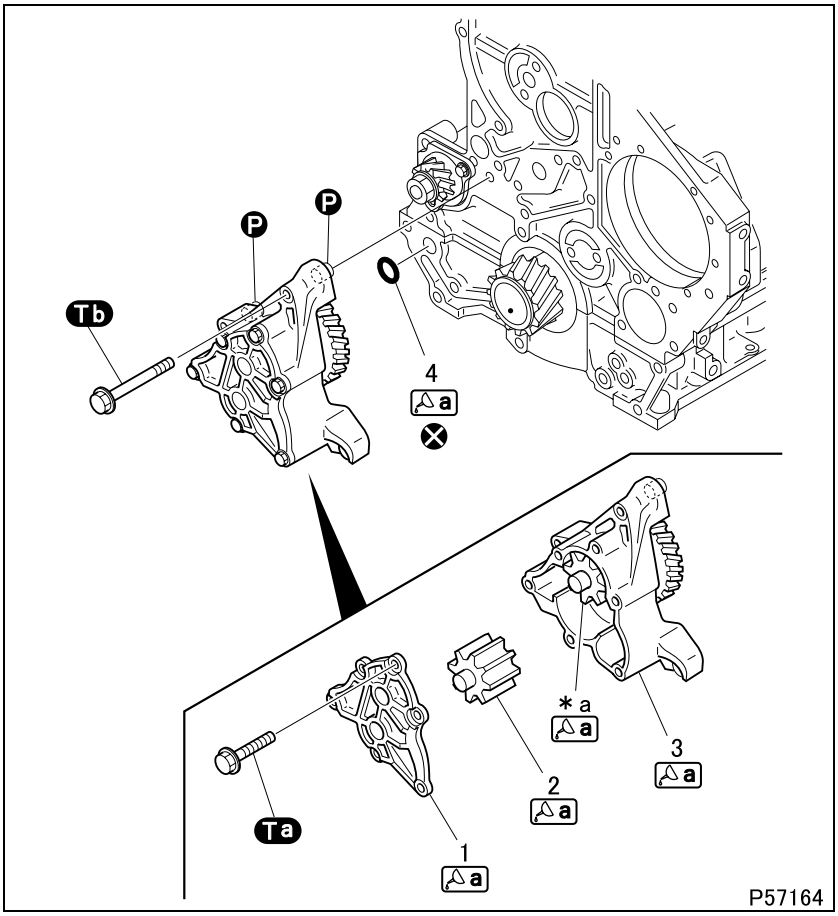
■ Installation: Oil pan

- Clean the mating surfaces of each part.
- Apply a bead of sealant to the mating surface of the oil pan evenly and without any breaks as shown in the illustration.
- Mount the oil pan within three minutes of applying the sealant. Make sure that the sealant stays in place.

CAUTION ⚠

- **Do not start the engine less than an hour after installation.**
- **If the oil pan mounting bolts were loosened or removed, be sure to reapply sealant.**

OIL PUMP



●Disassembly sequence

1 Oil pump
2 Oil pump cover
3 Driven gear
4 Gear and case assembly
5 O-ring

✱a: Drive gear
Ⓟ: Locating pin
⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly procedure in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
1, 2	Oil pump cover-to-driven gear shaft clearance	0.04 to 0.075 {0.0016 to 0.0030}	0.15 {0.0059}	Replace
1, ✱a	Oil pump cover-to-drive gear shaft clearance	0.04 to 0.075 {0.0016 to 0.0030}	0.15 {0.0059}	Replace
2, 3	Gear and case assembly-to-driven gear shaft clearance	0.04 to 0.075 {0.0016 to 0.0030}	0.15 {0.0059}	Replace
2, 3, ✱a	Sinkage of each gear from gear and case assembly end surface	0.05 to 0.11 {0.0020 to 0.0043}	0.15 {0.0059}	Replace
	Gear and case assembly-to-tooth tip clearance for each gear	0.13 to 0.22 {0.0051 to 0.0087}	0.23 {0.0091}	Replace

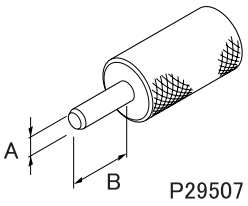
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (oil pump cover mounting)	27.4 {20, 2.8}	–
Tb	Bolt (oil pump mounting)	28 {21, 2.9}	–

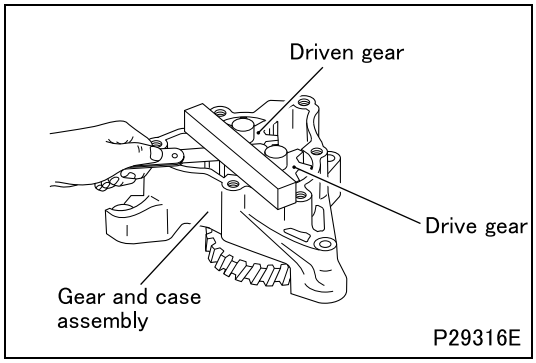
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Oil pump contact surfaces	Engine oil	As required
	O-ring		

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
Ca	Pump cover pin A: $\phi 7\ ^{0}_{-0.14}$ {$\phi 0.28\ ^{0}_{-0.0055}$} B: 20 {0.79}  P29507	MH063431	Installation of oil pump cover

◆Inspection procedure◆

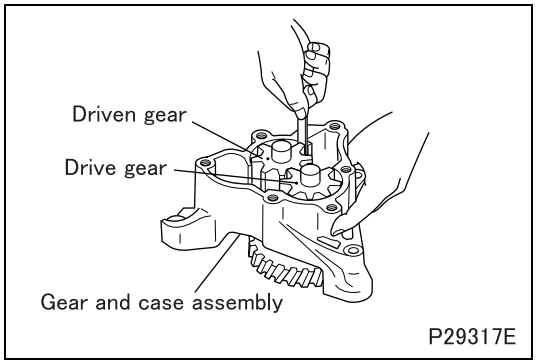


P29316E

■Inspection: Driven gear, drive gear and gear and case assembly

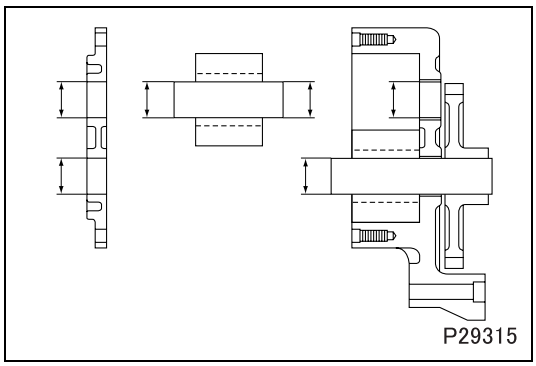
- Carry out the following inspection. Replace the oil pump if any defects are found.

(1) Sinkage of each gear from gear and case assembly end surface



P29317E

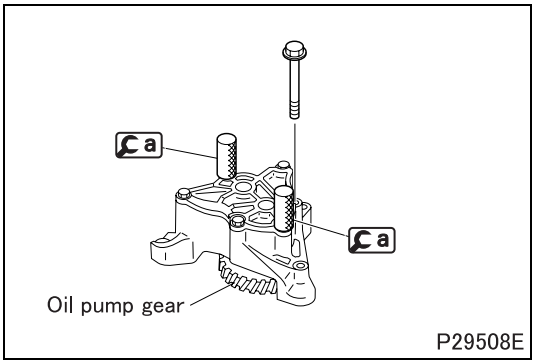
(2) Gear and case assembly-to-tooth tip clearance for each gear


P29315

■Inspection: Oil pump cover, driven gear, and gear and case assembly

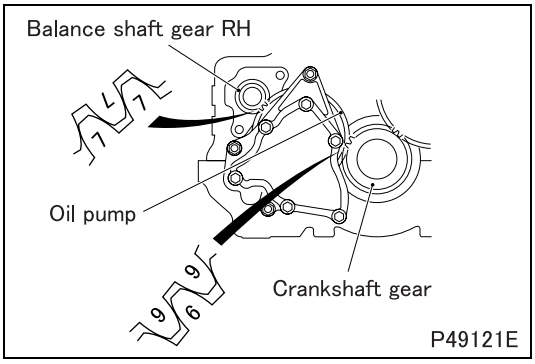
- Measure the clearance between each gear's shaft and the oil pump cover, as well as between each gear's shaft and the gear and case assembly.
- If the measurements are not within the standard value range, replace the oil pump.

◆Installation procedure◆



■ Installation: Oil pump cover and gear and case assembly

- Apply engine oil to each component.
- Hold the oil pump cover in place on the gear and case assembly by fitting two a s in the illustrated locations.
- Install a bolt into an empty bolt hole and tighten it to the specified torque.
- Remove the two a s. Install the rest of the bolts and tighten them to the specified torque.
- After installing all the bolts, turn the oil pump gear by hand and check that it rotates smoothly.
- Disassemble and reassemble the oil pump cover and gear and case assembly if the oil pump gear does not rotate smoothly.

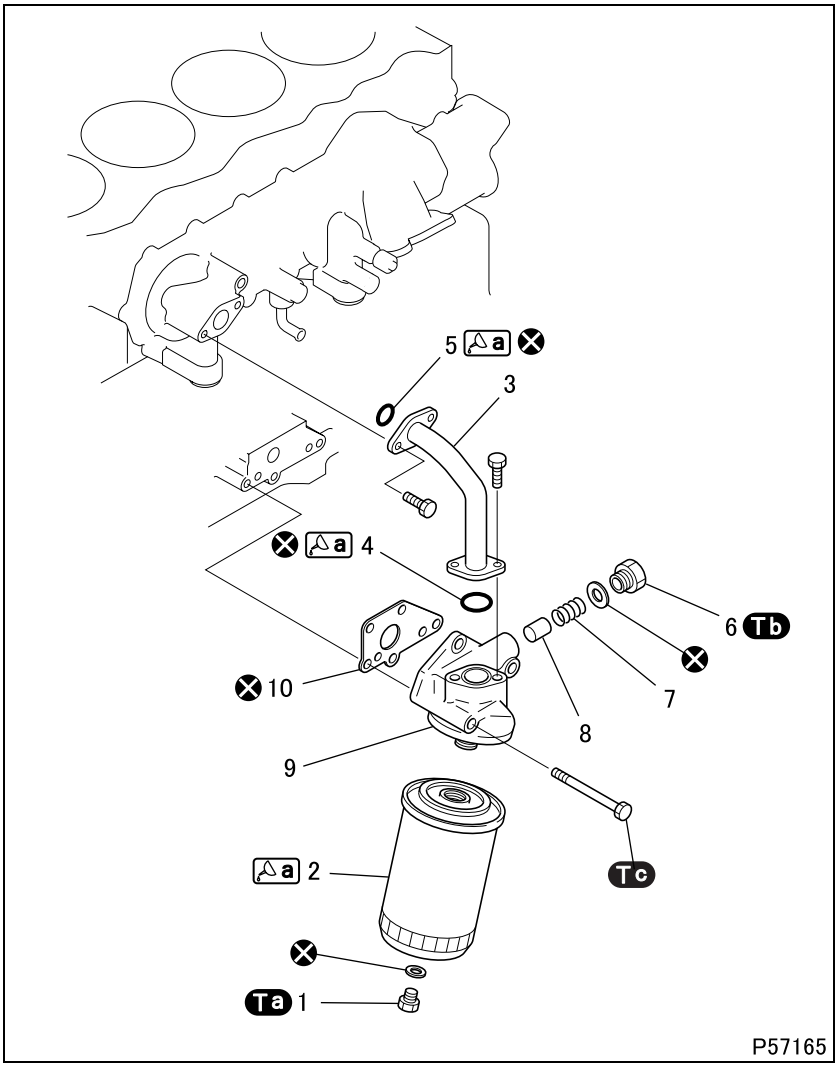


■ Installation: Oil pump

- Place the No.1 cylinder piston at top dead center to bring the crankshaft gear to an appropriate position.
- Inject approximately 5 cm^3 {0.3 cu. in.} of engine oil.
- Align the mating mark "**6**" on the crankshaft gear and the mating mark "**7**" on the balance shaft gear RH with the corresponding mating marks on the oil pump gear, and then install the oil pump gear.

M E M O

OIL FILTER



● Disassembly sequence

1 Drain plug
2 Oil filter
3 Oil pipe
4 O-ring
5 O-ring
6 Plug
7 Regulator valve spring
8 Regulator valve
9 Oil filter head
10 Gasket

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

- **Wipe up any spilled engine oil, as it can cause fires.**

CAUTION ⚠

- **Make sure not to put any engine oil on the V-belt when working on the oil cooler and oil filter. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.**
- **Make sure to install the gasket in the correct position so that it does not cover up the oil hole.**

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
7	Load of installed regulator valve spring (installed length: $39^{+0.3}_{0}$ {$1.54^{+0.012}_{0}$})	93.5 ± 0.5 N {21 ± 0.1 lbs, 9.5 ± 0.05 kgf}	–	Replace

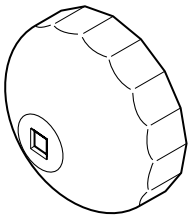
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	9.8 ± 1.96 {7.2 ± 1.4, 1.0 ± 0.2}	–
Tb	Plug (regulator valve mounting)	60 {44, 6.0}	–

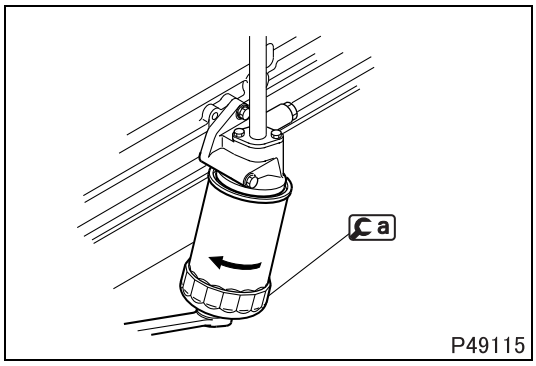
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Oil filter gasket	Engine oil	As required
	O-ring		

Special tools

Mark	Tool name and shape	Part No.	Application
a	Oil filter element socket  P08550	MH061566	Removal of oil filter

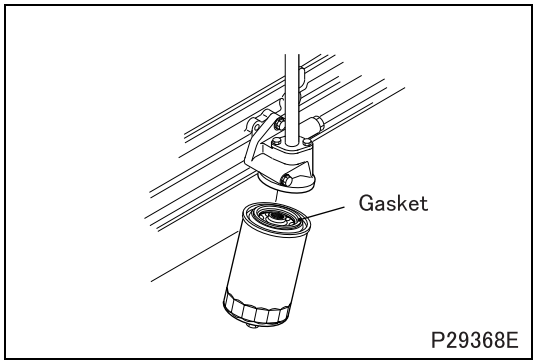
◆Removal procedure◆



P49115

■ **Removal: Oil filter**

◆Installation procedure◆

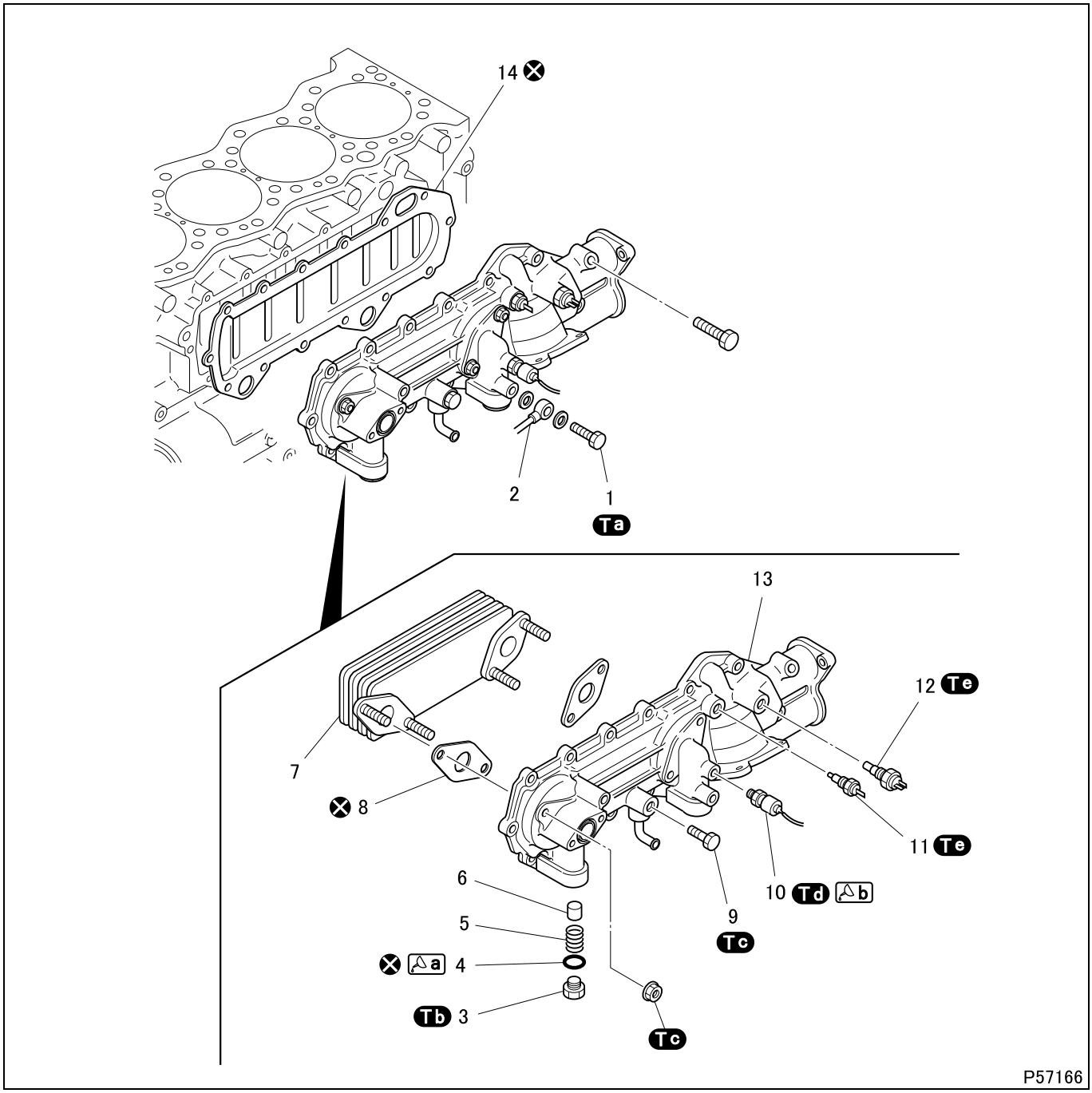


P29368E

■ **Installation: Oil filter**

- Clean the oil filter mounting surface of the oil filter head.
- Apply a thin coat of engine oil on the oil filter gasket.
- Screw in the oil filter by hand until the gasket touches the oil filter head. Then, tighten the filter by turning further by three quarters (3/4) of a turn.
- After installing the oil filter, start the engine and check that there are no oil leaks from the gasket.
- Remove and reinstall the oil filter if it is leaky.
- Stop the engine and check the engine oil level.
- Add engine oil if necessary.

OIL COOLER



● **Disassembly sequence**

1 Eyebolt
2 Oil pipe
3 Plug
4 O-ring
5 Bypass valve spring
6 Bypass valve
7 Oil cooler element
8 Gasket
9 Water drain valve
10 Engine oil pressure switch
11 Coolant temperature sensor (for water temperature gage)
12 Coolant temperature sensor (for engine control)
13 Oil cooler body
14 Gasket

⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
5	Load of bypass valve spring (installed length: $48^{0}_{-0.5}$ {$1.89^{0}_{-0.02}$})	95.3 ± 4.9 N {21 ± 1.1 lbs, 9.7 ± 0.5 kgf}	–	Replace
7	Air leakage from oil cooler element (air pressure: 980 kPa {140 psi, 10 kgf/cm^2} for 15 seconds)	0 cm^3 {0 cu. in.}	–	Replace

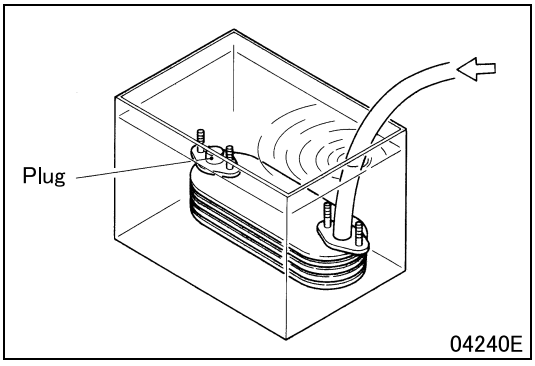
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eyebolt (oil pipe mounting)	21.6 {16, 2.2}	–
Tb	Plug	30 ± 5 {22 ± 3.7, 3.1 ± 0.5}	–
Tc	Nut (oil cooler element mounting)	25 ± 5 {1.8 ± 3.7, 2.5 ± 0.5}	–
	Water drain valve		
Td	Engine oil pressure switch	12 {8.9, 1.2}	Sealant With cold engine
Te	Coolant temperature sensor (for water temperature gage)	34.3 {25, 3.5}	–
Tf	Coolant temperature sensor (for engine control)	39{29, 4}	

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required
b	Engine oil pressure switch threads	ThreeBond 1215	As required

◆Inspection procedure◆



■ Inspection: Oil cooler element

- Plug the outlet of the oil cooler element and connect a hose to the engine oil inlet port. Then, immerse the oil cooler element in a tank of water.
- Apply an air pressure of 980 kPa {140 psi, 10 kgf/cm^2} for 15 seconds through the hose, and check for any air leaks.
- Replace the element if it leaks air.

INDEX

SPECIFICATIONS 13A-2

STRUCTURE AND OPERATION
1. **Fuel System (Flow of Fuel) 13A-3**
2. **Engine Control 13A-4**
3. **Fuel Filter 13A-5**

TROUBLESHOOTING 13A-6

ON-VEHICLE INSPECTION AND ADJUSTMENT
1. **Inspecting and Adjusting No-load Minimum and Maximum Speeds 13A-8**
2. **Air-bleeding of Fuel System 13A-9**
3. **Fuel Filter Replacement 13A-10**

FUEL TANK
- **<OUT SIDE FRAME TYPE> 13A-12**
- **<IN SIDE FRAME TYPE> 13A-14**

FUEL FILTER 13A-16

ENGINE CONTROL 13A-18

COMMON RAIL 13A-22

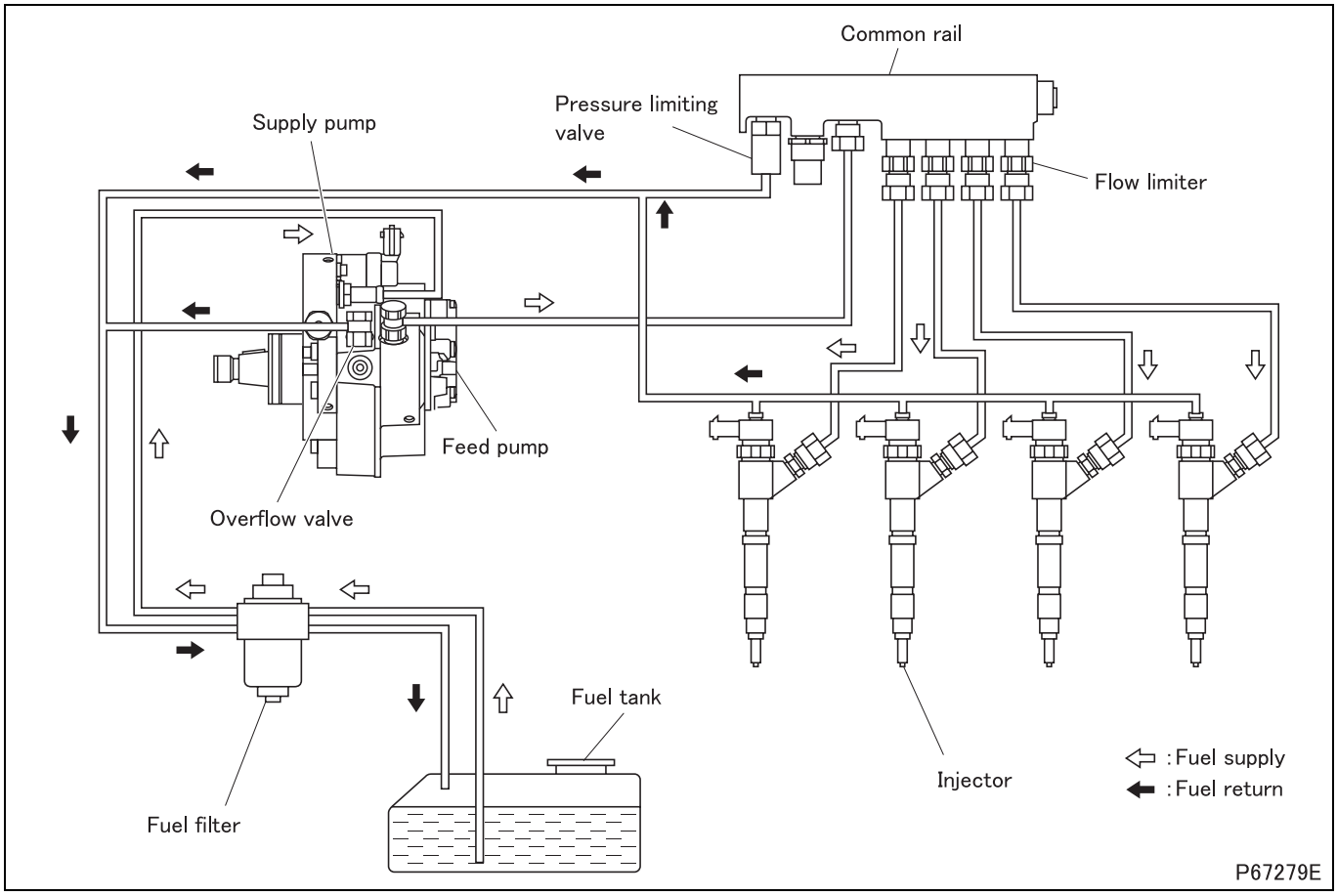
SUPPLY PUMP 13A-26

INJECTOR 13A-30

SPECIFICATIONS

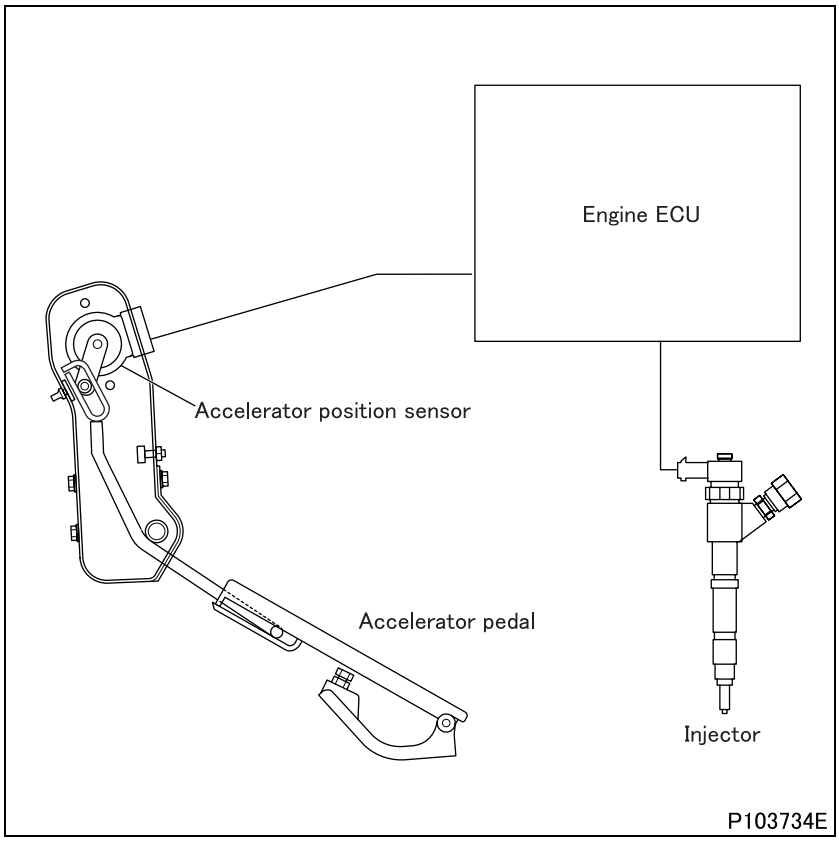
Item			Specifications
Supply pump	Manufacturer		Bosch
	Model		CP3.3 NH
	Control method		Electronic
	Type		Radial, 3-cylinder
	Type		External gear type
	Injection quantity adjustment valve	Model	MPROP
		Rated voltage V	12
	Max. common rail pressure MPa {psi, kgf/cm^2}		180 {26100, 1840}
Common rail	Manufacturer		Bosch
	Common rail volume cm^3 {cu.in., ml}		18.7{1.14, 18.7}
	Pressure limiting valve opening pressure MPa {psi, kgf/cm^2}		210to 220 {30450 to 31900, 2140 to 2240}
	Common rail pressure sensor supply voltage V		5
Injectors	Manufacturer		Bosch
	Control method		Electrical
	Max. operating pressure MPa {psi, kgf/cm^2}		180 {26100, 1840}
	Min. operating pressure MPa {psi, kgf/cm^2}		25 {3630, 255}
Common rail electronic control unit	Manufacturer		Bosch
	Rated voltage V		12

1. Fuel System (Flow of Fuel)



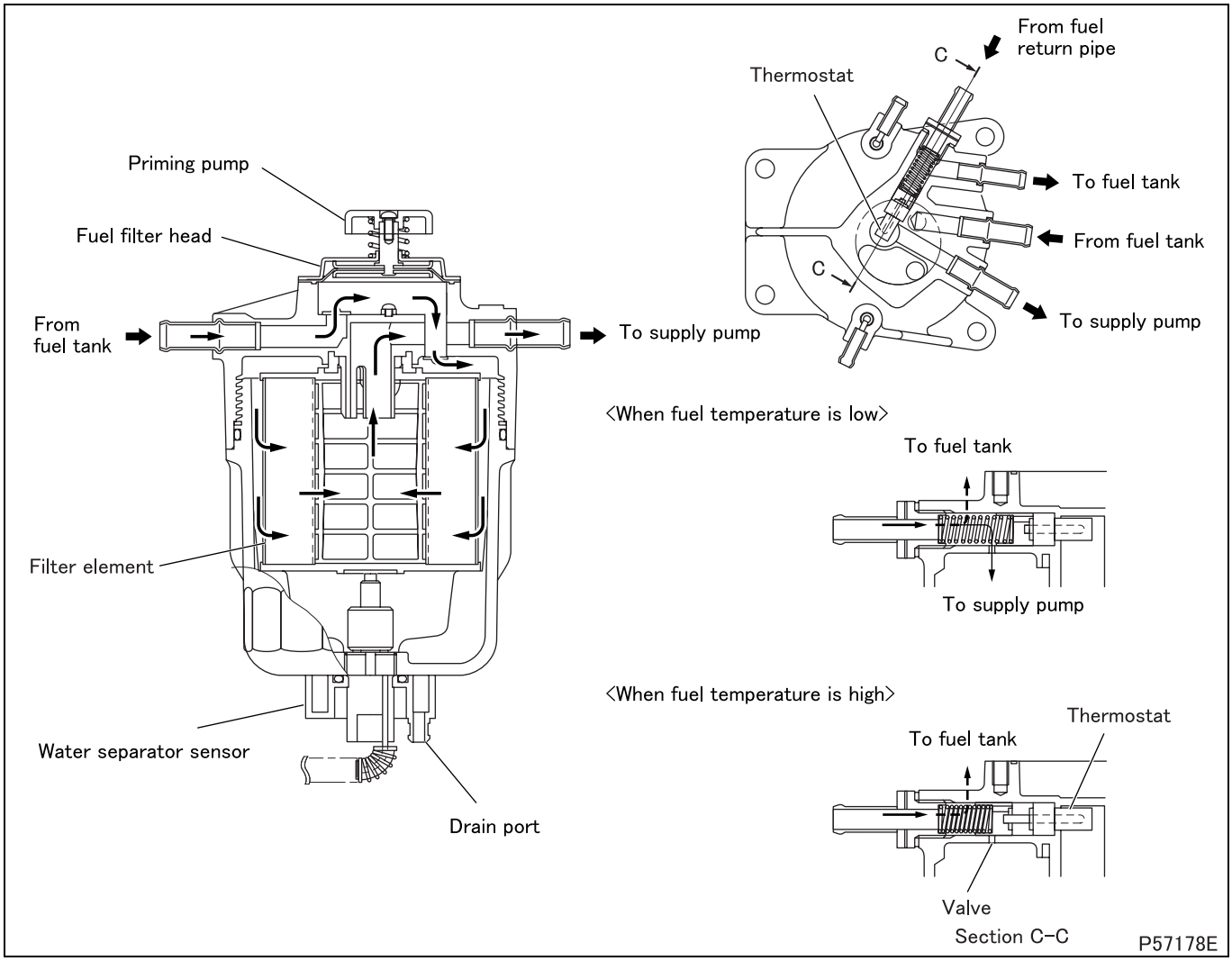
- The feed pump, which is driven by the camshaft inside the supply pump, draws up the fuel from inside the fuel tank and sends it through the fuel filter, where dust and other impurities in the fuel are filtered out.
- The filtered fuel is then sent to the supply pump, where it is compressed. The compressed fuel is accumulated in the common rail for a time, then sprayed out through the injection nozzles into the combustion chamber.
- If fuel leaks from an injection pipe at the pipe joint, the flow limiter is activated to close the fuel passage, preventing the fuel from flowing elsewhere.
- The excess fuel from the injectors returns to the fuel tank through the fuel return hose.
- When the internal fuel pressure of the Common Rail exceeds the limit, the pressure limiting valve opens to allow part of the fuel to return to the fuel tank.
- When the internal fuel pressure of the supply pump exceeds the limit, the overflow valve opens to allow part of the fuel to return to the fuel tank.

2. Engine Control



- The engine is electronically controlled by the engine electronic control unit (ECU).
- The accelerator position sensor detects how much the accelerator pedal is pressed and sends the corresponding electronic signal to the engine electronic control unit, which calculates an appropriate amount of fuel based on the signals and controls fuel injection accordingly.

3. Fuel Filter



- The fuel filter removes impurities in the fuel through the filter element and also separates water from fuel.
- The water that has been separated from the fuel collects at the bottom of the fuel filter. A water separator sensor is installed in the fuel filter, which activates the warning lamp on the meter cluster when the water reaches a certain level.
- The water can be drained through the drain port by loosening the water separator sensor.
- A priming pump is provided at the fuel filter head. The priming pump is used for air-bleeding the fuel system.
- When the fuel temperature rises, the thermostat swells and the valve of the fuel filter head is closed. The high-temperature fuel entirely returns to the fuel tank through the fuel return pipe.
- When the fuel temperature lowers, the thermostat does not swell and the valve to the fuel filter remains open. The high-temperature fuel returning through the fuel return pipe is let through the valve to mix into the fuel around the element. The fuel around the element is warmed as a result and wax in it (precipitated when the fuel temperature is low) is dissolved to prevent clogging of the element.

Possible causes \ Symptoms		Engine refuses to start	Engine is difficult to start	Engine knocks	Engine output is unstable	Engine output is insufficient	Engine maximum speed is too high	Engine is idling unstably	Engine stops soon after starting	Engine does not reach maximum speed	Engine does not stop	Accelerator pedal is too stiff	Fuel supply is insufficient	warning lamp illuminates	Reference Gr
Faulty electronic fuel control system														O	Gr13E
Supply pump	Malfunctioning feed pump check valve		O			O			O		O				*
	Defective feed pump		O			O			O		O				*
	Poorly airtight supply pump overflow valve		O			O			O		O				*
	Open or short circuit failure, poor contact of supply pump M/V		O			O			O		O			O	*
	Defective supply pump M/V, defective supply pump		O			O			O		O				*
Injectors	Open or short circuit failure, poor contact of injector M/V		O	O		O					O			O	*
	Defective injector, defective injector M/V, defective nozzle		O	O		O					O				*
Clogged fuel filter		O			O			O	O						
No fuel in fuel tank		O													
Clogged fuel pipe and/or leaky pipe joints		O													
Air or water in fuel system		O			O			O	O						
Use of low quality fuel			O	O		O		O							
Open or short circuit failure, poor contact of common rail pressure sensor, defective sensor		O	O		O	O			O					O	*
Flow limiter activated				O		O								O	*
Fuel leakage from high pressure pipe joint			O	O	O	O					O				*
Engine control	Poorly adjusted accelerator pedal stopper bolt					O				O					
	Defective accelerator pedal position sensor													O	
Cracked fuel pipe and/or hose													O		

*****: Contact a Bosch service station for repair.

Symptoms / Possible causes	Engine refuses to start	Engine is difficult to start	Engine knocks	Engine output is unstable	Engine output is insufficient	Engine maximum speed is too high	Engine is idling unstably	Engine stops soon after starting	Engine does not reach maximum speed	Engine does not stop	Accelerator pedal is too stiff	Fuel supply is insufficient	warning lamp illuminates	Reference Gr
Inappropriate oil viscosity		O					O							Gr12
Poorly adjusted valve clearance		O					O							Gr11
Defective cylinder head gasket		O					O							
Wear of and/or carbon deposits on valve and valve seat		O					O							
Distorted valve springs		O					O							
Worn or damaged piston rings		O					O							
Worn or damaged piston ring groove		O												
Worn piston and/or cylinder liner		O					O							
Poorly functioning cooling system		O					O							Gr14
Defective starter switch	O	O												Gr54
Defective glow plug		O												
Open-circuited, short-circuited or poorly connected engine speed sensor and/or cylinder sensor	O	O											O	Gr13E
Open-circuited, short-circuited or poorly connected boost pressure sensor			O	O	O				O				O	
Open-circuited, short-circuited or poorly connected coolant temperature sensor	O	O											O	
Poorly connected injection rate adjusting resistor			O		O								O	
Poorly connected idling adjustment control			O				O						O	
Blown fuse	O	O						O					O	Gr54

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspecting and Adjusting No-load Minimum and Maximum Speeds

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	No-load minimum speed (idling speed)	650 ± 25 rpm	–	Adjust
–	No-load maximum speed	3,100 ± 50 rpm	–	Adjust

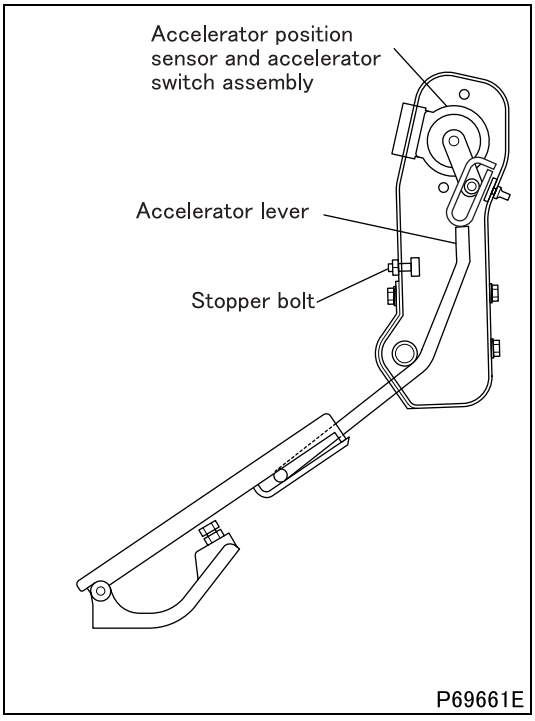
[Work before inspection and adjustment]

- Before starting the inspection and adjustment, carry out the following preparatory steps:
- Warm up the engine until the engine coolant temperature is approximately 80 to 95°C {176 to 203°F};
- turn off all lamps and accessories;
- put the transmission in neutral (P-range for automatic transmission);
- set the steering wheel at the straight-ahead position; and
- attach the probe of the tachometer to an infector.

[Inspection and adjustment]

(1) No-load minimum speed

- Without pressing the accelerator pedal, measure the engine speed.
- If the speed is not within the standard value range, inspect the accelerator position sensor and accelerator switch assembly. (See Gr13EA)
- If no defects are evident during the above inspection, check for any diagnosis codes related with the fuel system and inspect the supply pump and engine electronic control unit. (See Gr13EA)



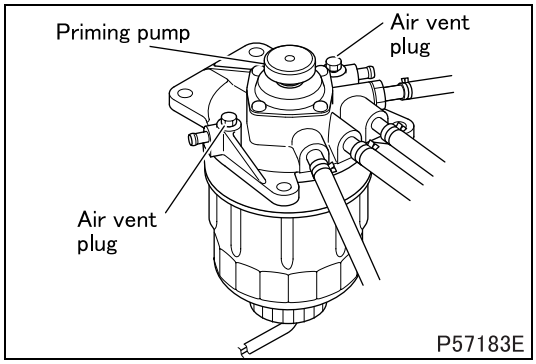
(2) No-load maximum speed

- Press the accelerator pedal as far as it will go.
- With the accelerator lever touching the stopper bolt, measure the engine speed.
- If the speed is not within the standard value range, inspect the accelerator position sensor and accelerator switch assembly. (See Gr13EA)
- If no defects are evident during the above inspection, check for any diagnosis codes related with the fuel system and inspect the supply pump and engine electronic control unit. (See Gr13EA)

2. Air-bleeding of Fuel System

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Air vent plug	10 ± 2 {7.4 ± 1.5, 1 ± 0.2}	–



- Loosen one of the air vent plugs on the fuel filter.
- Move the priming pump up and down to pump out the fuel.
- Continue operating the priming pump until the fuel flowing out of the air vent plug is free of air bubbles.
- When no more air bubbles are evident, tighten the air vent plug to the specified torque.
- Feed the fuel some more by operating the priming pump further until a strong resistance is felt.

NOTE

- **When the fuel temperature is low, you may not feel the resistance. Be sure to operate the priming pump several times even in such a case.**

- Wipe up any spilled fuel and start the engine.
- Check that there is no fuel leakage.

WARNING ⚠

- **Fuel is highly flammable. Keep it away from flames and sources of heat.**
- **To avoid risk of fire, wipe up any spilled fuel.**

3. Fuel Filter Replacement

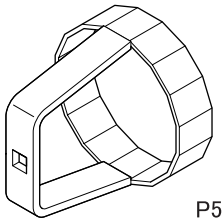
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

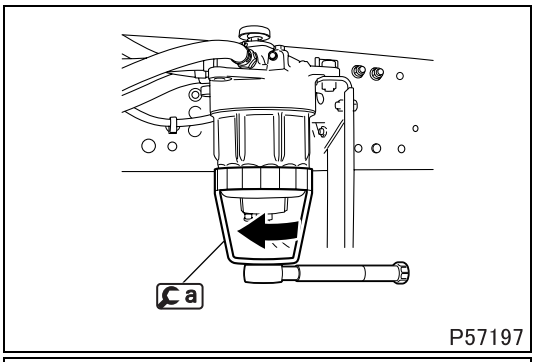
Mark	Parts to be tightened	Tightening torque	Remarks
–	Water separator sensor	5 ± 1 {3.7 ± 0.7, 0.5 ± 0.1}	–
–	Case	30 ± 2 {22 ± 1.5, 3.1 ± 0.2}	–

Lubricant and/or sealant

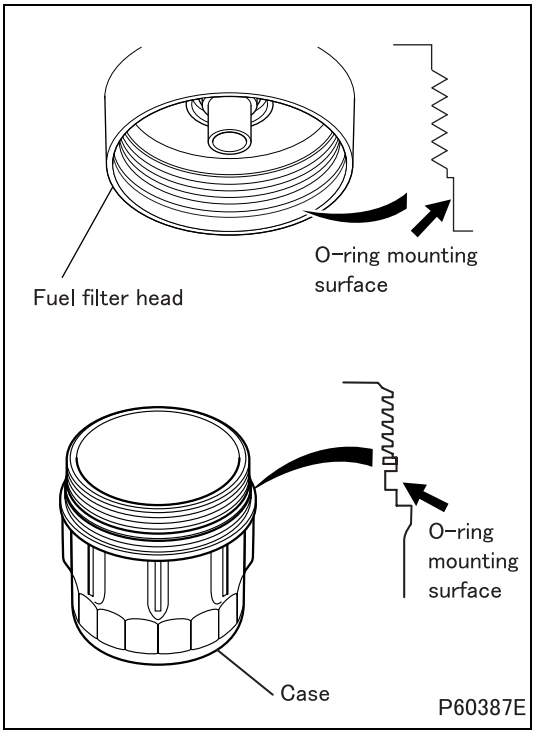
Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Fuel filter gasket	Engine oil	As required

Special tools

Mark	Tool name and shape	Part No.	Application
ⓐ	Filter wrench  P57179	MH063203	Removal and installation of case



P57197



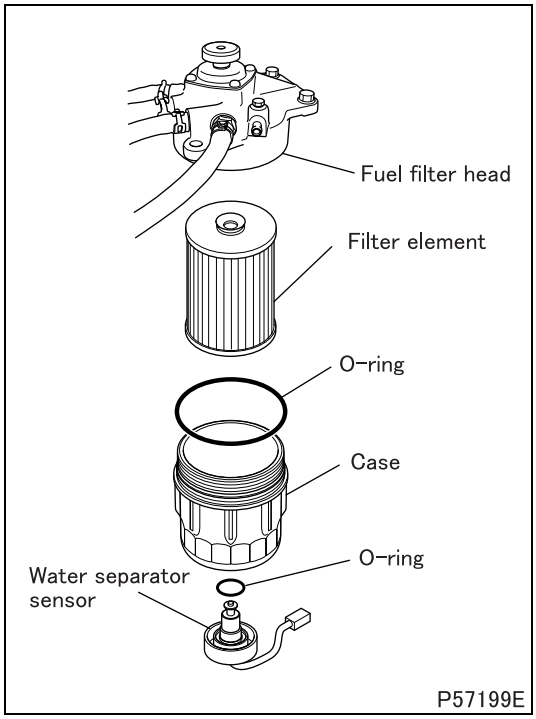
P60387E

[Removal]

- Loosen the water separator sensor and drain fuel from the case.
- Remove the case using ⓐ.

[Installation]

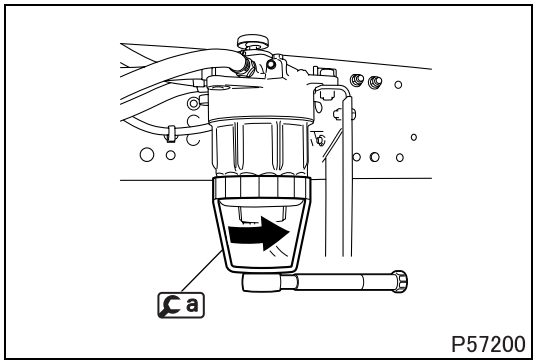
- Clean the O-ring mounting surface of the fuel filter head.



- Replace the filter element and O-ring with new one.
- Apply a thin coat of engine oil to the O-ring, and install it on the case and water separator sensor.

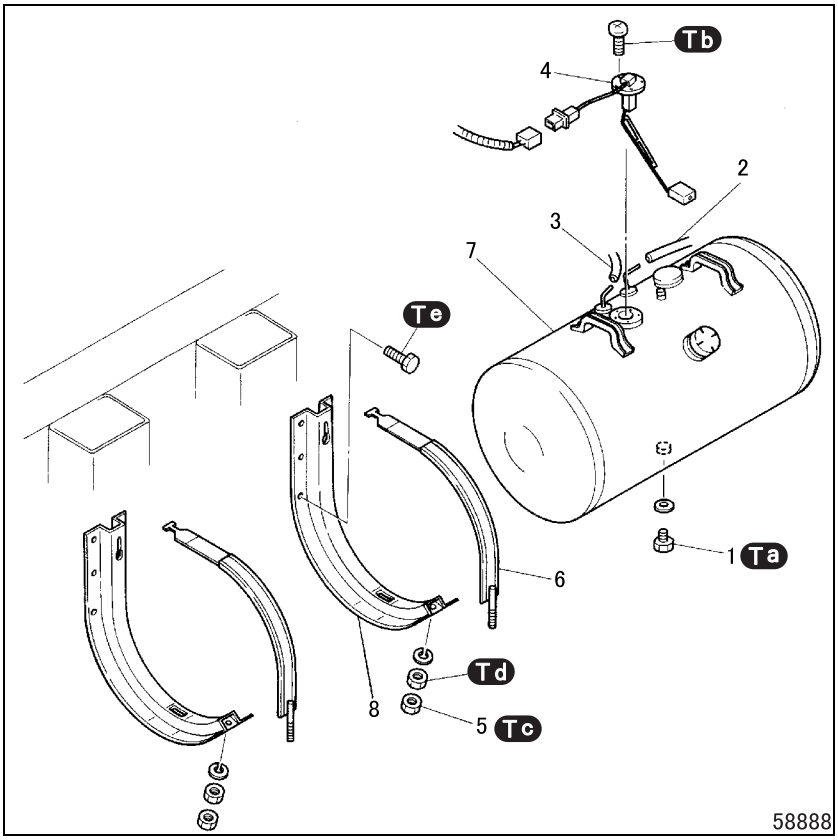
CAUTION ⚠

- **Be sure to use only genuine MITSUBISHI filter elements. The use of non-genuine fuel filters can cause engine failure.**
- **Prevent fine dust particles from entering the fuel filter and fuel pipe, as they can cause problems such as faulty fuel injection.**



- Use a to tighten the case to the specified torque.
- Install the water separator sensor, and then air-bleed the fuel system.
- Start the engine, and check that there is no fuel leakage.
- Reinstall the fuel filter if there is any leakage.

FUEL TANK <OUT SIDE FRAME TYPE>



● Removal sequence

1 Drain plug
2 Suction hose
3 Return hose
4 Fuel level sensor
5 Lock nut
6 Fuel tank band
7 Fuel tank
8 Fuel tank bracket

● Installation sequence

Follow the removal sequence in reverse.

DANGER ⚠

- **Do not allow any flames or sources of heat near the fuel tank, as it may explode.**

WARNING ⚠

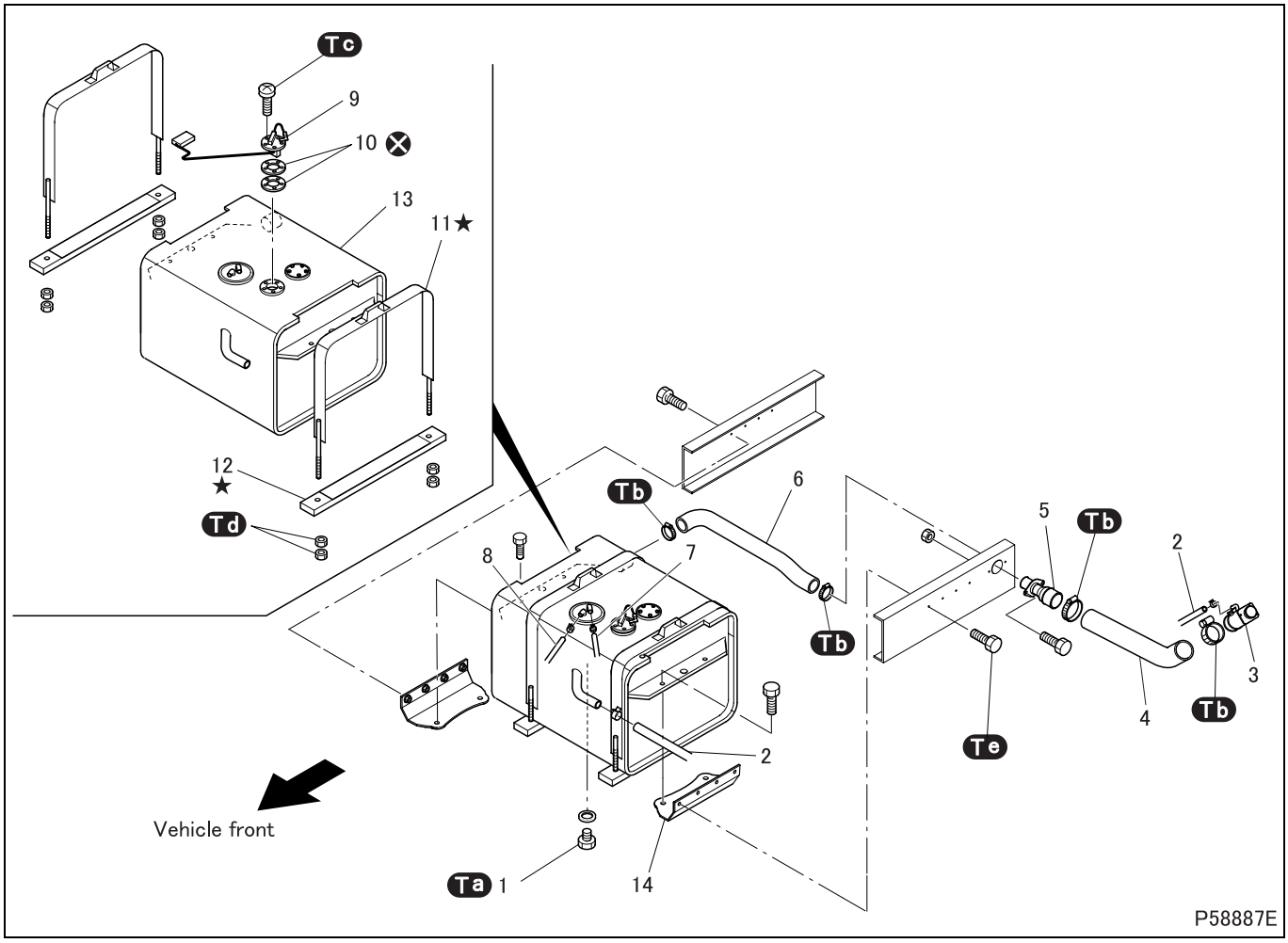
- **Fuel is highly flammable. Keep it away from flames and sources of heat.**
- **To avoid risk of fire, wipe up any spilled fuel.**

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	49 to 88.2 {36 to 65, 5.0 to 9.0}	–
Tb	Screw (fuel level sensor mounting)	0.98 to 1.47 {0.7 to 1.1, 0.10 to 0.15}	–
Tc	Lock nut (fuel tank band mounting)	9 to 28 {6.6 to 21, 0.9 to 2.8}	–
Td	Nut (fuel tank band mounting)	6 to 10 {4.4 to 7.4, 0.6 to 1.0}	–
Te	Bolt (fuel tank bracket mounting)	70 to 90 {52 to 66, 7.1 to 9.2}	–

M E M O

FUEL TANK <IN SIDE FRAME TYPE>



● **Removal sequence**

1	Drain plug	**6**	Fuel hose	★**11**	Fuel tank band
2	Air vent tube	**7**	Suction hose	★**12**	Fuel tank support
3	End filler	**8**	Return hose	**13**	Fuel tank
4	Fuel hose	**9**	Fuel lever sensor	**14**	Fuel tank bracket
5	Fuel pipe	**10**	Gasket	⊗:	Non-reusable parts

DANGER ⚠

- **Do not allow any flames or sources of heat near the fuel tank, as it may explode.**

WARNING ⚠

- **Fuel is highly flammable. Keep it away from flames and sources of heat.**
- **To avoid risk of fire, wipe up any spilled fuel.**

CAUTION ⚠

- **Install the air vent tube without deformation or slack because it causes shrilling fuel refueling.**

NOTE

- **The parts indicated with the mark ★ should never be removed, loosened or moved unless they are defective.**

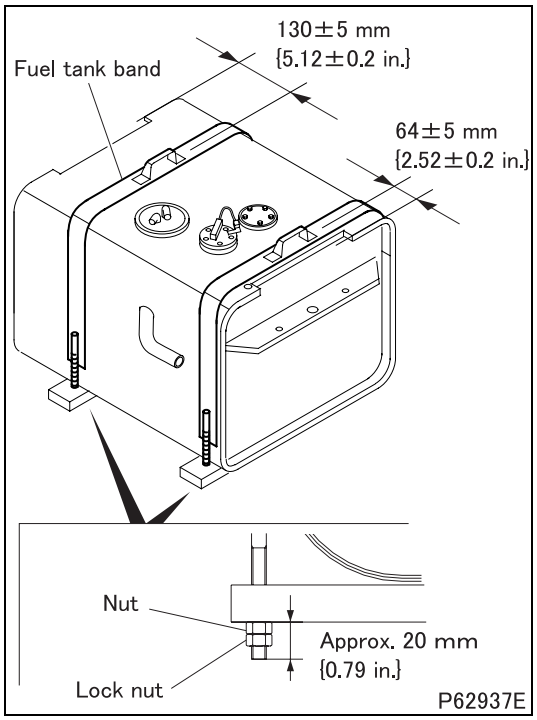
● **Installation sequence**

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	29.4 ± 4.9 {22 ± 3.6, 3.0 ± 0.5)	–
Tb	Clamp	3.9 ± 1.0 {2.9 ± 0.7, 0.4 ± 0.1)	–
Tc	Screw (fuel level sensor mounting)	0.98 to 1.47 {0.7 to 1.1, 0.10 to 0.15}	–
Td	Nut (fuel tank band mounting)	3 to 4 {2.2 to 3.0, 0.3 to 0.4}	–
Te	Bolt (fuel tank bracket mounting)	70 to 90 {52 to 66, 7.1 to 9.2}	–

◆Inspection procedure◆



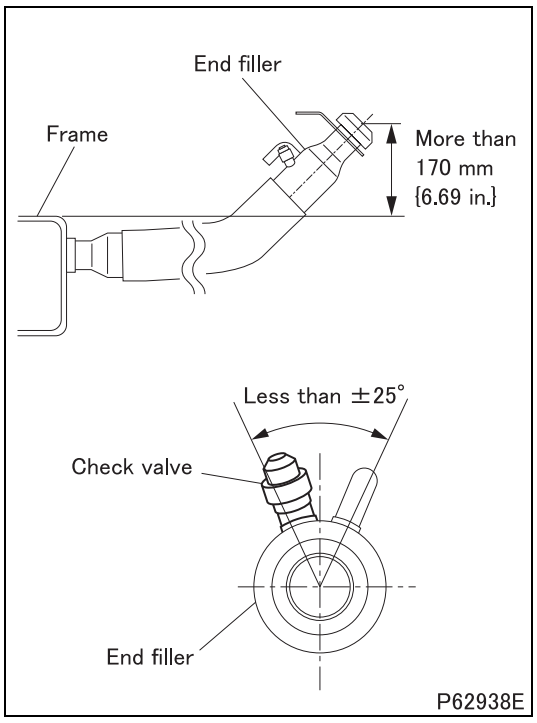
■Installation: Fuel tank band

- Install the fuel tank band so that the position of the band and the protrusion of the band thread is as illustrated.

CAUTION ⚠

- **Install the fuel tank band so that the band isn't over the protrusion of the fuel tank.**

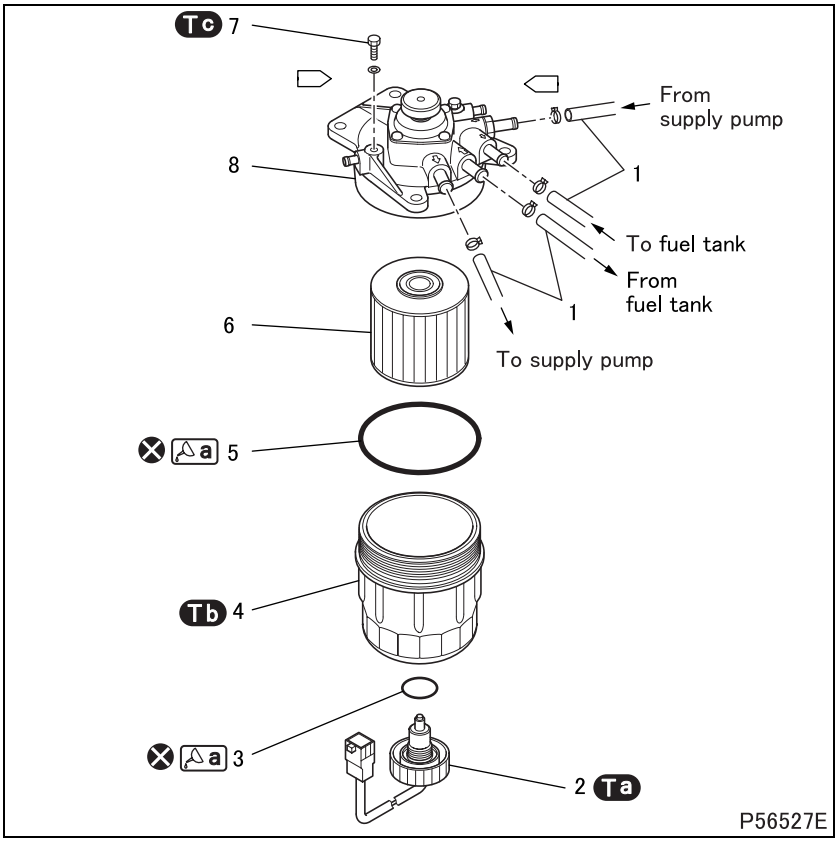
- Tighten the nuts alternately so that the fuel tank contacts the fuel support in order symmetry and evenly.
- After tightening the nuts to the specified torque, tighten the lock nut the specified torque.



■Installation: End filler

- Install the end filler so that the installing positions of the end filler mouth and the check valve are as illustrated.

FUEL FILTER



● Disassembly sequence

1 Fuel hose
2 Water separator sensor
3 O-ring
4 Case
5 O-ring
6 Filter element
7 Plug
8 Fuel filter head

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

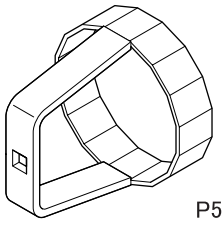
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

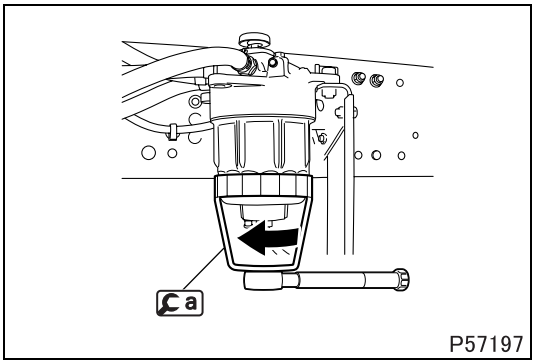
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Water separator sensor	5 ± 1 {3.7 ± 0.7, 0.5 ± 0.1}	–
Tb	Case	30 ± 2 {22 ± 1.5, 3.1 ± 0.2}	–
Tc	Plug	10 ± 2 {7.4 ± 1.5, 1 ± 0.2}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

Special tools

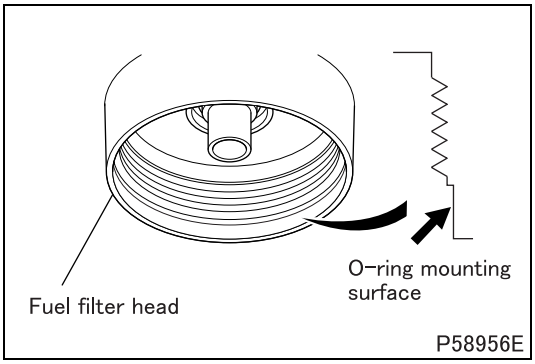
Mark	Tool name and shape	Part No.	Application
a	Filter wrench  P57179	MH063203	Removal and installation of case



■ **Removal: Case**

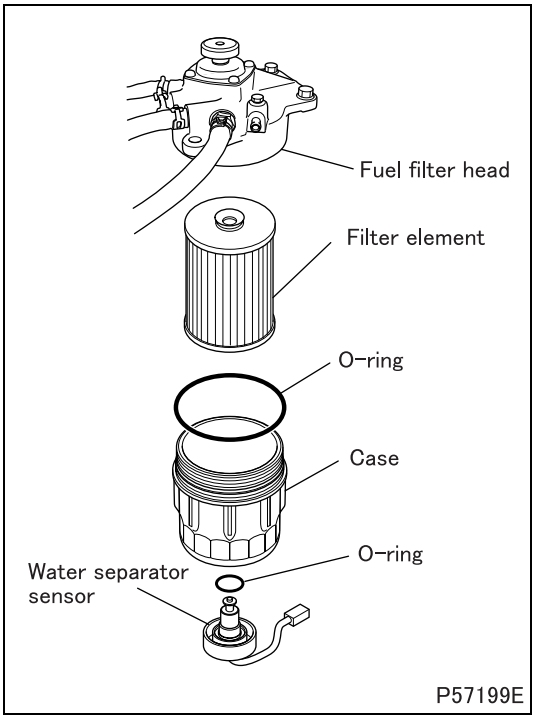
- Loosen the water separator sensor and drain fuel from the case.
- Remove the case using [a].

◆Installation procedure◆



■ **Installation: Case**

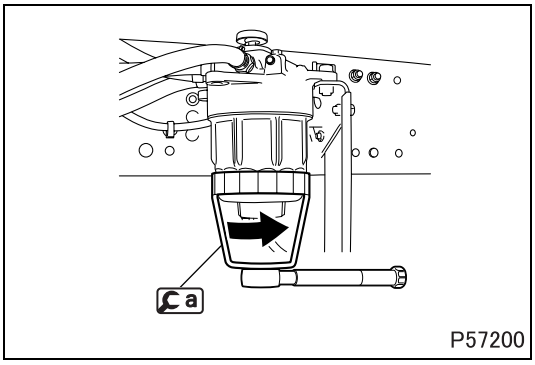
- Clean the O-ring mounting surface of the fuel filter head.



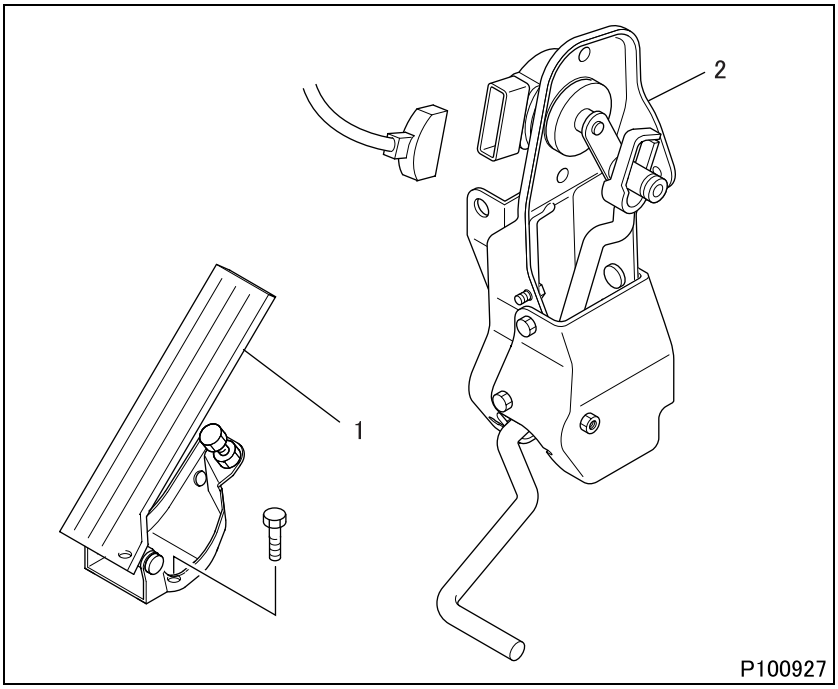
- Replace the filter element and O-ring with new one.
- Apply a thin coat of engine oil to the O-ring, and install it on the case and water separator sensor.

CAUTION ⚠

- **Be sure to use only genuine MITSUBISHI filter elements. The use of non-genuine fuel filters can cause engine failure.**
- **Prevent fine dust particles from entering the fuel filter and fuel pipe, as they can cause problems such as faulty fuel injection.**



- Use [a] to tighten the case to the specified torque.
- Install the water separator sensor, and then air-bleed the fuel system.
- Start the engine, and check that there is no fuel leakage.
- Reinstall the fuel filter if there is any leakage.



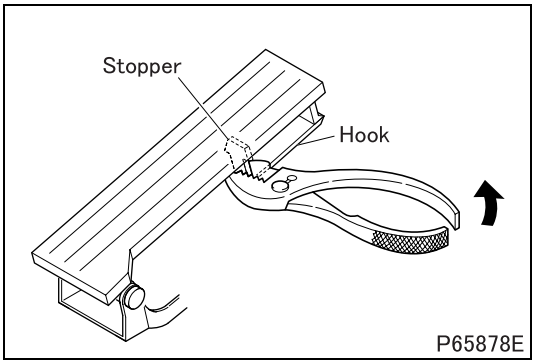
● **Removal sequence**

1. Accelerator pedal (See later sections.)
2. Accelerator link (See later sections.)

● **Installation sequence**

Follow the removal sequence in reverse.

◆Removal procedure◆



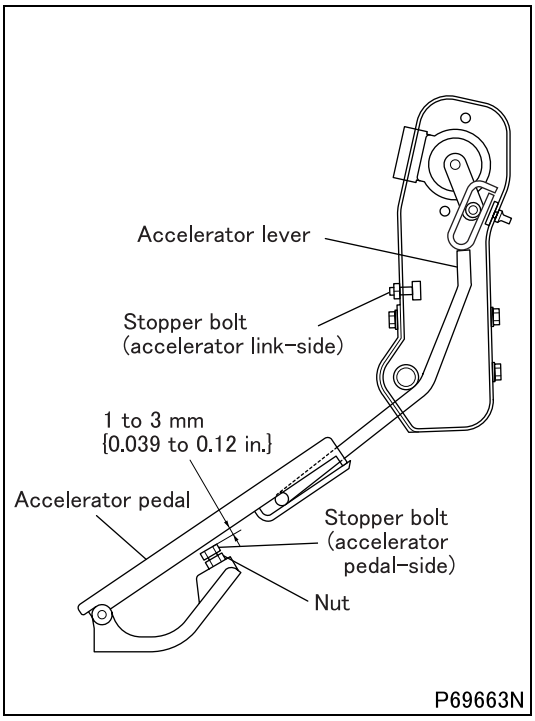
■ **Removal: Accelerator pedal**

- Using pliers, pinch the hook of the stopper on the accelerator pedal. Separate the stopper from the pedal while turning the hook by about 15 degrees.

CAUTION ⚠

- **Do not yank on the stopper, as this may damage it.**

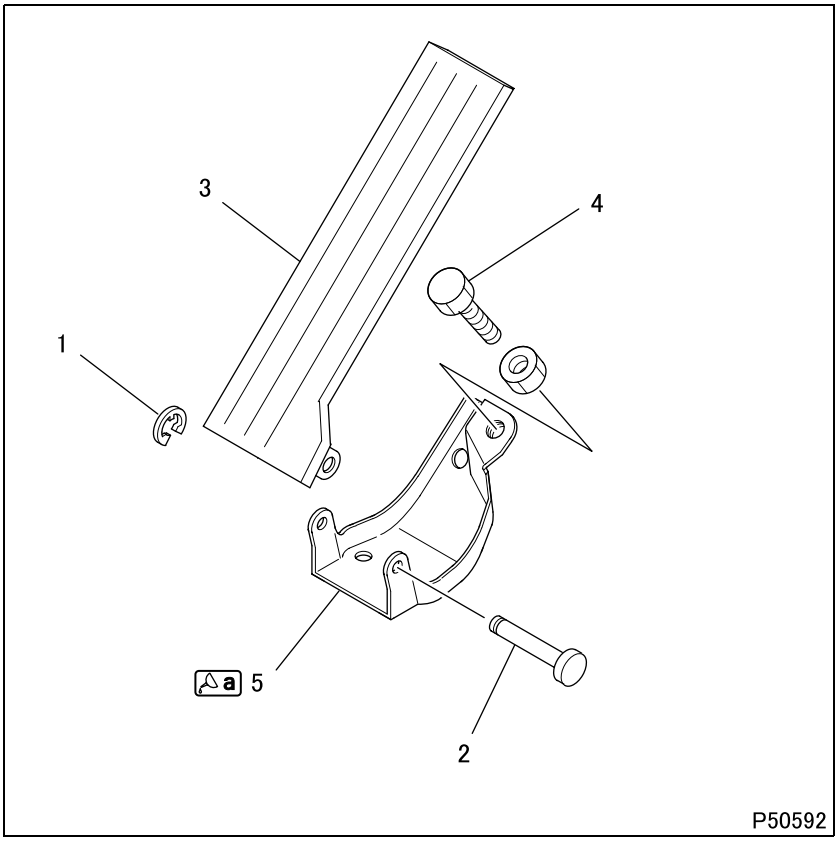
◆Installation procedure◆



■ **Installation: Accelerator pedal**

- Press the accelerator pedal until the accelerator lever touches the accelerator link stopper bolt.
- Check that the clearance between the stopper and the stopper bolt contact surface of the pedal is as indicated in the illustration.
- If the clearance is not within the indicated value range, adjust the stopper bolt and lock it with the nut.

Accelerator Pedal



● Disassembly sequence

1 E-ring
2 Clevis pin
3 Accelerator pedal
4 Stopper bolt
5 Accelerator pedal bracket

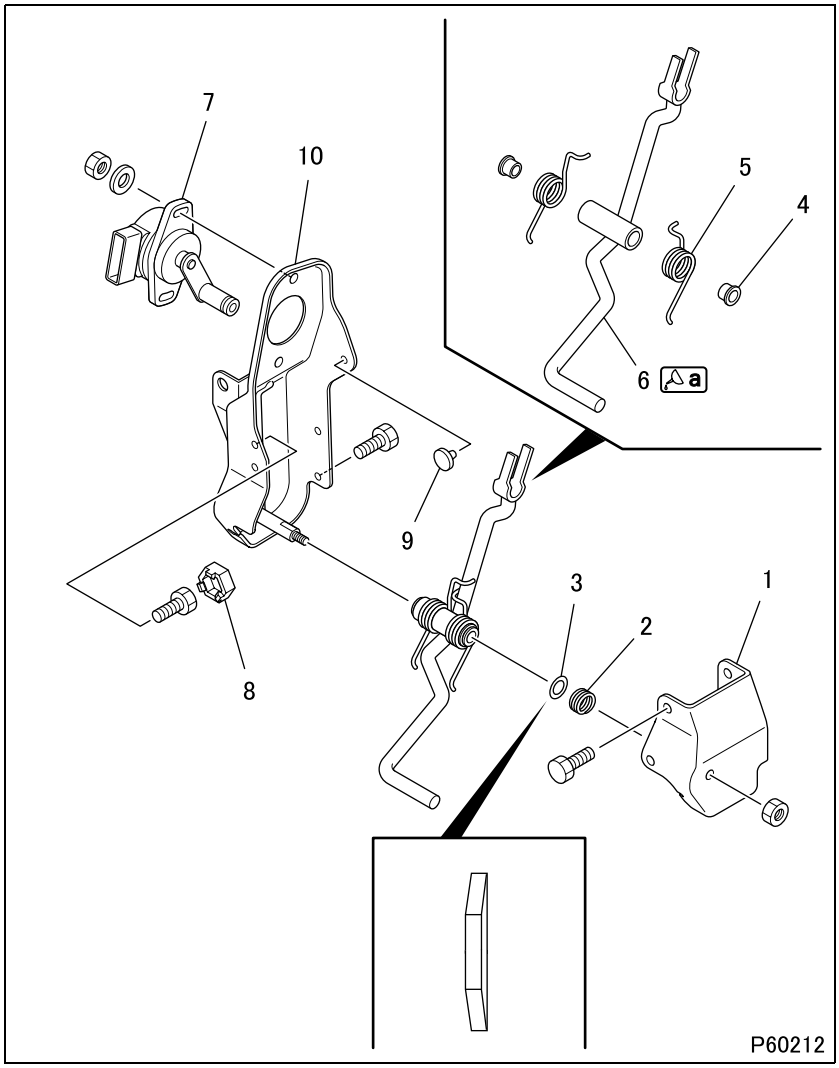
● Assembly sequence

Follow the disassembly sequence in reverse.

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Accelerator pedal and bracket contact surfaces	Chassis grease [NLGI No. 1 (Li soap)]	As required

Accelerator Linkage



● Disassembly sequence

1 Cover
2 Spring
3 Washer
4 Bushing
5 Return spring
6 Accelerator lever
7 Accelerator position sensor and accelerator switch assembly
8 Lever stopper
9 Rubber stopper
10 Accelerator link bracket

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

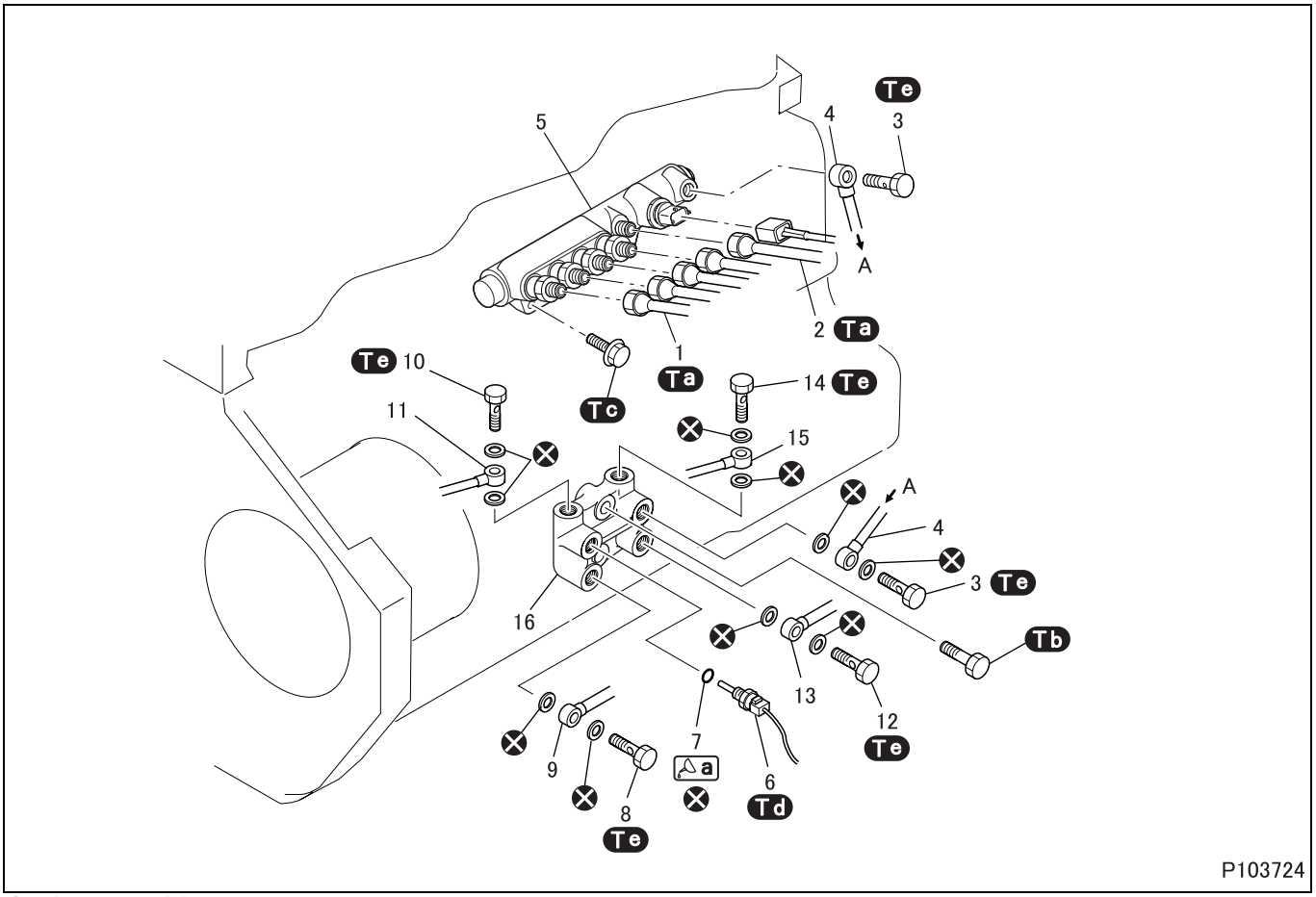
- **Inspection and adjustment of accelerator position sensor (See Gr13E).**

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Accelerator lever and return spring sliding surface	Chassis grease [NLGI No. 1 (Li soap)]	As required

M E M O

COMMON RAIL



● **Disassembly sequence**

1	Injection pipe	**7**	O-ring	**13**	Fuel return pipe A
2	Fuel pipe	**8**	Eyebolt	**14**	Eyebolt
3	Eyebolt	**9**	Fuel suction pipe B	**15**	Fuel return pipe C
4	Fuel return pipe B	**10**	Eyebolt	**16**	Adaptor
5	Common rail	**11**	Fuel suction pipe A		
6	Fuel temperature sensor	**12**	Eyebolt	⊗:	Non-reusable parts

WARNING ⚠

- **Fuel is highly flammable. Do not handle it near flames or heat.**
- **Spilled fuel may catch fire and therefore, must be wiped off completely.**

CAUTION ⚠

- **Contact each seating surface fully and evenly, tighten the bolt or nut temporarily, and finally tighten it to the specified torque.**
- **For servicing the common rail, contact a BOSCH service station.**
- **If dust enters the common rail, the engine performance will be greatly affected. To prevent it, be sure to cover up openings left after pipes and other parts are removed. Also, wash eyebolts, gaskets, etc. in light oil to clear of dirt.**
- **Before installing, make sure that the seat surfaces of fuel pipes and injection pipes are free of scratches and irregularities.**

- Contact Bosch service station for any service needs of the common rail.

● Assembly sequence

Follow the disassembly sequence in reverse.

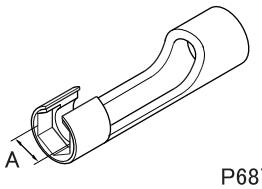
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Location	Parts to be tightened	Tightening torque	Remarks
Ta	Injection pipe	30.4 to 35 {22 to 26, 3.1 to 3.6}	–
	Fuel pipe		
Tb	Bolt (adaptor mounting)	46 {34, 4.7}	–
Tc	Bolt (common rail mounting)	33 {24, 3.4}	–
Td	Fuel temperature sensor	17.6 to 21.5 {13 to 16, 1.8 to 2.2}	–
Te	Eyebolt (fuel suction pipe mounting)	39 {29, 4.0}	–
	Eyebolt (fuel return pipe mounting)		

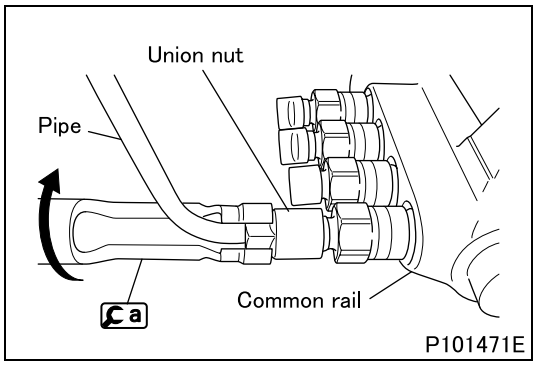
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
a	Socket wrench A: 17 {0.67}  P68771	MH063020	Removal and installation of injection pipe and fuel pipe

◆Removal procedure◆

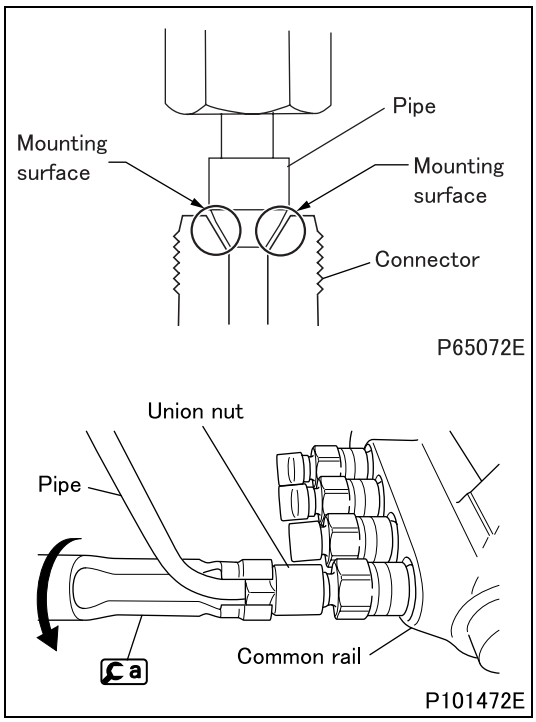


P101471E

■ Removal: Injection pipe and fuel pipe

- Position a on the pipe and then loosen the union nut.

◆Installation procedure◆

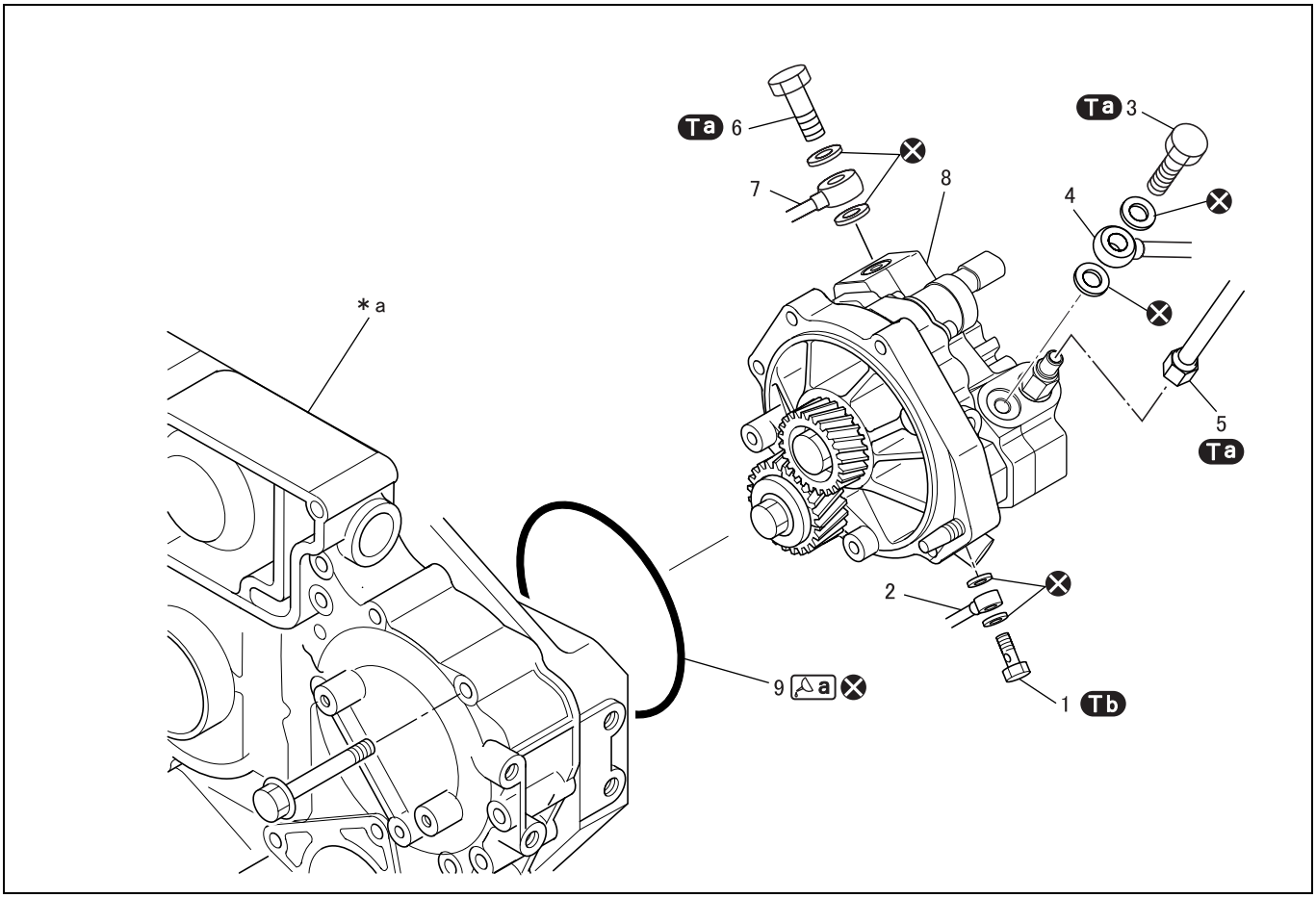


■ **Installation: Injection pipe and fuel pipe**

- Ensure that the pipe and mounting surfaces of the connector are flat and free from damage.
- Bring the pipe into intimate contact with mounting surfaces of the connector evenly, and temporarily tighten it without applying an excessive force.
- After temporary tightening, position the torque wrench on a and then tighten them to the specified torque.

M E M O

SUPPLY PUMP



● **Removal sequence**

1 Eyebolt
2 Oil pipe
3 Eyebolt
4 Fuel return pipe C
5 Fuel pipe
6 Eyebolt (with gauze filter)
7 Fuel suction pipe A
8 Supply pump
9 O-ring

***a**: Front case
⊗: Non-reusable parts

CAUTION ⚠

- **Contact each seating surface fully and evenly, tighten the bolt or nut temporarily, and finally tighten it to the specified torque.**
- **Have the injection pump assembly serviced by a BOSCH service station.**
- **Dirt and dust in the injection pump assembly can seriously detract from engine performance. To prevent this from happening, fully cover all open joints after removing any pipes or hoses.**

● **Installation sequence**

Follow the removal sequence in reverse.

CAUTION ⚠

- **Make sure that the harness (marked with " ★ ") of MPROP (rail pressure control valve) is connected to the supply pump before starting the engine. Starting the engine without connection causes a malfunction.**

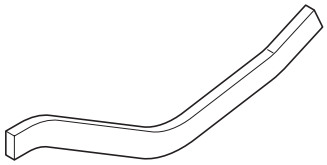
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Fuel pipe	25 {18, 2.6}	–
	Eyebolt (fuel return pipe C mounting)		
	Eyebolt (fuel suction pipe A mounting)		
Tb	Eyebolt (oil pipe mounting)	21 {15, 2.1}	–

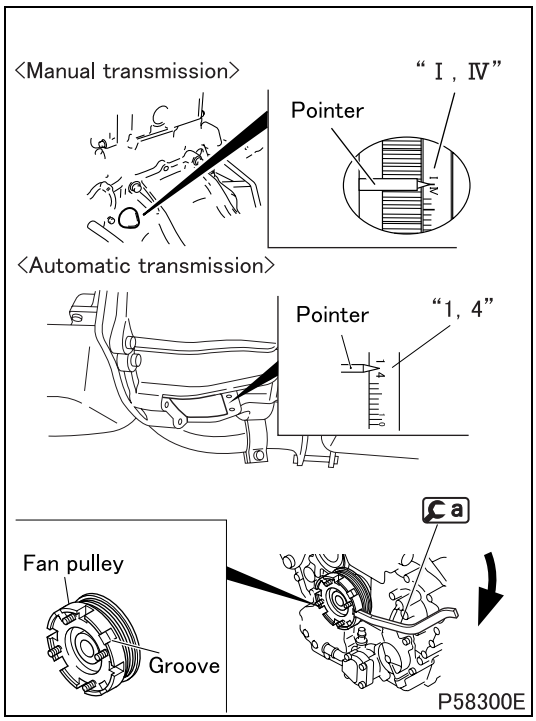
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

Special tools

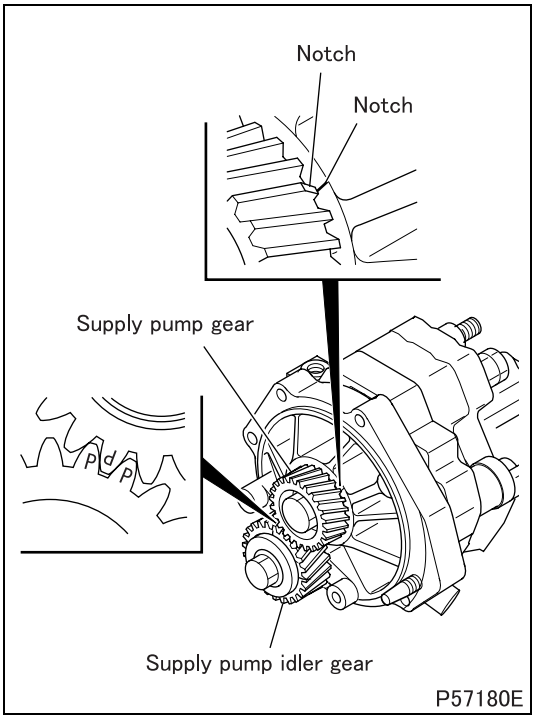
Mark	Tool name and shape	Part No.	Application
a	Cranking handle  P58299	MH063704	Rotating the fan pulley

◆Installation procedure◆

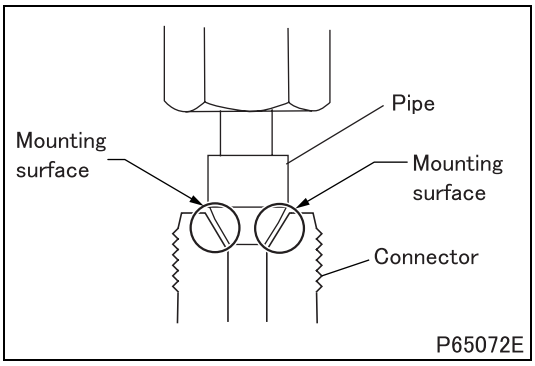


■Installation: Supply pump

- Remove the rocker cover.
- Bring the No. 1 cylinder piston to the top dead center (TDC) on the compression stroke by the following procedure:
- Hook a on a groove in the fan pulley.
- Turn the fan pulley in the illustrated direction so that the pointer is aligned with the "I – IV" or "1 – 4" mark on the inscribed scale on the flywheel.
- This will place either the No. 1 or No. 4 cylinder piston at TDC on the compression stroke. The cylinder in which the rocker arms for both the intake and exhaust valves can be pushed down by hand by the valve clearance amounts has its piston at TDC. Rotate the engine by one full turn to switch the TDCs of the No. 1 and No. 4 cylinder pistons.



- Align the match mark “P” on the supply pump idler gear with that of the supply pump gear.
- Align the notch on the flange plate with the notch on the supply pump gear.
- Check that the notch on the flange plate and the notch on the supply pump gear are correctly aligned, and then push the supply pump.

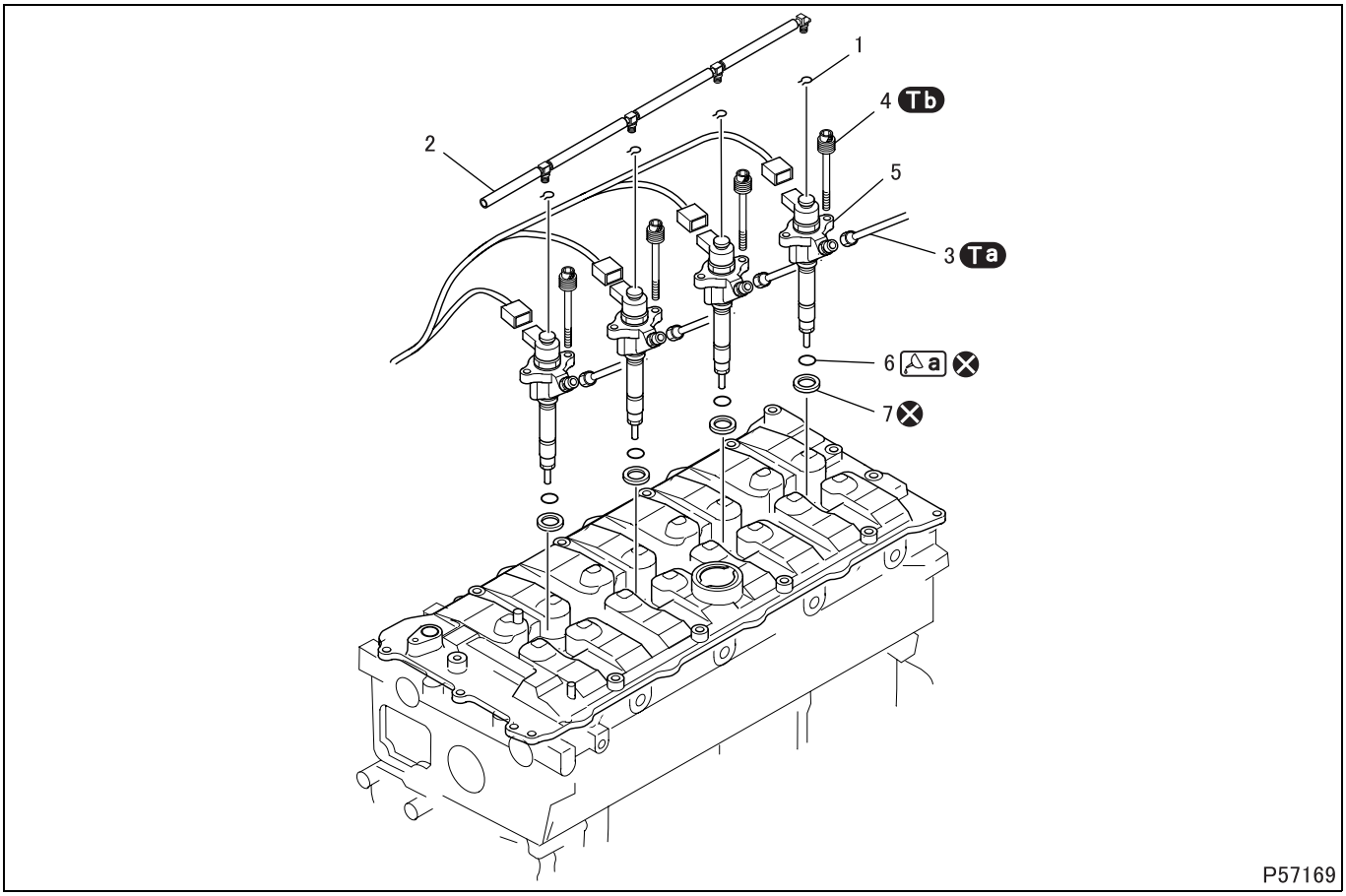


■ Installation: Fuel pipe

- Ensure that the pipe and mounting surfaces of the connector are flat and free from damage.
- Bring the pipe into intimate contact with mounting surfaces of the connector evenly, and temporarily tighten it without applying an excessive force.
- Tighten it to the specified torque after temporary tightening.

M E M O

INJECTOR



I

● Disassembly sequence

1 Snap ring
2 Fuel return hose
3 Injection pipe
4 Bolt (with hexagonal hole)
5 Injector
6 O-ring
7 Nozzle gasket

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

- **Before removing the injectors, always turn the starter switch to the LOCK position.**
- **Fuel is highly flammable. Wipe up spilled fuel to avoid the risk of fire.**

CAUTION ⚠

- **Contact each seating surface fully and evenly, tighten the bolt or nut temporarily, and finally tighten it to the specified torque.**
- **When removing the injectors, take care not to strike them with the tool, etc.**
- **To prevent an injection failure or any other trouble, make sure that no dust enters the injectors and injection pipes.**

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Injection pipe (union nut mounting)	30.4 to 35 {22 to 26, 3.1 to 3.6}	–
Tb	Bolt (injector mounting)	5.2 to 7.2 {3.8 to 5.3, 0.53 to 0.73}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

CAUTION ⚠

- **Do not attempt to clean the nozzle hole with a wire brush or other similar tools, or the hole can be damaged.**
- **Be sure to tighten the nozzle bridge bolts to the specified torque. Overtightening the bolts can deform the injectors, resulting in incorrect fuel injection.**
- **If an injector is replaced with a new one, the injector correction data must be written in the engine electronic control unit.**
- **For the data writing work, consult your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.**

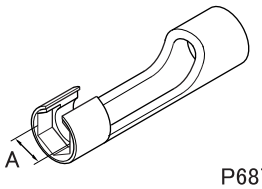
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Injection pipe	30.4 to 35 {22 to 26, 3.1 to 3.6}	–
Tb	Bolt (injector mounting)	5.2 to 7.2 {3.8 to 5.3, 0.53 to 0.73}	–

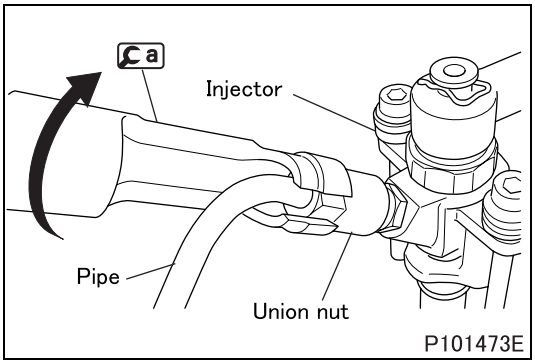
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
Ca	Socket wrench A: 17 {0.67}  P68771	MH063020	Removal and installation of injection pipe

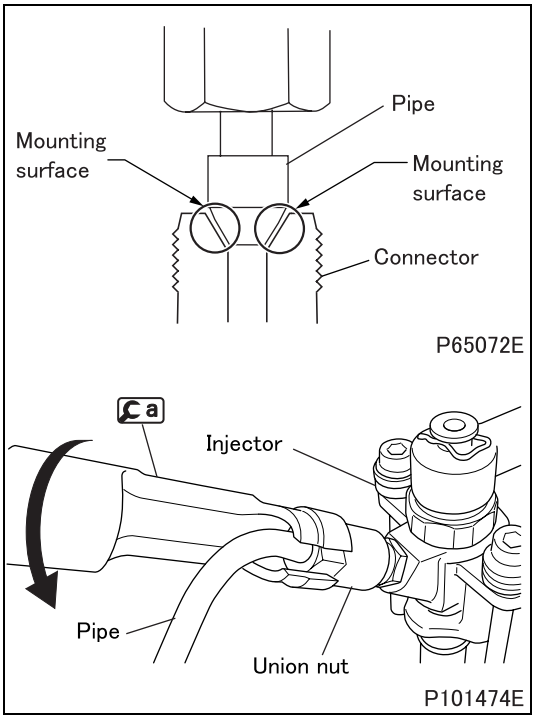
◆Removal procedure◆



■ **Removal: Injection pipe**

- Position [a] on the pipe and then loosen the union nut.

◆Installation procedure◆



■ **Installation: Injection pipe**

- Ensure that the pipe and mounting surfaces of the connector are flat and free from damage.
- Bring the pipe into intimate contact with mounting surfaces of the connector evenly, and temporarily tighten it without applying an excessive force.
- After temporary tightening, position the torque wrench on [a] and then tighten them to the specified torque.

INDEX

SPECIFICATIONS 13EA-2

STRUCTURE AND OPERATION
1. **Overview 13EA-3**
2. **Electronic Control System 13EA-12**
3. **Electronic Control Unit Connection Diagram 13EA-20**

TROUBLESHOOTING
1. **Diagnosis Procedure 13EA-22**
2. **Diagnostic Precautions 13EA-22**
3. **Inspections Based on Fault Codes 13EA-23**
4. **Multi-Use Tester Service Data 13EA-962**
5. **Mode 06 Data 13EA-966**
6. **Actuator Tests Performed Using Multi-Use Tester 13EA-968**

REGISTRATION AND ALTERATION OF DATA IN ENGINE ELECTRONIC CONTROL UNIT
1. **Operation at Electronic Control Unit Replacement 13EA-972**
2. **Resetting the Diesel Particulate Filter Related Information (Resetting Electronic Control Unit) 13EA-972**

INSPECTION OF ELECTRICAL EQUIPMENT 13EA-974

INSTALLED LOCATIONS OF PARTS 13EA-984

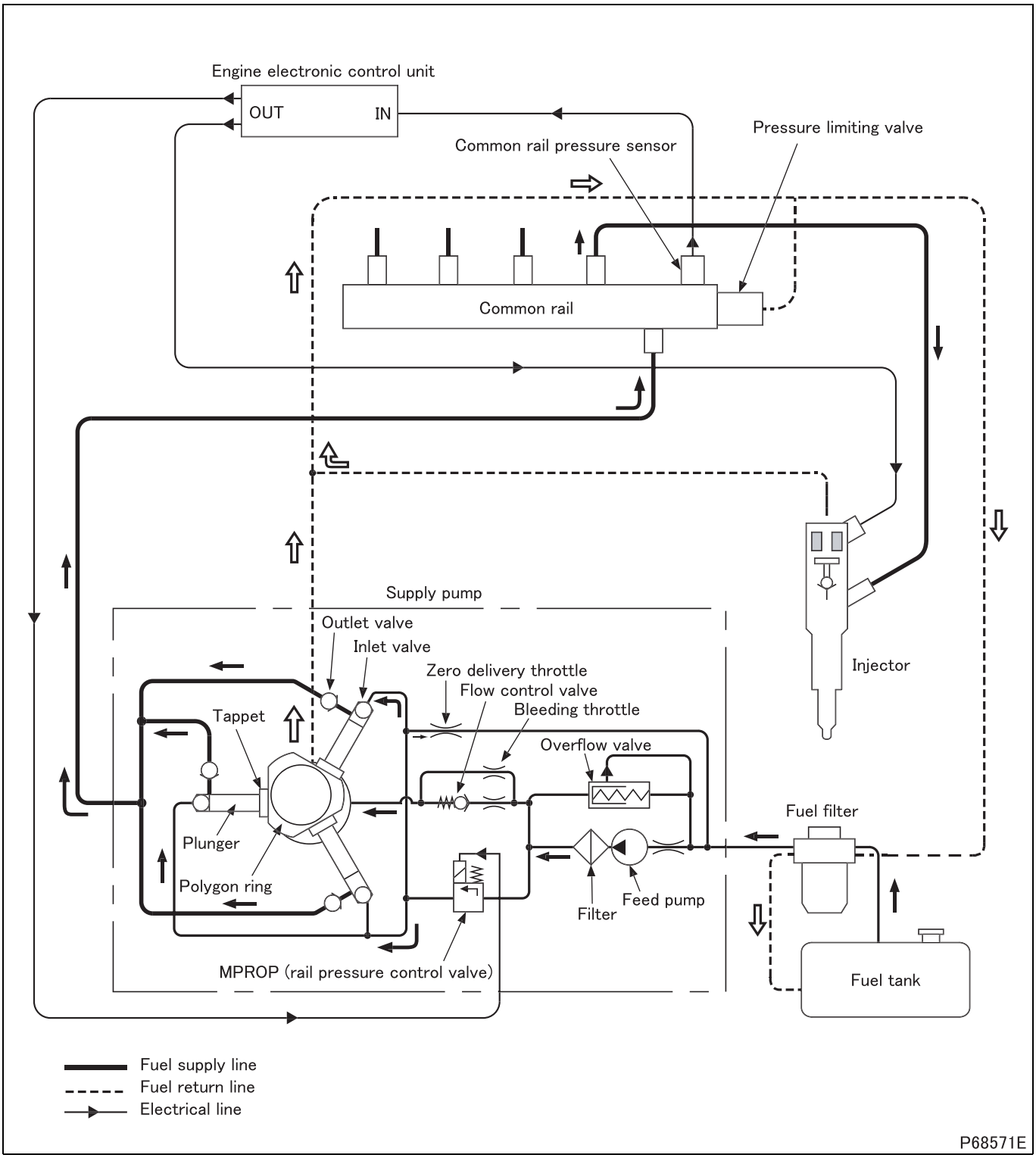
ELECTRIC CIRCUIT DIAGRAM 13EA-990

SPECIFICATIONS

Item			Specifications
Supply pump	Manufacturer		Bosch
	Model		CP3.3 NH
	Control method		Electronic
	Type		Radial, 3-cylinder
	Type		External gear type
	Rail pressure control valve	Model	MPROP
		Rated voltage V	12
	Max. common rail pressure MPa {psi, kgf/cm^2}		180 {26100, 1840}
Common rail	Manufacturer		Bosch
	Common rail volume cm^3 {cu. in., ml}		18.7 {1.14, 18.7}
	Pressure limiting valve opening pressure MPa {psi, kgf/cm^2}		210 to 220 {30450 to 31900, 2141 to 2243}
	Common rail pressure sensor supply voltage V		5
Injectors	Manufacturer		Bosch
	Control method		Electrical
	Max. operating pressure MPa {psi, kgf/cm^2}		180 {26100, 1840}
	Min. operating pressure MPa {psi, kgf/cm^2}		25 {3630, 255}
Common rail electronic control unit	Manufacturer		Bosch
	Rated voltage V		12

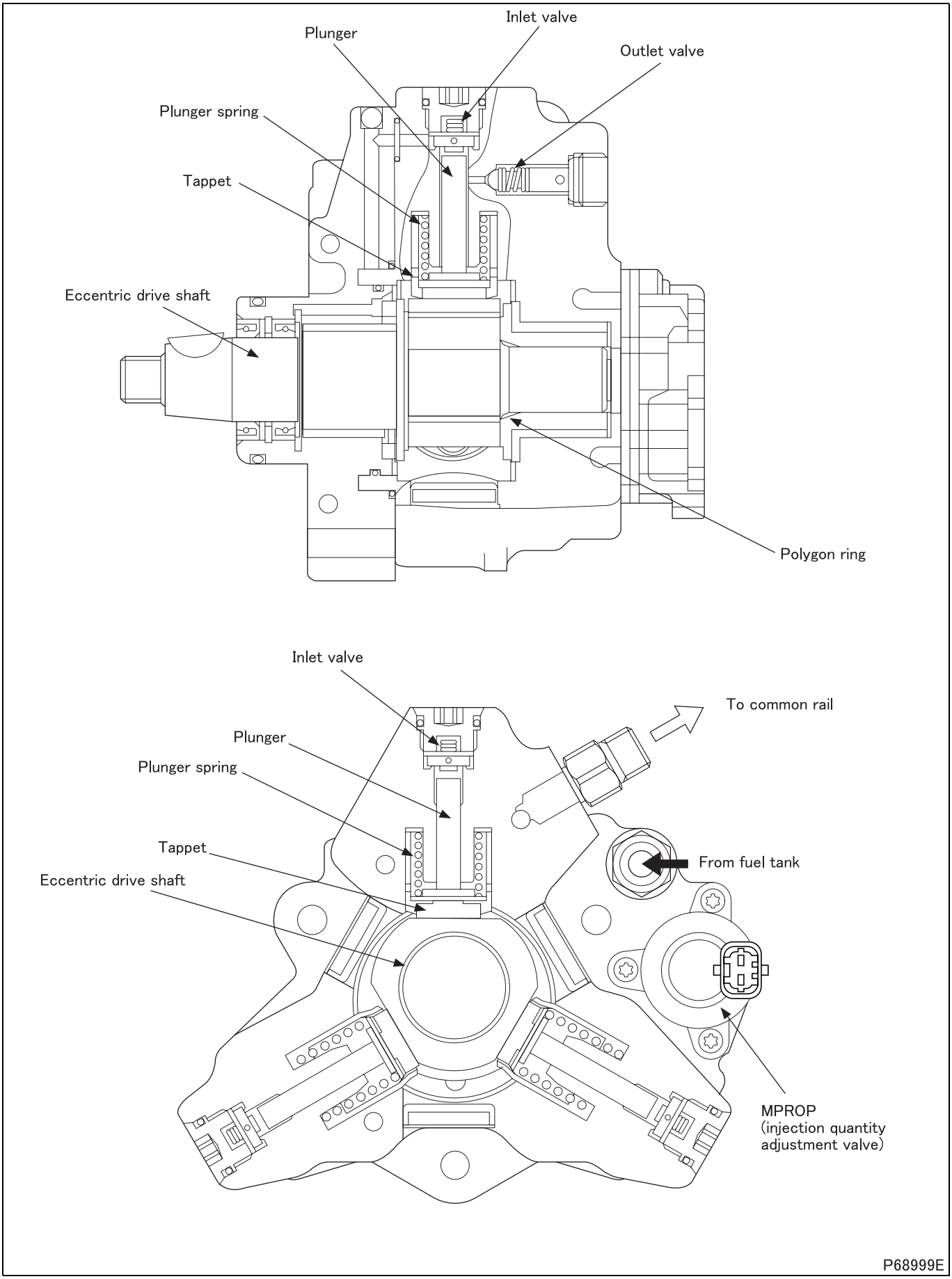
1. Overview

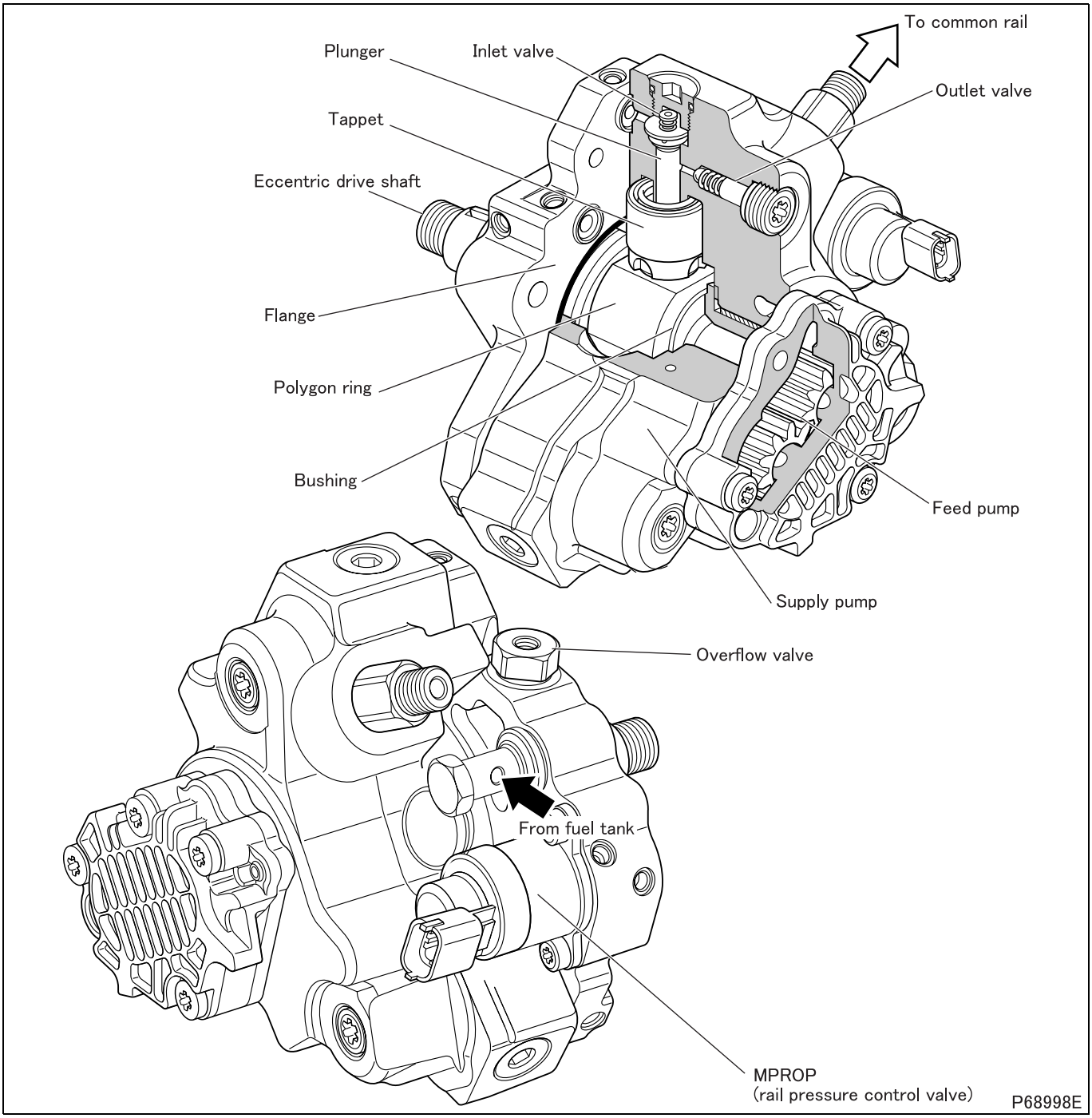
- In the common rail system, an electronic control unit monitors various aspects of the engine (engine speed, throttle opening, coolant temperature, etc.) using information from sensors. In accordance with these data, the electronic control unit effects control over the fuel injection quantity, fuel injection timing, and fuel injection pressure in order to optimize the engine's operation.
- The electronic control unit has a diagnosis function that enables it to recognize abnormalities in the common rail system's major components and alert the driver to them.
- The common rail system consists mainly of an electronically controlled supply pump; injectors; a common rail; and the electronic control unit and sensors that are used to control the other components.



- When the engine is cranked by means of the starter switch, the feed pump (this is located inside the supply pump) simultaneously draws fuel from the fuel tank and feeds it via the fuel filter to the MPROP (rail pressure control valve). A quantity of fuel metered by the MPROP is supplied via the inlet valves to the plunger chambers.
- The fuel in the plunger chambers is pressurized. The outlet valves are then opened, and the fuel is fed under pressure to the common rail.
- The pressurized fuel is held in the common rail and then uniformly fed to the injectors.
- In response to signals from the engine electronic control unit, a magnetic valve in each injector causes the injector to inject fuel into the relevant combustion chamber at the optimal timing and in the optimal quantity.

1.1 Supply pump

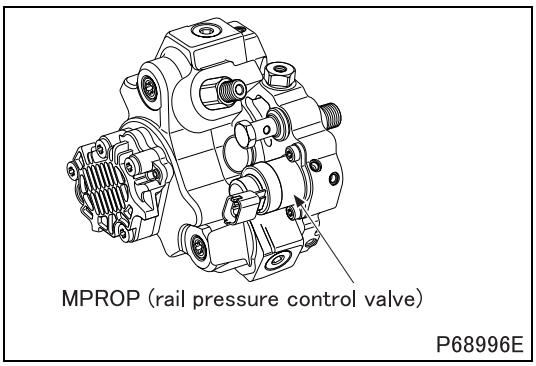




CAUTION ⚠

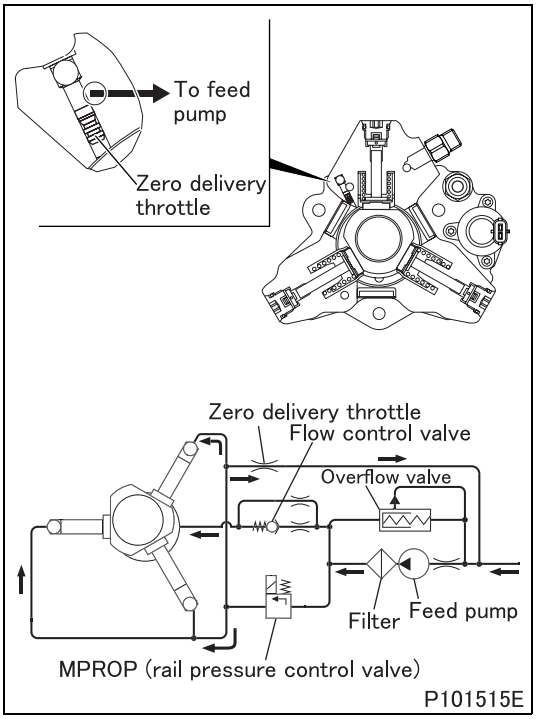
- **Be sure to connect the MPROP (rail pressure control valve) connector to the engine harness before starting the engine. If the engine were started with the MPROP connector not connected, control of the supply pump by the engine electronic control unit would not be possible and a fault would ensue.**

- The supply pump pressurizes fuel and supplies it in a highly pressurized state.
- Fuel drawn from the fuel tank by the feed pump is not supplied directly to the plungers. It is supplied first to the MPROP (rail pressure control valve), which controls the amount of fuel reaching the plungers.
- If the fuel pressure exceeds a certain level, the overflow valve returns fuel to the inlet side of the feed pump. This operation keeps the fuel pressure constant.
- Rotation of the eccentric drive shaft causes (via the tappets) up-down movement of the plungers. Fuel in the plunger chambers is thus highly pressurized.



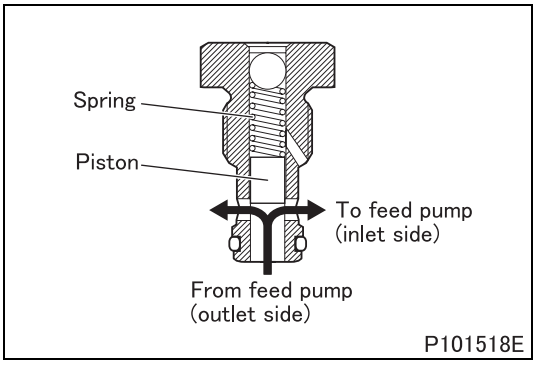
(1) MPROP (rail pressure control valve)

- The MPROP receives fuel from the feed pump and feeds fuel toward the plungers of the supply pump in such a quantity that the fuel pressure corresponds to that required by the engine electronic control unit.
- When the MPROP is not operating, i.e., when current is not flowing, fuel flows at its maximum rate. When current flows, the piston in the MPROP is pressed down such that fuel is not fed toward the plungers.



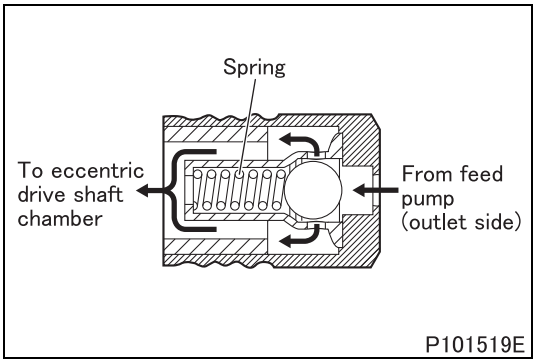
(2) Zero delivery throttle

- A small amount of fuel can flow through the MPROP (rail pressure control valve) even when no fuel is to be supplied. The zero delivery throttle prevents this fuel flow by returning the fuel to the inlet port side of the feed pump to zero the fuel delivery to the plunger.



(3) Overflow valve

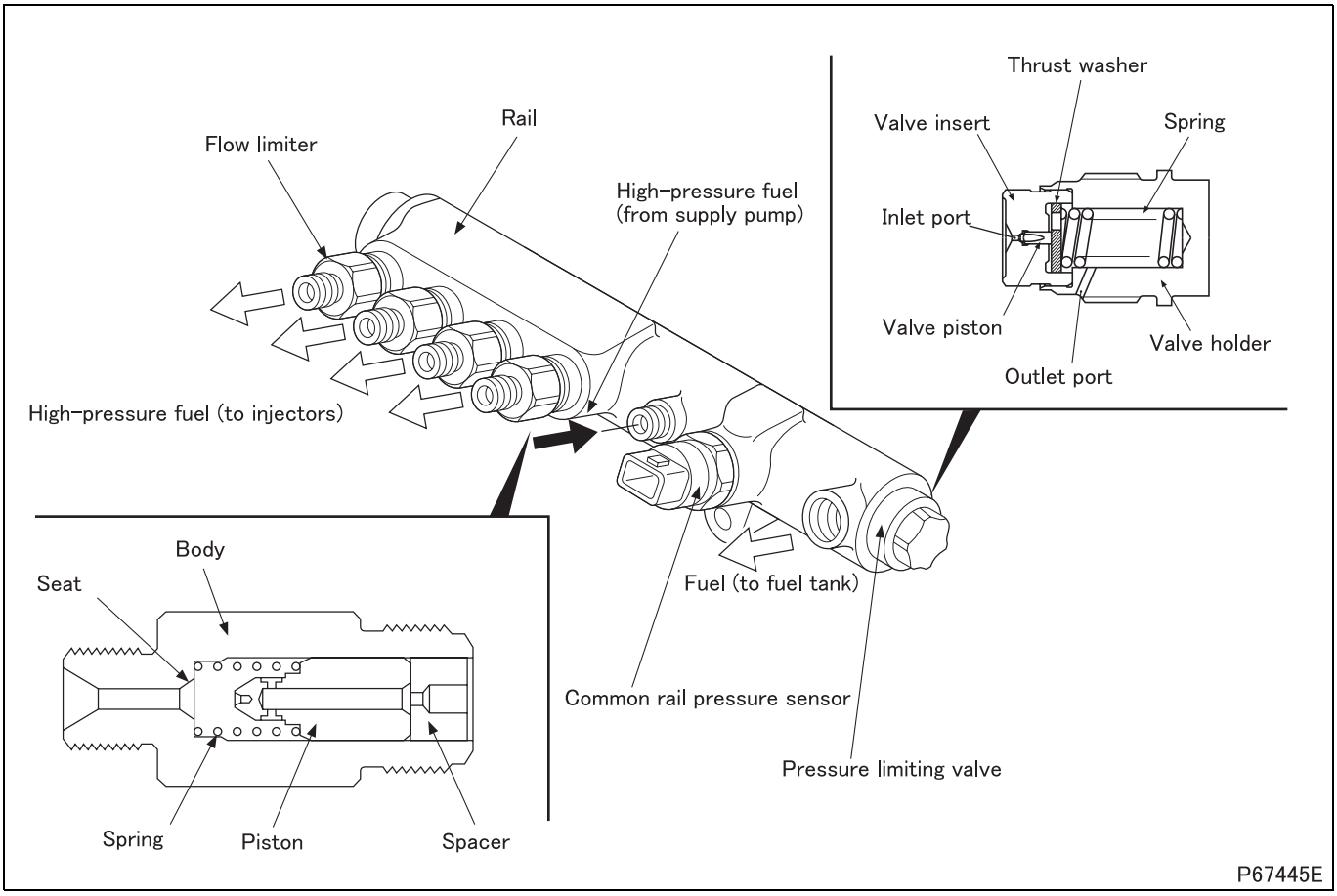
- The overflow valve limits the pressure of the fuel sent from the feed pump to the predetermined level.
- When fuel pressure exceeds the predetermined level, it overcomes the spring force of the overflow valve to move the piston, returning the fuel to the inlet side of the feed pump.
  The fuel which has overflowed enters into the eccentric drive shaft chamber to lubricate the parts in the chamber.



(4) Flow control valve

- The flow control valve sends the fuel from the feed pump into the eccentric drive shaft chamber for lubrication of parts in the chamber.
- When the revolution of the feed pump increases, fuel pressure also increases. It overcomes the spring force of the flow control valve to move the ball, sending the fuel to the eccentric drive shaft chamber for lubrication of parts in the chamber.

1.2 Common rail

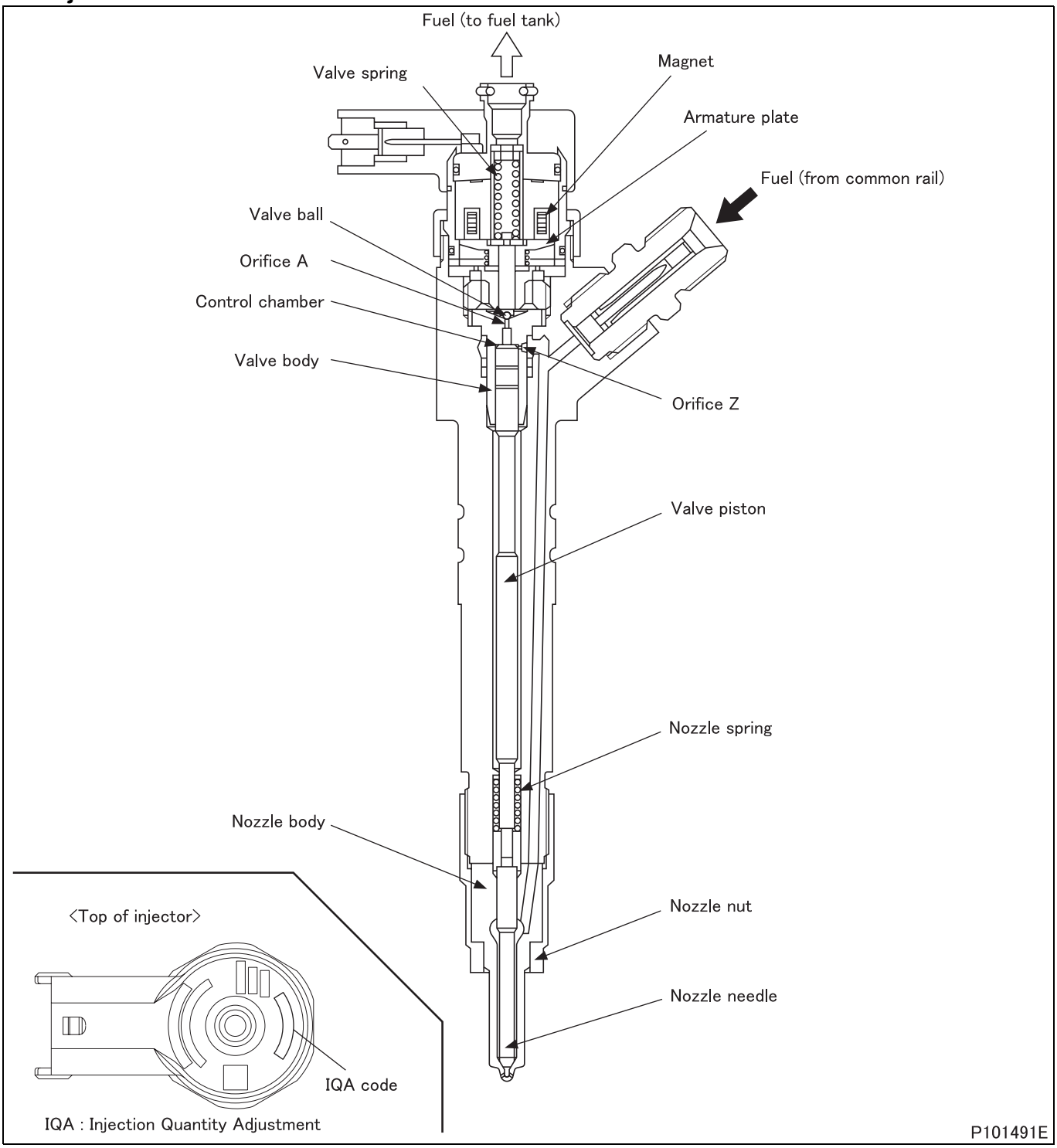


- The common rail distributes to the injectors high-pressure fuel that has been fed from the supply pump.
- Each flow limiter prevents an abnormal outflow of fuel. It does so by blocking the fuel passage in the event of fuel leakage from the injection pipe or excessive injection of fuel from the injector.
- The common rail pressure sensor is used in feedback control. It senses the fuel pressure inside the common rail and feeds a corresponding signal to the electronic control unit.
- If the fuel pressure in the common rail exceeds a certain, set level, the piston in the pressure limiting valve pushes and compresses the spring such that fuel is able to escape. The pressure limiting valve thus prevents the fuel pressure from becoming higher than the set pressure.

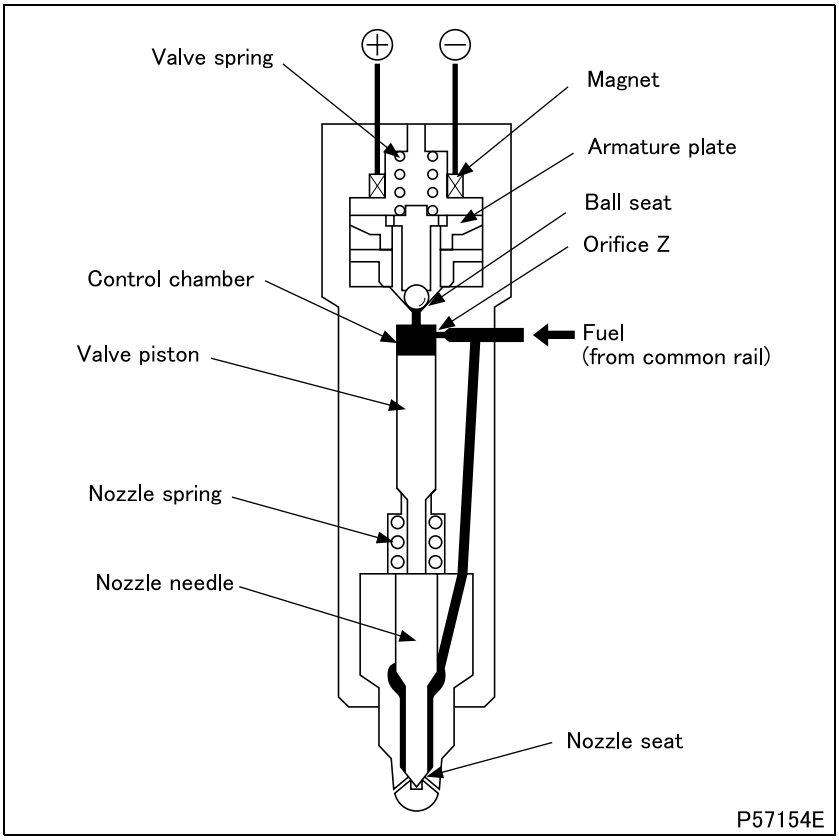
Flow limiter

- During normal operation, the piston moves (thus pushing and compressing the spring) to the extent necessary for one injection quantity to pass through. The piston does not make contact with the seat at this time. When injection is complete, the piston is returned to its initial position by the spring.
- If the amount of fuel passing through the flow limiter becomes excessively great, the piston presses against the seat, thereby closing the fuel passage and preventing an abnormal outflow of fuel.
  When the piston has pressed against the seat, it does not return to its original position until the engine has been stopped and the pressure in the common rail has come down.

1.3 Injector



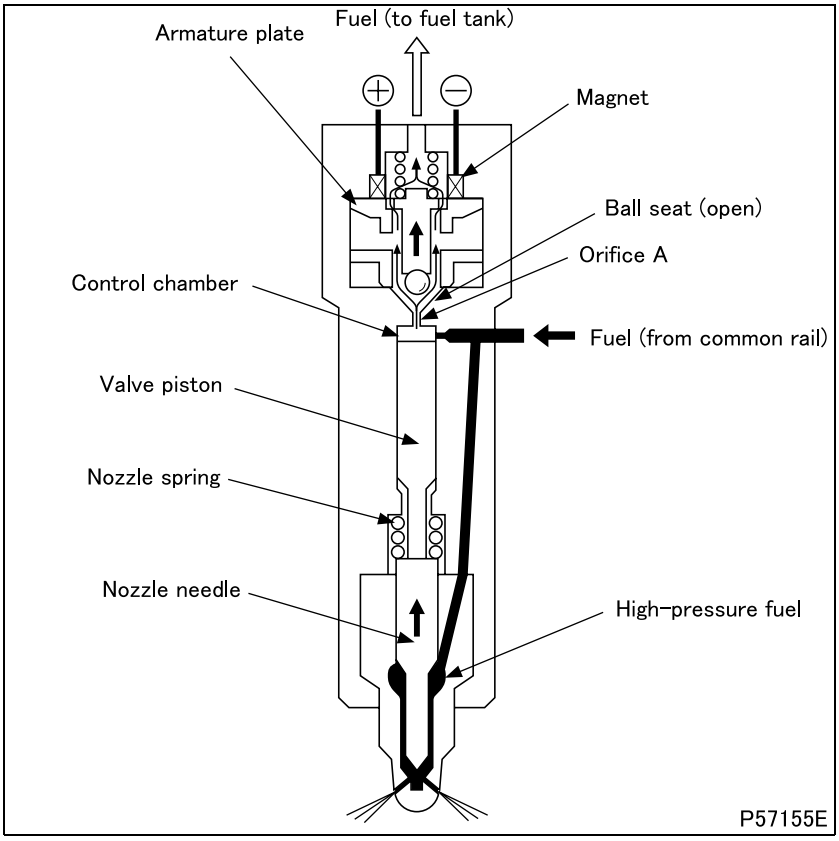
- In accordance with electrical signals from the engine electronic control unit, the injector supplies high-pressure fuel from the common rail to the relevant combustion chamber of the engine at the optimal timing and in the optimal quantity.
- The injector is divided into the control section and injector section.
  - The control section consists of the control chamber, magnet, spring, armature plate, valve ball, valve body, valve piston, orifice A, and orifice Z. The valve piston is located between the control section and the injector section.
  - The injector section consists of the nozzle body, nozzle needle, nozzle spring, and nozzle nut.
- On the top of the injector is marked the IQA (Injection Quantity Adjustment) code for entry of injector correction data into the engine electronic control unit.
- The fluctuation of each injector in injection quantity is thereby restrained.



(1) Operation

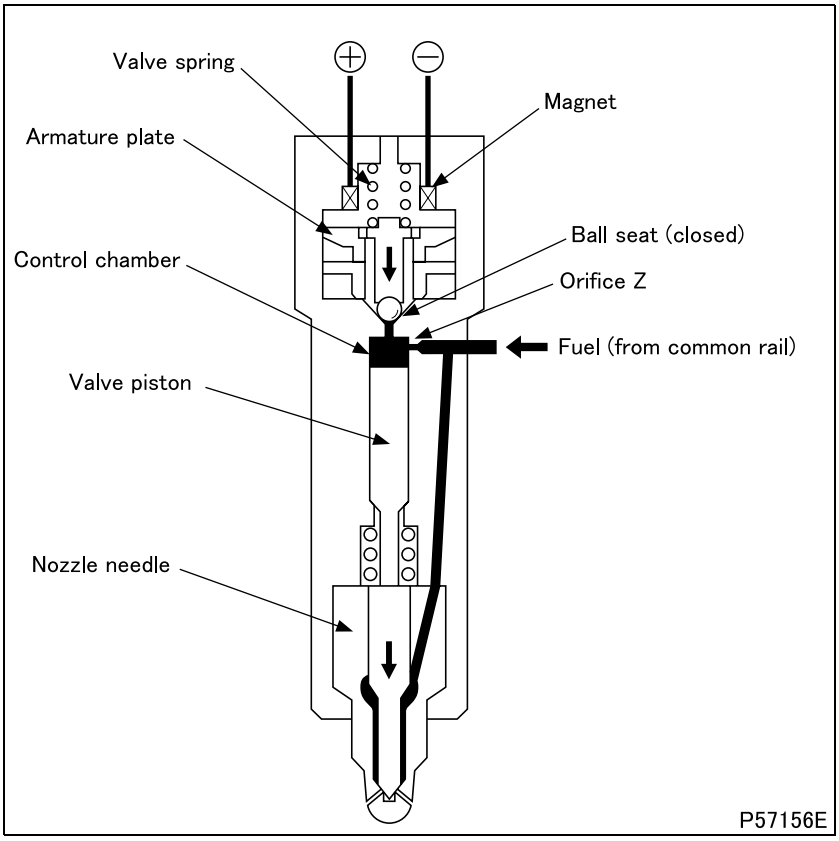
(1.1) Injection not taking place

- With the magnet not energized, the armature plate is pushed up by the valve spring such that the ball seat is closed.
- The high-pressure fuel acts upon the control chamber via orifice Z. The same pressure acts upon the nozzle needle.
- The fuel pressure acting on the nozzle needle cannot overcome the valve piston and nozzle spring, so the nozzle needle stays in its downward-pushed position and injection does not take place.



(1.2) Start of injection

- When the magnet is energized, the resulting electromagnetic force draws the armature plate upward, causing the ball seat to open.
- Fuel in the control chamber passes through the ball seat and orifice A and flows to the fuel tank.
- With the pressure in the control chamber reduced, the fuel acting on the nozzle needle overcomes the valve piston and nozzle spring, pushing up the nozzle needle such that injection starts.
- If the magnet remains energized, the injection rate reaches its maximum level.

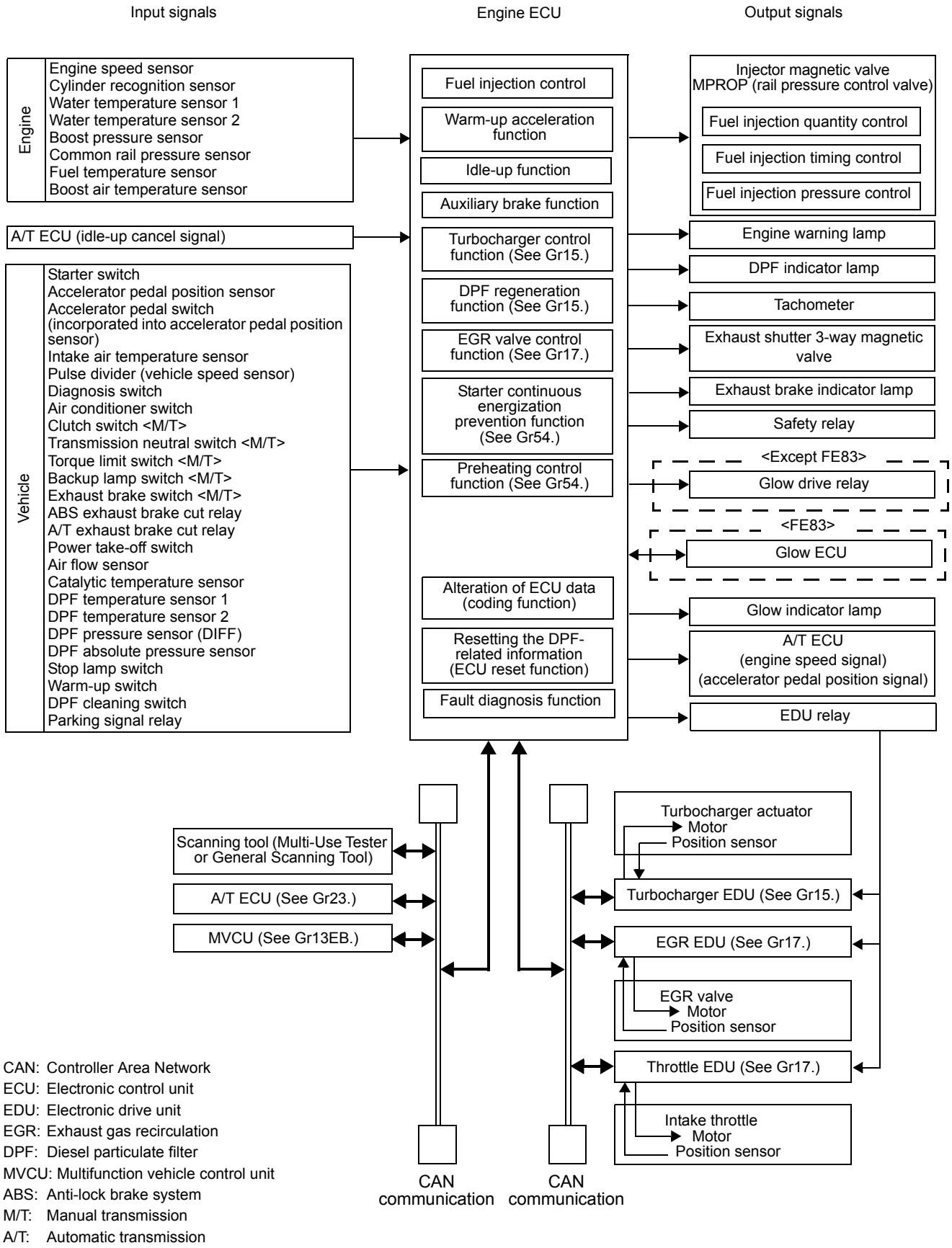


(1.3) End of injection

- When energization of the magnet is stopped, the armature plate is pushed downward by the valve spring such that the ball seat closes. At this time, fuel flows into the control chamber via orifice Z, pushing down the valve piston and nozzle needle such that injection finishes.

2. Electronic Control System

2.1 System block diagram

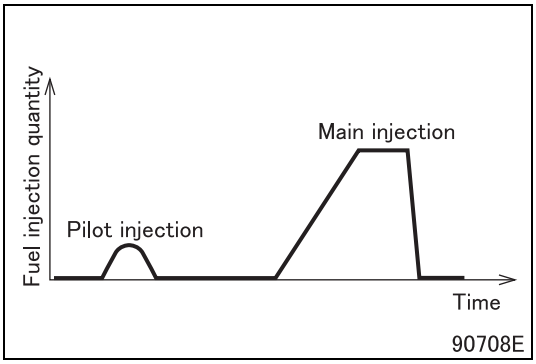


CAN: Controller Area Network
ECU: Electronic control unit
EDU: Electronic drive unit
EGR: Exhaust gas recirculation
DPF: Diesel particulate filter
MVCU: Multifunction vehicle control unit
ABS: Anti-lock brake system
M/T: Manual transmission
A/T: Automatic transmission

Part name	Main function/operation
Engine speed sensor	Sensing of engine speed
Cylinder recognition sensor	Cylinder recognition
Water temperature sensor 1	Sensing of coolant temperature
Water temperature sensor 2	• Backup of coolant temperature • Sensing of coolant temperature for temperature gauge
Boost pressure sensor	Sensing of boost pressure
Common rail pressure sensor	Sensing of common rail pressure
Fuel temperature sensor	Sensing of fuel temperature
Boost air temperature sensor	Detection of intake air temperature after joining the exhaust gas recirculation
Starter switch	Senses that the engine is in starting condition with the starter switch in START position.
Accelerator pedal position sensor	Sensing of extent of accelerator pedal depression
Accelerator pedal switch (incorporated into accelerator pedal position sensor)	Sensing of released/pressed condition of accelerator pedal (ON with pedal released)
Intake air temperature sensor	Sensing of intake air temperature
Pulse divider (vehicle speed sensor)	Sensing of vehicle speed
Diagnosis switch	Output of diagnosis codes
Air conditioner switch	ON when air conditioner is operating
Clutch switch <M/T>	Sensing of released/pressed condition of clutch pedal (OFF with pedal released)
Transmission neutral switch <M/T>	Detection of transmission neutral condition (OFF with transmission in neutral)
Torque limit switch <M/T>	Detection of transmission 1st and Rev positions
Backup lamp switch <M/T>	
Exhaust brake switch	Operation of auxiliary brake
ABS exhaust brake cut relay	Exhaust brake cut signal for ABS operation
Automatic transmission exhaust brake cut relay	Exhaust brake cut signal with selector in P or N range position and vehicle at low speed
Power take-off switch	Operation of power take-off
Air flow sensor	Sensing of intake air flow rate
Catalytic temperature sensor	Detection of front oxidation catalytic inlet temperature
DPF temperature sensor 1	Detection of ceramic filter inlet temperature
DPF temperature sensor 2	Detection of ceramic filter outlet temperature
DPF absolute pressure sensor	Sensing of DPF absolute pressure value
DPF pressure sensor (DIFF)	Sensing of DPF filter differential pressure
Stop lamp switch	Sensing of released/pressed condition of brake pedal (OFF with pedal released)
Warm-up switch	Warm-up acceleration
DPF cleaning switch	ON/OFF changeover of DPF manual regeneration
Parking signal relay (parking brake switch)	Detection of parking condition (turns ON when the parking brake is applied)
Injector magnetic valve	Control of fuel injection pressure, fuel injection quantity, and fuel injection timing
MPROP (rail pressure control valve)	Control of fuel injection pressure
Engine warning lamp	Indication of system abnormalities Illuminates when the particulate matter accumulation in the DPF ceramic filter is excessive
DPF indicator lamp	Illuminates when the particulate matter accumulates in the DPF ceramic filter

Part name		Main function/operation
Tachometer		Indicates engine speed (revolutions per minute)
Exhaust shutter 3-way magnetic valve		ON/OFF changeover of exhaust shutter valve
Exhaust brake indicator lamp		Illuminates when exhaust brake system is operating
Safety relay		Changeover of starter continuous energization prevention function
Glow drive relay <Except FE83>		ON/OFF changeover of glow plugs
Glow ECU <FE83>		ON/OFF changeover of glow plugs and troubleshooting
Glow indicator lamp		ON when preheating system is started
Automatic transmission ECU	Idle-up cancel signal	Releasing the idle-up except N range
	Engine speed signal	Output of engine speed for A/T control
	Accelerator pedal position signal	Output of extent of accelerator pedal for A/T control
EDU relay		ON/OFF changeover of power supply to turbocharger, EGR and throttle EDU
CAN communication (Turbocharger EDU, EGR EDU, throttle EDU)		Engine data recognized by the engine ECU are outputted to the CAN bus to enable systems to obtain data that they need for control. Each system's EDU issues signals to the engine ECU to enable it to effect engine control appropriate to control of the system. (See Gr15 for Turbocharger EDU control.) (See Gr17 for EGR EDU and throttle EDU control.)
CAN communication (A/T ECU, MVCU)		Engine data recognized by the engine ECU are outputted to the CAN bus to enable systems to obtain data that they need for control. The A/T ECU and MVCU issue signals to the engine ECU to enable it to effect engine control appropriate to control of the system. (See Gr23 for A/T ECU.) (See Gr13EB for MVCU.)
CAN communication (scanning tool)		Indicating and erasing fault codes and obtaining the vehicle data of the ECU

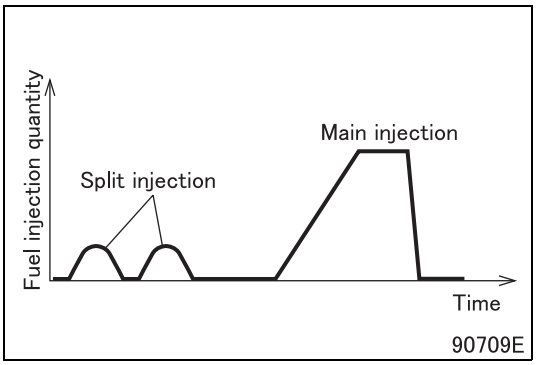
M E M O



2.2 Fuel injection rate control

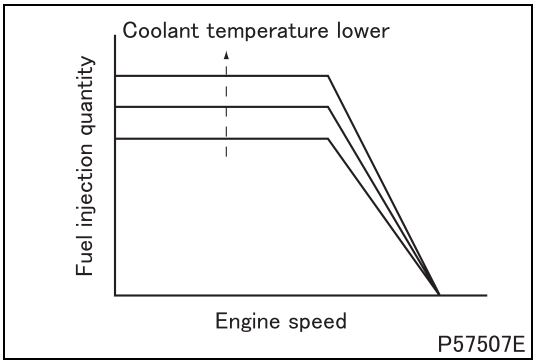
(1) Pilot injection

- Pilot injection entails the injection of an extremely small amount of fuel ahead of the main injection.
- Pilot injection suppresses heat generation early in the injection cycle and thus suppresses NOx generation and noise at the start of combustion.



(2) Split injection control

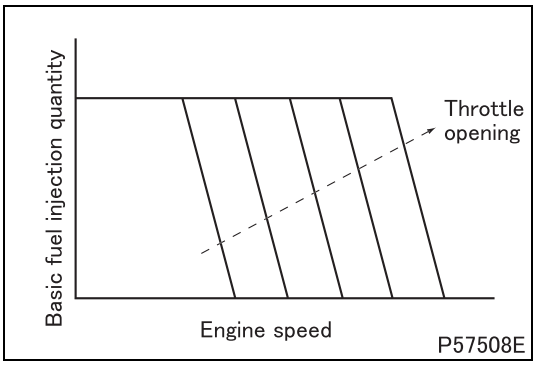
- Split injection entails the injection of an extremely small amount of fuel two or more times ahead of the main injection.
- Split injection increases the fuel's combustibility and thus enhances the engine's cold startability.



2.3 Fuel injection quantity control

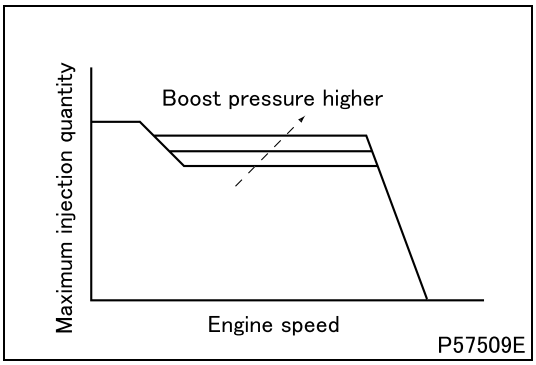
(1) Fuel injection quantity during engine startup

- During engine startup, the fuel injection quantity is determined in accordance with the engine speed and coolant temperature.



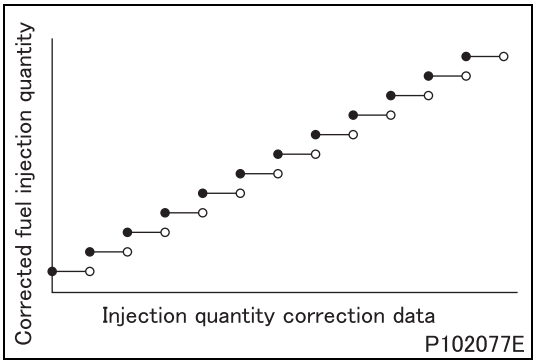
(2) Basic fuel injection quantity

- The basic fuel injection quantity is determined in accordance with the engine speed and throttle opening.



(3) Maximum injection quantity

- The maximum injection quantity is calculated from the engine speed and boost pressure.



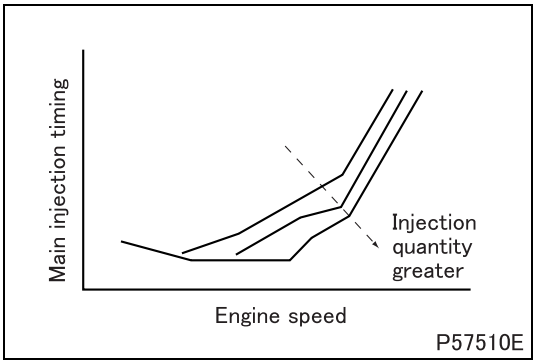
(4) Injection quantity correction

- Injection quantity correction is performed to restrain fluctuations in fuel injection quantity.
- Injection quantity correction data are stored in the engine electronic control unit.
- The storage of injection quantity correction data is effected by the coding function of the Multi-Use Tester.

2.4 Fuel injection timing control

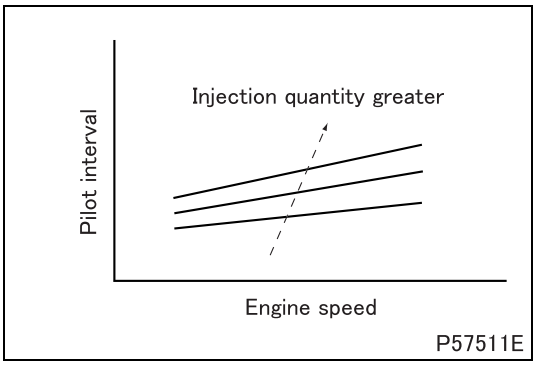
(1) Main injection timing

- The main injection timing is calculated from the fuel injection quantity and engine speed.



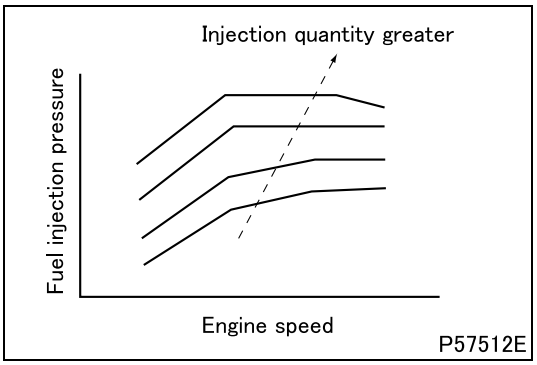
(2) Pilot injection timing (pilot interval)

- The pilot interval is calculated from the fuel injection quantity and engine speed.



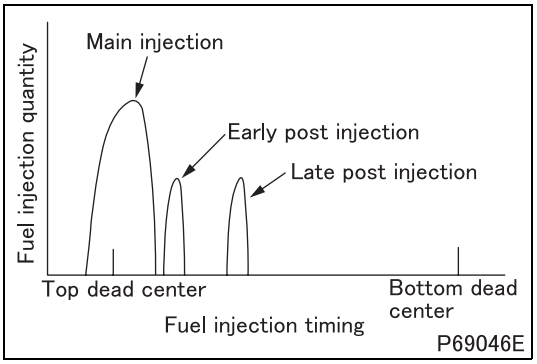
2.5 Fuel injection pressure control

- The fuel injection pressure is calculated from the fuel injection quantity and engine speed.

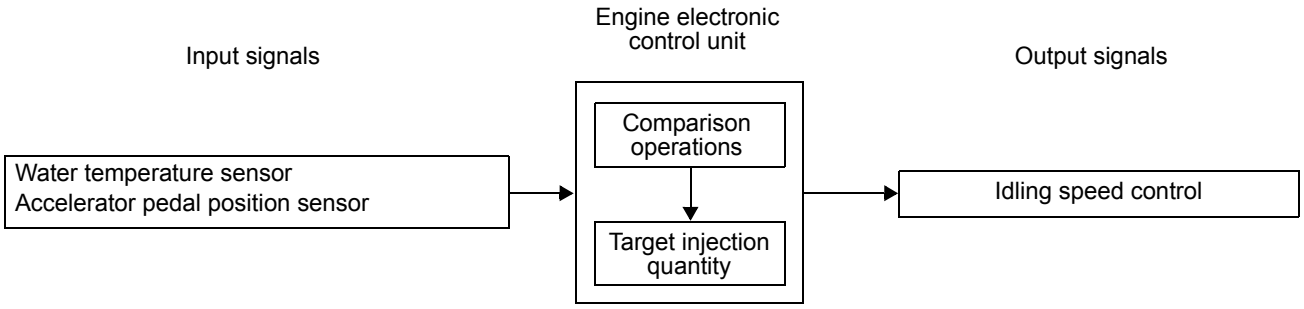


2.6 Fuel injection control for DPF regeneration

- Fuel injection control for diesel particular filter regeneration is performed in such a way, with early post injection and late post injection added after conventional fuel injection (main injection), exhaust gas temperature is increased to burn out particulate matter (PM) collected in the DPF.

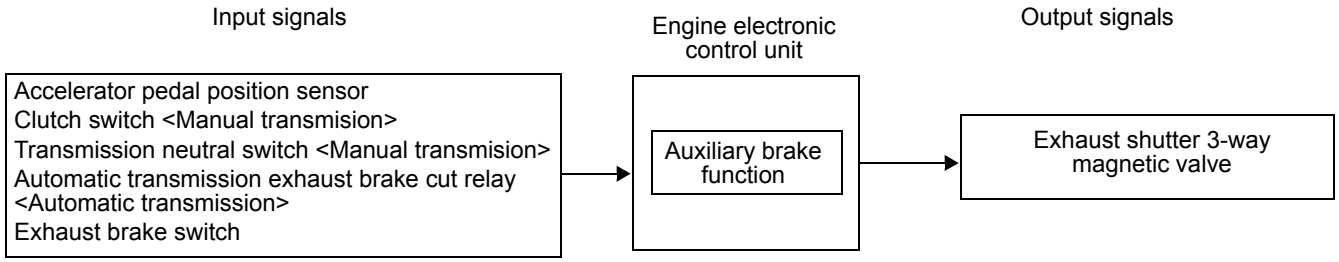


2.7 Warm-up acceleration function



- The warm-up acceleration function accelerates engine warm-up by varying the engine's idling speed in accordance with the engine's coolant temperature.

2.8 Auxiliary brake function



- The auxiliary brake function activates or deactivates the exhaust shutter 3-way magnetic valve according to the vehicle condition to control the exhaust brake.

2.9 Idle-up function

- The idle-up function increases the engine idling speed when a load is applied to the engine by other system (such as air conditioner, PTO) or when the warm-up acceleration function and DPF regeneration are activated.

2.10 Alteration of electronic control unit data (coding function)

- Vehicle information and equipment specifications are registered in each engine electronic control unit as coded data (coding data).
- When an engine electronic control unit or some equipment is replaced, it is necessary to alter registered related data or register new related data using a Multi-Use Tester (for details, see REGISTRATION AND ALTERATION OF DATA IN ENGINE ELECTRONIC CONTROL UNIT).
- For data alteration/registration and data write operation, contact your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.

2.11 Resetting the diesel particulate filter related information (resetting electronic control unit)

- In the diesel particulate filter regeneration control system, the engine electronic control unit accumulates various information to control the diesel particulate filter regeneration as diesel particulate filter history.
- These accumulated data are automatically initialized by the engine electronic control unit at diesel particulate filter cleaning for regeneration. In the case where the diesel particulate filter regeneration involved the replacement of ceramic filter, etc., however, the initialization of accumulated data is impossible and therefore it is necessary to reset diesel particulate filter related information (the electronic control unit) using a Multi-Use Tester. (for reset procedure, see Gr15.)
- It is necessary to reset diesel particulate filter related information (the electronic control unit) after the following operations are performed.
  - Replacement of diesel particulate filter ceramic filter
  - Cleaning of diesel particulate filter ceramic filter

2.12 Diagnostic function

(1) Overview

- The system continuously monitors the sensors and other system components. If any fault is detected, the system warns the driver of this by displaying the relevant fault information on the meter cluster. At the same time, the system also stores a relevant fault code in the memory and starts operation in the fault mode.
- When control is performed during a failure, the system function is limited to ensure the safety of the vehicle and driver.

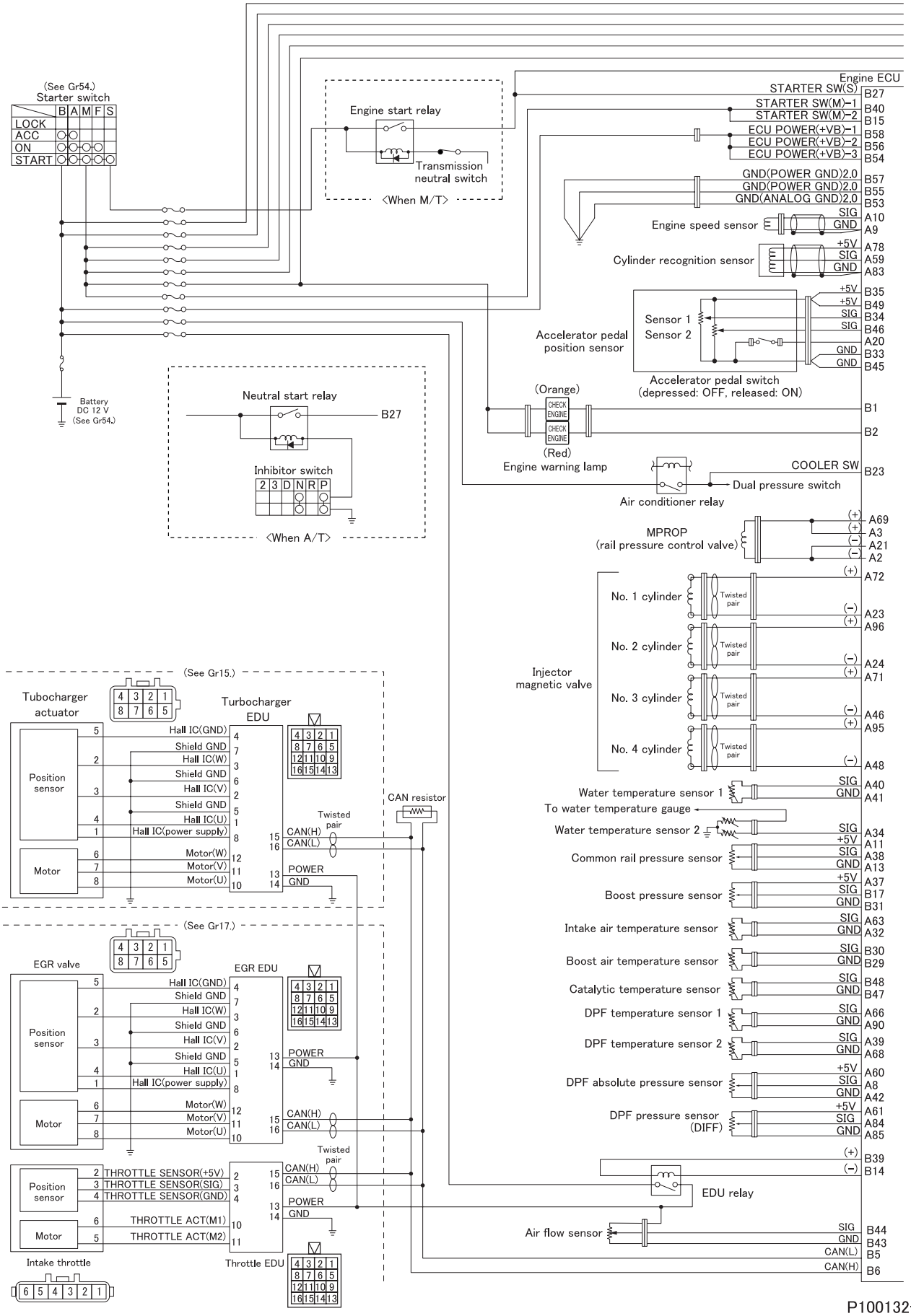
(2) Reading fault code

- It is possible to read memorized fault codes using a scanning tool (Multi-Use Tester or General Scanning Tool) or from the number of flashes of the warning lamp in the meter cluster.
- Diagnosis codes shown by the scanning tool (Multi-Use Tester or General Scanning Tool) and those indicated by the flashing of the warning lamp (flash codes) are different.
- Diagnosis codes shown by the scanning tool are more specific than flash codes.

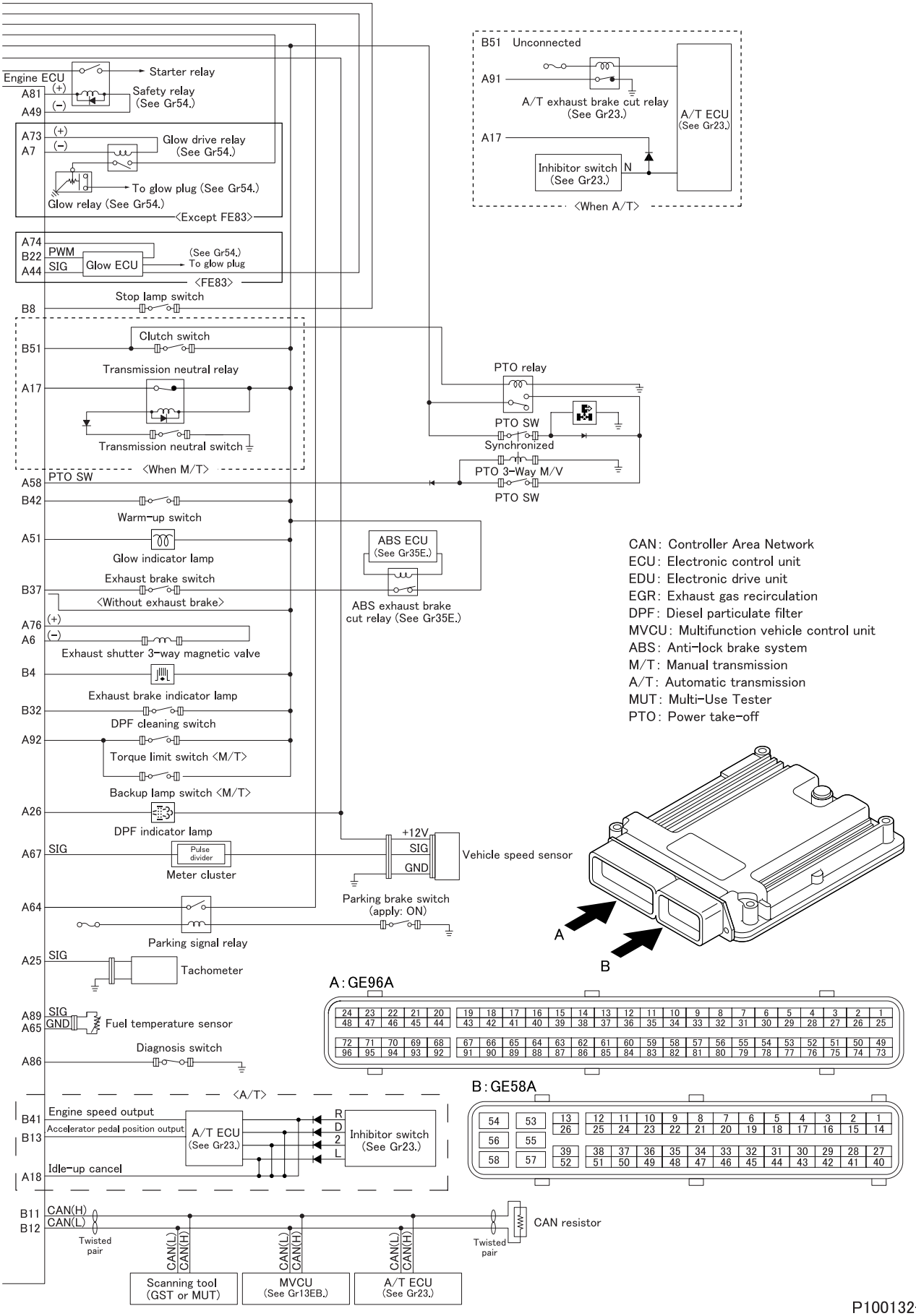
(3) Erasing of fault code

- Control status during fault is back to normal with the fault location serviced. Although it depends on fault code, the warning lamp is not extinguished until the driving cycle has been repeated several times.
- The driving cycle means a period of a series of engine operations from engine start with starter switch ON to completion of after-run sequence with the starter switch OFF.

3. Electronic Control Unit Connection Diagram



P100132-1E



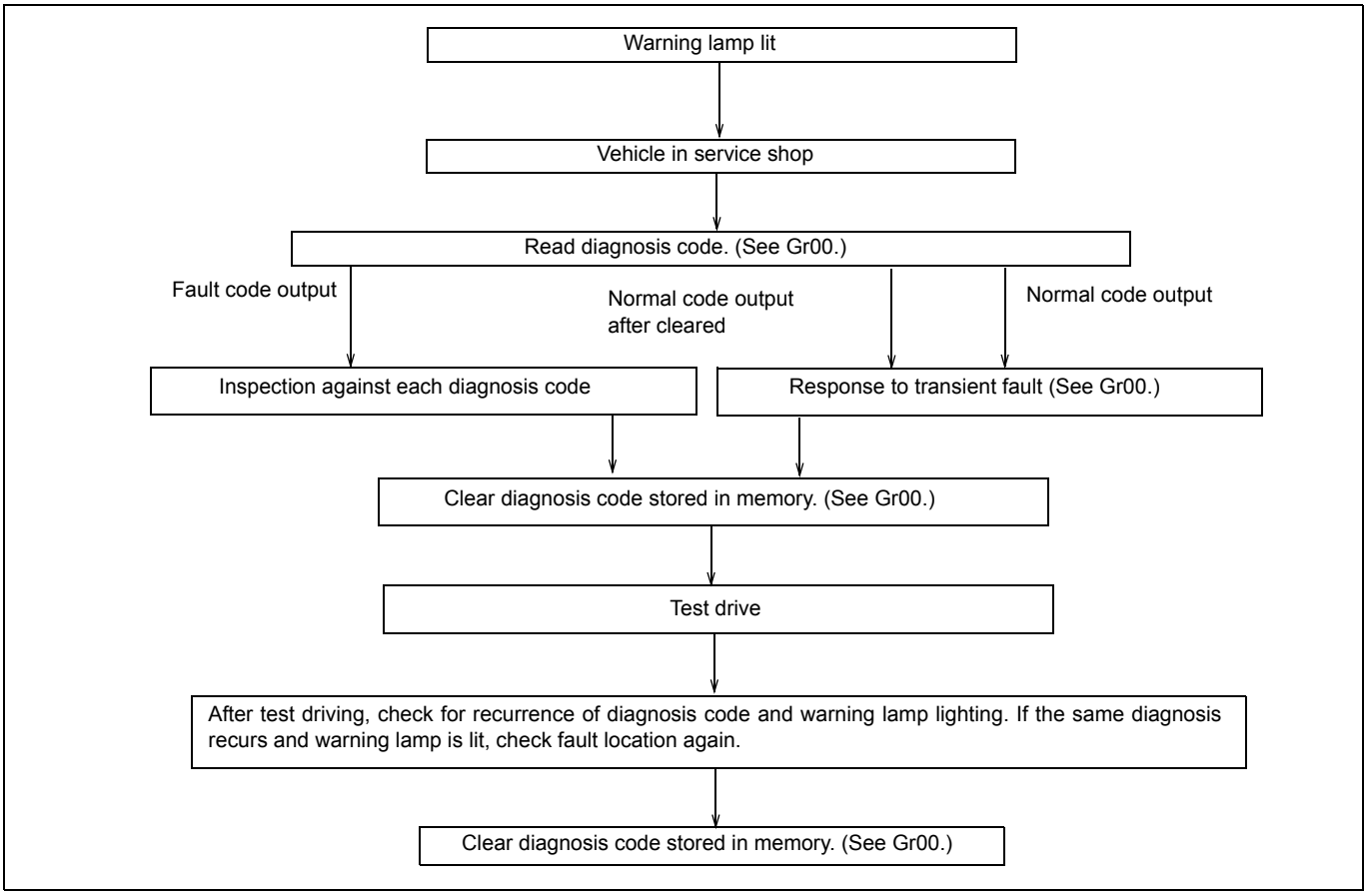
CAN: Controller Area Network
ECU: Electronic control unit
EDU: Electronic drive unit
EGR: Exhaust gas recirculation
DPF: Diesel particulate filter
MVCU: Multifunction vehicle control unit
ABS: Anti-lock brake system
M/T: Manual transmission
A/T: Automatic transmission
MUT: Multi-Use Tester
PTO: Power take-off

P100132-2E

TROUBLESHOOTING

1. Diagnosis Procedure

- Carry out system inspection in accordance with the flow chart given below.
- System inspection is roughly divided into two types as follows according to trouble symptom and diagnosis code.
  - Inspection against each diagnosis code stored in memory by the electronic control unit
  - Response to transient fault



2. Diagnostic Precautions

- Before measuring voltage, check the charge and specific gravity of the battery. If system inspection is performed with the battery uncharged or reduced in specific gravity, accurate measurements cannot be achieved.
- To avoid possible damage to electric parts, set the starter switch and lighting switch to LOCK or OFF before disconnecting and reconnecting battery terminals.
- Before disconnecting connectors, set the starter to LOCK or OFF, then allow at least 20 seconds. Voltage may remain in electric parts or connected circuit.
- When performing measurement with the tester, internal circuit and other electrical parts of the electronic control unit could be damaged by the test bar. To avoid it, handle the test bar carefully not to cause a short-circuit failure between connector terminals or between connector and body.
- Resistance is affected by temperature. Determine the necessity of resistance measurement by reference to given temperature specification as a guide. Otherwise, use normal temperature (10 to 35°C {50 to 95°F}) as the measuring condition.

NOTE

When installing the new electronic control unit by the replacement, the data must be stored in the electronic control unit. (See “Registration and Alteration of Data in Engine Electronic Control Unit”)

3. Inspections Based on Fault Codes

3.1 Fault code list

- Fault codes can be monitored through the scanning tool (General Scanning Tool or Multi-Use Tester) or the flashing of the warning lamp in the meter cluster.
- There are two kinds of fault codes, i.e., fault code displayed by the General Scanning Tool or Multi-Use Tester and flash code given by the flashing of the warning lamp.
- Scanning tool (General Scanning Tool or Multi-Use Tester) can display diagnosis codes that are more specific than flash codes.
- Diagnosis codes asterisked in the list differ in fault diagnosis period according to the fault diagnosis condition. (For details on fault diagnosis condition, see “Inspection against Each Diagnosis Code”)
- Occurrence of diagnosis codes marked with ■ or ▲ in the list depends on vehicle specification.
  ■: Automatic transmission
  ▲: FE83

Fault code		Monitor	Fault (outline)	Warning		Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code			Orange	Red		
P0002	63	Failure of MPROP (rail pressure control valve)	MPROP (rail pressure control valve) control saturated	O		Fuel system	IMD
P0003	63	Failure of MPROP (rail pressure control valve)	Low signal range check	O		Fuel system (Low)	IMD
P0004	63	Failure of MPROP (rail pressure control valve)	High signal range check	O		Fuel system (High)	IMD
*P0016	12, 14, 15	Both speed sensor (Engine speed sensor, Cylinder recognition sensor)	• Cam/crank signals present • Gap phase shift	O		Ne SNSR Offset/Backup Mode	IMD
P0045	51	Failure of turbocharger actuator	Circuit	O		VGT Acutuator (Open)	2DC
P0046	51	Failure of turbocharger actuator	Circuit	O		VGT Acutuator (Performance)	2DC
P0047	51	Failure of turbocharger actuator	Circuit	O		VGT Acutuator (Low)	2DC
P0069	19	Characteristic abnormality of atmospheric pressure sensor (built into engine electronic control unit)	Gain and offset drift	O		Boost Press SNSR (Correlation)	2DC
P0087	36	Abnormality of common rail pressure (comparison)	Rail pressure regulator adjustment	O		CRS (Too Low)	IMD
*P0088	23	Abnormality of common rail pressure (pressure: high)	Plausibility	O	O	CRS (Too High)	IMD
P0089	63	Failure of MPROP (rail pressure control valve)	Overload	O		MPROP (Over Load)	IMD
P0090	63	Failure of MPROP (rail pressure control valve)	MPROP (rail pressure control valve) open – circuit	O		MPROP (Open Circuit)	IMD
P0091	63	Failure of MPROP (rail pressure control valve)	MPROP (rail pressure control valve) short circuit	O		MPROP (Low)	IMD
P0092	63	Failure of MPROP (rail pressure control valve)	MPROP (rail pressure control valve) short circuit	O		MPROP (High)	IMD
P0093	22	Abnormality of common rail pressure (fuel leakage)	Fuel leakage		O	CRS (Fuel Leak)	IMD
P0097	9	Failure of boost air temperature sensor	Low signal range check	O		INT Air Temp SNSR2 (Low)	2DC

IMD: Immediate
DC[Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.

Fault code		Monitor	Fault (outline)	Warning		Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code			Orange	Red		
P0098	9	Failure of boost air temperature sensor	High signal range check	O		INT Air Temp SNSR2 (High)	2DC
P0101	17	Characteristic abnormality in air flow sensor	Gain and offset drift	O		Airflow Sensor (Plausibility)	2DC
P0102	17	Failure of air flow sensor	Low signal range check	O		Airflow Sensor (Low)	2DC
P0103	17	Failure of air flow sensor	High signal range check	O		Airflow Sensor (High)	2DC
P0112	44	Failure of intake air temperature sensor	Low signal range check	O		INT Air Temp SNSR (Low)	2DC
P0113	44	Failure of intake air temperature sensor	High signal range check	O		INT Air Temp SNSR (High)	2DC
P0117	21	Failure of water temperature sensor	Low signal range check	O		Water Temp SNSR (Low)	2DC
P0118	21	Failure of water temperature sensor	High signal range check	O		Water Temp SNSR (High)	2DC
P011A	21	Characteristic abnormality of water temperature sensor	Gain drift	O		Water Temp SNSR	2DC
P0122	24	Failure of accelerator pedal position sensor 1	Low signal range check	O		Accel Pedal Sensor 1	IMD
P0123	24	Failure of accelerator pedal position sensor 1	High signal range check	O		Accel Pedal Sensor 1	IMD
▲P0127	27	Abnormality of intercooler	Intercooler failure	O		Intake Air Temperature Too High	2DC
▲P0128	5	Failure of thermostat	Below regulating temperature	O		Coolant Thermostat	2DC
P0148	22	Abnormality of common rail pressure (pressure: low)	Plausibility		O	CRS (Fuel Delivery)	IMD
P0182	41	Failure of fuel temperature sensor	Low signal range check			Fuel Temp Sensor (inlet) Low	IMD
P0183	41	Failure of fuel temperature sensor	High signal range check			Fuel Temp Sensor (inlet) High	IMD
P0191	11	Characteristic abnormality of common rail pressure sensor	Offset	O		CRS Pressure SNSR (Plausibility)	IMD
P0192	11	Failure of common rail pressure sensor	Low signal range check	O		CRS Pressure SNSR (Low)	IMD
P0193	11	Failure of common rail pressure sensor	High signal range check	O		CRS Pressure SNSR (High)	IMD
P0201	37	Failure of injector magnetic valve (No. 1 cylinder)	Injector open circuit (No. 1 cylinder)	O		Injector M/V-Cylinder 1 (Load)	IMD
P0202	8	Failure of injector magnetic valve (No. 2 cylinder)	Injector open circuit (No. 2 cylinder)	O		Injector M/V-Cylinder 2 (Load)	IMD
P0203	38	Failure of injector magnetic valve (No. 3 cylinder)	Injector open circuit (No. 3 cylinder)	O		Injector M/V-Cylinder 3 (Load)	IMD
P0204	39	Failure of injector magnetic valve (No. 4 cylinder)	Injector open circuit (No. 4 cylinder)	O		Injector M/V-Cylinder 4 (Load)	IMD
P0219	7	Abnormality of engine speed	High signal range check		O	Engine Overrunning	IMD
P0222	16	Failure of accelerator pedal position sensor 2	Low signal range check	O		Accel Pedal Sensor 2	IMD

IMD: Immediate

DC[Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.

Fault code		Monitor	Fault (outline)	Warning		Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code			Orange	Red		
P0223	16	Failure of accelerator pedal position sensor 2	High signal range check	O		Accel Pedal Sensor 2	IMD
P0226	28	Failure of intake throttle	• Signal range check • Ref voltage	O		Throttle Valve Position	2DC
*P0234	32, 54	Overboost	Overboost	O	O	Over Boost	2DC IMD
P0236	32	Characteristic abnormality of boost pressure sensor	• Offset and gain drift (High) • Offset and gain drift (Low)	O		Boost Press SNSR (Plausi)	2DC
P0237	32	Failure of boost pressure sensor	Low signal range check	O		Boost Press SNSR (Low)	2DC
P0238	32	Failure of boost pressure sensor	High signal range check	O		Boost Press SNSR (High)	2DC
P0251	36	Valve opening of common rail safety valve (DBV)	Common rail pressure (maximum)		O	Common Rail Pressure Defect	IMD
P0253	22	Rail pressure is abnormal (to low) during opening of safety valve (DBV).	Common rail pressure (minimum)		O	Common Rail Pressure Defect	IMD
*P0254	23	Rail pressure is abnormal (to high) during opening of safety valve (DBV).	• Pressure shock • Not open • Common rail pressure (maximum)		O	Common Rail Pressure Defect	IMD
P0261	37	Failure of injector magnetic valve (No. 1 cylinder)	Injector short circuit (No. 1 cylinder)	O		Injector #1-A (Low)	IMD
P0262	37	Failure of injector magnetic valve (No. 1 cylinder)	Injector short circuit (No. 1 cylinder)	O		Injector #1-A (High)	IMD
▲P0263	53	Abnormality in cylinder balance correction	Cylinder balancing out of range	O		Injector #1-A (Plausibility)	2DC
P0264	8	Failure of injector magnetic valve (No. 2 cylinder)	Injector short circuit (No. 2 cylinder)	O		Injector #2-A (Low)	IMD
P0265	8	Failure of injector magnetic valve (No. 2 cylinder)	Injector short circuit (No. 2 cylinder)	O		Injector #2-A (High)	IMD
▲P0266	53	Abnormality in cylinder balance correction	• Cylinder balancing out of range • Sensor signal range check • Ref voltage	O		Injector #2-A (Plausibility)	2DC
P0267	38	Failure of injector magnetic valve (No. 3 cylinder)	Injector short circuit (No. 3 cylinder)	O		Injector #3-A (Low)	IMD
P0268	38	Failure of injector magnetic valve (No. 3 cylinder)	Injector short circuit (No. 3 cylinder)	O		Injector #3-A (High)	IMD
▲P0269	53	Abnormality in cylinder balance correction	Cylinder balancing out of range	O		Injector #3-A (Plausibility)	2DC
P0270	39	Failure of injector magnetic valve (No. 4 cylinder)	Injector short circuit (No. 4 cylinder)	O		Injector #4-A (Low)	IMD
P0271	39	Failure of injector magnetic valve (No. 4 cylinder)	Injector short circuit (No. 4 cylinder)	O		Injector #4-A (High)	IMD
▲P0272	53	Abnormality in cylinder balance correction	Cylinder balancing out of range	O		Injector #4-A (Plausibility)	2DC
▲P0299	32	Underboost	Underboost	O		Turbocharger (Underboost)	2DC
▲P0300	45	Cylinder misfire (multiple cylinders)	Misfire multiple cylinders	O		Multiple Cylinder Misfire	2DC

IMD: Immediate

DC[Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.

Fault code		Monitor	Fault (outline)	Warning		Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code			Orange	Red		
▲P0301	45	Cylinder misfire (individual cylinders)	Misfire individual cylinder 1	O		Cylinder 1 Misfire	2DC
▲P0302	45	Cylinder misfire (individual cylinders)	Misfire individual cylinder 2	O		Cylinder 2 Misfire	2DC
▲P0303	45	Cylinder misfire (individual cylinders)	Misfire individual cylinder 3	O		Cylinder 3 Misfire	2DC
▲P0304	45	Cylinder misfire (individual cylinders)	Misfire individual cylinder 4	O		Cylinder 4 Misfire	2DC
P0335	15	Failure of engine speed sensor	No pulse check	O		Engine Revolution SNSR	IMD
*P0339	15	Failure of engine speed sensor	Abnormality of pulse count	O	O	Engine Revolution SNSR (Plausi)	IMD
P0340	12	Failure of cylinder recognition sensor	No pulse check	O		Camshaft Position SNSR	IMD
P0344	12	Failure of cylinder recognition sensor	Abnormality of pulse count	O		Camshaft Position SNSR (Plausi)	IMD
▲P0381	26	Failure of preheating indicator lamp	• Short circuit battery • Short circuit ground • Open circuit • Overload	O		Glow Lamp	2DC
P0383	26	Failure of preheating control	Short circuit ground	O		Relay for Glow Relay	2DC
P0384	26	Failure of preheating control	Short circuit battery	O		Relay for Glow Relay	2DC
P0401	2	Insufficient air flow rate in exhaust gas recirculation system	• Exhaust gas recirculation system insufficient flow • Exhaust gas recirculation mass flow too low	O		EGR Flow (Insufficient)	2DC
P0402	2	Excessive air flow rate in exhaust gas recirculation system	• Exhaust gas recirculation system excessive flow • Exhaust gas recirculation mass flow too high	O		EGR Flow (Excessive)	2DC
P0403	2, 67	Failure of exhaust gas recirculation system	• Circuit • Plausibility	O		EGR1 (Actuator Circuit)	2DC
P0404	67	Failure of exhaust gas recirculation valve	• Circuit • Open valve	O		EGR System	2DC
P0409	67	Failure of exhaust gas recirculation valve	• Low signal range check • High signal range check	O		EGR1 (Position Sensor)	2DC
P0426	42	Characteristic abnormality of catalytic temperature sensor	Gain and offset drift	O		EXH Gas Temp SNSR1 (Plausibility)	2DC
P0427	42	Failure of catalytic temperature sensor	Low signal range check	O		EXH Gas Temp SNSR1 (Low)	2DC
P0428	42	Failure of catalytic temperature sensor	High signal range check	O		EXH Gas Temp SNSR1 (High)	2DC
P0470	92	Characteristic abnormality of DPF absolute pressure sensor and DPF pressure sensor (DIFF)	• Gain drift • Offset and gain drift	O		DPF Press SNSR (Plausi)	2DC
P0471	98	Failure of DPF absolute pressure sensor	Offset drift	O		DPF Press SNSR (Plausi)	2DC

IMD: Immediate

DC[Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.

Fault code		Monitor	Fault (outline)	Warning		Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code			Orange	Red		
P0472	98	Failure of DPF absolute pressure sensor	Low signal range check	O		DPF Press SNSR (Low)	2DC
P0473	98	Failure of DPF absolute pressure sensor	High signal range check	O		DPF Press SNSR (High)	2DC
▲P0476	93	Failure of exhaust brake	Valve stuck open/shut	O		Exhaust Brake PWR (Performance)	2DC
P0489	67	Failure of exhaust gas recirculation system	Power out of range	O		EGR Power Supply	2DC
P0490	67	Failure of exhaust gas recirculation system	Power out of range	O		EGR Power Supply	2DC
*P0500	25	Failure of vehicle speed sensor	Signal	O	O	Vehicle Speed Sensor	2DC IMD
P0502	25	Failure of vehicle speed sensor	Too low	O		Vehicle Speed Sensor (Low)	2DC
P0503	25	Failure of vehicle speed sensor	Too high	O		Vehicle Speed Sensor (High)	2DC
▲P0506	52	Abnormality in idling control (idling speed is too low)	Idle speed too low	O		Idle Volume	2DC
▲P0507	52	Abnormality in idling control (idling speed is too high)	Idle speed too high	O		Idle Volume	2DC
P0544	87	Characteristic abnormality of DPF temperature sensor 1	Gain and offset drift	O		DPF Temp SNSR (upstream)	2DC
P0545	87	Failure of DPF temperature sensor 1	Low signal range check	O		DPF Temp SNSR (upstream) Low	2DC
P0546	87	Failure of DPF temperature sensor 1	High signal range check	O		DPF Temp SNSR (upstream) High	2DC
*P0562	33	Failure inside engine electronic control unit	Low signal range check	O	O	Power Supply Voltage (Low)	2DC IMD
*P0563	33	Failure inside engine electronic control unit	High signal range check	O	O	Power Supply Voltage (High)	2DC IMD
P0600	64, 76	Abnormality of speed limitation device system	• Controller area network • Message timeout		O	CAN Communication	IMD
P0605	33	Failure inside engine electronic control unit	Electronic controll unit		O	ECU System (Hardware)	IMD
*P0607	33	Failure inside engine electronic control unit	Injector driver circuit	O	O	ECU System	IMD
P060B	33	Failure inside engine electronic control unit	A/D Converter fault	O		A/D Converter	IMD
P0611	47	Injector adjustment data	Electronic controll unit		O	No adjustment data of injector	IMD
P0615	48	Failure of safety relay	Overload		O	Starter Safety Relay (Over Load)	IMD
P0616	48	Failure of safety relay	• Short circuit ground • Open circuit		O	Starter Safety Relay (Low)	IMD
P0617	48	Failure of safety relay	Short circuit battery		O	Starter Safety Relay (High)	IMD

IMD: Immediate

DC[Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.

Fault code		Monitor	Fault (outline)	Warning		Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code			Orange	Red		
P061B	33	Failure inside engine electronic control unit	Plausibility		O	ECU Performance (Calc)	IMD
P061C	33	Failure inside engine electronic control unit	Plausibility		O	ECU Performance (Ne)	IMD
P062D	82	Failure of injector circuit inside engine electronic control unit	Injector driver circuit (No. 1 and 3 cylinders)	O		Injector Bank 1	IMD
P062E	82	Failure of injector circuit inside engine electronic control unit	Injector driver circuit (No. 2 and 4 cylinders)	O		Injector Bank 2	IMD
P0642	81	Sensor power supply abnormal	Low signal range check	O		Sensor Supply Voltage 1 (Low)	IMD
P0643	81	Sensor power supply abnormal	High signal range check	O		Sensor Supply Voltage 1 (High)	IMD
▲P0650	3	Failure of engine warning lamp (orange)	• Short circuit battery • Short circuit ground • Open circuit • Overload	O		MIL	2DC
P0652	81	Sensor power supply abnormail	Low signal range check	O		Sensor Supply Voltage 2 (Low)	IMD
P0653	81	Sensor power supply abnormail	High signal range check	O		Sensor Supply Voltage 2 (High)	IMD
P0657	79	Abnormality of magnetic valve power supply	Short circuit ground		O	M/V Voltage (Low)	IMD
P0670	26	Failure of preheating control system	• Open circuit • Overload • GCU communication error	O		Glow ECU	2DC
▲P0671	26	Failure of preheating control system	No. 1 cylinder fault	O		Glow Plug 1	2DC
▲P0672	26	Failure of preheating control system	No. 2 cylinder fault	O		Glow Plug 2	2DC
▲P0673	26	Failure of preheating control system	No. 3 cylinder fault	O		Glow Plug 3	2DC
▲P0674	26	Failure of preheating control system	No. 4 cylinder fault	O		Glow Plug 4	2DC
▲P0684	26	Failure of preheating control	Overload	O		Glow ECU communication	2DC
P0685	84	Failure of electronic drive unit relay	Open circuit	O		EDU Relay (Open)	2DC
P0686	84	Failure of electronic drive unit relay	Short circuit ground	O		EDU Relay (Low)	2DC
P0687	84	Failure of electronic drive unit relay	Short circuit battery	O		EDU Relay (High)	2DC
P0688	84	Failure of electronic drive unit relay	Overload	O		EDU Relay (Over Load)	2DC
P0698	81	Sensor power supply abnormal	Low signal range check	O		Sensor Supply Voltage 3 (Low)	IMD
P0699	81	Sensor power supply abnormal	High signal range check	O		Sensor Supply Voltage 3 (High)	IMD

IMD: Immediate

DC[Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.

Fault code		Monitor	Fault (outline)	Warning		Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code			Orange	Red		
▲■P0700	71	Failure of automatic transmission control	Fault present in TCM (TCM: Transmission Control Module)	O		Transmission ECU MIL Request	IMD
P1169	56	Characteristic value of air flow sensor	Electronic control unit		O	Abnormal adjustment data of AFS	IMD
P1170	34	Injection quantity adjustment data	Electronic control unit		O	Abnormal adjustment data of Q	IMD
P1410	92	Excessive exhaust pressure	• Low signal range check • High signal range check		O	Exhaust Absolute Pressure (High)	IMD
P1411	88	Diesel particulate filter is overheated.	• Low signal range check • High signal range check • Plausibility		O	Excessive exhaust Temperature	IMD
P1412	92	Temperature increase is insufficient for automatic diesel particulate filter regeneration control	Plausibility			DPF Temp Abnormal1 (Auto)(Low)	IMD
P1413	92	Temperature increase is insufficient for automatic diesel particulate filter regeneration control	Plausibility			DPF Temp Abnormal2 (Auto)(Low)	IMD
P1414	92	Temperature increase is insufficient for automatic diesel particulate filter regeneration control	Plausibility			DPF Temp Abnormal3 (Auto)(High)	IMD
P1415	92	Failure of automatic diesel particulate filter regeneration control	Plausibility			DPF Interval Abnormal (Auto)	IMD
P1416	92	Temperature increase is insufficient for manual diesel particulate filter regeneration control	Plausibility		O	DPF Temp Abnormal1 (Manual)(Low)	IMD
P1417	92	Temperature increase is insufficient for manual diesel particulate filter regeneration control	Plausibility		O	DPF Temp Abnormal2 (Manual)(Low)	IMD
P1418	92	Temperature increase is insufficient for manual diesel particulate filter regeneration control	Plausibility		O	DPF Temp Abnormal3 (Manual)(High)	IMD
P1419	92	Failure of manual diesel particulate filter regeneration control	Plausibility		O	DPF Interval Abnormal (Manual)	IMD
P1421	92	Diesel particulate filter clogged	Plausibility		O	PM accumulation amount level 1	IMD
P1422	92	Diesel particulate filter clogged	Plausibility		O	PM accumulation amount level 2	IMD
P1430	78	Failure of diesel particulate filter cleaning switch	Plausibility			DPF Regeneration Switch	IMD
P1435	92	Diesel particulate filter broken	Efficiency below threshold (blocked diesel particulate filter)	O		Exhaust Relative Pressure (Low)	2DC
P1440	92	For counter recording of diagnosis code P1412, P1413, P1414	Plausibility			DPF Temp Abnormal4 (Auto)	IMD

IMD: Immediate

DC[Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.

Fault code		Monitor	Fault (outline)	Warning		Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code			Orange	Red		
P1441	92	For counter recording of diagnosis code P1416, P1417, P1418	High signal range check			DPF Temp Abnormal4 (Manual)	IMD
P1632	73	Abnormality in controller area network 2 communication	Message timeout	O		CAN (EGR1 Time out)	2DC
P1635	74	Abnormality in controller area network 2 communication	Message timeout	O		CAN (Intake Throttle)	2DC
P1640	75	Abnormality in controller area network 2 communication	Time out	O		CAN Communication (W/G)	2DC
▲P1660	29	Failure of diesel particulate filter indicator lamp	• Short circuit battery • Short circuit ground • Open circuit • Overload	O		DPF Lamp Control Circuit (Low)	IMD
P2002	92	Diesel particulate filter clogged	Efficiency below threshold (leaking diesel particulate filter)	O		DPF MFF	2DC IMD
P2031	88	Characteristic abnormality of DPF temperature sensor 2	Gain and offset drift	O		Exhaust Gas Temp	2DC
P2032	88	Failure of DPF temperature sensor 2	Low signal range check	O		Exhaust Gas Temp (Low)	2DC
P2033	88	Failure of DPF temperature sensor 2	High signal range check	O		Exhaust Gas Temp (High)	2DC
P2080	42	Relative check between catalytic temperature sensor and DPF temperature sensor 1	Gain and offset drift	O		DOC Temp SNSR	2DC
P2084	92	Relative check between DPF temperature sensors (1 and 2)	Gain and offset drift	O		DOC Temp SNSR (Plausibility)	2DC
P2100	28	Failure of intake throttle system	Circuit check	O		TVA (Open)	2DC
P2101	28	Failure of intake throttle system	• Intake throttle valve slow response/steady state position deviation • Circuit check	O		TVA (System)	2DC
P2102	28	Failure of intake throttle system	Circuit check	O		TVA (Short)	2DC
P2108	28	Failure of intake throttle system	Plausibility	O		TVA (Controller)	2DC
P2120	65	Failure of accelerator pedal switch	Plausibility			Acc Switch	IMD
P2135	16, 24, 58	Failure of accelerator pedal position sensors (1 and 2)	Gain and offset drift	O		TVA SNSR (Voltage)	IMD
P2138	58	Failure of accelerator pedal position sensors (1 and 2)	• Low signal range check • High signal range check • Plausibility		O	Acc Sensor Correlation	IMD

IMD: Immediate

DC[Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.

Fault code		Monitor	Fault (outline)	Warning		Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code			Orange	Red		
P2147	82	Injector magnetic valve	Injector short circuit (No. 1 and 3 cylinders)	O		Injector Bank 1 (Low)	IMD
P2148	82	Injector magnetic valve	Injector short circuit (No. 1 and 3 cylinders)	O		Injector Bank 1 (High)	IMD
P2150	82	Injector magnetic valve	Injector short circuit (No. 2 and 4 cylinders)	O		Injector Bank 2 (Low)	IMD
P2151	82	Injector magnetic valve	Injector short circuit (No. 2 and 4 cylinders)	O		Injector Bank 2 (High)	IMD
P2169	93	Failure of exhaust shutter 3-way magnetic valve	Open circuit	O		Exhaust Valve Act (Open)	2DC
P2170	93	Failure of exhaust shutter 3-way magnetic valve	Short circuit ground	O		Exhaust Valve Act (Gnd)	2DC
P2171	93	Failure of exhaust shutter 3-way magnetic valve	Short circuit battery	O		Exhaust Valve Act (Batt)	2DC
P2184	21	Failure of water temperature sensor 2	Low signal range check	O		Water Temp SNSR2 (Low)	2DC
P2185	21	Failure of water temperature sensor 2	High signal range check	O		Water Temp SNSR2 (High)	2DC
▲P2187	52	Abnormality in idling control	Idle fuelling too low	O		Low Idle Speed (Low)	2DC
▲P2188	52	Abnormality in idling control	Idle fuelling too high	O		Low Idle Speed (High)	2DC
P2199	44	Characteristic abnormality of intake air temperature sensor	Gain and offset drift	O		EGR Temp Sensor (Correlation)	2DC
P2228	19	Failure of atmospheric pressure sensor (inside engine electronic control unit)	Low signal range check	O		Atm Press SNSR (Low)	2DC
P2229	19	Failure of atmospheric pressure sensor (inside engine electronic control unit)	High signal range check	O		Atm Press SNSR (High)	2DC
P2263	51	Turbocharger actuator system	• Turbocharger actuator slow response/steady state position deviation • Plausibility • Motor lock	O		VGT System	2DC
P2413	67, 95	Abnormality in exhaust gas recirculation valve position	• Exhaust gas recirculation valve slow response/ steady state position deviation • Plausibility	O		EGR System	2DC
▲P2423	46	Failure of front oxidation catalyst	Inactive (unable to generate exotherm for diesel particulate filter regeneration)	O		Catalyst Efficiency	2DC
*P2453	97	Failure of DPF pressure sensor (DIFF)	• Dynamic check • Offset check	O	O	DPF Diff SNSR (Plausi) & MFF	2DC IMD
P2454	97	Failure of DPF pressure sensor (DIFF)	Low signal range check	O		DPF Diff SNSR (Low) & MFF	2DC

IMD: Immediate

DC[Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.

Fault code		Monitor	Fault (outline)	Warning		Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code			Orange	Red		
P2455	97	Failure of DPF pressure sensor (DIFF)	High signal range check	O		DPF Diff SNSR (High) & MFF	2DC
▲P2457	2	Failure of exhaust gas recirculation cooler	Exhaust gas recirculation cooler failure	O		EGR Cooler Performance	2DC
▲P2459	92	Frequent diesel particulate filter regeneration	Excessive diesel particulate filter regeneration frequency (diesel particulate filter clogged up)	O		DPF Regeneration Frequency	2 Regen
P2533	66	Failure of starter switch	Open circuit at electronic control unit inout	O		Starter SW	2DC
P253C	61	Failure of auxiliary equipment sensor	Low signal range check			PTO Acc (Low)	IMD
P253D	61	Failure of auxiliary equipment sensor	High signal range check			PTO Acc (High)	IMD
P2563	51	Turbocharger actuator system	• Low signal range check • High signal range check	O		Boost Pressure Actuator	2DC
P2670	36	Abnormality of common rail pressure (comparison)	Short circuit ground		O	MPROP Voltage (Low)	IMD
U0001	73	Abnormality in controller area network 2 communication	Message timeout	O		High Speed CAN Communication	2DC
U0002	73	Abnormality in controller area network 2 communication	Controller area network B bus off	O		High Speed CAN Communication	2DC
U0028	72	Abnormality in controller area network 1 communication	Message timeout	O		Vehicle Communication Bus A	2DC
U0029	76	Abnormality in controller area network 1 communication	Controller area network A bus off	O		Vehicle Communication Bus Off	2DC
▲*U0101	76	Abnormality in controller area network (automatic transmission) communication	Engine warning lamp (orange) request message timeout	O		CAN (A/T ECU)	2DC IMD

IMD: Immediate

Regen: Regeneration

DC[Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.

[Fault code]
Diagnosis code: P0002/Flash code: 63
[Monitor]
Failure of MPROP (rail pressure control valve)
[Fault (outline)]
MPROP (rail pressure control valve) control saturated
[Diagnosis check]
- MPROP (rail pressure control valve) signal conversion (analog/digital) function in the engine electronic control unit is monitored for fault.

[Code generation condition]
- Signal remains unconverted for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- MPROP (rail pressure control valve) control is stopped.
- Misfire detection is stopped.
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of engine electronic control unit)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0003/Flash code: 63
[Monitor]
Failure of MPROP (rail pressure control valve)
[Fault (outline)]
Low signal range check
[Diagnosis check]
- MPROP (rail pressure control valve) is monitored for fault.

[Code generation condition]
- MPROP (rail pressure control valve) voltage exceeds 4 V.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

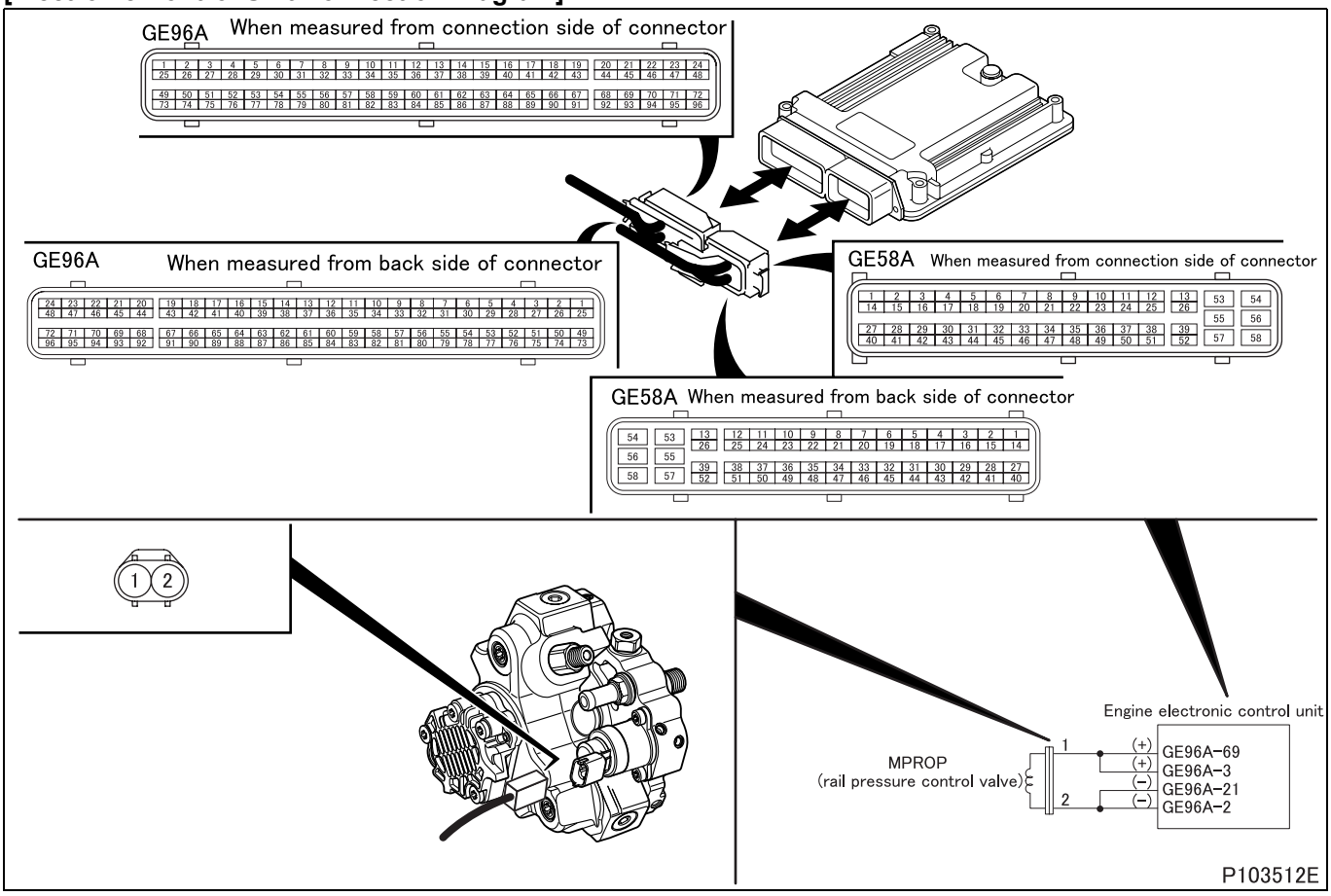
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- MPROP (rail pressure control valve) control is stopped.
- Misfire detection is stopped.
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

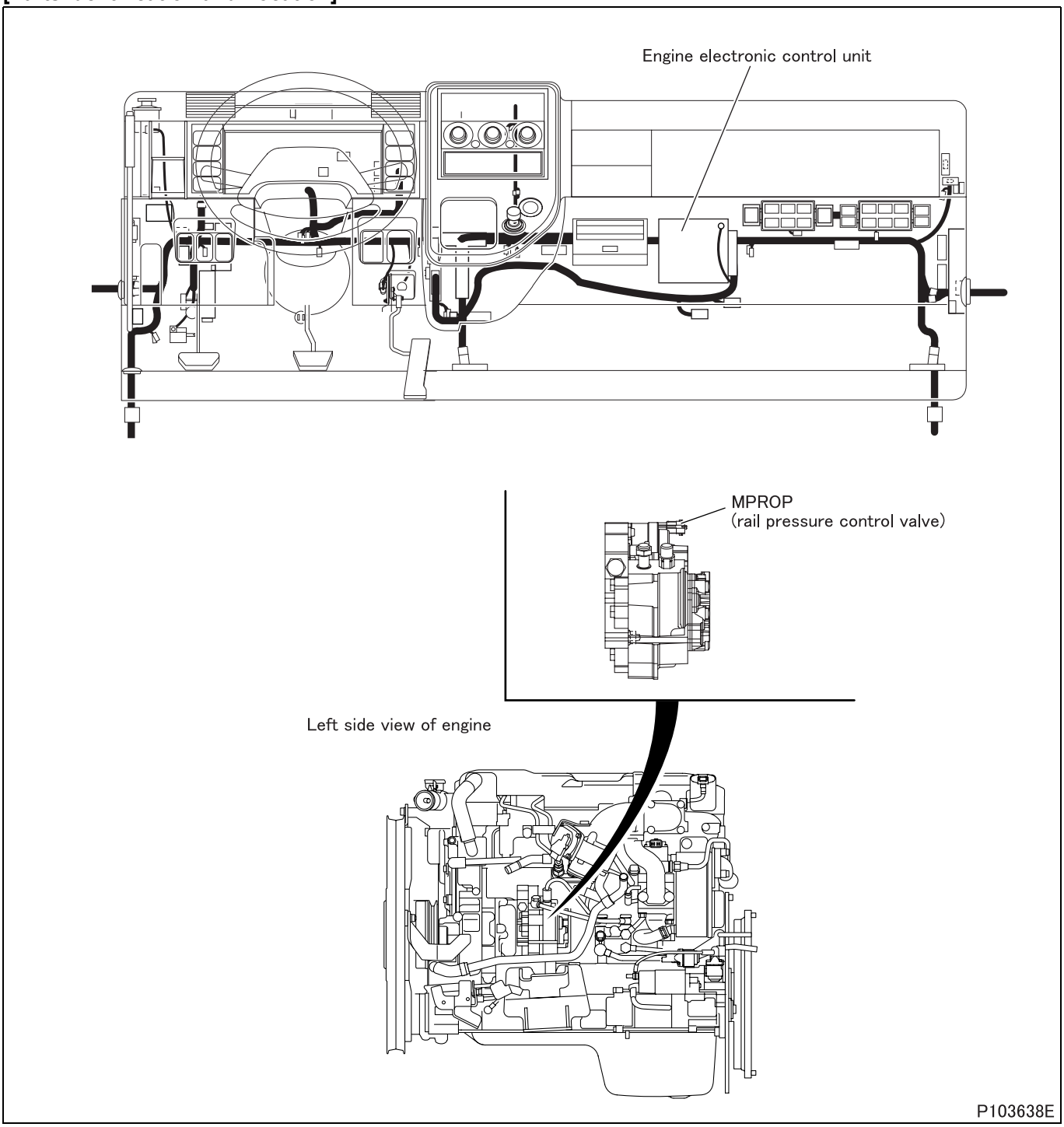
[Probable cause of trouble]
- Open-circuit of harness between electronic control unit and MPROP (rail pressure control valve)
- Malfunction of each connector
- Malfunction of MPROP (rail pressure control valve)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 3 or No. 69 and No. 2 or No. 21.
	Inspection condition		Disconnect electronic control unit and harness, and measure from connection side of harness connector.
	Requirements		2.6 to 3.15 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of MPROP (rail pressure control valve) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of supply pump
		NO	Modify connector.

[Fault code]
Diagnosis code: P0004/Flash code: 63
[Monitor]
Failure of MPROP (rail pressure control valve)
[Fault (outline)]
High signal range check
[Diagnosis check]
- MPROP (rail pressure control valve) is monitored for fault.

[Code generation condition]
- MPROP (rail pressure control valve) voltage remains below 0 V for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

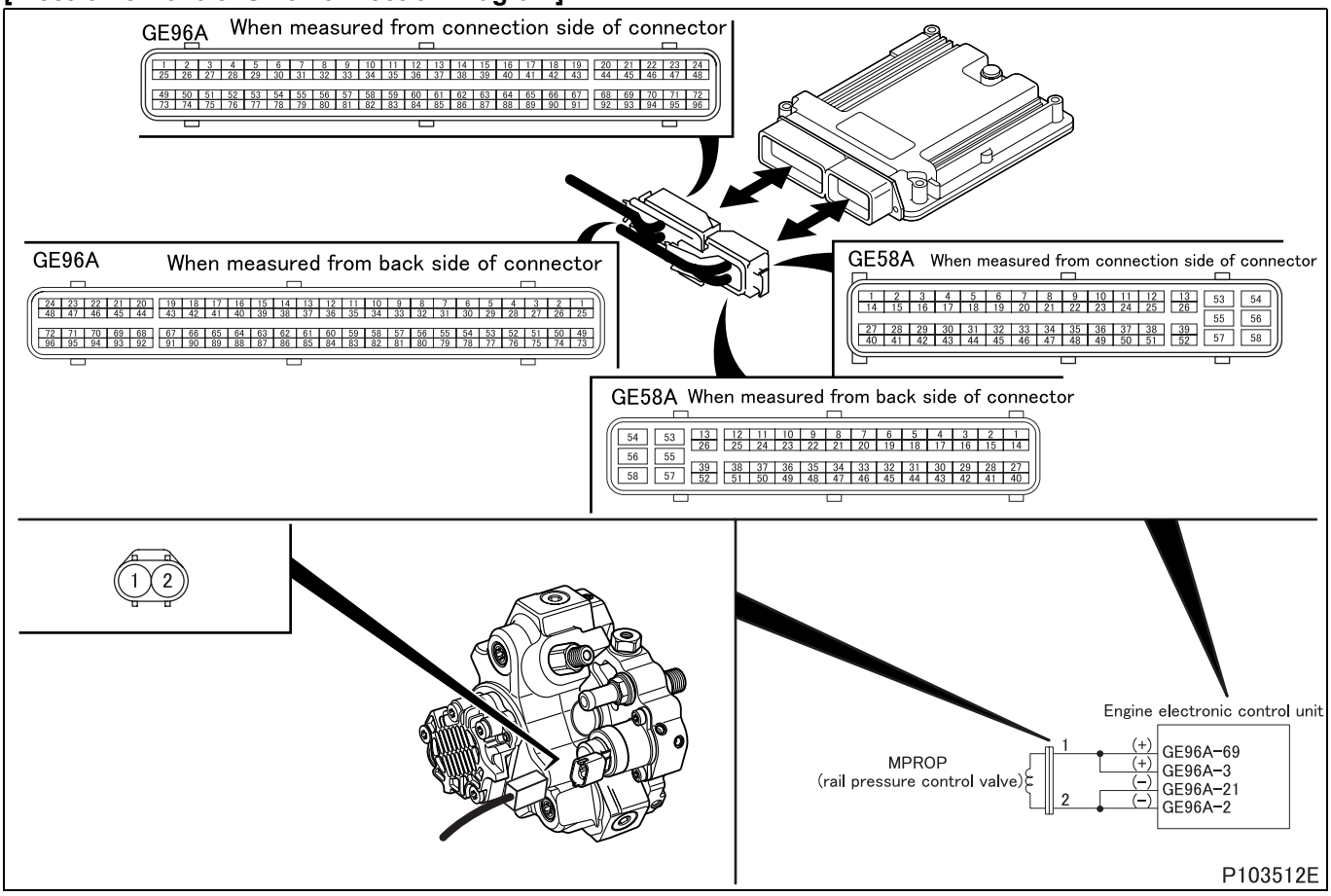
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- MPROP (rail pressure control valve) control is stopped.
- Misfire detection is stopped.
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

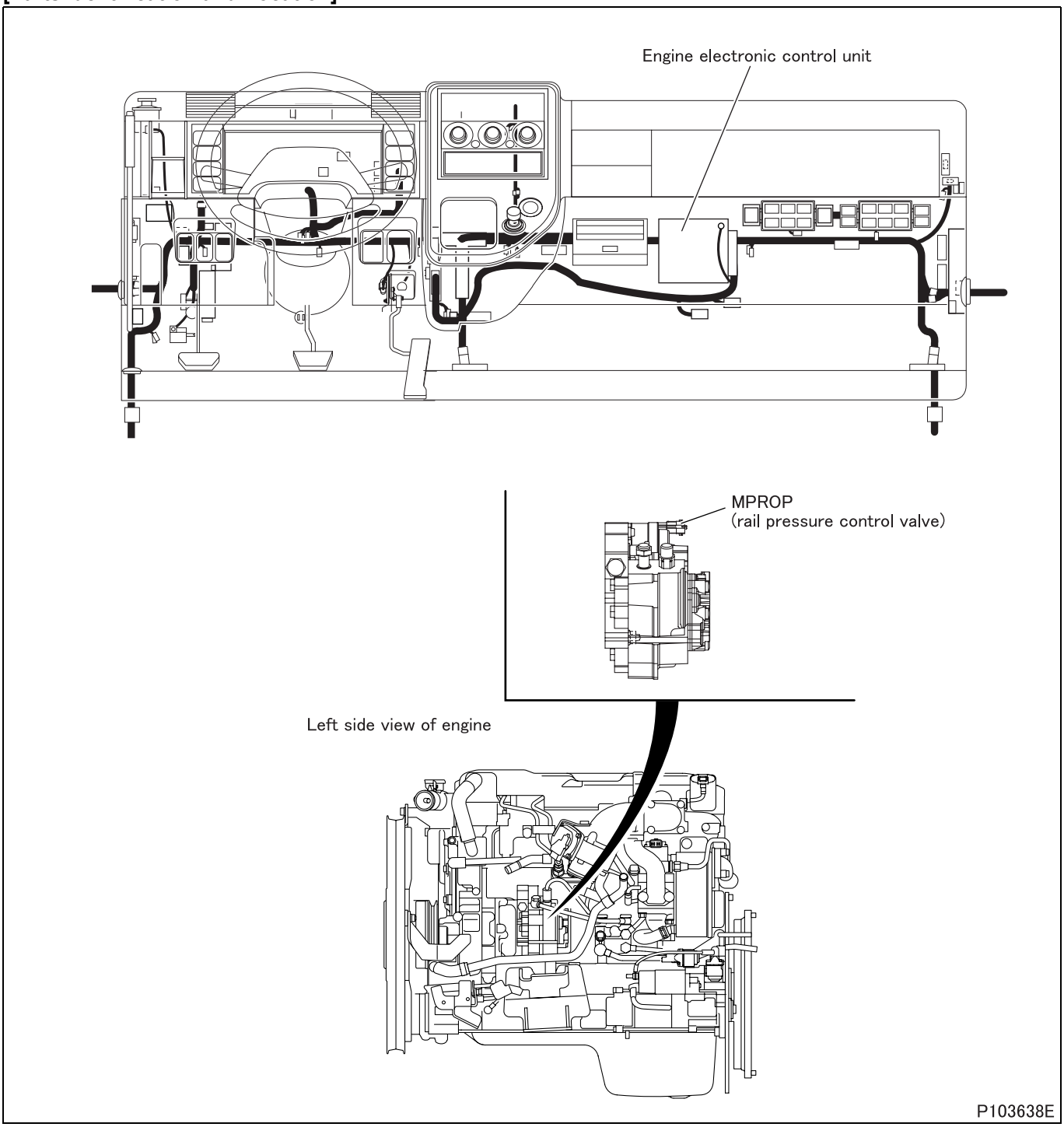
[Probable cause of trouble]
- Short-circuit harness between electronic control unit and MPROP (rail pressure control valve)
- Malfunction of each connector
- Malfunction of MPROP (rail pressure control valve)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 3 or No. 69 and No. 2 or No. 21.
	Inspection condition		Disconnect electronic control unit and harness, and measure from connection side of harness connector.
	Requirements		2.6 to 3.15 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of MPROP (rail pressure control valve) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of supply pump
		NO	Modify connector.

[Fault code]
Diagnosis code: P0016/Flash code: 12, 14, 15
[Monitor]
Both speed sensor (Engine speed sensor, Cylinder recognition sensor)
[Fault (outline)]
- Cam/crank signals present
- Gap phase shift

[Diagnosis check]
- Output signals of engine speed sensor and cylinder recognition sensor at engine start are compared for abnormality.

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Condition (1)>
- Input signals from engine speed sensor and cylinder recognition sensor remain unreceived for more than 6 consecutive seconds.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

<Condition (2)>
- Signals from engine speed sensor and cylinder recognition sensor differ by more than 12 pulses.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation.)

<Condition (3)>
- Backup control of cylinder recognition sensor is started due to failure of engine speed sensor.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
<Condition (1)>
- Engine operating mode: starting
- Safety relay: OFF

<Condition (2)>
- Starter switch: ON
- Engine speed: more than 20 rpm

<Condition (3)>
- Engine speed sensor: faulty

[Control effected by electronic control unit during fault]
- Electronic control unit differs in the way of control by the diagnosis check item.

<Condition (1)>
- Engine stopped

<Condition (2)>
- Misfire detection is stopped.
- Related fault check is stopped.

<Condition (3)>
- Engine torque is limited.
- Auto cruise control stopped
- Related fault check is stopped.

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of engine speed sensor
- Malfunction of cylinder recognition sensor
- Malfunction of electronic control unit

[Recoverability]

- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

<Condition (1)>

- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

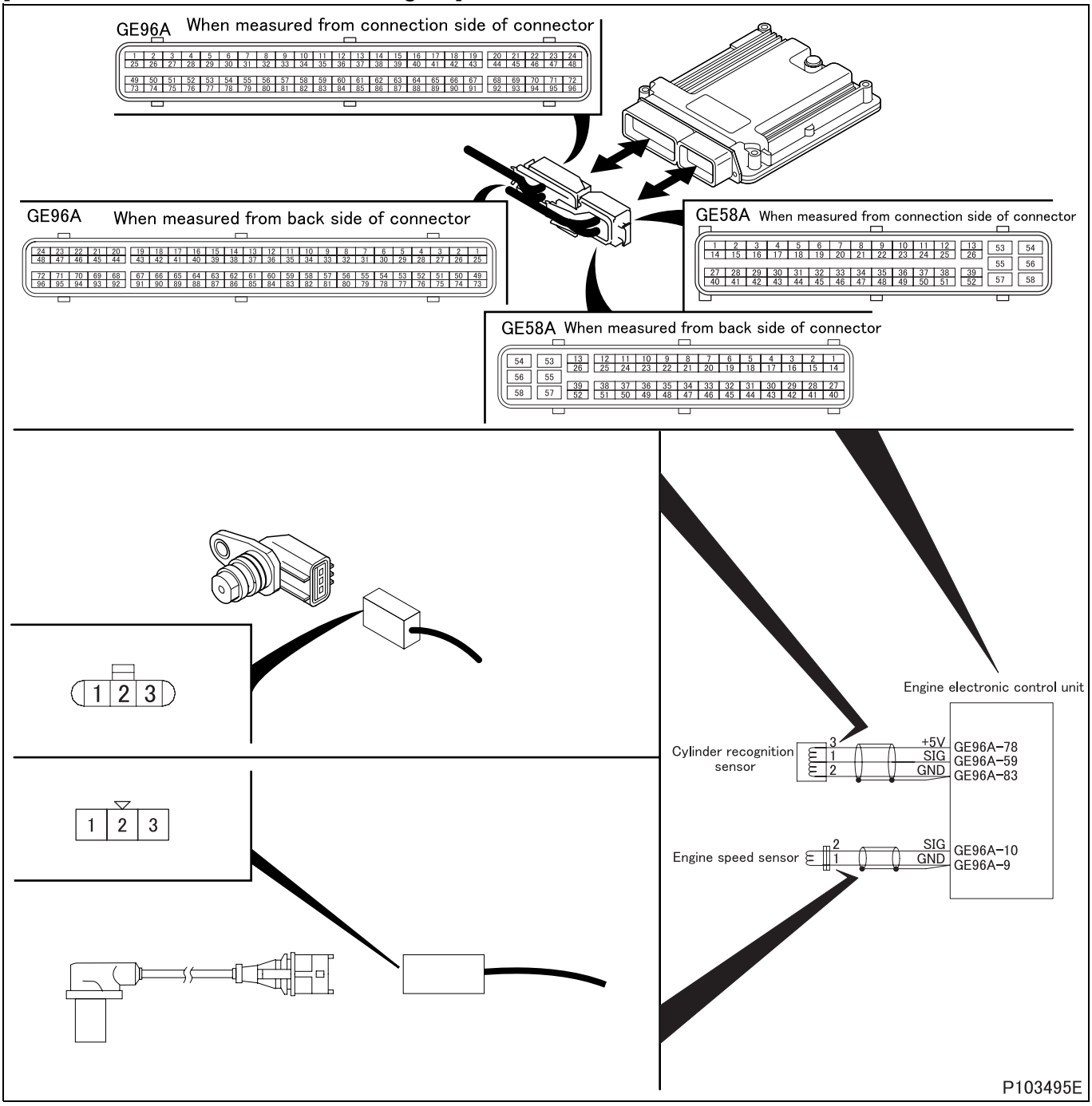
<Condition (2)>

- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

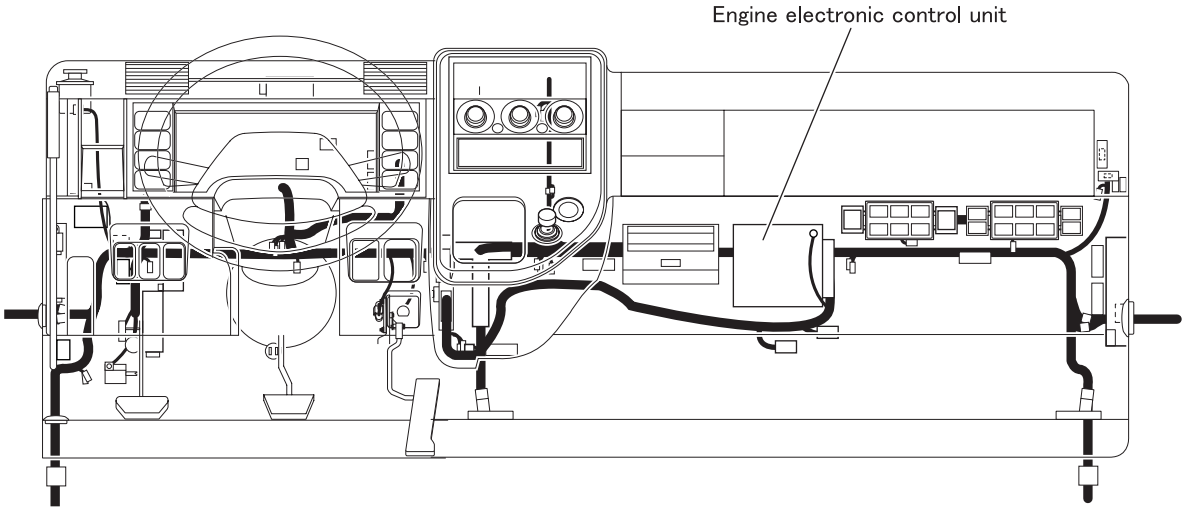
<Condition (3)>

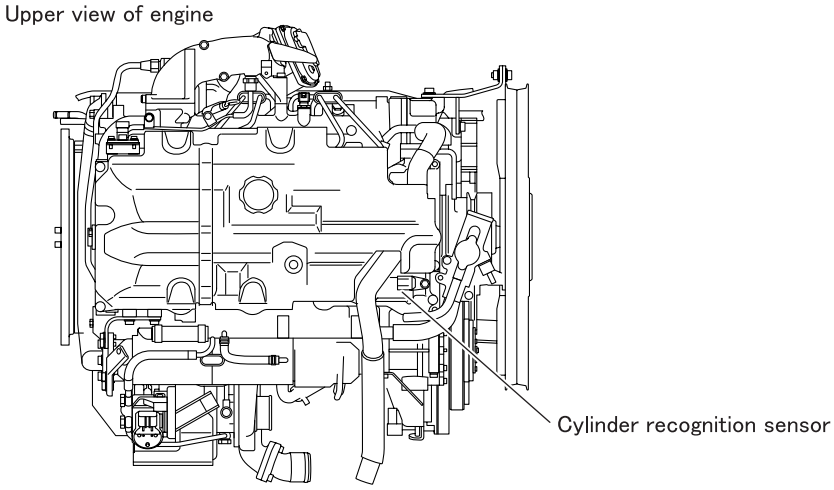
- Diagnosis code is cleared simultaneously with recovery.

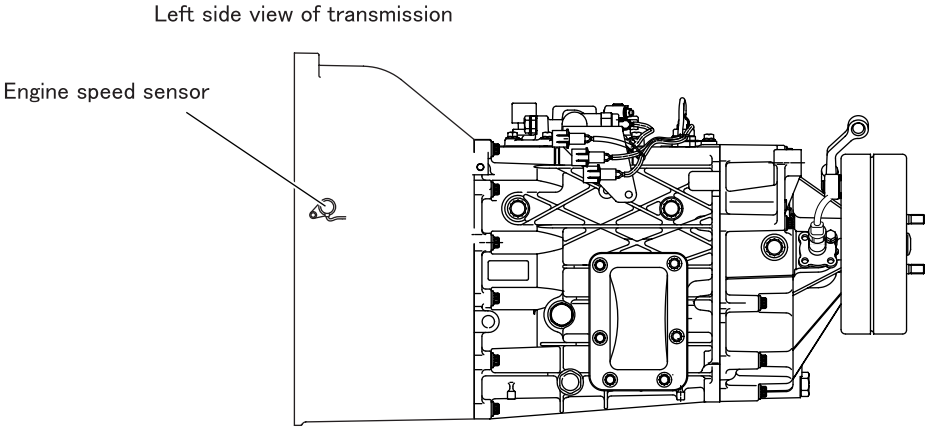
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]







P103623E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

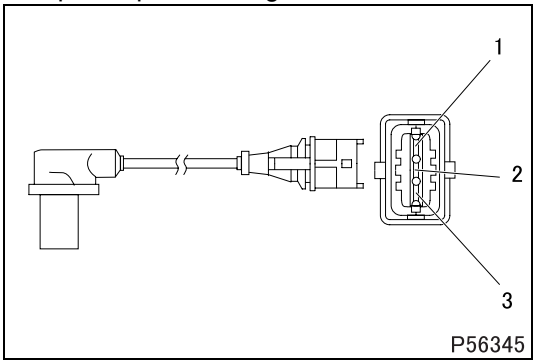
Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Ne”. **<Multi-Use Tester used>** • Measure item No. 01 “Engine Revolution” of Service Data.
	Inspection condition		–
	Requirements		Same indication as tachometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (engine speed sensor)
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 9 and 10.
	Inspection condition		Disconnect electronic control unit and harness, and measure from connection side of harness connector.
	Requirements		860 ± 86 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of engine speed sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of engine speed sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		860 ± 86 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of sensor

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between electronic control unit and engine speed sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 10
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between electronic control unit and engine speed sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 9
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by electronic control unit connector (signal) (cylinder recognition sensor)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 59 (+) and 83 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		1 V or more
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 8.

Step 8	Inspection items		Inspection by electronic control unit connector (power supply) (cylinder recognition sensor)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 78 (+) and 83 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Go to step 10.

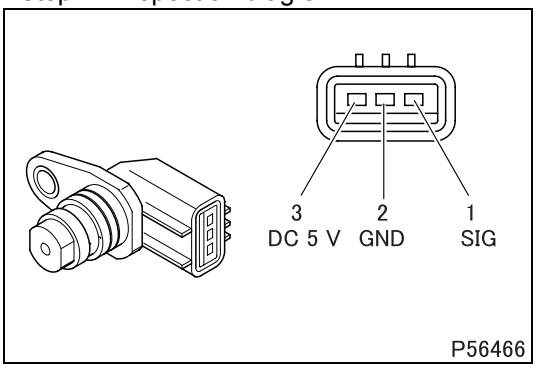
Step 9	Inspection items		Inspection by electronic control unit connector (ground) (cylinder recognition sensor)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 83 (+) and (GE58A) 53 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Go to step 10.

Step 10	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 17.
		NO	Modify connector.

Step 11	Inspection items		Inspection of cylinder recognition sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 12	Inspection items		Inspection of cylinder recognition sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 2 and 3.
	Inspection condition		–
	Requirements		200 to 1800 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of sensor

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of harness between electronic control unit and cylinder recognition sensor (power supply)
	Maintenance item		Measure value of voltage between sensor connector terminal No. 3 (+) and 2 (–).
	Inspection condition		• Remove connector and measure from harness side. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 15.
		NO	Go to step 14.

Step 14	Inspection items		Inspection of harness between electronic control unit and cylinder recognition sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 78
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 17.
		NO	Modify harness.

Step 15	Inspection items		Inspection of harness between electronic control unit and cylinder recognition sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 83
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Modify harness.

Step 16	Inspection items		Inspection of harness between electronic control unit and cylinder recognition sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 59
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 17.
		NO	Modify harness.

Step 17	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Ne”. **<Multi-Use Tester used>** • Measure item No. 01 “Engine Revolution” of Service Data.
	Inspection condition		–
	Requirements		Same indication as tachometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0045/Flash code: 51
[Monitor]
Failure of turbocharger actuator
[Fault (outline)]
Circuit
[Diagnosis check]
- Turbocharger electronic drive unit monitors built-in motor of turbocharger actuator for circuit fault and sends fault information to engine electronic control unit through controller area network communication.
- Monitoring by turbocharger electronic drive unit is performed from initial operational status of motor at starter switch ON.

[Code generation condition]
- Actuator motor circuit remains open as detected by electronic drive unit for 2 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

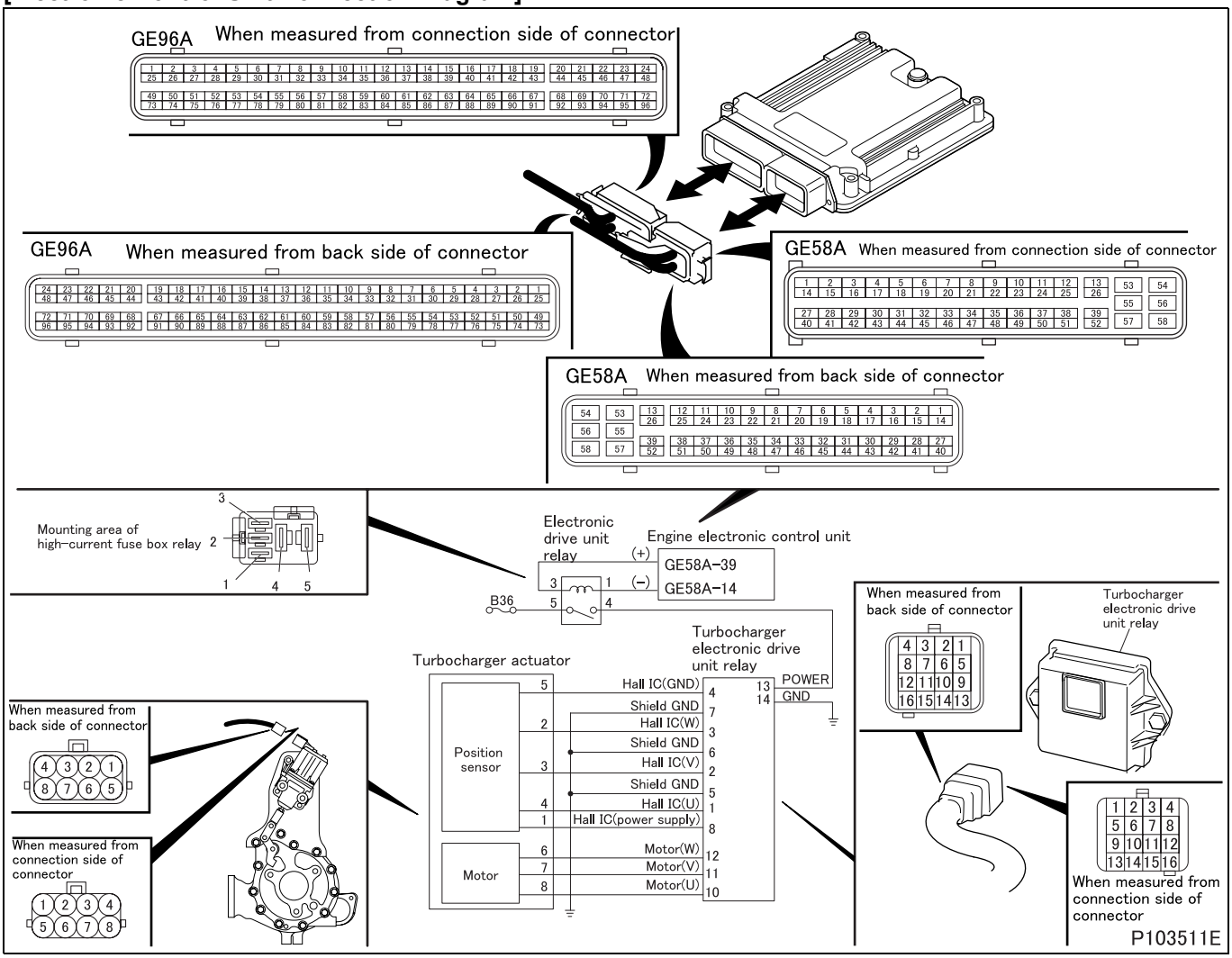
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

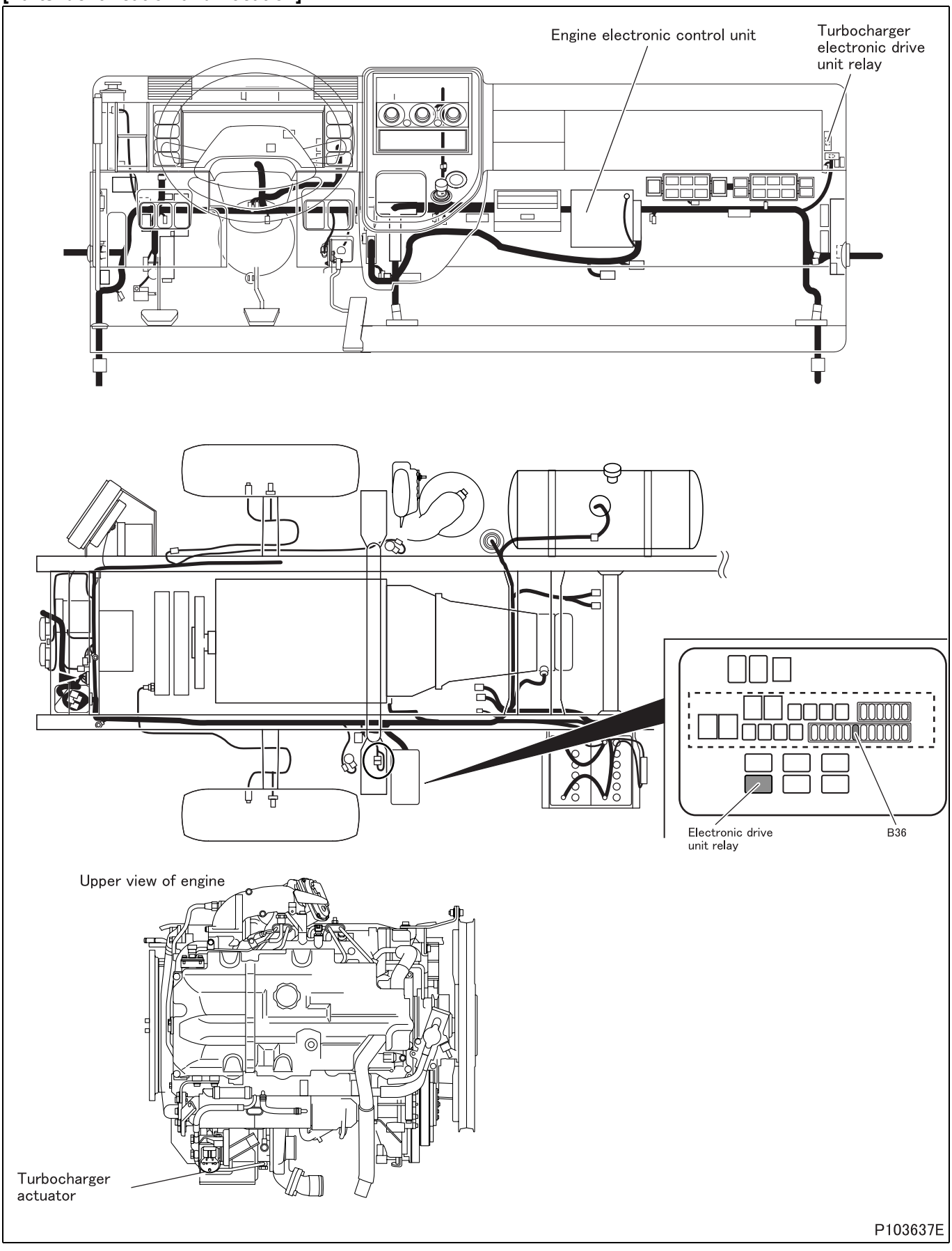
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and turbocharger actuator
- Malfunction of each connector
- Malfunction of turbocharger motor (built in turbocharger actuator)
- Malfunction of turbocharger position sensor (built in turbocharger actuator)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A4 “VGT 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “54: Target VGT Position, 55: Actual VGT Position”) **NOTE** • **Set turbocharger opening to the range of 20 to 80%.** • **As initial operational check of turbocharger actuator is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of turbocharger actuator connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Inspect diagnosis code that is occurring.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Remove connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of electronic drive unit relay, go to step 9
		NO	Modify harness.

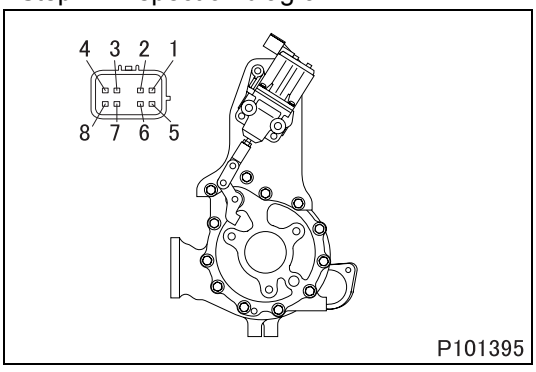
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector terminals • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor shield ground (U): terminal No. 5 - 14 • Sensor shield ground (V): terminal No. 6 - 14 • Sensor shield ground (W): terminal No. 7 - 14 • Sensor ground: terminal No. 4 - 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between following connector terminals. • Between U - V: 10 - 11 • Between U - W: 10 - 12 • Between V - W: 11 - 12
	Inspection condition		–
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and turbocharger actuator (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (U): electronic drive unit connector terminal No. 10 - turbocharger actuator connector terminal No. 8 • Motor (V): electronic drive unit connector terminal No. 11 - turbocharger actuator connector terminal No. 7 • Motor (W): electronic drive unit connector terminal No. 12 - turbocharger actuator connector terminal No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of turbocharger actuator unit (motor)
	Maintenance item		Measure value of resistance between following turbocharger actuator connector terminals • Between U - V: 8 - 7 • Between U - W: 8 - 6 • Between V - W: 7 - 6
	Inspection condition		Keep turbocharger actuator installed on vehicle. Remove harness connector, and measure turbocharger actuator side.
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of turbocharger actuator.

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of turbocharger actuator connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 1 (+) and 5 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		10 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure value of voltage between following electronic drive unit connector terminals • U signal output: terminal 1 (+) - 4 (–) • V signal output: terminal 2 (+) - 4 (–) • W signal output: terminal 3 (+) - 4 (–)
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON • Perform actuator test item No. A4 “VGT 1”
	Requirements		8 to 11 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and turbocharger actuator (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 8 - turbocharger actuator connector terminal No. 1 • Sensor (U): electronic drive unit connector terminal No. 1 - turbocharger actuator connector terminal No. 4 • Sensor (V): electronic drive unit connector terminal No. 2 - turbocharger actuator connector terminal No. 3 • Sensor (W): electronic drive unit connector terminal No. 3 - turbocharger actuator connector terminal No. 2 • Sensor (ground): electronic drive unit connector terminal No. 4 - turbocharger actuator connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of turbocharger, go to step 16
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A4 “VGT 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “54: Target VGT Position, 55: Actual VGT Position”) **NOTE** • **Set turbocharger opening to the range of 20 to 80%.** • **As initial operational check of turbocharger actuator is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P0046/Flash code: 51
[Monitor]
Failure of turbocharger actuator
[Fault (outline)]
Circuit
[Diagnosis check]
- Turbocharger electronic control drive monitors built-in motor of turbocharger actuator for sticking of parts and sends fault information to engine electronic control unit through controller area network communication.
- Turbocharger electronic drive unit determines actual shaft position from position sensor output data and calculates target shaft position from actual position data.

[Code generation condition]
- Actuator motor remains stuck as detected by electronic drive unit for 2 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

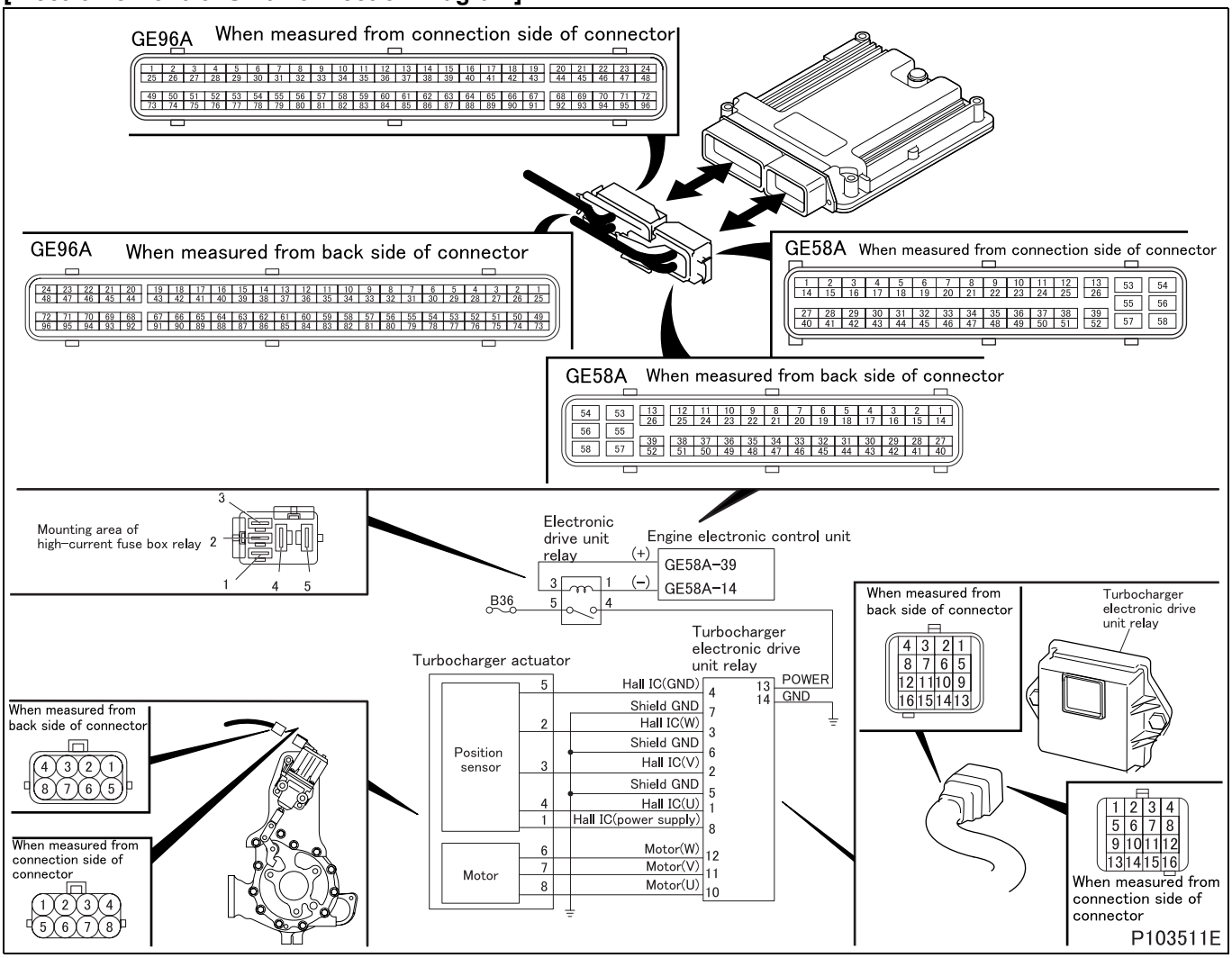
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

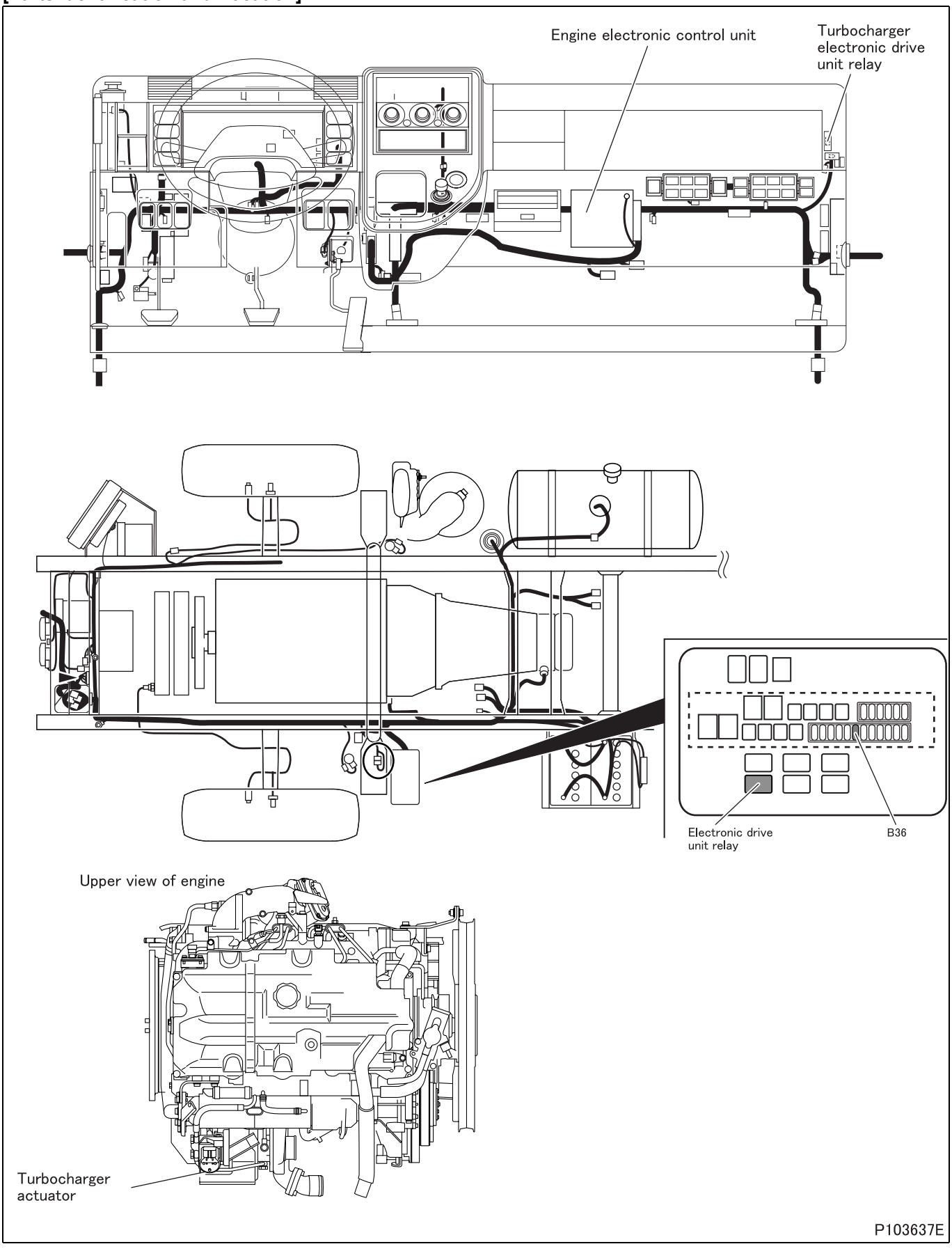
[Probable cause of trouble]
- Turbocharger actuator unit stuck
- Malfunction of electronic drive unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A4 “VGT 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “54: Target VGT Position, 55: Actual VGT Position”) **NOTE** • **Set turbocharger opening to the range of 20 to 80%.** • **As initial operational check of turbocharger actuator is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of turbocharger actuator connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Inspect diagnosis code that is occurring.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Remove connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of electronic drive unit relay, go to step 9
		NO	Modify harness.

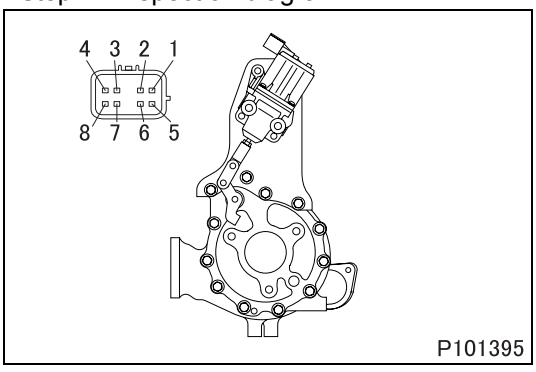
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector terminals • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor shield ground (U): terminal No. 5 - 14 • Sensor shield ground (V): terminal No. 6 - 14 • Sensor shield ground (W): terminal No. 7 - 14 • Sensor ground: terminal No. 4 - 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between following connector terminals. • Between U - V: 10 - 11 • Between U - W: 10 - 12 • Between V - W: 11 - 12
	Inspection condition		–
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and turbocharger actuator (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (U): electronic drive unit connector terminal No. 10 - turbocharger actuator connector terminal No. 8 • Motor (V): electronic drive unit connector terminal No. 11 - turbocharger actuator connector terminal No. 7 • Motor (W): electronic drive unit connector terminal No. 12 - turbocharger actuator connector terminal No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of turbocharger actuator unit (motor)
	Maintenance item		Measure value of resistance between following turbocharger actuator connector terminals • Between U - V: 8 - 7 • Between U - W: 8 - 6 • Between V - W: 7 - 6
	Inspection condition		Keep turbocharger actuator installed on vehicle. Remove harness connector, and measure turbocharger actuator side.
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of turbocharger actuator.

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of turbocharger actuator connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 1 (+) and 5 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		10 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure value of voltage between following electronic drive unit connector terminals • U signal output: terminal 1 (+) - 4 (–) • V signal output: terminal 2 (+) - 4 (–) • W signal output: terminal 3 (+) - 4 (–)
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON • Perform Multi-Use Tester actuator test item No. A4 “VGT 1”
	Requirements		8 to 11 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and turbocharger actuator (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 8 - turbocharger actuator connector terminal No. 1 • Sensor (U): electronic drive unit connector terminal No. 1 - turbocharger actuator connector terminal No. 4 • Sensor (V): electronic drive unit connector terminal No. 2 - turbocharger actuator connector terminal No. 3 • Sensor (W): electronic drive unit connector terminal No. 3 - turbocharger actuator connector terminal No. 2 • Sensor (ground): electronic drive unit connector terminal No. 4 - turbocharger actuator connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of turbocharger, go to step 16
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A4 “VGT 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “54: Target VGT Position, 55: Actual VGT Position”) **NOTE** • **Set turbocharger opening to the range of 20 to 80%.** • **As initial operational check of turbocharger actuator is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P0047/Flash code: 51
[Monitor]
Failure of turbocharger actuator
[Fault (outline)]
Circuit
[Diagnosis check]
- Turbocharger electronic drive unit monitors built-in motor of turbocharger actuator for circuit fault and sends fault information to engine electronic control unit through controller area network communication.
- Monitoring by turbocharger electronic drive unit is performed from internal current detection circuit.

[Code generation condition]
- Actuator motor circuit remains shorted as detected by electronic drive unit for 2 seconds. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

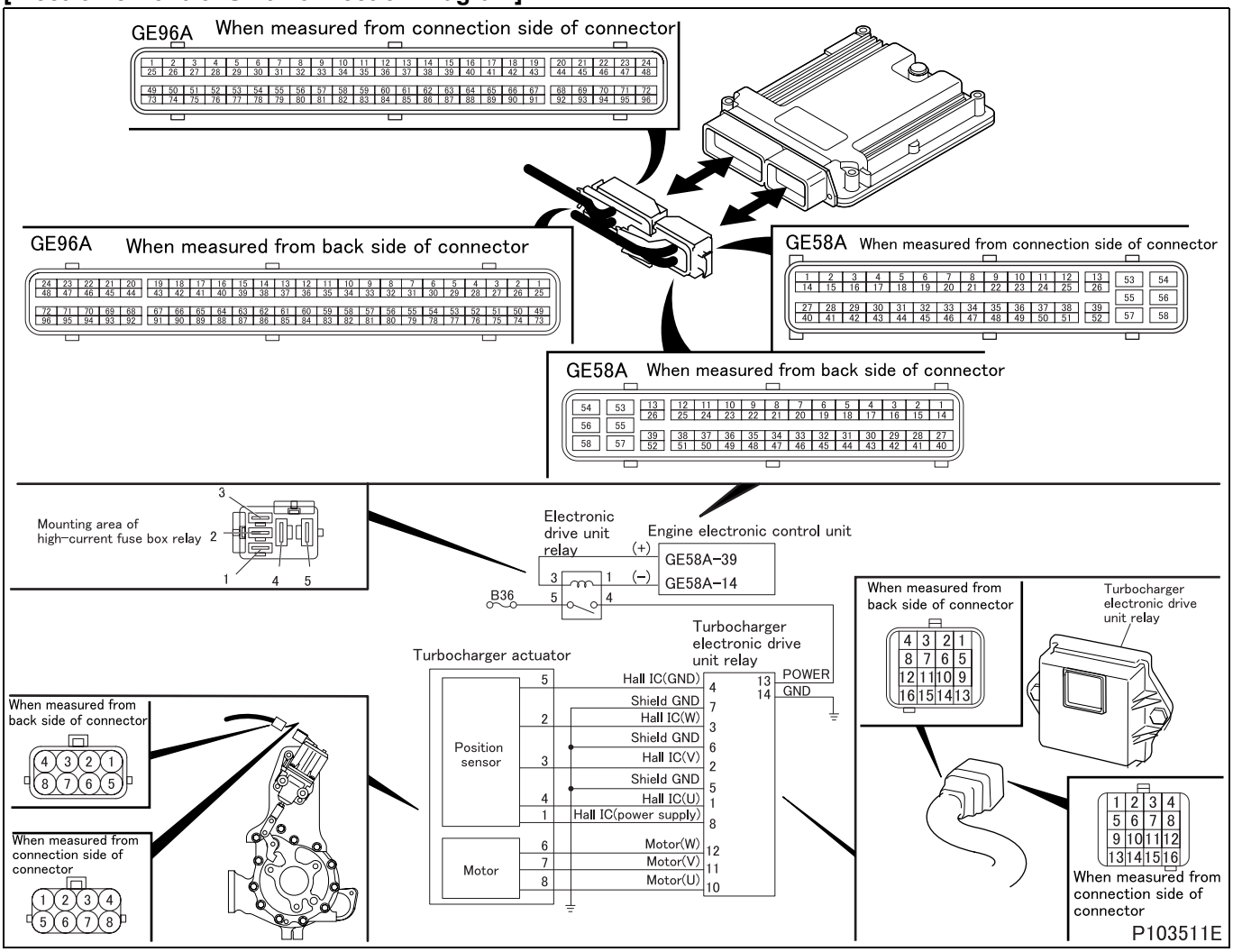
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

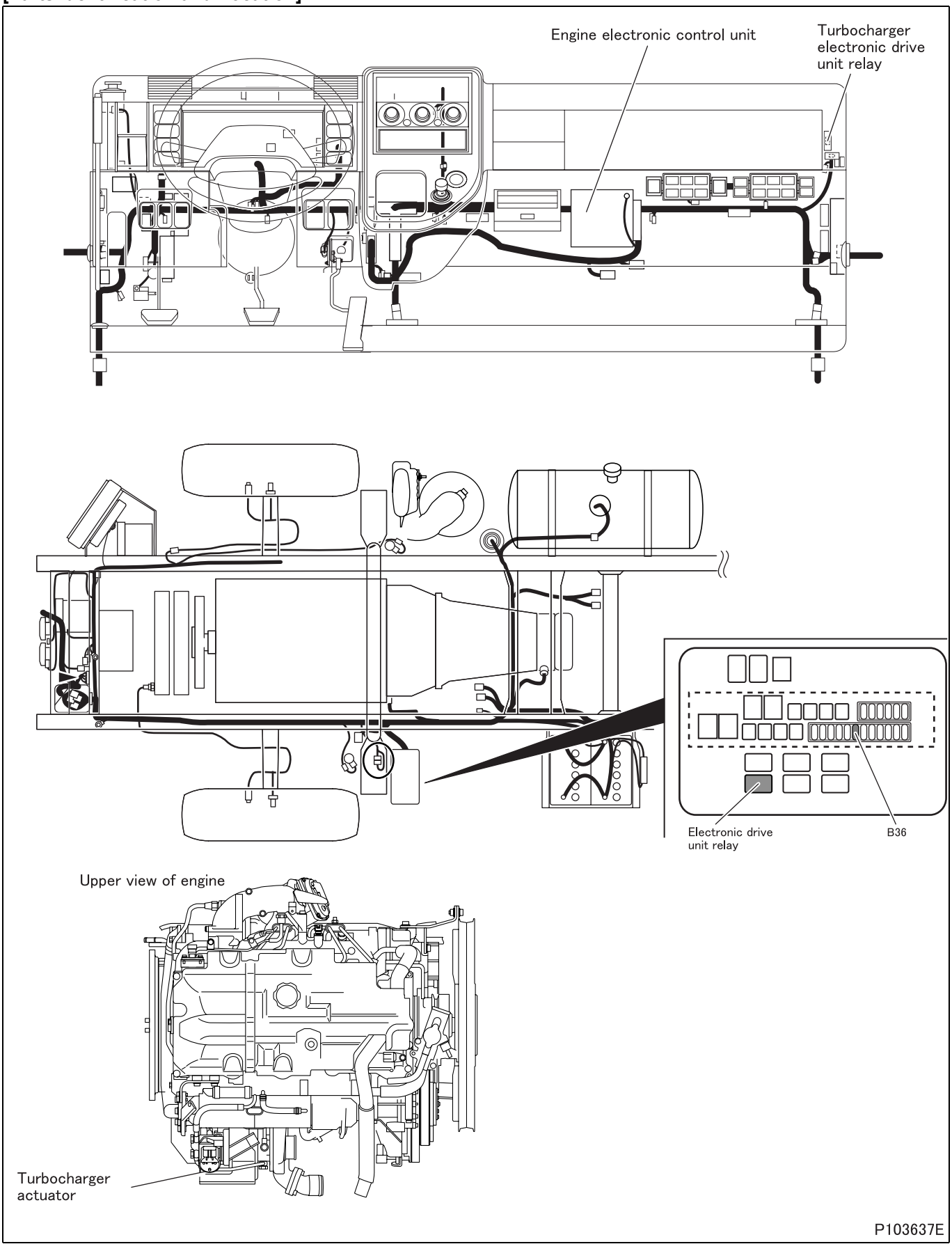
[Probable cause of trouble]
- Open-circuit or short-circuit harness between electronic drive unit and turbocharger actuator
- Malfunction of each connector
- Malfunction of turbocharger motor (built in turbocharger actuator)
- Malfunction of turbocharger position sensor (built in turbocharger actuator)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A4 “VGT 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Mult-Use Tester. (check with service data “54: Target VGT Position, 55: Actual VGT Position”) **NOTE** • **Set turbocharger opening to the range of 20 to 80%.** • **As initial operational check of turbocharger actuator is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit relay
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of turbocharger actuator connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Inspect diagnosis code that is occurring.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Remove connector and measure from harness side. • Starter switch: ON • Perform Multi-Use Tester actuator test item No. AF “EDU Relay”
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of electronic drive unit relay, go to step 9
		NO	Modify harness.

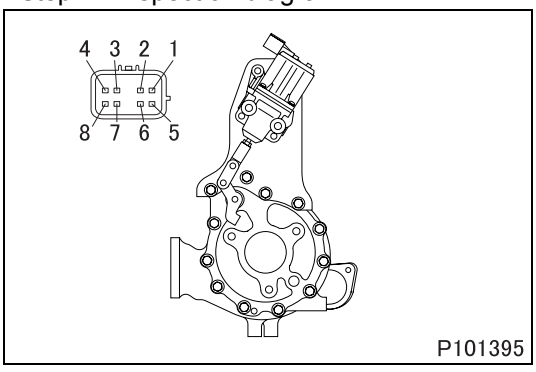
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector terminals • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor shield ground (U): terminal No. 5 - 14 • Sensor shield ground (V): terminal No. 6 - 14 • Sensor shield ground (W): terminal No. 7 - 14 • Sensor ground: terminal No. 4 - 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between following connector terminals. • Between U - V: 10 - 11 • Between U - W: 10 - 12 • Between V - W: 11 - 12
	Inspection condition		–
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and turbocharger actuator (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (U): electronic drive unit connector terminal No. 10 - turbocharger actuator connector terminal No. 8 • Motor (V): electronic drive unit connector terminal No. 11 - turbocharger actuator connector terminal No. 7 • Motor (W): electronic drive unit connector terminal No. 12 - turbocharger actuator connector terminal No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of turbocharger actuator unit (motor)
	Maintenance item		Measure value of resistance between following turbocharger actuator connector terminals • Between U - V: 8 - 7 • Between U - W: 8 - 6 • Between V - W: 7 - 6
	Inspection condition		Keep turbocharger actuator installed on vehicle. Remove harness connector, and measure turbocharger actuator side.
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of turbocharger actuator

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of turbocharger actuator connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 1 (+) and 5 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		10 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure value of voltage between following electronic drive unit connector terminals • U signal output: terminal 1 (+) - 4 (–) • V signal output: terminal 2 (+) - 4 (–) • W signal output: terminal 3 (+) - 4 (–)
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON • Perform actuator test item No. A4 “VGT 1”
	Requirements		8 to 11 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and turbocharger actuator (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 8 - variable geometry turbocharger actuator connector terminal No. 1 • Sensor (U): electronic drive unit connector terminal No. 1 - turbocharger actuator connector terminal No. 4 • Sensor (V): electronic drive unit connector terminal No. 2 - turbocharger actuator connector terminal No. 3 • Sensor (W): electronic drive unit connector terminal No. 3 - turbocharger actuator connector terminal No. 2 • Sensor (ground): electronic drive unit connector terminal No. 4 - turbocharger actuator connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of turbocharger, go to step 16
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A4 “VGT 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “54: Target VGT Position, 55: Actual VGT Position”) **NOTE** • **Set turbocharger opening to the range of 20 to 80%.** • **As initial operational check of turbocharger actuator is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P0069/Flash code: 19
[Monitor]
Characteristic abnormality of atmospheric pressure sensor (built into engine electronic control unit)
[Fault (outline)]
Gain and offset drift
[Diagnosis check]
- Values of atmospheric pressure sensor and boost pressure sensor are compared when engine is in considerably low speed operation (value of boost pressure sensor is corrected value by exhaust gas recirculation valve position and throttle position)

[Code generation condition]
- Atmospheric pressure value remains higher than boost pressure value by 14 kPa {2.0 psi, 0.1 kgf/cm^2} for 10 consecutive seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine operating mode: normal (engine in operation)
- Engine speed: less than 850 rpm
- Fuel injection quantity: less than 10 mg/cyc
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- Injector: in order
- MPROP (rail pressure control valve): in order
- Fuel feed when engine is idling: in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- In-use performance counter is stopped.
- Related fault check is stopped.

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0234 “Overboost” • P0236 “Boost Press SNSR (Plausi)” • P0237 “Boost Press SNSR (Low)” • P0238 “Boost Press SNSR (High)” • P0299 “Turbocharger (Underboost)” • P2228 “Atm Press SNSR (Low)” • P2229 “Atm Press SNSR (High)”
	Inspection condition		• Starter switch: ON • Engine: Idling
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Inspect diagnosis code that is occurring.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake MAP”. **<Multi-Use Tester used>** • Measure item No. 20 “Atmospheric Pressure” of Service Data.
	Inspection condition		Starter switch ON (engine stationary) → After engine has started, press accelerator pedal.
	Requirements		Coincides with atmospheric pressure → Gradually increases
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0087/Flash code: 36
[Monitor]
Abnormality of common rail pressure (comparison)
[Fault (outline)]
Rail pressure regulator adjustment
[Diagnosis check]
- Pressure in common rail is detected as actual common rail pressure by common rail pressure sensor and compared with target common rail pressure for control by engine electronic control unit.

[Code generation condition]
- Actual common rail pressure remains higher than target common rail pressure by 300 bar or more for 10 seconds (not reaching the target pressure). (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Common rail pressure control: closed loop control

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of supply pump (overflow valve)
- Malfunction of pressure limiting valve
- Airtight malfunction of injector
- Plugged fuel system
- Fuel leakage
- Malfunction of common rail pressure sensor

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0093 “CRS (Fuel Leak)” • P0148 “CRS (Fuel Delivery)” • P0191 “CRS Pressure SNSR (Plausibility)” • P0192 “CRS Pressure SNSR (Low)” • P0193 “CRS Pressure SNSR (High)” • P0201 “Injector M/V-Cylinder 1 (Load)” • P0202 “Injector M/V-Cylinder 2 (Load)” • P0203 “Injector M/V-Cylinder 3 (Load)” • P0204 “Injector M/V-Cylinder 4 (Load)” • P0261 “Injector #1-A (Low)” • P0262 “Injector #1-A (High)” • P0263 “Injector #1-A (Plausibility)” • P0264 “Injector #2-A (Low)” • P0265 “Injector #2-A (High)” • P0266 “Injector #2-A (Plausibility)” • P0267 “Injector #3-A (Low)” • P0268 “Injector #3-A (High)” • P0269 “Injector #3-A (Plausibility)” • P0270 “Injector #4-A (Low)” • P0271 “Injector #4-A (High)” • P0272 “Injector #4-A (Plausibility)” • P0562 “Power Supply Voltage (Low)” • P0563 “Power Supply Voltage (High)” • P0607 “ECU System” • P060B “A/D Converter” • P061B “ECU Performance (Calc)” • P061C “ECU Performance (Ne)”
	Inspection condition		• Starter switch: ON • Do not start engine.
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Inspect diagnosis code that is occurring.

Step 2	Inspection items		Checking of engine appearance
	Maintenance item		Check fuel system for fuel leak.
	Inspection condition		Starter switch: OFF
	Requirements		There is no fuel leak.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 6.

Step 3	Inspection items		Inspection of low pressure piping (fuel tank – supply pump)
	Maintenance item		Check suction pipe or hose for bend.
	Inspection condition		Starter switch: OFF
	Requirements		There is no bend on pipe or hose.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Correct and replace suction pipe or hose.

Step 4	Inspection items		Checking of air bleeding
	Maintenance item		Bleed air from fuel filter.
	Inspection condition		Starter switch: OFF
	Requirements		Problem is solved by bleeding air.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 5.

Step 5	Inspection items		Inspection of low pressure piping
	Maintenance item		Fuel filter
	Inspection condition		Starter switch: OFF
	Requirements		Problem is solved by replacing fuel filter.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 6.

Step 6	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from supply pump.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of supply pump

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from fuel pipe between supply pump and rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of fuel pipe

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of rail

Step 9	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from fuel injection pipes (four) between injector and rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of injection pipe

Step 10	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Replacement of injector

Step 11	Inspection items		Check inside of combustion chamber.
	Maintenance item		Check for fuel leak.
	Inspection condition		• After performing actuator test item No. B2 “Fuel Leak Check”, stop engine. • Remove glow plug, and check from glow plug mounting hole using bore scope.
	Requirements		Inside of combustion chamber is not wet.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Replacement of injector of object cylinder

Step 12	Inspection items		Replacement of rail (common rail pressure sensor, flow damper and pressure limiter abnormal)
	Maintenance item		–
	Inspection condition		–
	Requirements		Problem is solved by replacing rail.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 13.

Step 13	Inspection items		Replacement of supply pump
	Maintenance item		–
	Inspection condition		–
	Requirements		Problem is solved by replacing supply pump.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Replacement of injectors (four)

[Fault code]
Diagnosis code: P0088/Flash code: 23
[Monitor]
Abnormality of common rail pressure (pressure: high)
[Fault (outline)]
Plausibility
[Diagnosis check]
- Pressure in common rail is detected as actual common rail pressure by common rail pressure sensor and compared with target common rail pressure for control by engine electronic control unit.

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Condition (1)>
- Actual common rail pressure remains 300 bar apart from target common rail pressure for 10 seconds (considerably exceeding the target value).
  (Warning lamp (orange) is lit and diagnosis code is displayed on first establishment of code generation condition.)

<Condition (2)>
- Common rail pressure remains at 190 MPa {27560 psi, 1937 kgf/cm^2} or higher for 5 consecutive seconds.
  (Warning lamp (red) is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Common rail pressure control: closed loop control

[Control effected by electronic control unit during fault]
Electronic control unit varies in the way of control by the color of warning lamp.
<Warning lamp: Orange>
- Engine torque is limited.
- MPROP (rail pressure control valve) control is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

<Warning lamp: Red>
- Engine torque is limited.
- MPROP (rail pressure control valve) control is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.

[Probable cause of trouble]
- Malfunction of supply pump (overflow valve)
- Malfunction of pressure limiting valve
- Airtight malfunction of injector
- Plugged fuel system
- Fuel leakage
- Malfunction of common rail pressure sensor

[Recoverability]

- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

<Condition (1)>

- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

<Condition (2)>

- Lamp is extinguished and code is cleared simultaneously with recovery.

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0093 “CRS (Fuel Leak)” • P0148 “CRS (Fuel Delivery)” • P0191 “CRS Pressure SNSR (Plausibility)” • P0192 “CRS Pressure SNSR (Low)” • P0193 “CRS Pressure SNSR (High)” • P0201 “Injector M/V-Cylinder 1 (Load)” • P0202 “Injector M/V-Cylinder 2 (Load)” • P0203 “Injector M/V-Cylinder 3 (Load)” • P0204 “Injector M/V-Cylinder 4 (Load)” • P0261 “Injector #1-A (Low)” • P0262 “Injector #1-A (High)” • P0263 “Injector #1-A (Plausibility)” • P0264 “Injector #2-A (Low)” • P0265 “Injector #2-A (High)” • P0266 “Injector #2-A (Plausibility)” • P0267 “Injector #3-A (Low)” • P0268 “Injector #3-A (High)” • P0269 “Injector #3-A (Plausibility)” • P0270 “Injector #4-A (Low)” • P0271 “Injector #4-A (High)” • P0272 “Injector #4-A (Plausibility)” • P0562 “Power Supply Voltage (Low)” • P0563 “Power Supply Voltage (High)” • P0607 “ECU System” • P060B “A/D Converter” • P061B “ECU Performance (Calc)” • P061C “ECU Performance (Ne)”
	Inspection condition		• Starter switch: ON • Do not start engine.
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of supply pump
		NO	Inspect diagnosis code that is occurring.

[Fault code]
Diagnosis code: P0089/Flash code: 63
[Monitor]
Failure of MPROP (rail pressure control valve)
[Fault (outline)]
Overload
[Diagnosis check]
- Engine electronic control unit internal function monitors MPROP (rail pressure control valve) circuit for overcurrent.

[Code generation condition]
- Overcurrent remains as detected by engine electronic control unit internal function for 3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

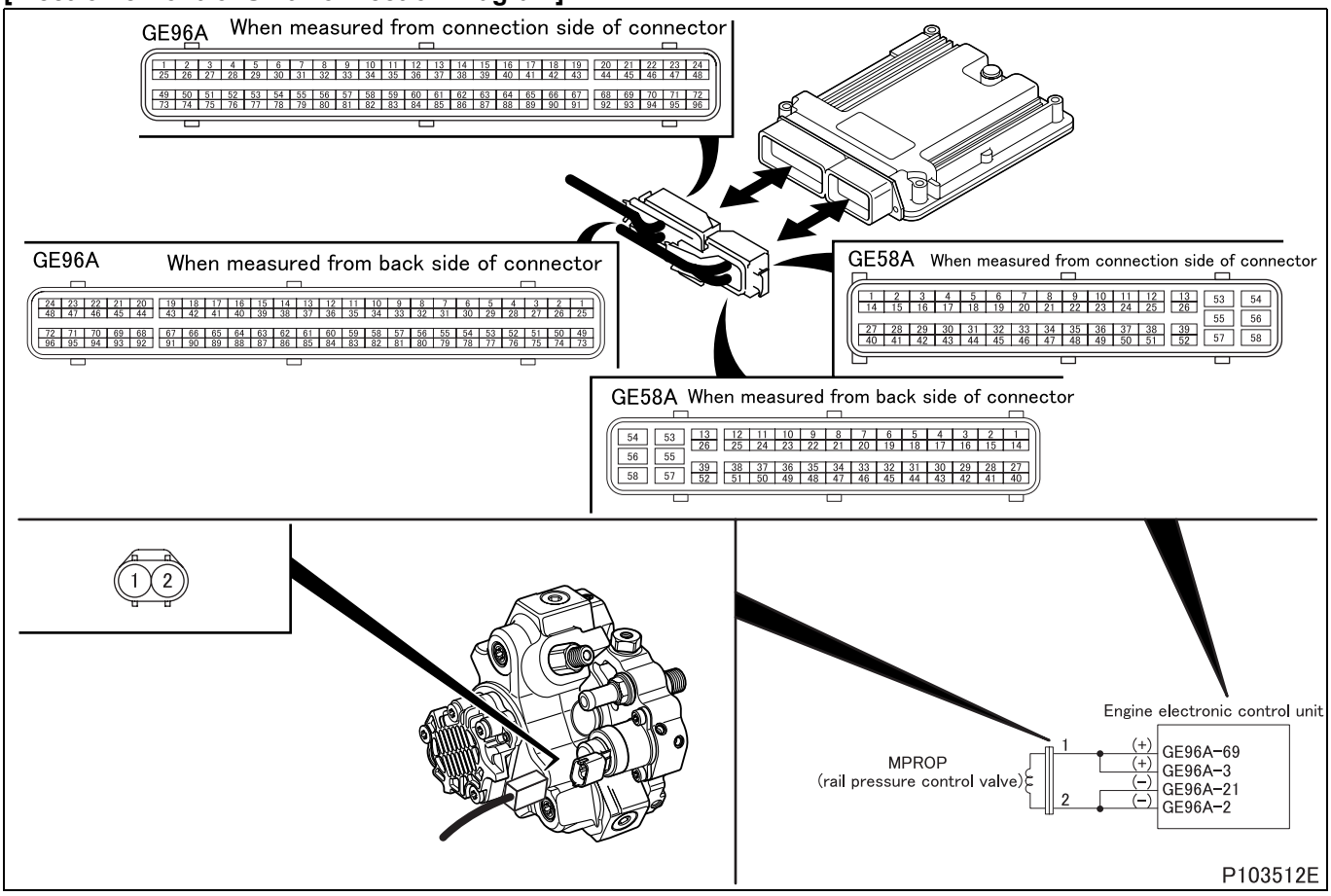
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- MPROP (rail pressure control valve) control is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

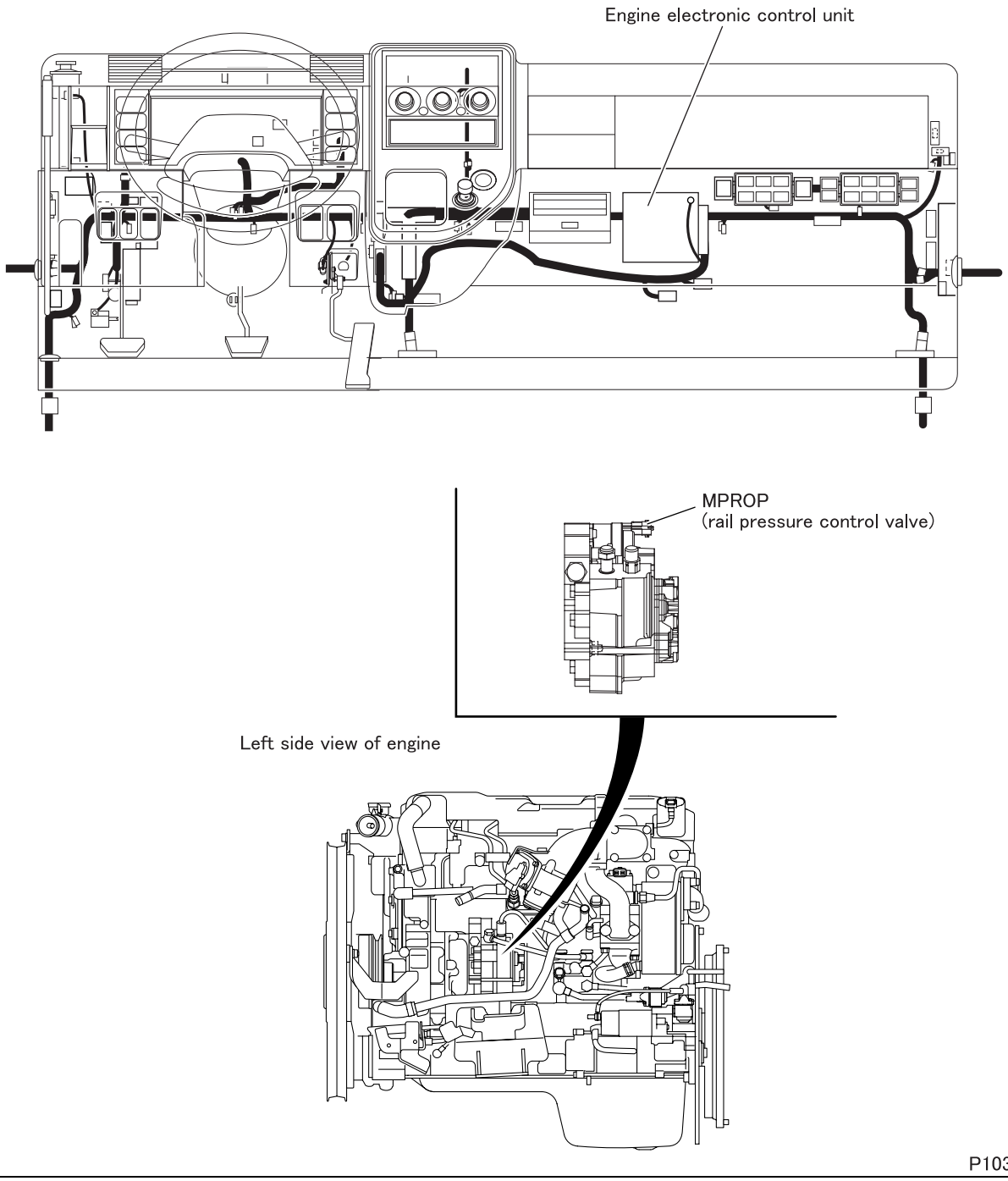
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and MPROP (rail pressure control valve)
- Malfunction of each connector
- Malfunction of MPROP (rail pressure control valve)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

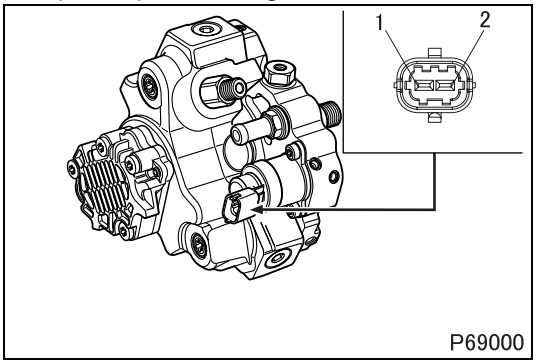
Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 3 or No. 69 and No. 2 or No. 21.
	Inspection condition		Disconnect electronic control unit and harness, and measure from connection side of harness connector.
	Requirements		2.6 to 3.15 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Go to step 3.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 3	Inspection items		Inspection of MPROP (rail pressure control valve) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of MPROP (rail pressure control valve) unit
	Maintenance item		Check continuity across MPROP (rail pressure control valve) connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of supply pump

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between electronic control unit and MPROP (rail pressure control valve) (power supply)
	Maintenance item		Check circuit between MPROP (rail pressure control valve) connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 3 or No. 69.
	Inspection condition		–
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between electronic control unit and MPROP (rail pressure control valve) (ground)
	Maintenance item		Check circuit between MPROP (rail pressure control valve) connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 2 or No. 21.
	Inspection condition		–
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check” under the following conditions.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		This diagnosis code is not displayed again.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0090/Flash code: 63
[Monitor]
Failure of MPROP (rail pressure control valve)
[Fault (outline)]
MPROP (rail pressure control valve) open – circuit
[Diagnosis check]
- Engine electronic control unit internal function monitors MPROP (rail pressure control valve) for open-circuit.

[Code generation condition]
- Open-circuit remains as detected by engine electronic control unit internal function for 0.3 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

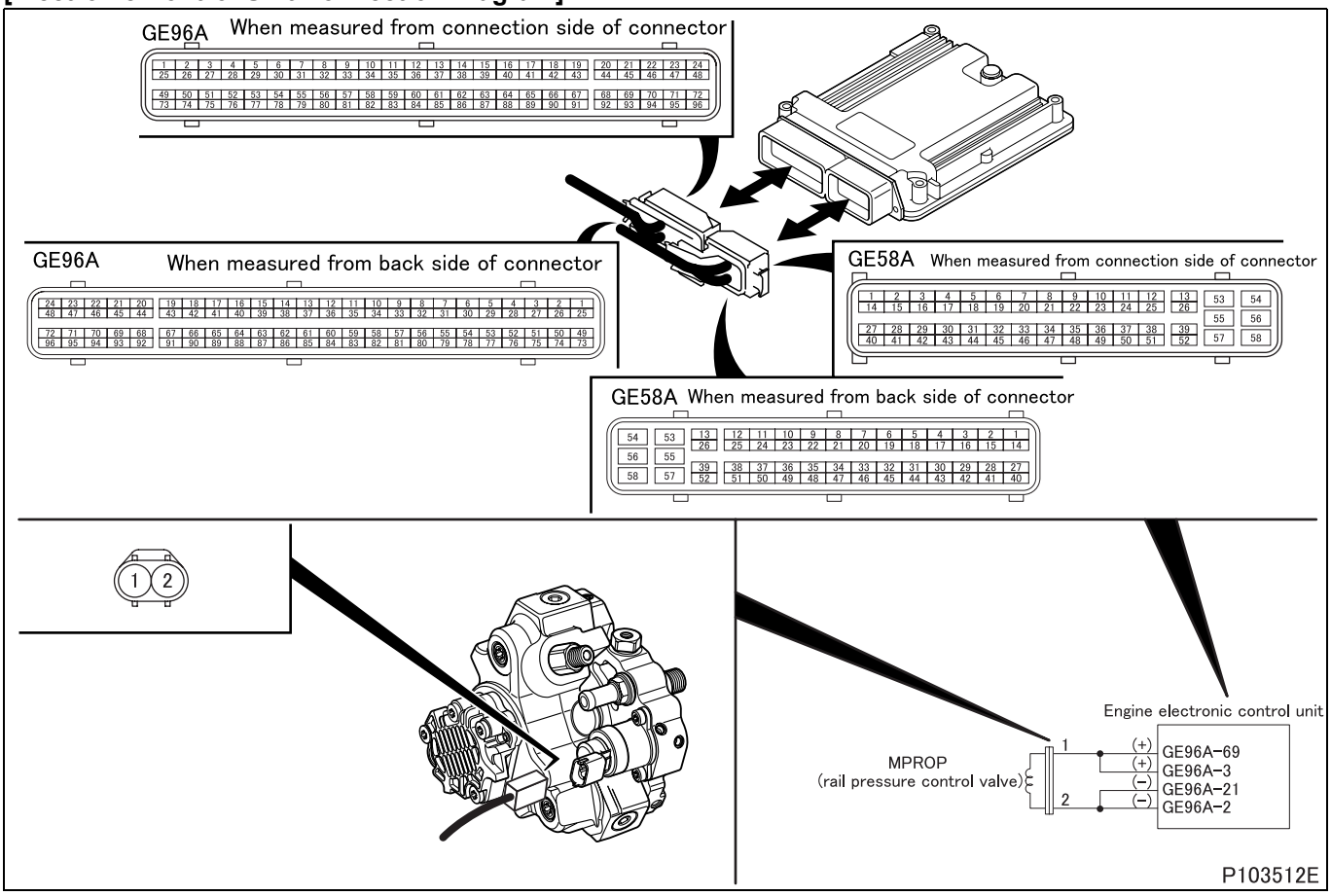
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- MPROP (rail pressure control valve) control is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

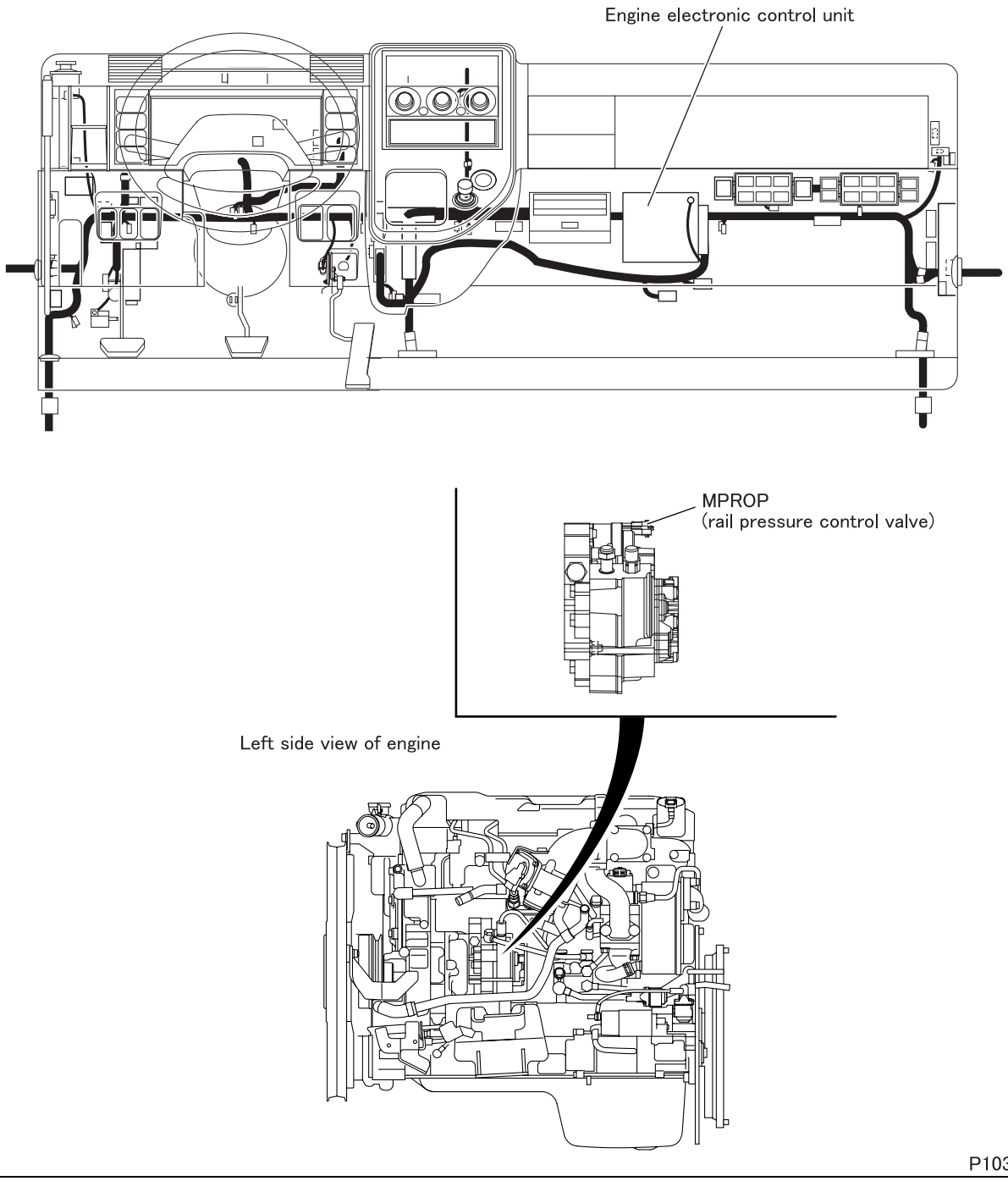
[Probable cause of trouble]
- Open-circuit of harness between electronic control unit and MPROP (rail pressure control valve)
- Malfunction of each connector
- Malfunction of MPROP (rail pressure control valve)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 3 or No. 69 and No. 2 or No. 21.
	Inspection condition		Disconnect electronic control unit and harness, and measure from connection side of harness connector.
	Requirements		2.6 to 3.15 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of MPROP (rail pressure control valve) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of supply pump
		NO	Modify connector.

[Fault code]
Diagnosis code: P0091/Flash code: 63
[Monitor]
Failure of MPROP (rail pressure control valve)
[Fault (outline)]
MPROP (rail pressure control valve) short circuit
[Diagnosis check]
- Engine electronic control unit internal function monitors MPROP (rail pressure control valve) for short-circuit to ground.

[Code generation condition]
- MPROP circuit remains shorted to ground as detected by engine electronic control unit internal function for 0.3 second. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

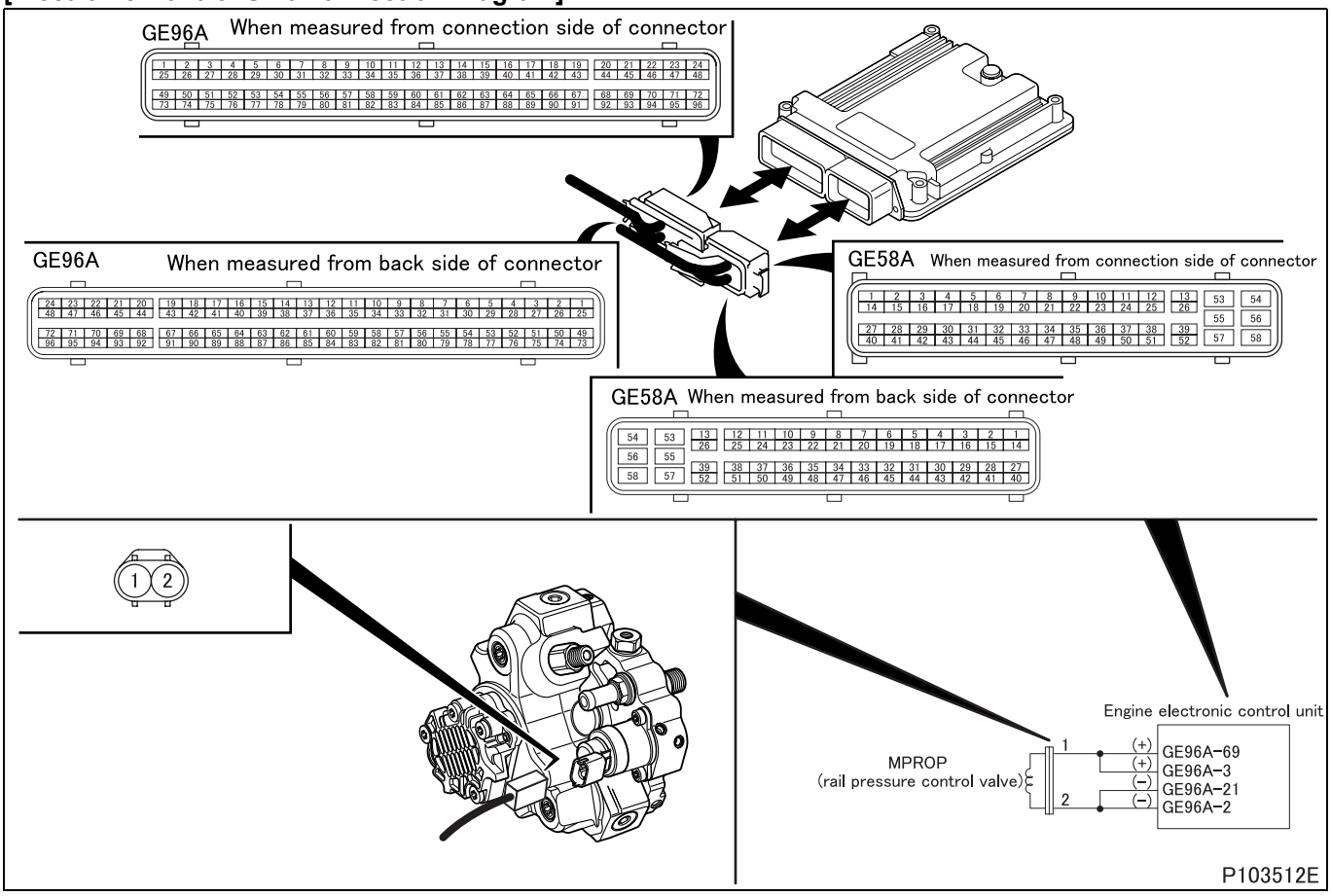
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- MPROP (rail pressure control valve) control is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

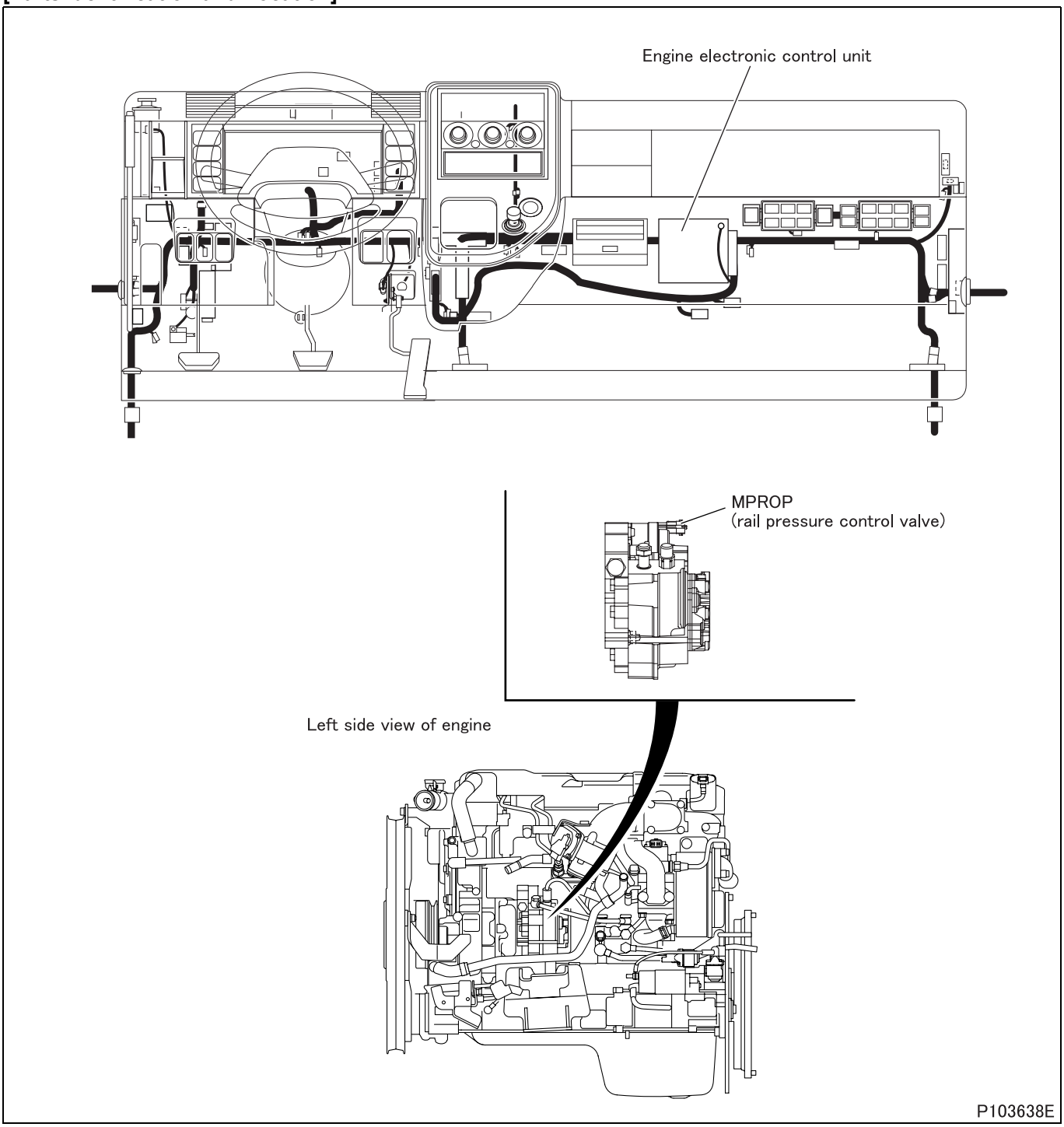
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and MPROP (rail pressure control valve)
- Malfunction of each connector
- Malfunction of MPROP (rail pressure control valve)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 3 or No. 69 and No. 2 or No. 21.
	Inspection condition		Disconnect electronic control unit and harness, and measure from connection side of harness connector.
	Requirements		2.6 to 3.15 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of MPROP (rail pressure control valve) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of supply pump
		NO	Modify connector.

[Fault code]
Diagnosis code: P0092/Flash code: 63
[Monitor]
Failure of MPROP (rail pressure control valve)
[Fault (outline)]
MPROP (rail pressure control valve) short circuit
[Diagnosis check]
- Engine electronic control unit internal function monitors MPROP (rail pressure control valve) for short-circuit to power supply.

[Code generation condition]
- MPROP circuit remains shorted to power supply as detected by engine electronic control unit internal function for 0.3 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

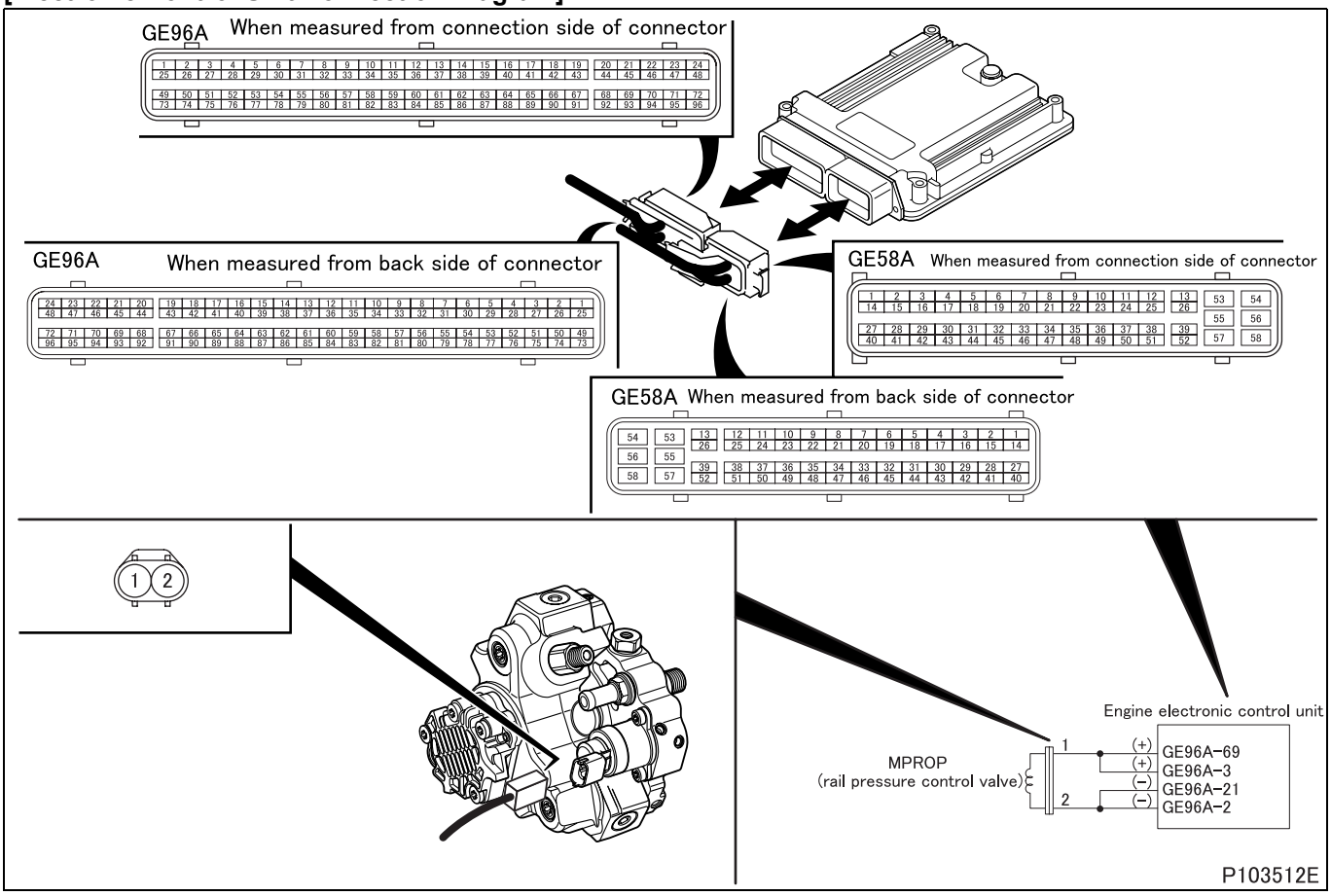
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- MPROP (rail pressure control valve) control is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

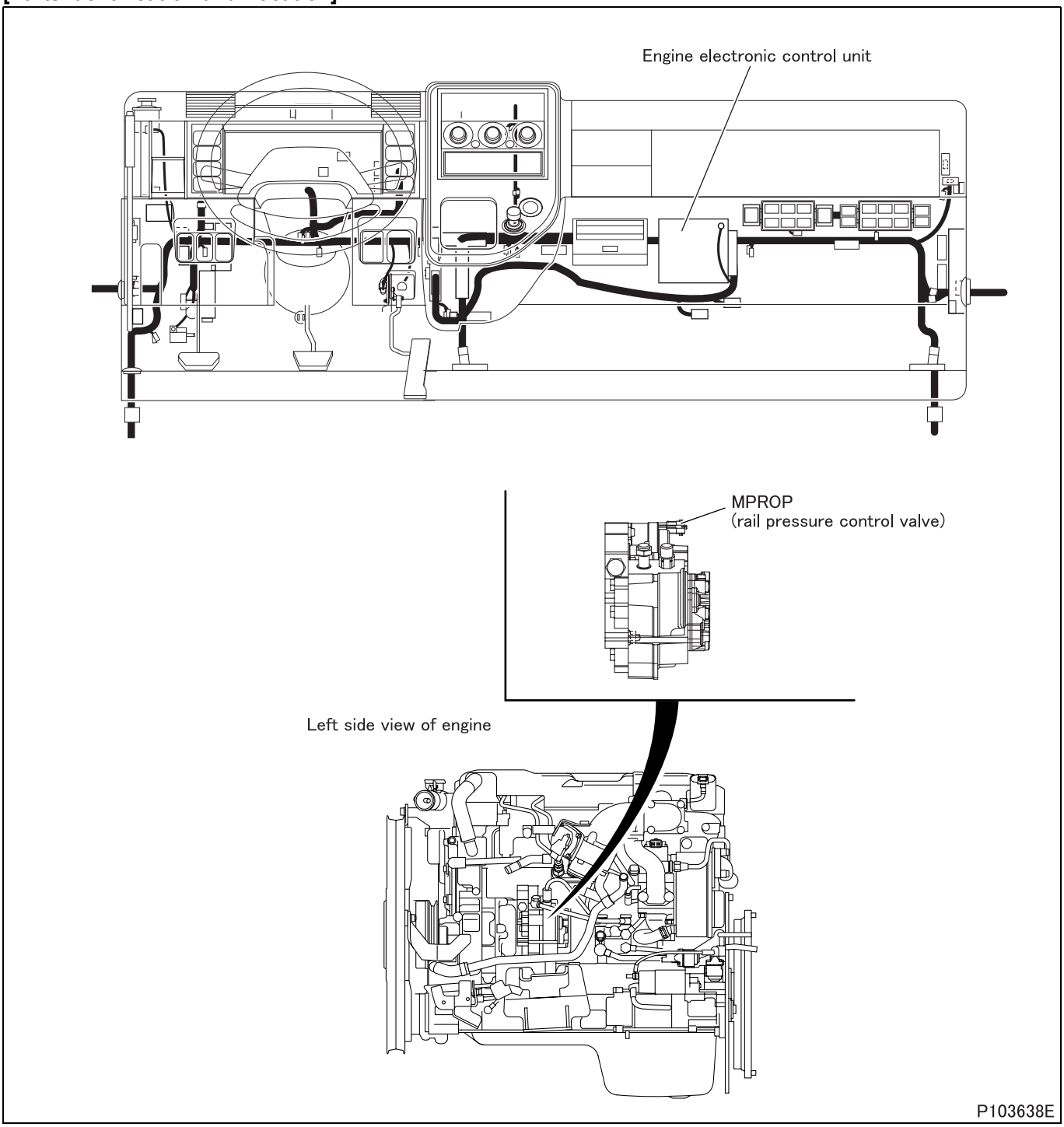
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and MPROP (rail pressure control valve)
- Malfunction of each connector
- Malfunction of MPROP (rail pressure control valve)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 3 or No. 69 and No. 2 or No. 21.
	Inspection condition		Disconnect electronic control unit and harness, and measure from connection side of harness connector.
	Requirements		2.6 to 3.15 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of MPROP (rail pressure control valve) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of supply pump
		NO	Modify connector.

[Fault code]
Diagnosis code: P0093/Flash code: 22
[Monitor]
Abnormality of common rail pressure (fuel leakage)
[Fault (outline)]
Fuel leakage
[Diagnosis check]
- Common rail pressure is monitored during at-fault control (diagnosis code P0087).

[Code generation condition]
- Actual common rail pressure remains 300 bar apart from target common rail pressure for 60 seconds in spite of full supply pump output.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine stopped

[Probable cause of trouble]
- Malfunction of supply pump
- Malfunction of pressure limiter
- Airtight malfunction of injector
- Plugged fuel system
- Fuel leakage
- Malfunction of common rail pressure sensor

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (At the same time as recovery, warning lamp is extinguished and diagnosis code is cleared.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0093 “CRS (Fuel Leak)” • P0148 “CRS (Fuel Delivery)” • P0191 “CRS Pressure SNSR (Plausibility)” • P0192 “CRS Pressure SNSR (Low)” • P0193 “CRS Pressure SNSR (High)” • P0201 “Injector M/V-Cylinder 1 (Load)” • P0202 “Injector M/V-Cylinder 2 (Load)” • P0203 “Injector M/V-Cylinder 3 (Load)” • P0204 “Injector M/V-Cylinder 4 (Load)” • P0261 “Injector #1-A (Low)” • P0262 “Injector #1-A (High)” • P0263 “Injector #1-A (Plausibility)” • P0264 “Injector #2-A (Low)” • P0265 “Injector #2-A (High)” • P0266 “Injector #2-A (Plausibility)” • P0267 “Injector #3-A (Low)” • P0268 “Injector #3-A (High)” • P0269 “Injector #3-A (Plausibility)” • P0270 “Injector #4-A (Low)” • P0271 “Injector #4-A (High)” • P0272 “Injector #4-A (Plausibility)” • P0562 “Power Supply Voltage (Low)” • P0563 “Power Supply Voltage (High)” • P0607 “ECU System” • P060B “A/D Converter” • P061B “ECU Performance (Calc)” • P061C “ECU Performance (Ne)”
	Inspection condition		• Starter switch: ON • Do not start engine.
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Inspect diagnosis code that is occurring.

Step 2	Inspection items		Checking of engine appearance
	Maintenance item		Check fuel system for fuel leak.
	Inspection condition		Starter switch: OFF
	Requirements		There is fuel leak.
	Inspection result (Is the judging standard satisfied?)	YES	Correct and replace wet or abnormal parts.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of low pressure piping (fuel tank – supply pump)
	Maintenance item		Check suction pipe or hose for bend.
	Inspection condition		Starter switch: OFF
	Requirements		There is no bend on pipe or hose.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Correct and replace suction pipe or hose.

Step 4	Inspection items		Checking of air bleeding
	Maintenance item		Bleed air from fuel filter.
	Inspection condition		Starter switch: OFF
	Requirements		Problem is solved by bleeding air.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 5.

Step 5	Inspection items		Inspection of low pressure piping
	Maintenance item		Fuel filter
	Inspection condition		Starter switch: OFF
	Requirements		Problem is solved by replacing fuel filter.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 6.

Step 6	Inspection items		Check inside of combustion chamber.
	Maintenance item		Check for fuel leak.
	Inspection condition		• After performing actuator test item No. B2 “Fuel Leak Check”, stop engine. • Remove glow plug, and check from glow plug mounting hole using bore scope.
	Requirements		Inside of combustion chamber is not wet.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of supply pump
		NO	Replacement of injector of object cylinder

[Fault code]
Diagnosis code: P0097/Flash code: 9
[Monitor]
Failure of boost air temperature sensor
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Boost air temperature sensor output voltage is monitored.

[Code generation condition]
- Output voltage of boost air temperature sensor remains below 0.2 V for 1 second. (sensor temperature: 146°C {295°F} or higher)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

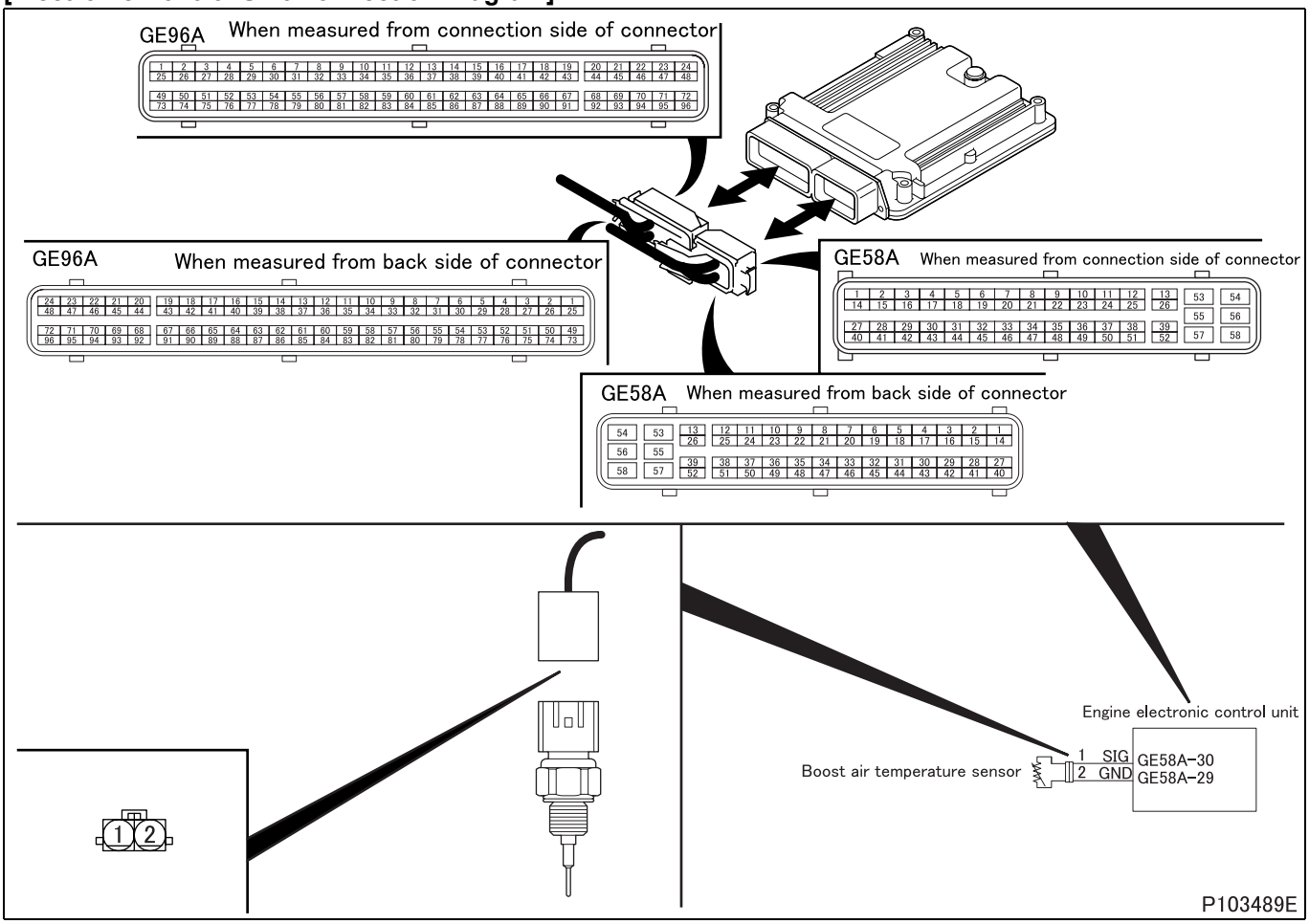
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation gas temperature is fixed at backup value.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Related fault check is stopped.

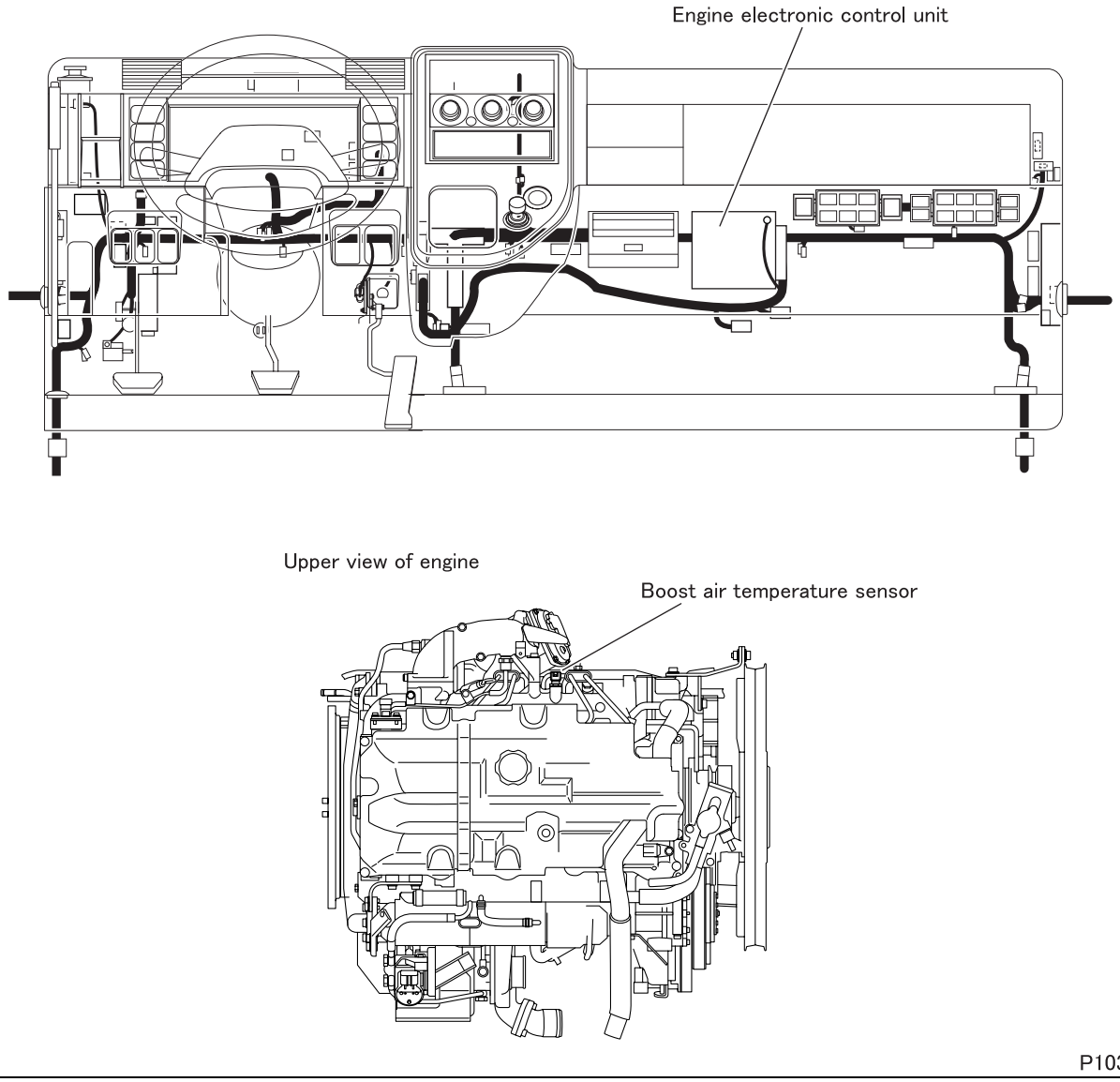
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and boost air temperature sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake Air Temperature”. **<Multi-Use Tester used>** • Measure item No. 10 “Intake Air Temperature (EGR)” of Service Data.
	Inspection condition		–
	Requirements		When engine is cold: Temperature is equivalent to outside temperature.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

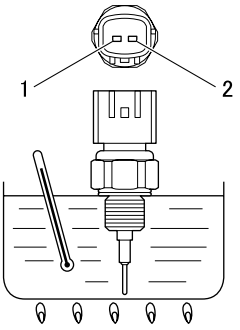
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE58A) terminal No. 29 and 30.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• 0°C {32°F}: 162.3 $^{+48.8}_{-36.5}$ kΩ • 20°C {68°F}: 61.47 $^{+15.99}_{-12.35}$ kΩ • 80°C {176°F}: 6.120 $^{+1.095}_{-0.907}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of boost air temperature sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of boost air temperature sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put boost air temperature sensor in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 0°C {32°F}: 162.3 $^{+48.8}_{-36.5}$ kΩ • 20°C {68°F}: 61.47 $^{+15.99}_{-12.35}$ kΩ • 80°C {176°F}: 6.120 $^{+1.095}_{-0.907}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE58A) terminal No. 30.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE58A) terminal No. 29.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake Air Temperature”. **<Multi-Use Tester used>** • Measure item No. 10 “Intake Air Temperature (EGR)” of Service Data.
	Inspection condition		–
	Requirements		When engine is cold: Temperature is equivalent to outside temperature.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0098/Flash code: 9
[Monitor]
Failure of boost air temperature sensor
[Fault (outline)]
High signal range check
[Diagnosis check]
- Boost air temperature sensor output voltage is monitored.

[Code generation condition]
- Output voltage of boost air temperature sensor remains over 4.9 V for 1 second. (sensor temperature: –37°C {–34.6°F} or lower)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

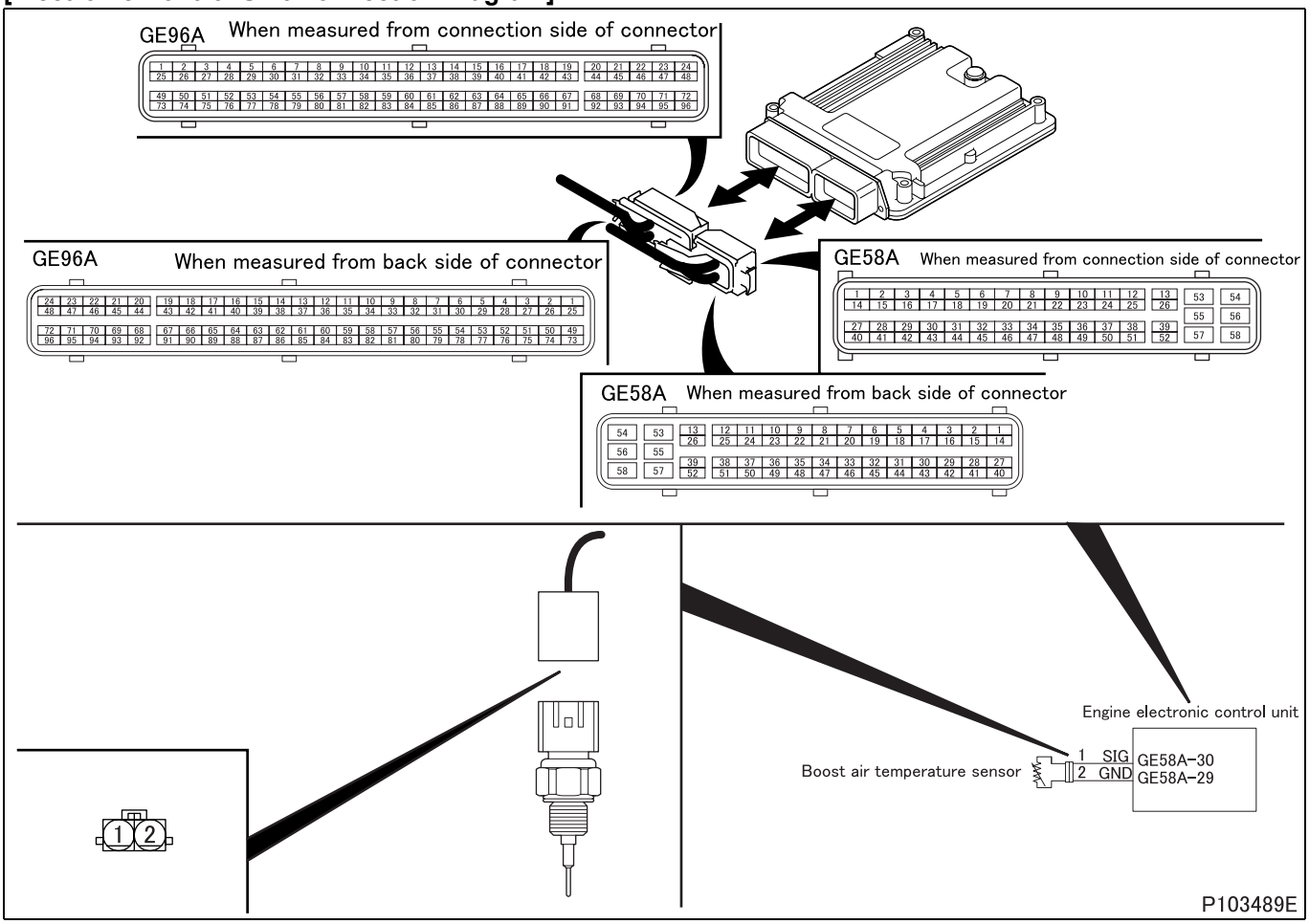
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation gas temperature is fixed at backup value.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

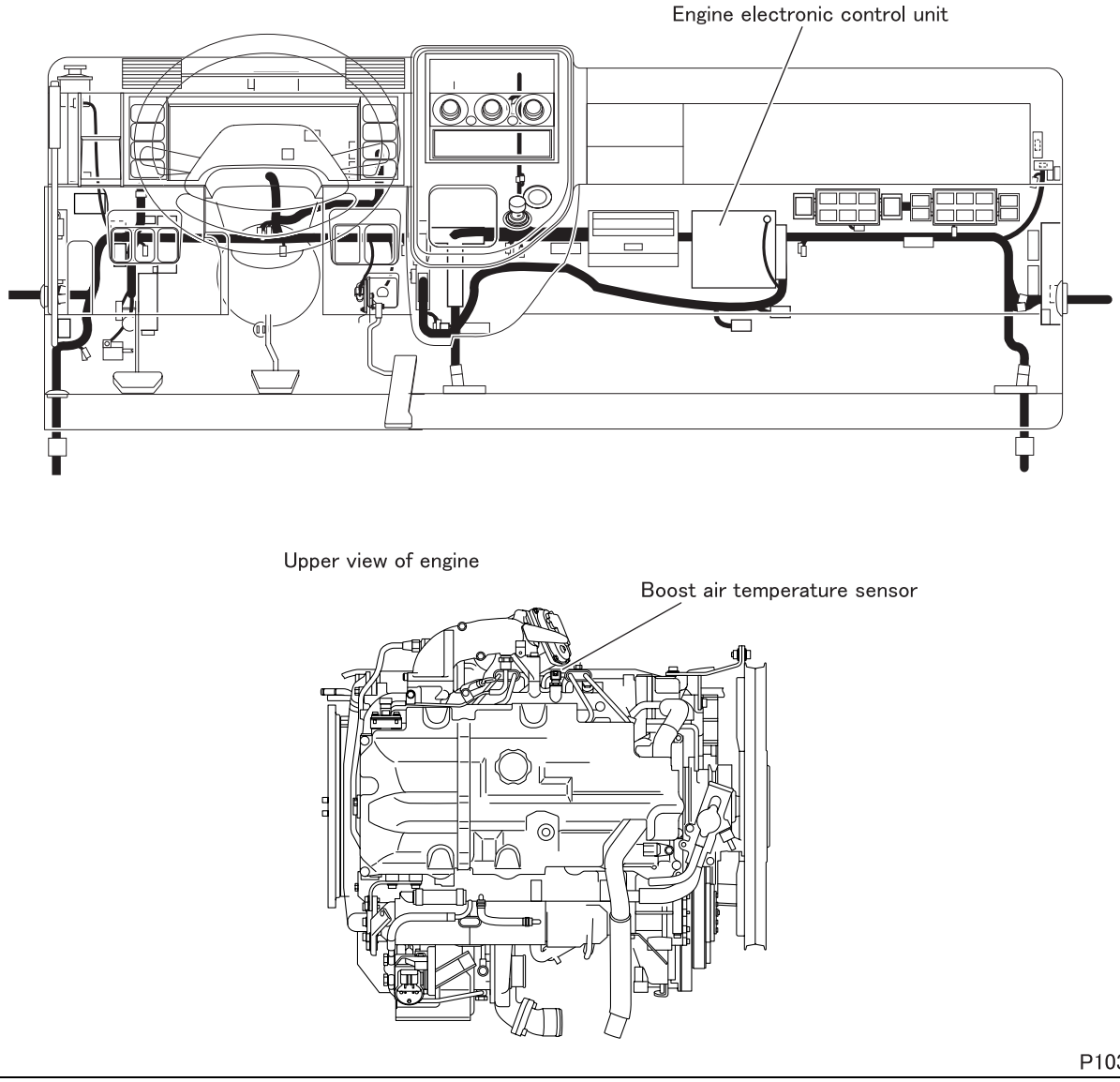
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and boost air temperature sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake Air Temperature”. **<Multi-Use Tester used>** • Measure item No. 10 “Intake Air Temperature (EGR)” of Service Data.
	Inspection condition		–
	Requirements		When engine is cold: Temperature is equivalent to outside temperature.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

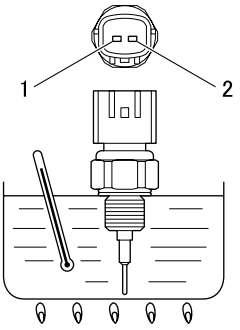
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE58A) terminal No. 29 and 30.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• 0°C {32°F}: 162.3 $^{+48.8}_{-36.5}$ kΩ • 20°C {68°F}: 61.47 $^{+15.99}_{-12.35}$ kΩ • 80°C {176°F}: 6.120 $^{+1.095}_{-0.907}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of boost air temperature sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of boost air temperature sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put boost air temperature sensor in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 0°C {32°F}: 162.3 $^{+48.8}_{-36.5}$ kΩ • 20°C {68°F}: 61.47 $^{+15.99}_{-12.35}$ kΩ • 80°C {176°F}: 6.120 $^{+1.095}_{-0.907}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE58A) terminal No. 30.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE58A) terminal No. 29.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake Air Temperature”. **<Multi-Use Tester used>** • Measure item No. 10 “Intake Air Temperature (EGR)” of Service Data.
	Inspection condition		–
	Requirements		When engine is cold: Temperature is equivalent to outside temperature.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0101/Flash code: 17
[Monitor]
Characteristic abnormality in air flow sensor
[Fault (outline)]
Gain and offset drift
[Diagnosis check]
- Intake air flow rate is detected as actual intake air flow rate by air flow sensor and monitored for ratio to target air flow rate for control by engine electronic control unit.

[Code generation condition]
- Difference shows intake air flow rate remains considerably high (1.5 or more) or low (0.6 or less) for 5 seconds. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
<When difference in intake air flow rate is abnormally high>
- Engine operating mode: normal (engine in operation)
- Engine speed: 1000 to 3000 rpm
- Fuel injection quantity: less than 100 mg/cyc
- Atmospheric pressure: above 828 mbar {12 psi}
- Boost pressure: less than 2500 mbar {36.25 psi}
- Intake throttle valve opening: 15° to 95°
- Water temperature: 64 to 110°C {147 to 230°F}
- Diesel particulate filter regeneration control: not effected
- Time till above conditions were met: more than 2 seconds
- Air flow sensor: normal in output signal
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Exhaust gas recirculation flow rate and exhaust gas recirculation valve operation: in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Boost air temperature sensor: in order
- Exhaust gas recirculation cooler: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- Injector: in order
- MPROP (rail pressure control valve): in order
- Fuel feed when engine is idling: in order
- Exhaust shutter 3-way magnetic valve: in order

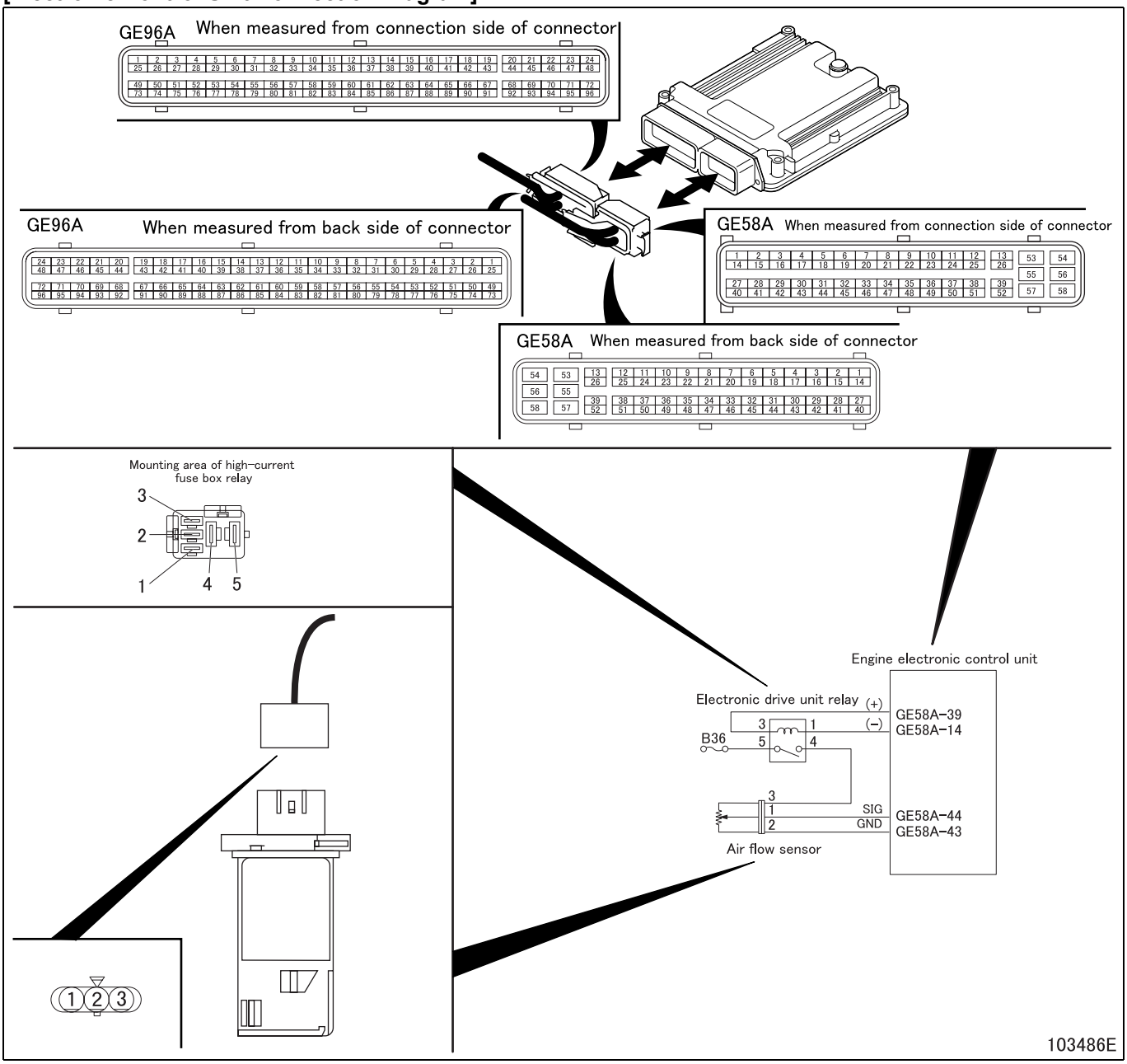
<When difference in intake air flow rate is abnormally low>
- Engine operating mode: normal (engine in operation)
- Engine speed: 1000 to 3000 rpm
- Fuel injection quantity: more than 12 mg/cyc
- Atmospheric pressure: above 828 mbar {12 psi}
- Boost pressure: less than 2500 mbar {36.25 psi}
- Intake throttle valve opening: more than 15°
- Exhaust gas recirculation λ value: 1.2 to 14
- Water temperature: 64 to 110°C {147 to 230°F}
- Diesel particulate filter regeneration control: not effected
- Time till above conditions were met: more than 2 seconds
- Air flow sensor: normal in output signal
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Exhaust gas recirculation flow rate and exhaust gas recirculation valve operation: in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Boost air temperature sensor: in order
- Exhaust gas recirculation cooler: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- Injector: in order
- MPROP (rail pressure control valve): in order
- Fuel feed when engine is idling: in order
- Exhaust shutter 3-way magnetic valve: in order

[Control effected by electronic control unit during fault]
- Intake air flow rate is fixed at backup value.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

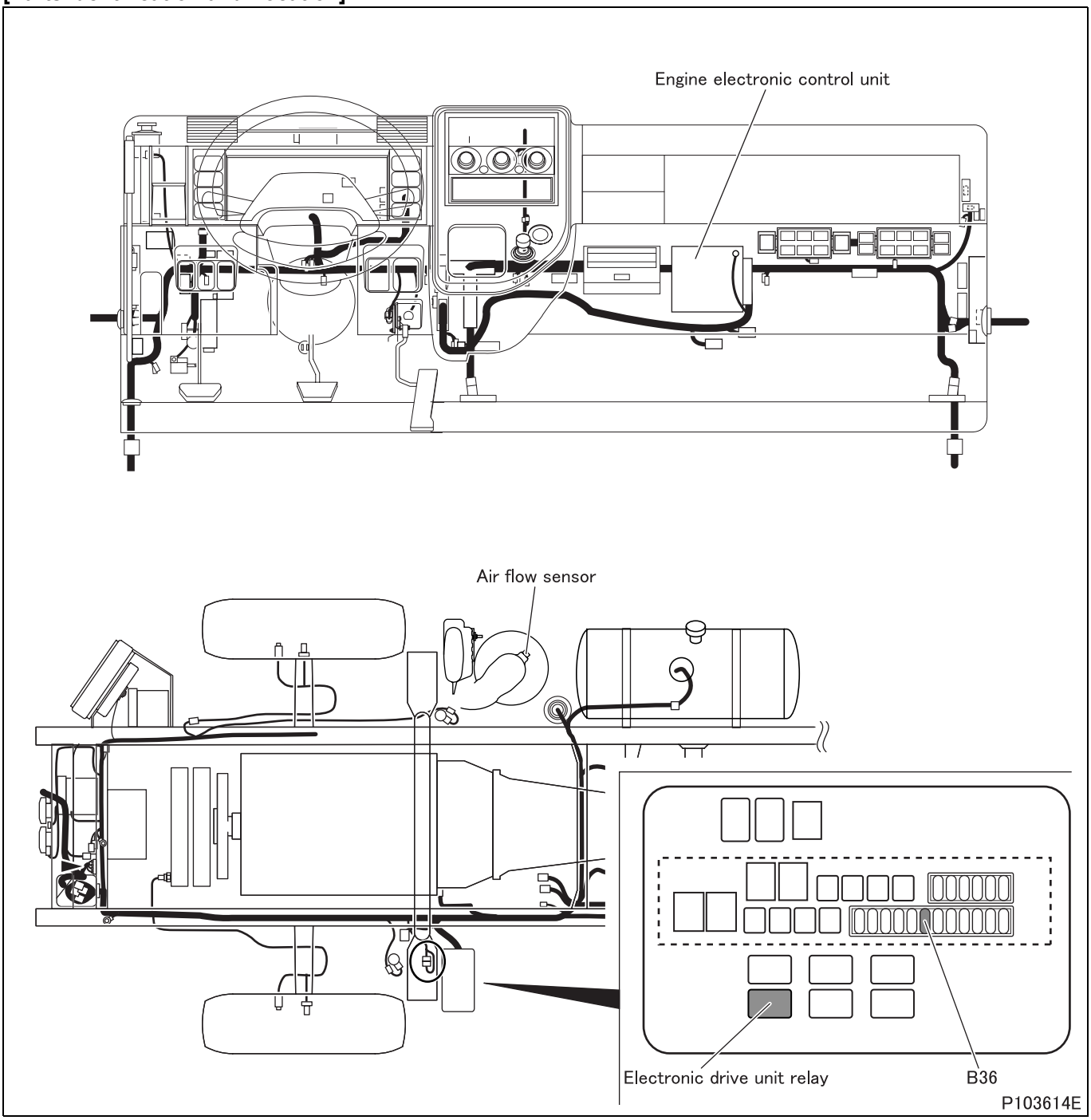
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 60 “Air mass flow” of Service Data.
	Inspection condition		• Perform actuator test item No. AF “EDU Relay” • Gradually press accelerator pedal.
	Requirements		The numeric value should gradually increase.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection by sensor connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 2 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Perform actuator test item No. AF “EDU Relay”
	Requirements		12 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 4.

Step 4	Inspection items		Inspection of harness between electronic drive unit relay and sensor (power supply)
	Maintenance item		Check circuit between electronic drive unit relay connector terminal No. 4 and sensor connector terminal No. 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE58A) terminal No. 43.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE58A) terminal No. 44.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

Step 8	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 60 “Air mass flow” of Service Data.
	Inspection condition		• Perform actuator test item No. AF “EDU Relay” • Gradually press accelerator pedal.
	Requirements		The numeric value should gradually increase.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0102/Flash code: 17
[Monitor]
Failure of air flow sensor
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Air flow sensor output voltage is monitored.

[Code generation condition]
- Air flow output from air flow sensor remains below 1 kg/hr for 3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

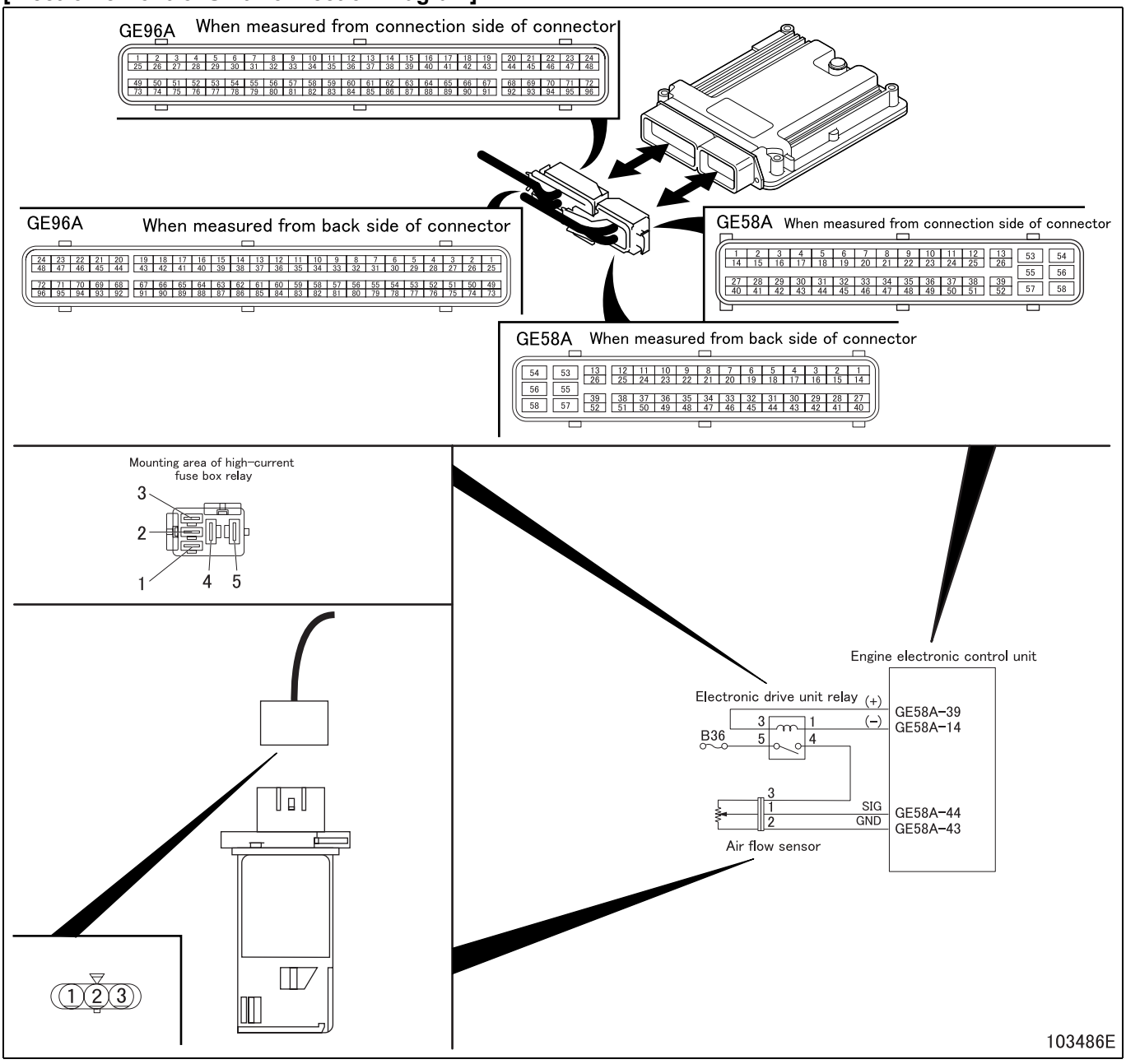
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Intake air flow rate is fixed at backup value.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

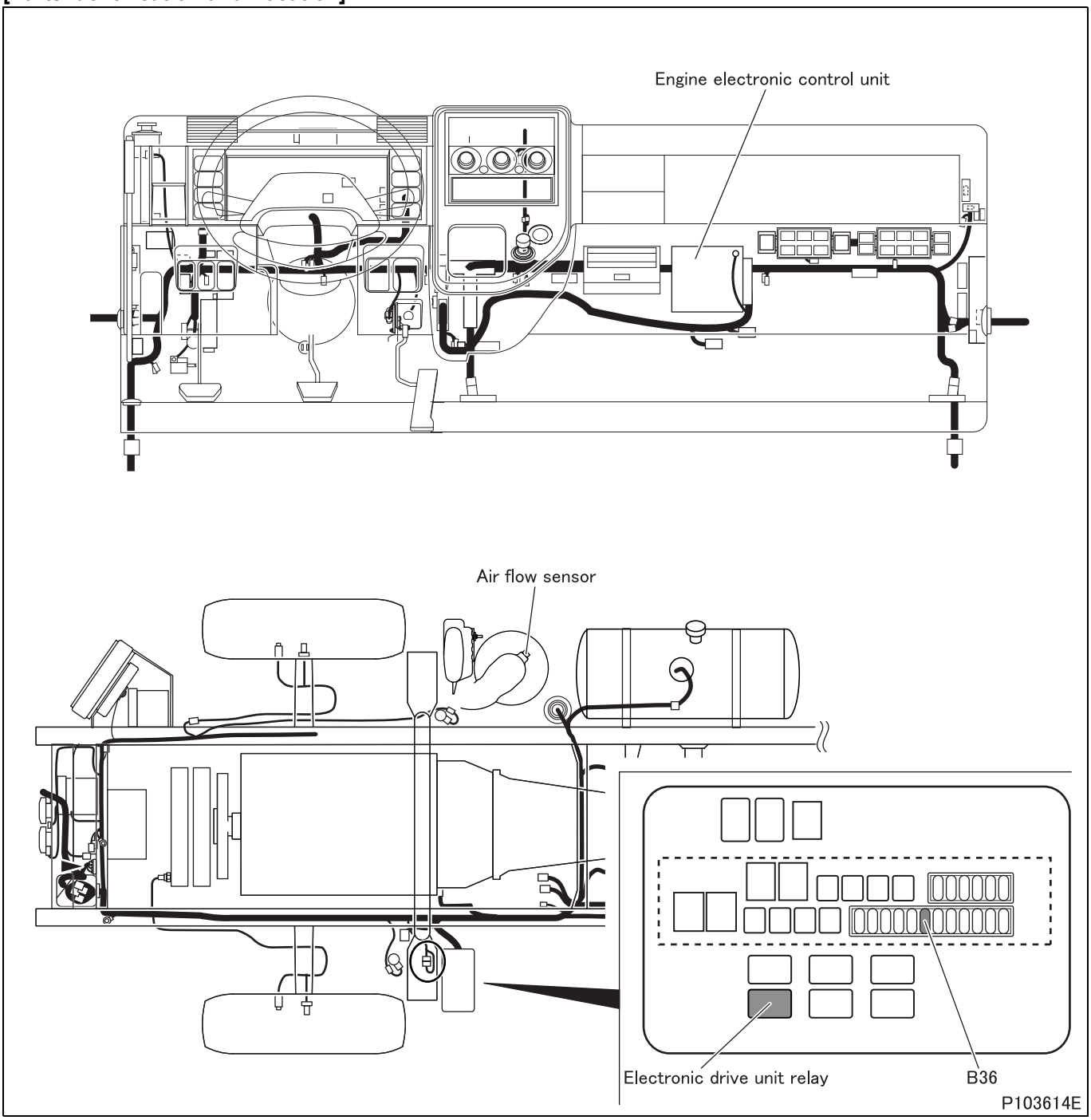
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and relay
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Open-circuit or short-circuit of harness between electronic drive unit and sensor
- Open-circuit or short-circuit of harness between fuse and relay
- Open-circuit or short-circuit of harness between relay and electronic drive unit
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of relay
- Malfunction of electronic drive unit
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 60 “Air mass flow” of Service Data.
	Inspection condition		• Perform actuator test item No. AF “EDU Relay” • Gradually press accelerator pedal.
	Requirements		The numeric value should gradually increase.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of sensor connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 2 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Perform actuator test item No. AF “EDU Relay”
	Requirements		12 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 4.

Step 4	Inspection items		Inspection of harness between electronic drive unit relay and sensor (power supply)
	Maintenance item		Check circuit between electronic drive unit relay connector terminal No. 4 and sensor connector terminal No. 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE58A) terminal No. 43.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE58A) terminal No. 44.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

Step 8	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 60 “Air mass flow” of Service Data.
	Inspection condition		• Perform actuator test item No. AF “EDU Relay” • Gradually press accelerator pedal.
	Requirements		The numeric value should gradually increase.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0103/Flash code: 17
[Monitor]
Failure of air flow sensor
[Fault (outline)]
High signal range check
[Diagnosis check]
- Air flow sensor output voltage is monitored.

[Code generation condition]
- Air flow output from air flow sensor remains over 970 kg/hr for 3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

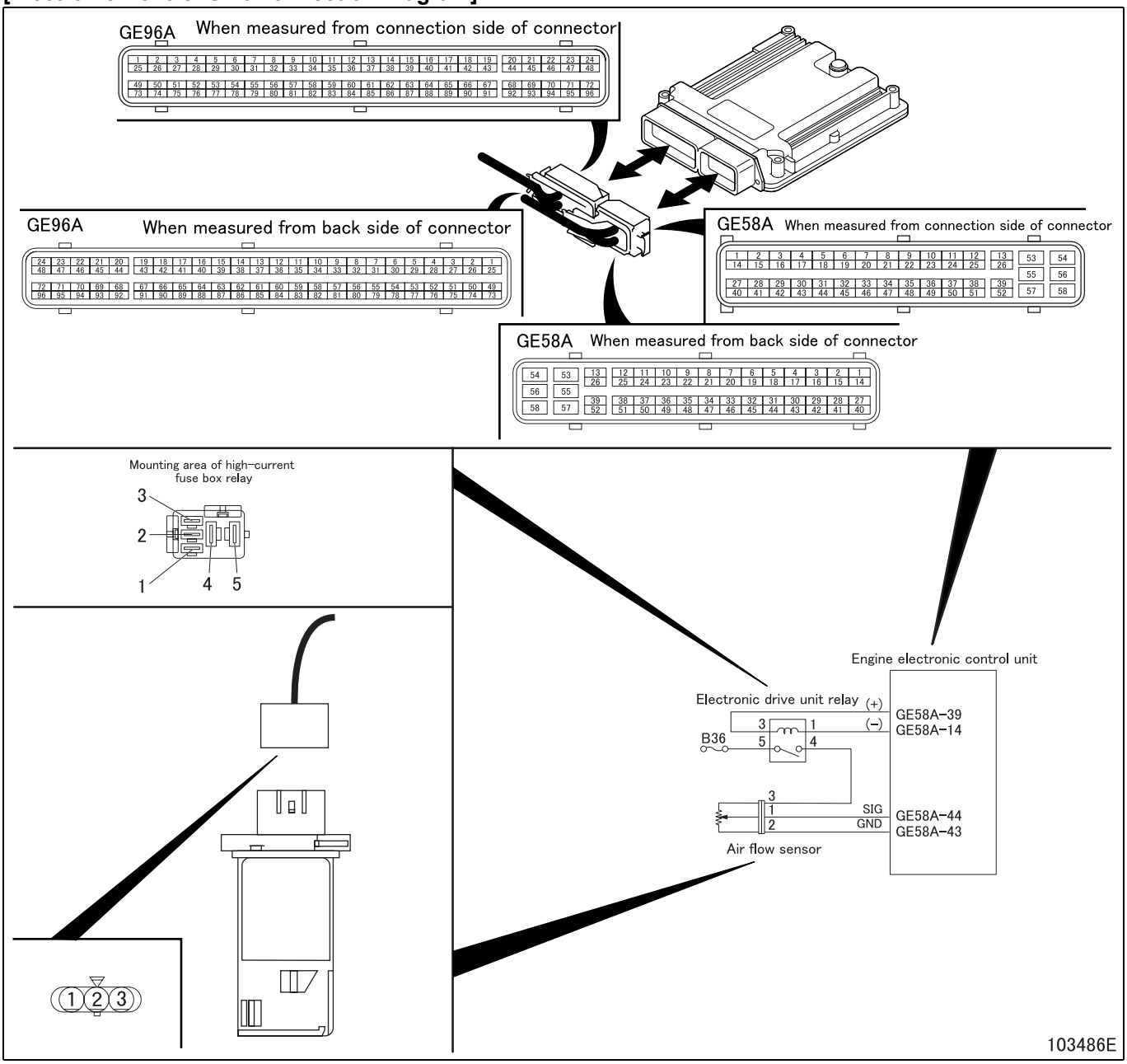
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Intake air flow rate is fixed at backup value.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

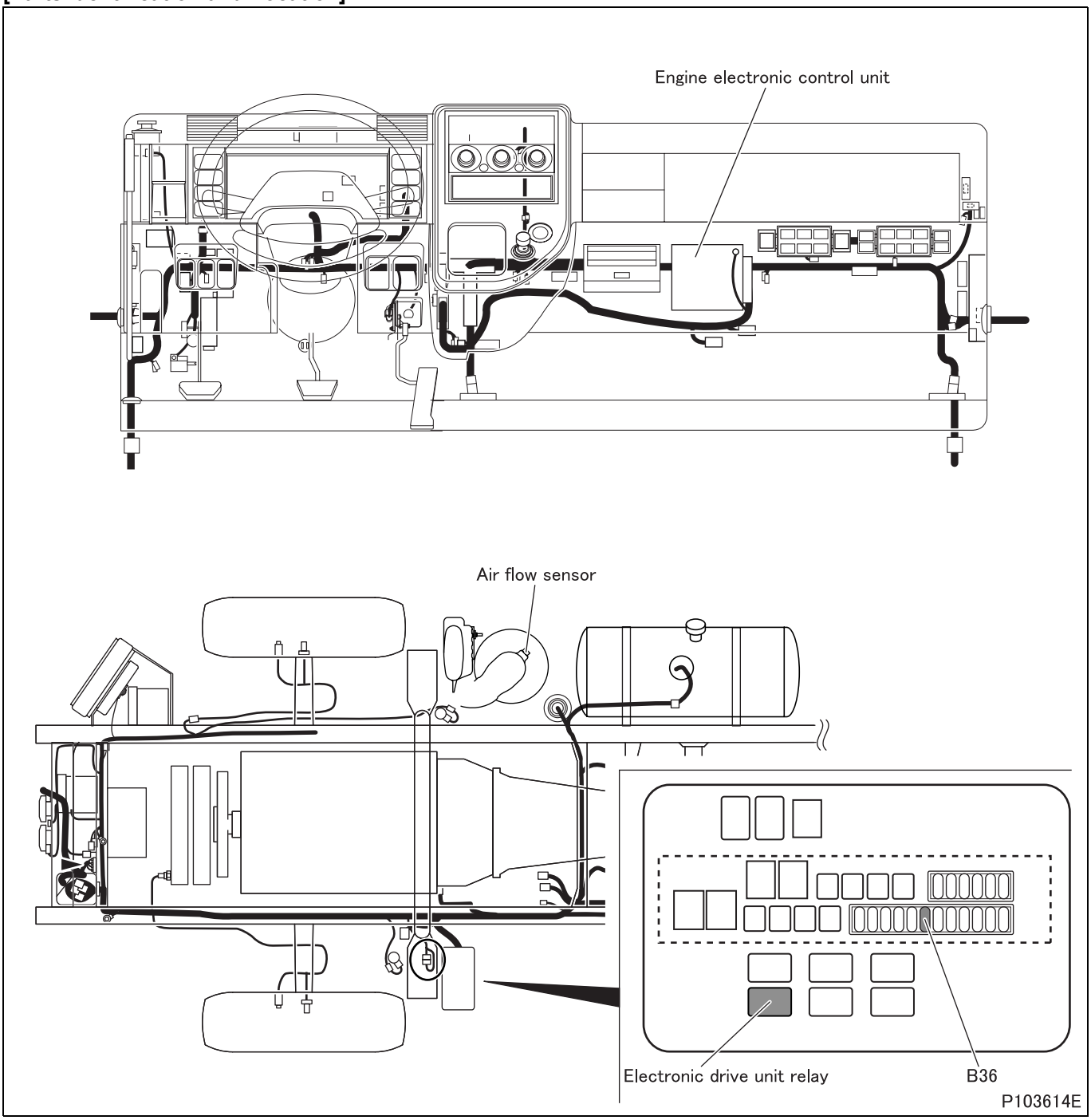
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and relay
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Open-circuit or short-circuit of harness between electronic drive unit and sensor
- Open-circuit or short-circuit of harness between fuse and relay
- Open-circuit or short-circuit of harness between relay and electronic drive unit
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of relay
- Malfunction of electronic drive unit
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 60 “Air mass flow” of Service Data.
	Inspection condition		• Perform actuator test item No. AF “EDU Relay” • Gradually press accelerator pedal.
	Requirements		The numeric value should gradually increase.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection by sensor connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 2 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Perform actuator test item No. AF “EDU Relay”
	Requirements		12 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 4.

Step 4	Inspection items		Inspection of harness between electronic drive unit relay and sensor (power supply)
	Maintenance item		Check circuit between electronic drive unit relay connector terminal No. 4 and sensor connector terminal No. 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE58A) terminal No. 43.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE58A) terminal No. 44.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

Step 8	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 60 “Air mass flow” of Service Data.
	Inspection condition		• Perform actuator test item No. AF “EDU Relay” • Gradually press accelerator pedal.
	Requirements		The numeric value should gradually increase.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0112/Flash code: 44
[Monitor]
Failure of intake air temperature sensor
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Intake air temperature sensor output voltage is monitored.

[Code generation condition]
- Output voltage of intake air temperature sensor remains below 0.2 V for 1 second. (sensor temperature: 198°C {388°F} or higher)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

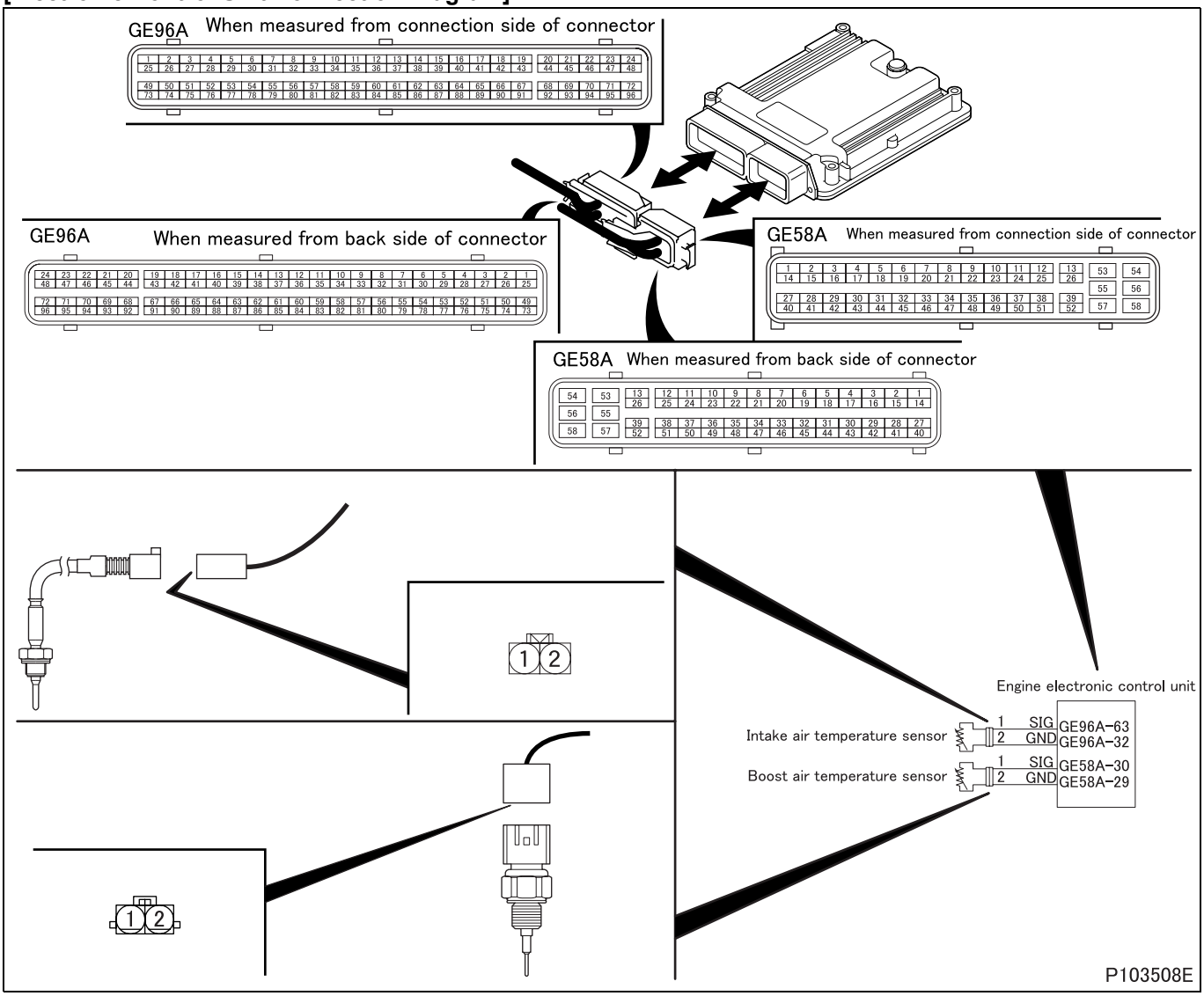
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Intake air flow rate is fixed at backup value.
- Related fault check is stopped.

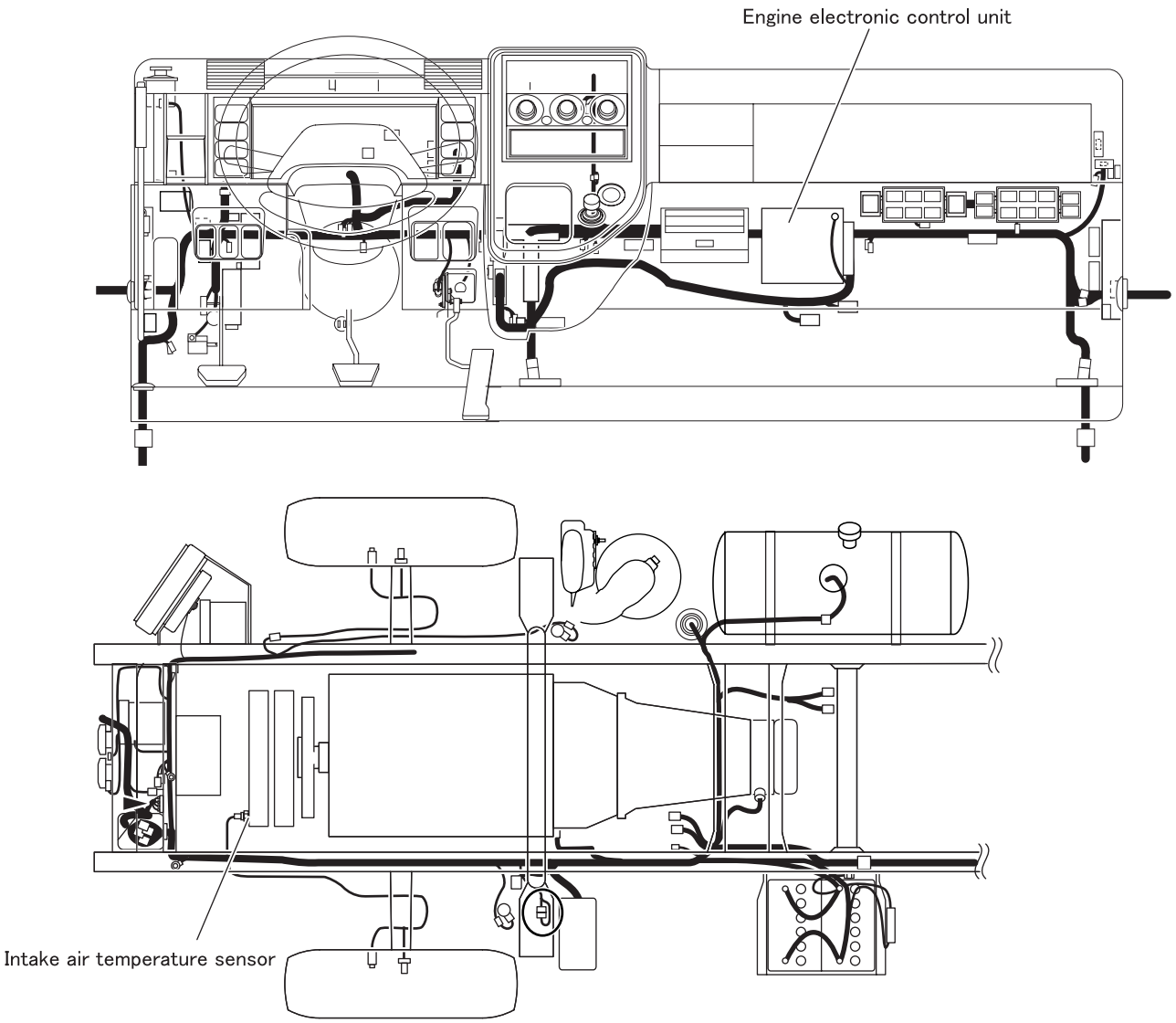
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and intake air temperature sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

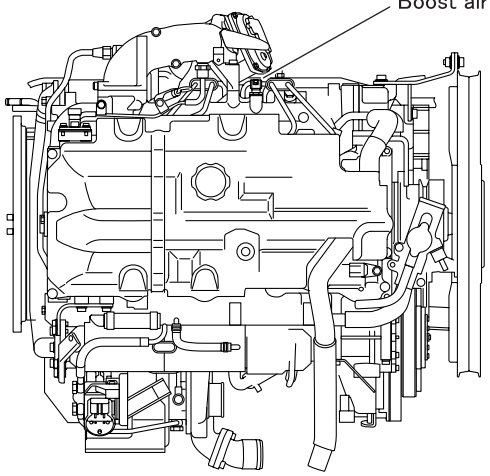
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Upper view of engine



P103634E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake Air Temperature” . **<Multi-Use Tester used>** • Measure item No. 30 “Intake Air Temp. (upstream)” of Service Data.
	Inspection condition		–
	Requirements		When engine is cold: Temperature is equivalent to outside temperature.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

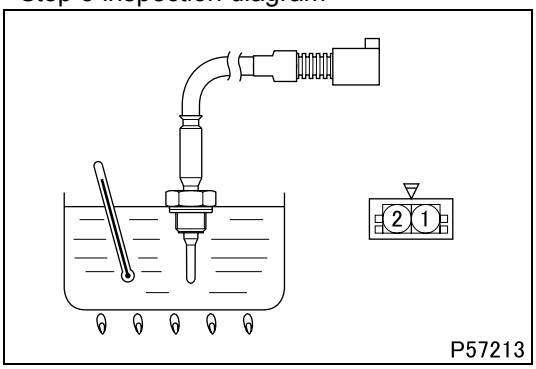
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 32 and 63.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• 50°C {122°F}: 2.202 $^{+0.233}_{-0.208}$ kΩ • 100°C {212°F}: 508.1 $^{+41.3}_{-37.7}$ Ω • 150°C {302°F}: 160.4 $^{+10.3}_{-9.6}$ Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of intake air temperature sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of intake air temperature sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put intake air temperature sensor in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 50°C {122°F}: 2.202 $^{+0.233}_{-0.208}$ kΩ • 100°C {212°F}: 508.1 $^{+41.3}_{-37.7}$ Ω • 150°C {302°F}: 160.4 $^{+10.3}_{-9.6}$ Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 63.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 32.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake Air Temperature”. **<Multi-Use Tester used>** • Measure item No. 30 “Intake Air Temp. (upstream)” of Service Data.
	Inspection condition		–
	Requirements		When engine is cold: Temperature is equivalent to outside temperature.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0113/Flash code: 44
[Monitor]
Failure of intake air temperature sensor
[Fault (outline)]
High signal range check
[Diagnosis check]
- intake air temperature sensor output voltage is monitored.

[Code generation condition]
- Output voltage of intake air temperature sensor remains above 4.87 V for 1 second. (sensor temperature: –37°C {–34.6°F} or lower)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

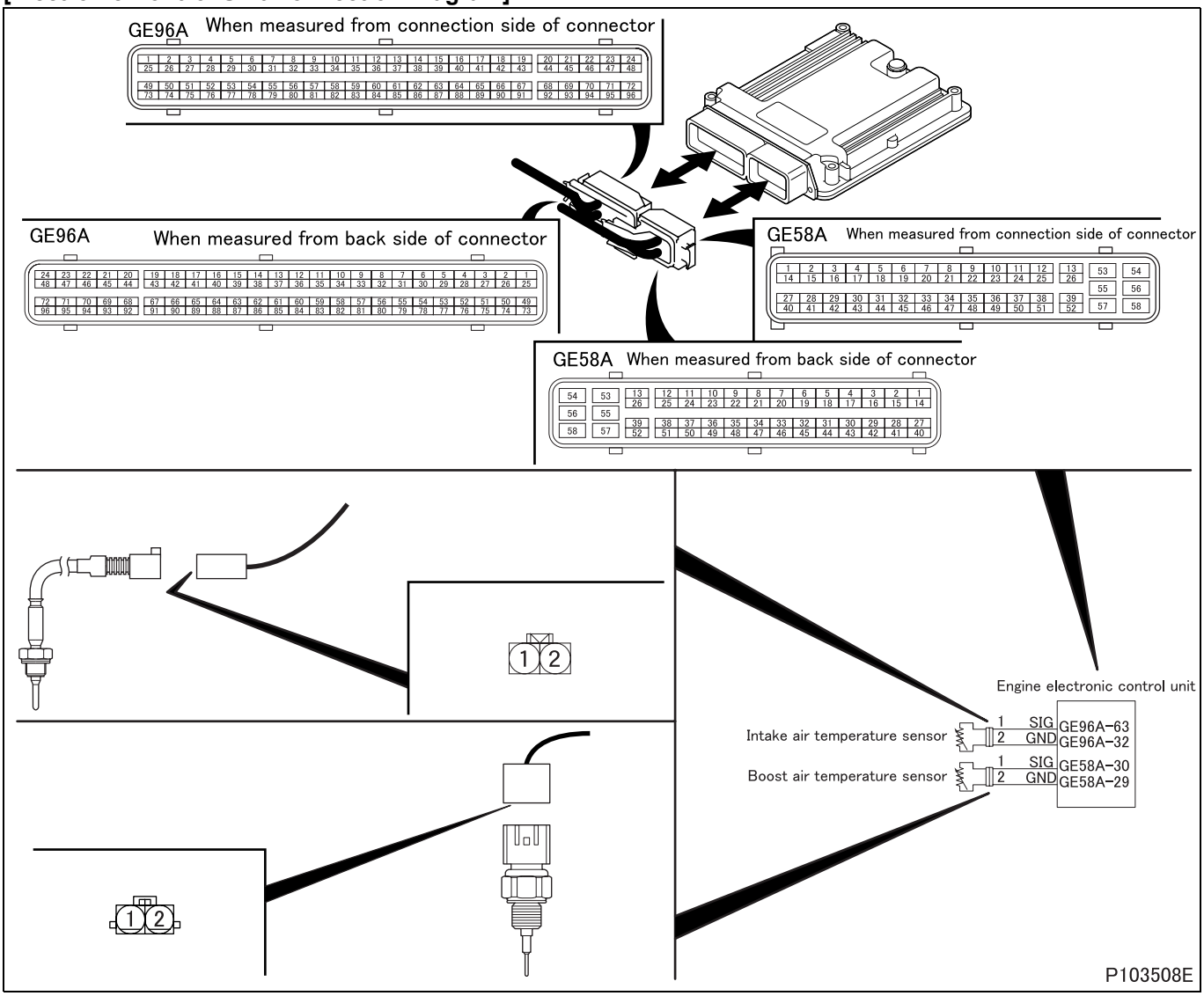
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Intake air flow rate is fixed at backup value.
- Related fault check is stopped.

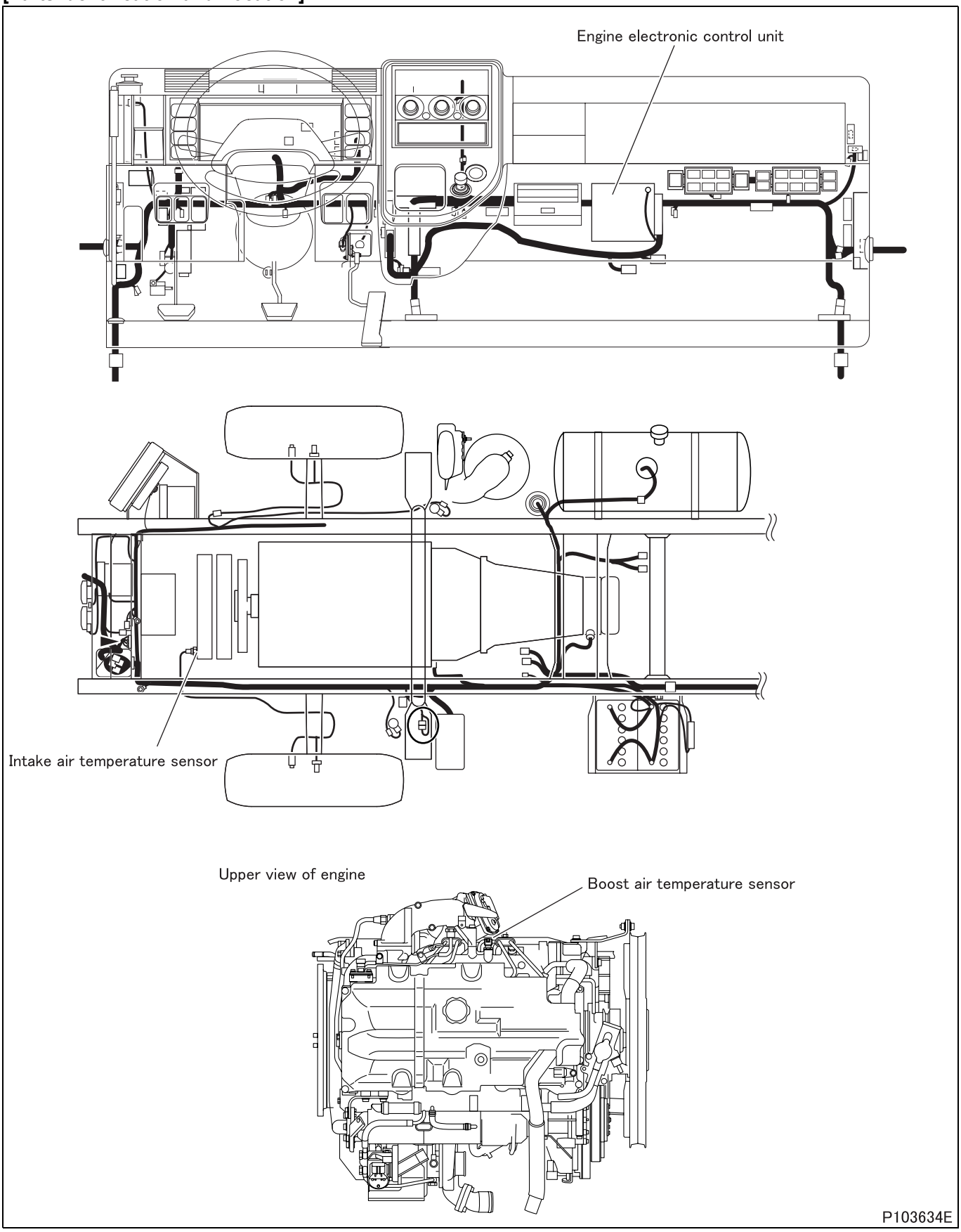
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and intake air temperature sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake Air Temperature”. **<Multi-Use Tester used>** • Measure item No. 30 “Intake Air Temp. (upstream)” of Service Data.
	Inspection condition		–
	Requirements		When engine is cold: Temperature is equivalent to outside temperature.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

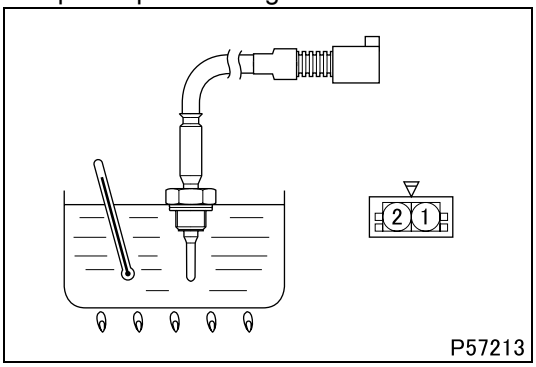
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 32 and 63.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• 50°C {122°F}: 2.202 $^{+0.233}_{-0.208}$ kΩ • 100°C {212°F}: 508.1 $^{+41.3}_{-37.7}$ Ω • 150°C {302°F}: 160.4 $^{+10.3}_{-9.6}$ Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of intake air temperature sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of intake air temperature sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put intake air temperature sensor in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 50°C {122°F}: 2.202 $^{+0.233}_{-0.208}$ kΩ • 100°C {212°F}: 508.1 $^{+41.3}_{-37.7}$ Ω • 150°C {302°F}: 160.4 $^{+10.3}_{-9.6}$ Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 63.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 32.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake Air Temperature”. **<Multi-Use Tester used>** • Measure item No. 30 “Intake Air Temp. (upstream)” of Service Data.
	Inspection condition		–
	Requirements		When engine is cold: Temperature is equivalent to outside temperature.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0117/Flash code: 21
[Monitor]
Failure of water temperature sensor
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Water temperature sensor 1 output voltage is monitored.

[Code generation condition]
- Output voltage of temperature sensor 1 remains below 0.1 V for 1 second. (sensor temperature: 150°C {302°F} or higher)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

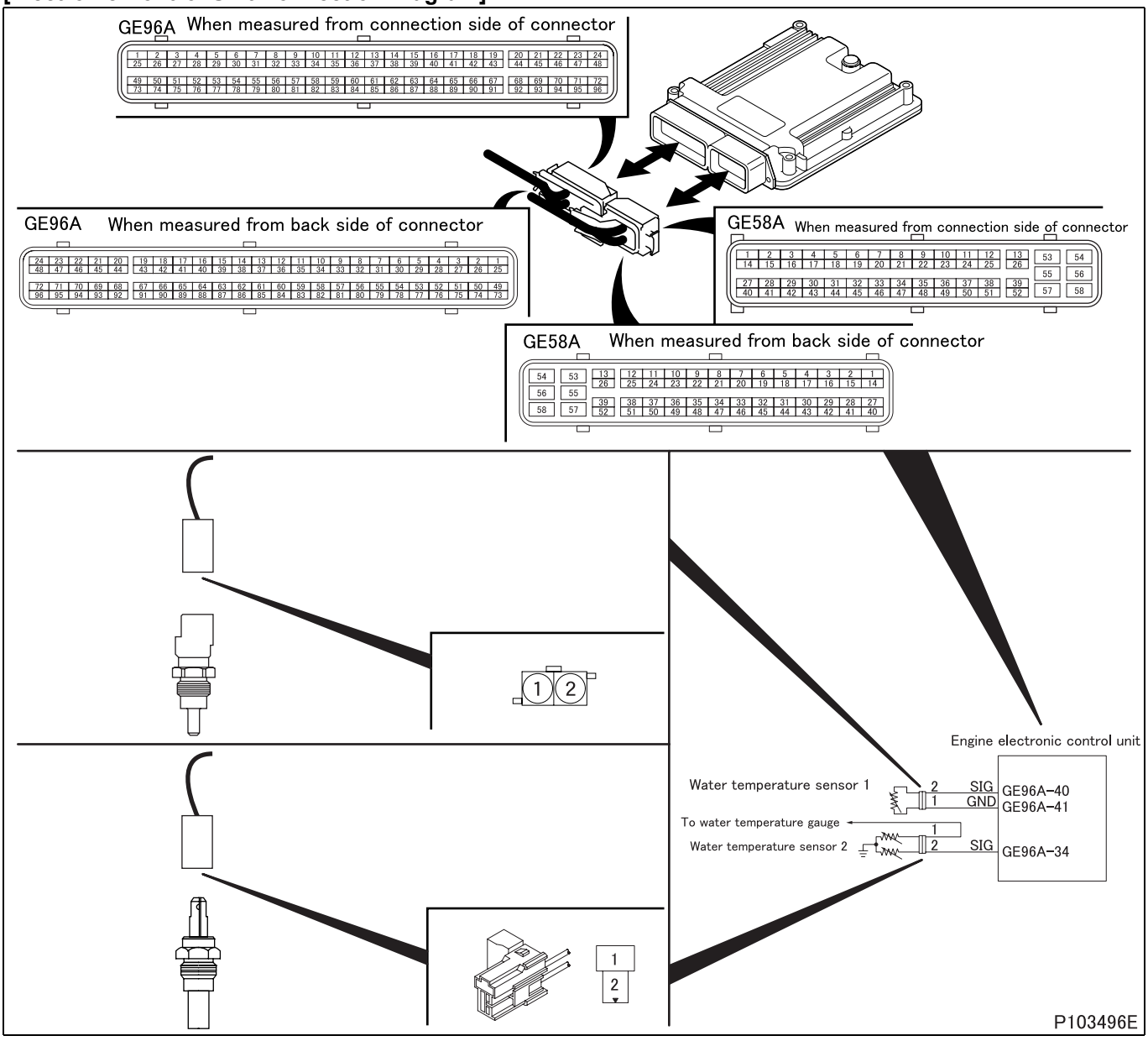
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine coolant temperature is fixed at backup value.
- Fuel system temperature is fixed at backup value.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Warm-up cycle counter is stopped.
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

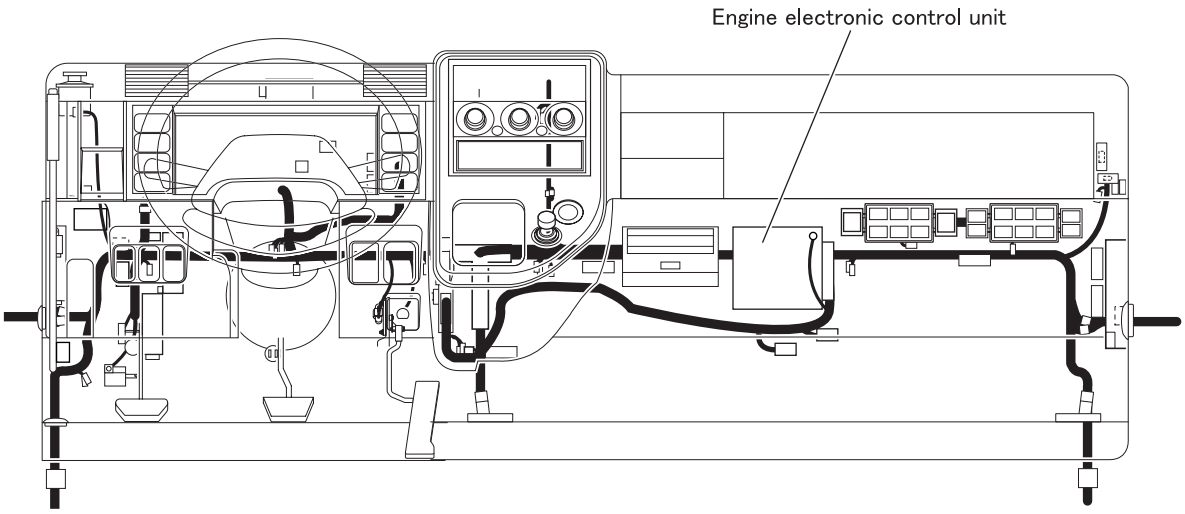
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and water temperature sensor 1
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

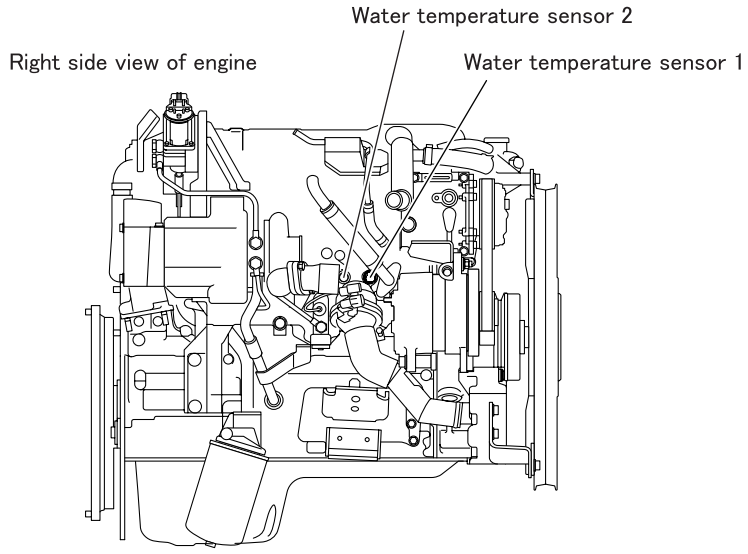
[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103624E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Engine Coolant Temperature”. **<Multi-Use Tester used>** • Measure item No. 31 “Water Temperature” of Service Data.
	Inspection condition		–
	Requirements		• When engine is cold: Temperature is equivalent to outside temperature. • While engine is warmed up: Temperature gradually increases. • When engine is stopped after warm-up: Temperature gradually declines.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

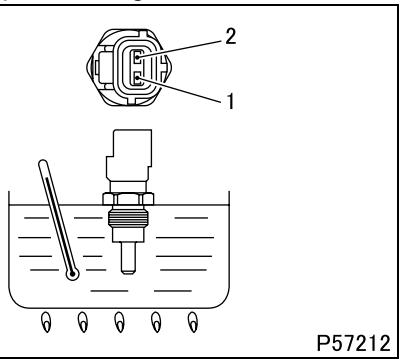
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminals No. 40 and No. 41.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• 20°C {68°F}: 2.45 ± 0.14 kΩ • 80°C {176°F}: 0.32 kΩ (reference value) • 110°C {230°F}: 141.7 ± 2 kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 4	Inspection items		Inspection of water temperature sensor 1 connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of water temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put water temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F}: 2.45 ± 0.14 kΩ • 80°C {176°F}: 0.32 kΩ (reference value) • 110°C {230°F}: 141.7 ± 2 kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 40.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 41.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Engine Coolant Temperature”. **<Multi-Use Tester used>** • Measure item No. 31 “Water Temperature” of Service Data.
	Inspection condition		–
	Requirements		• When engine is cold: Temperature is equivalent to outside temperature. • While engine is warmed up: Temperature gradually increases. • When engine is stopped after warm-up: Temperature gradually declines.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0118/Flash code: 21
[Monitor]
Failure of water temperature sensor
[Fault (outline)]
High signal range check
[Diagnosis check]
- Water temperature sensor 1 output voltage is monitored.

[Code generation condition]
- Output voltage of temperature sensor 1 remains above 4.8 V for 1 second. (sensor temperature: –45°C {–49°F} or lower)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

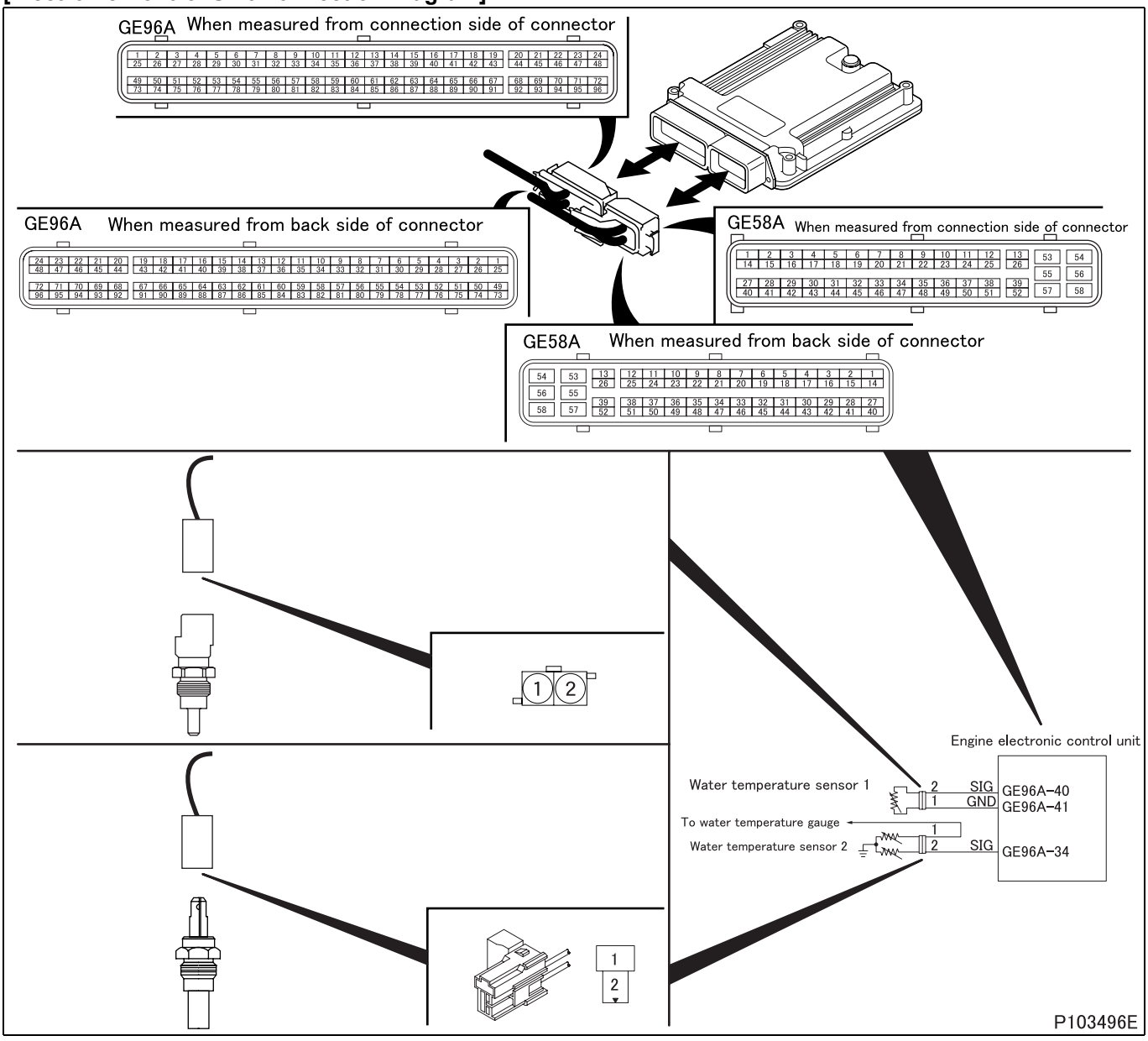
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine coolant temperature is fixed at backup value.
- Fuel system temperature is fixed at backup value.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Warm-up cycle counter is stopped.
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

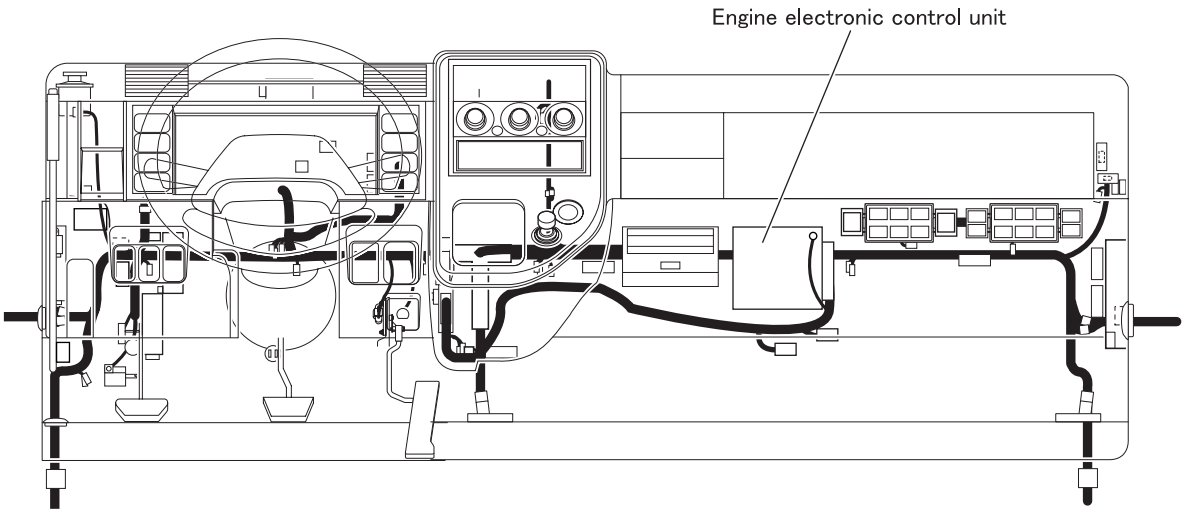
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and water temperature sensor 1
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

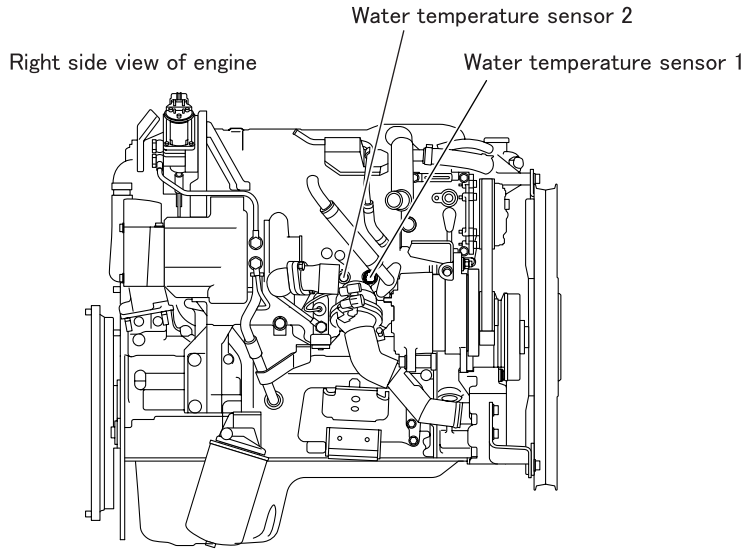
[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103624E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Engine Coolant Temperature”. **<Multi-Use Tester used>** • Measure item No. 31 “Water Temperature” of Service Data.
	Inspection condition		–
	Requirements		• When engine is cold: Temperature is equivalent to outside temperature. • While engine is warmed up: Temperature gradually increases. • When engine is stopped after warm-up: Temperature gradually declines.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

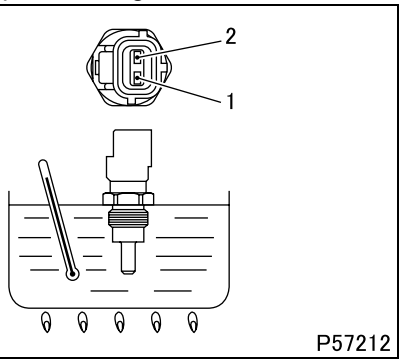
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminals No. 40 and No. 41.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• 20°C {68°F}: 2.45 ± 0.14 kΩ • 80°C {176°F}: 0.32 kΩ (reference value) • 110°C {230°F}: 141.7 ± 2 kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of water temperature sensor 1 connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of water temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put water temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F}: 2.45 ± 0.14 kΩ • 80°C {176°F}: 0.32 kΩ (reference value) • 110°C {230°F}: 141.7 ± 2 kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 40.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 41.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Engine Coolant Temperature”. **<Multi-Use Tester used>** • Measure item No. 31 “Water Temperature” of Service Data.
	Inspection condition		–
	Requirements		• When engine is cold: Temperature is equivalent to outside temperature. • While engine is warmed up: Temperature gradually increases. • When engine is stopped after warm-up: Temperature gradually declines.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P011A/Flash code: 21
[Monitor]
Characteristic abnormality of water temperature sensor
[Fault (outline)]
Gain drift
[Diagnosis check]
- Output temperature data from water temperature sensor 1 and sensor 2 are monitored for difference within specification.

[Code generation condition]
- 30 seconds after starting engine, difference in temperature data between sensor 1 and sensor 2 remains above 14°C {57°F} for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

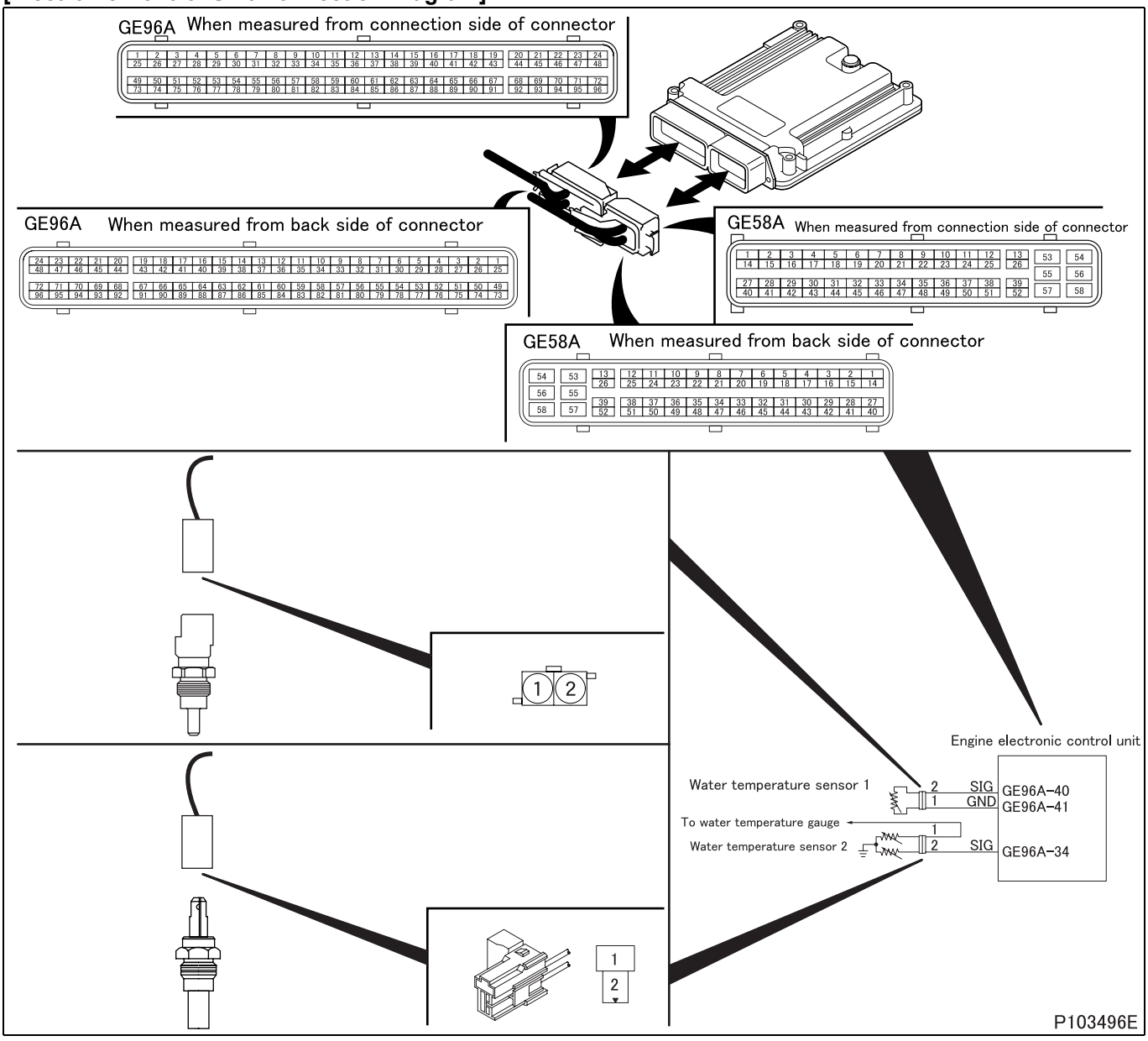
[Diagnostic requirement]
- Engine running time: 30 seconds

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Warm-up cycle counter is stopped.
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

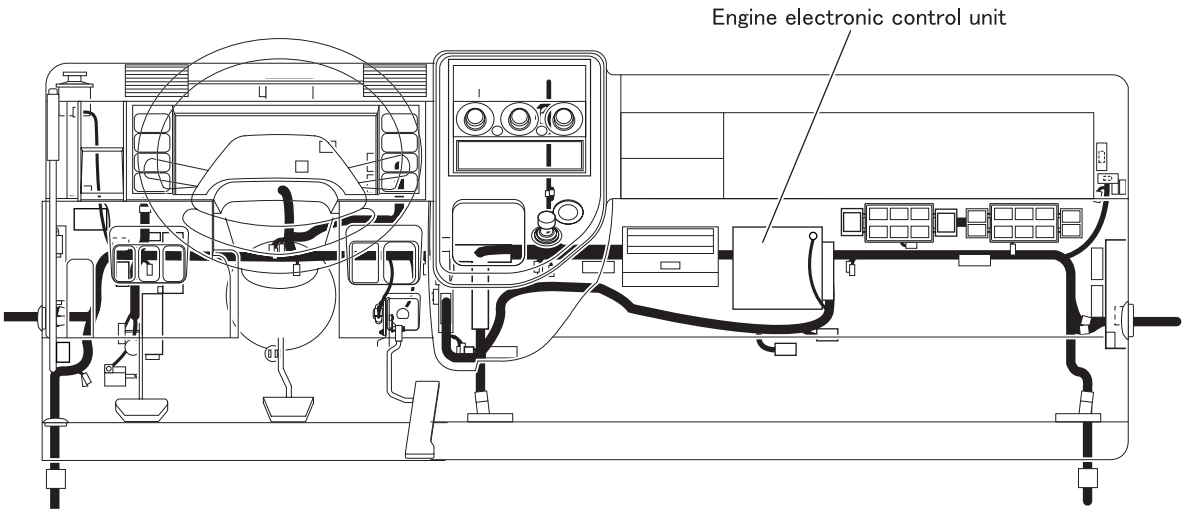
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

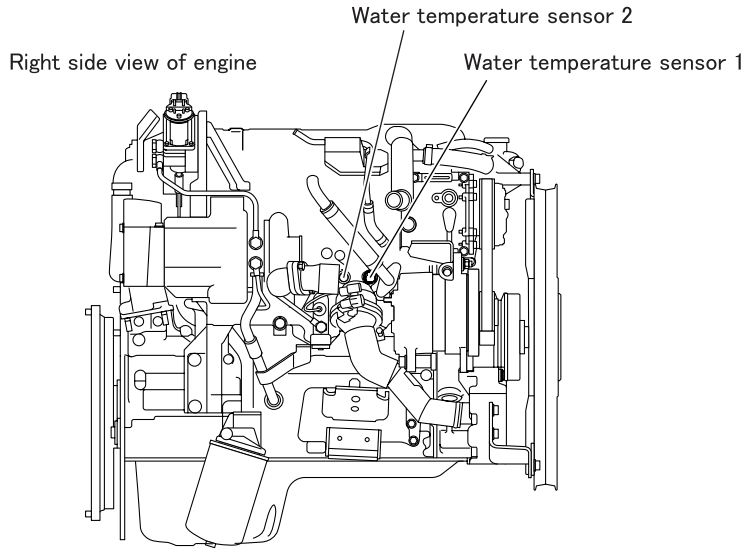
[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103624E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measurement of following service data • Water temperature sensor 1: Item No. 31 “Water Temperature” • Water temperature sensor 2: Item No. 32 “Water Temperature 2”
	Inspection condition		Engine coolant temperature: 80°C {176°F}
	Requirements		Each service data indicates same temperature
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

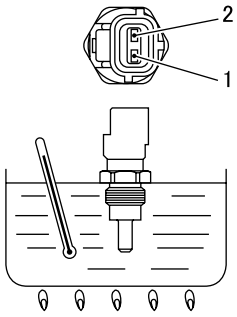
Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of water temperature sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by electronic control unit connector (water temperature sensor 1)
	Maintenance item		Measure value of resistance between connector (GE96A) terminals No. 40 and No. 41.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• 20°C {68°F}: 2.45 ± 0.14 kΩ • 80°C {176°F}: 0.32 kΩ (reference value) • 110°C {230°F}: 141.7 ± 2 kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of water temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put water temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F}: 2.45 ± 0.14 kΩ • 80°C {176°F}: 0.32 kΩ (reference value) • 110°C {230°F}: 141.7 ± 2 kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

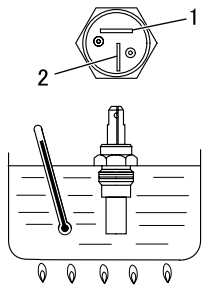
<Step 5 inspection diagram>



Step 6	Inspection items		Inspection by electronic control unit connector (water temperature sensor 2)
	Maintenance item		Measure value of resistance between connector (GE96A) terminals No. 34 and ground.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• –20°C {–4°F}: 24.8 ± 2.5 kΩ • 0°C {32°F}: 8.62 kΩ (reference value) • 20°C {68°F}: 3.25 ± 0.33 kΩ • 60°C {140°F}: 620 kΩ (reference value) • 80°C {176°F}: 300 kΩ (reference value)
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Go to step 7.

Step 7	Inspection items		Inspection of water temperature sensor 2 unit
	Maintenance item		Measure value of resistance between connector terminal No. 2 and body.
	Inspection condition		• Put water temperature sensor 2 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• –20°C {–4°F}: 24.8 ± 2.5 kΩ • 0°C {32°F}: 8.62 kΩ (reference value) • 20°C {68°F}: 3.25 ± 0.33 kΩ • 60°C {140°F}: 620 kΩ (reference value) • 80°C {176°F}: 300 kΩ (reference value)
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Replacement of sensor

<Step 7 inspection diagram>



P19463

[Fault code]
Diagnosis code: P0122/Flash code: 24
[Monitor]
Failure of accelerator pedal position sensor 1
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Accelerator pedal position sensor is monitored for output within specification.

[Code generation condition]
- Voltage from accelerator pedal position sensor 1 remains below 0.5 V for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

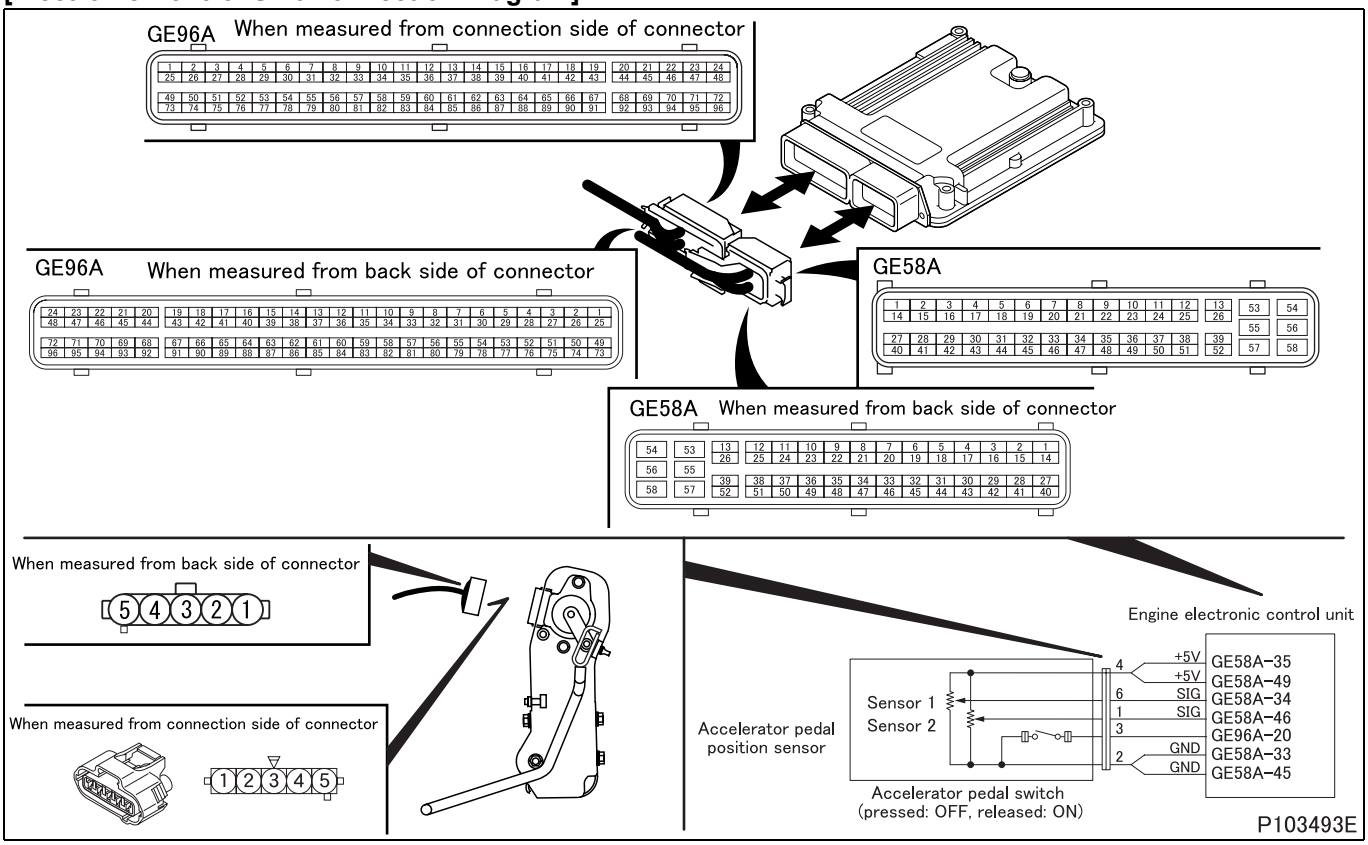
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Accelerator pedal position sensor 2 is computed with accelerator pedal position sensor 1 only.
- In-use performance counter is stopped.
- Related fault check is stopped.

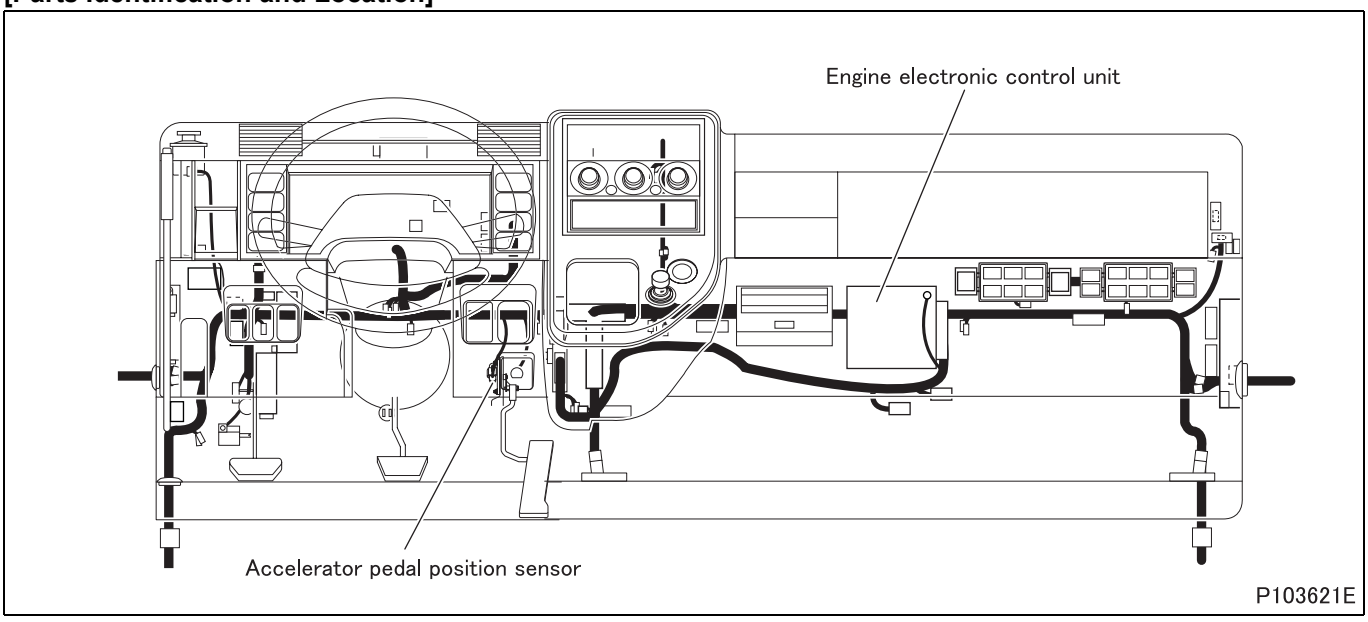
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure “Accelerator Pedal Position 1”. **<Multi-Use Tester used>** • Measure item No. 40 “Accelerator sensor voltage 1” of Service Data.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal not pressed: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 34 (+) and No. 33 and No. 45 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		• Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 35 (+) and No. 33 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 33 (+) and No. 53 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

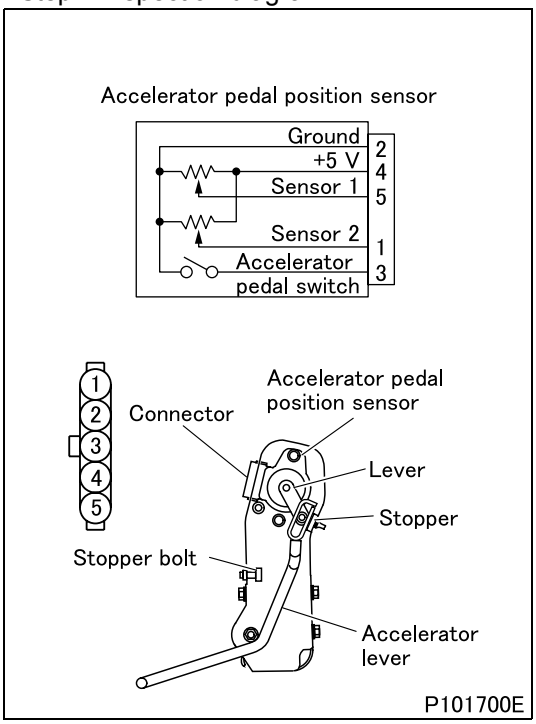
Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

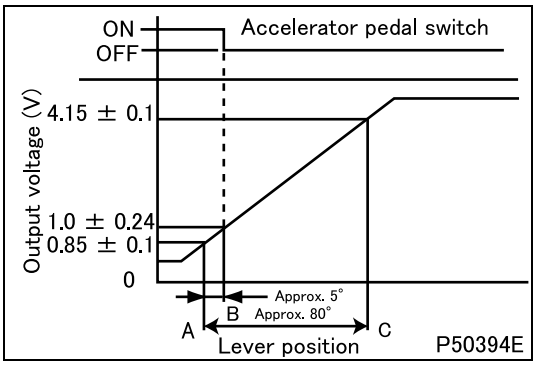
Step 7	Inspection items		Inspection of accelerator pedal position sensor 1 unit
	Maintenance item		Measure value of voltage between connector terminal No. 5 (+) and 2 (–).
	Inspection condition		Apply voltage DC 5 V across connector terminals No. 4 (+) and 2 (–).

	Requirements		• Idle position A: 0.85 ± 0.1 V
			• Accelerator switch operating position B: 1.0 ± 0.24 V
			• Full load position C: 4.15 ± 0.1 V
			  • A: When accelerator lever is in contact with stopper
			  • B: When accelerator pedal is pressed until there is no continuity between terminals 2 and 3.
			  • C: When lever is in contact with full load stopper bolt

	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Adjustment of sensor (If the measurement deviates from the standard value after adjustment, replace the sensor.) (See “INSPECTION OF ELECTRICAL PARTS” – “INSPECTION OF ACCELERATOR PEDAL POSITION SENSOR”.)

<Step 7 inspection diagram>





Step 8	Inspection items		Inspection by sensor connector
	Maintenance item		Measure value of voltage between connector terminal No. 4 (+) and 2 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 35 and sensor connector terminal No. 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector. (As connector terminal is too small, use extra fine test lead/probe.)
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 33 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector. (As connector terminal is too small, use extra fine test lead/probe.)
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 34 and sensor connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector. (As connector terminal is too small, use extra fine test lead/probe.)
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Accelerator Pedal Position 1”. **<Multi-Use Tester used>** • Measure item No. 40 “Accelerator sensor voltage 1” of Service Data.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal not pressed: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0123/Flash code: 24
[Monitor]
Failure of accelerator pedal position sensor 1
[Fault (outline)]
High signal range check
[Diagnosis check]
- Accelerator pedal position sensor is monitored for output within specification.

[Code generation condition]
- Voltage from accelerator pedal position sensor 1 remains over 4.7 V for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

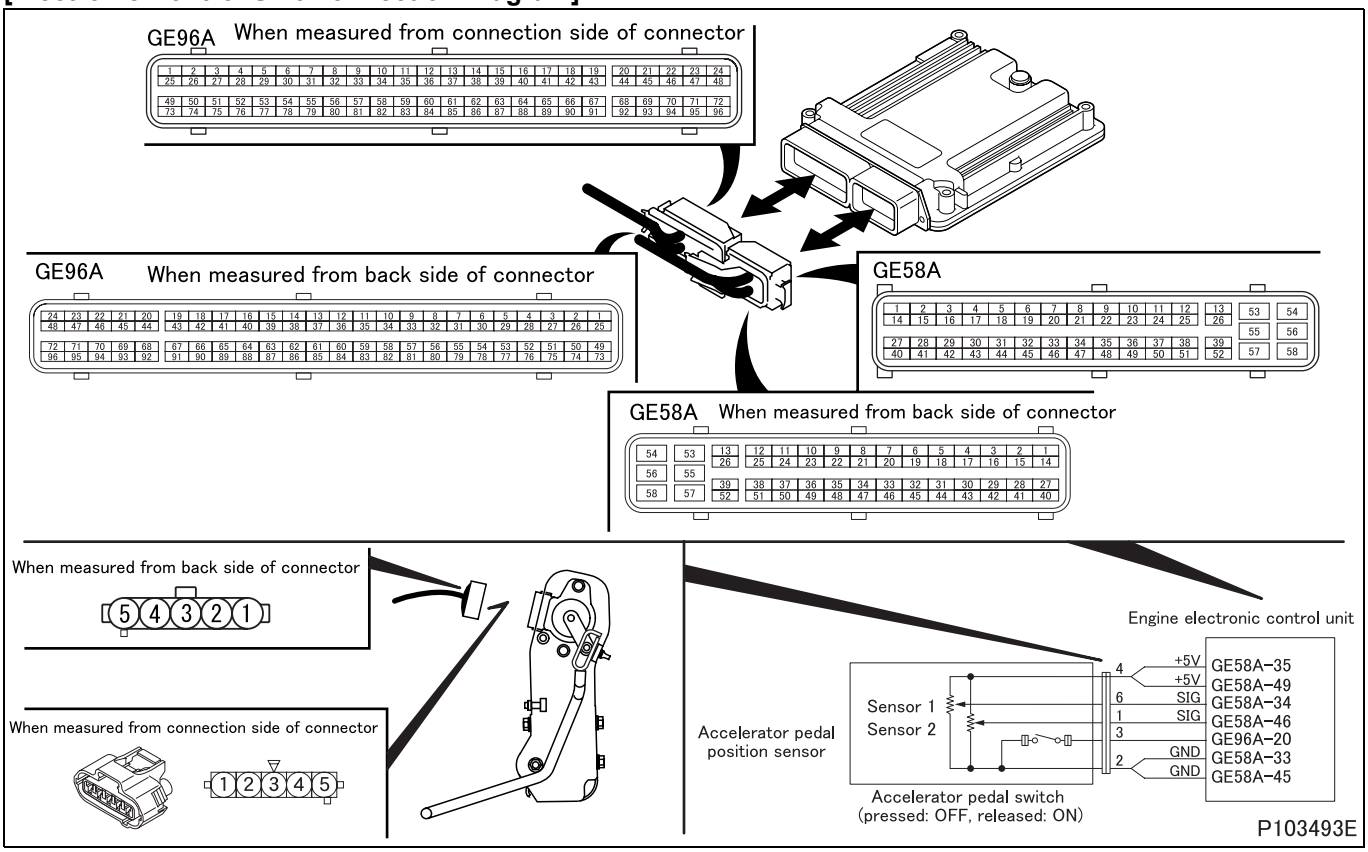
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Accelerator pedal position sensor 2 is computed with accelerator pedal position sensor 1 only.
- In-use performance counter is stopped.
- Related fault check is stopped.

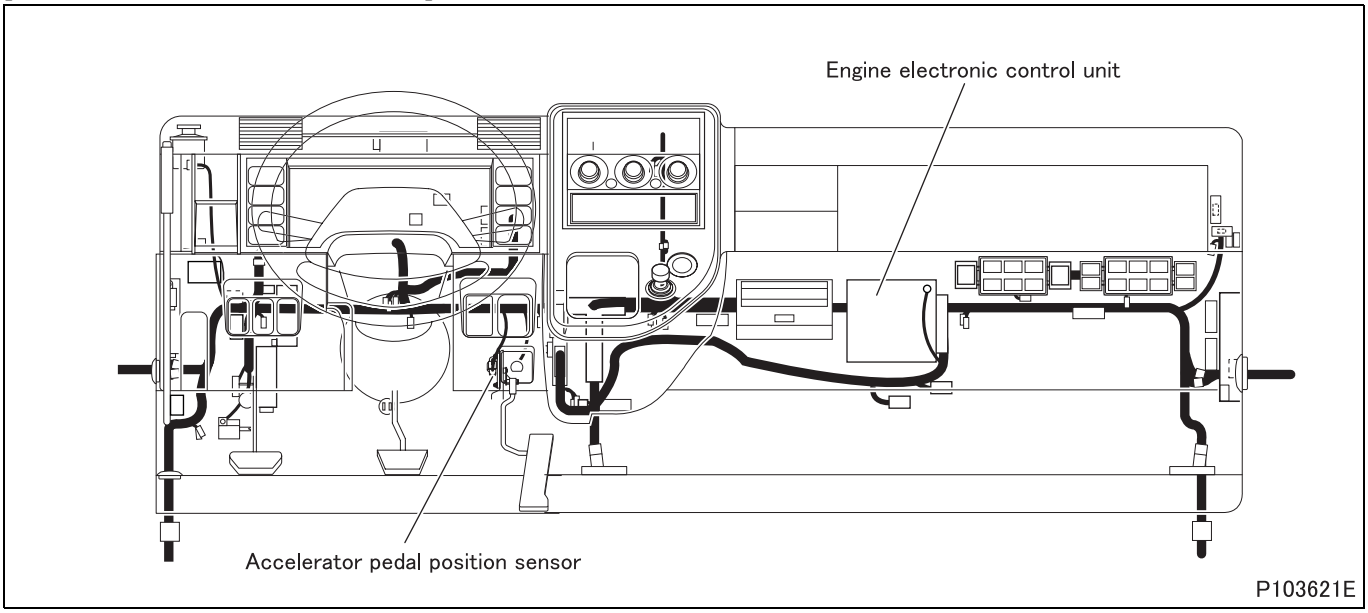
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Accelerator Pedal Position 1”. **<Multi-Use Tester used>** • Measure item No. 40 “Accelerator sensor voltage 1” of Service Data.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal not pressed: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 34 (+) and No. 33 and No. 45 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		• Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 35 (+) and No. 33 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 33 (+) and No. 53 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

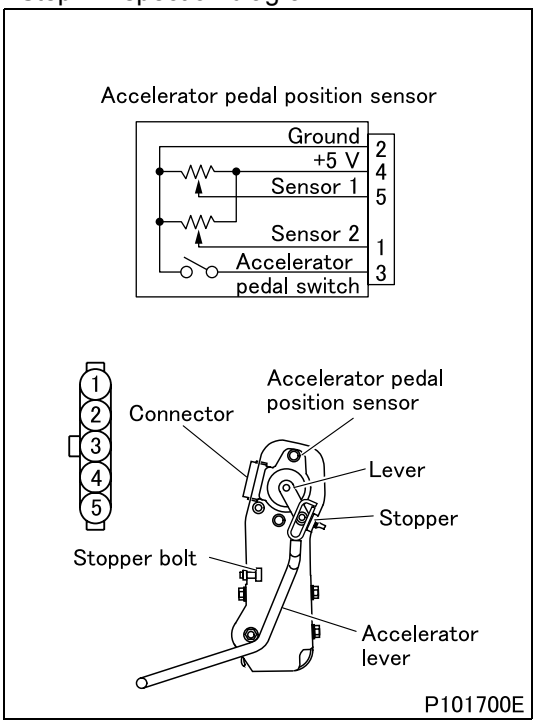
Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

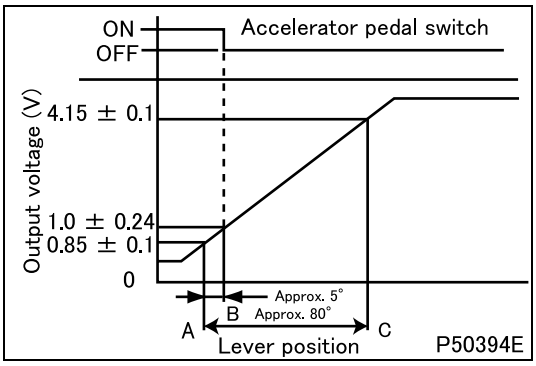
Step 7	Inspection items		Inspection of accelerator pedal position sensor 1 unit
	Maintenance item		Measure value of voltage between connector terminal No. 5 (+) and 2 (–).
	Inspection condition		Apply voltage DC 5 V across connector terminals No. 4 (+) and 2 (–).

	Requirements		• Idle position A: 0.85 ± 0.1 V
			• Accelerator switch operating position B: 1.0 ± 0.24 V
			• Full load position C: 4.15 ± 0.1 V
			  • A: When accelerator lever is in contact with stopper
			  • B: When accelerator pedal is pressed until there is no continuity between terminals 2 and 3.
			  • C: When lever is in contact with full load stopper bolt

	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Adjustment of sensor (If the measurement deviates from the standard value after adjustment, replace the sensor.) (See “INSPECTION OF ELECTRICAL PARTS” – “INSPECTION OF ACCELERATOR PEDAL POSITION SENSOR”.)

<Step 7 inspection diagram>





Step 8	Inspection items		Inspection by sensor connector
	Maintenance item		Measure value of voltage between connector terminal No. 4 (+) and 2 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 35 and sensor connector terminal No. 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector. (As connector terminal is too small, use extra fine test lead/probe.)
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 33 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector. (As connector terminal is too small, use extra fine test lead/probe.)
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 34 and sensor connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector. (As connector terminal is too small, use extra fine test lead/probe.)
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Accelerator Pedal Position 1”. **<Multi-Use Tester used>** • Measure item No. 40 “Accelerator sensor voltage 1” of Service Data.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal not pressed: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0127/Flash code: 27
[Monitor]
Abnormality of intercooler
[Fault (outline)]
Intercooler failure
[Diagnosis check]
- Intercooler outlet temperature is monitored to determine if it is within specified value.

[Code generation condition]
- Intercooler outlet temperature exceeds predetermined value.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Variation in engine speed: less than 300 rpm/s
- Exhaust shutter: open
- Engine speed: 1400 to 3000 rpm
- Vehicle speed: more than 20 km/h {12.4 MPH}
- Water temperature: 64 to 100°C {147 to 212°F}
- Approximate environment atmospheric temperature: –7 to 60°C {19 to 140°F}
- Engine running time: more than 60 seconds
- Turbocharger actuator: in order
- Controller area network communication of turbocharger electronic drive unit: in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

[Probable cause of trouble]
- Abnormality of intercooler (clogging, leak)
- Malfunction of cooling fan and automatic cooling fan coupling unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0112 “INT Air Temp SNSR (Low)” • P0113 “INT Air Temp SNSR (High)” • P2199 “EGR Temp Sensor (Correlation)”
	Inspection condition		• Starter switch: ON • Do not start engine.
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Inspect diagnosis code that is occurring.

Step 2	Inspection items		Inspection of intake air piping and hose for air leak
	Maintenance item		Check for leak.
	Inspection condition		Engine at high idle speed or vehicle running
	Requirements		Free of air leakage or noise
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Clamp is tightened.

Step 3	Inspection items		Inspection of intercooler for leak and clogging
	Maintenance item		Check intercooler for leak.
	Inspection condition		–
	Requirements		Free of air leakage or not clogged.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of intercooler

Step 4	Inspection items		Inspection of turbocharger boost pressure
	Maintenance item		Check of boost pressure
	Inspection condition		For boost pressure measurement and correction data calculation, see Gr15.
	Requirements		Boost pressure is normal.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of turbocharger

[Fault code]
Diagnosis code: P0128/Flash code: 5
[Monitor]
Failure of thermostat
[Fault (outline)]
Below regulating temperature
[Diagnosis check]
- Engine coolant temperature is monitored for rise up to standard level.

[Code generation condition]
- Actual engine coolant temperature is low at the point of predetermined time necessary for engine warm-up having passed.

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Water temperature at engine start: –7 to 45°C {19 to 113°F}
- Intake air temperature at engine start: above –7°C {19°F}
- Proportion of engine running time at idle: less than 50%
- When monitoring completed: This diagnosis code has already been cleared.
- Water temperature sensor: in order
- Boost pressure sensor: in order
- Intake air temperature sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order

[Control effected by electronic control unit during fault]
- Effects no special control.

[Probable cause of trouble]
- Malfunction of thermostat unit (abnormality of valve opening temperature)
- Malfunction of radiator unit
- Malfunction of cooling fan and automatic cooling fan coupling unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0117 “Water Temp SNSR (Low)” • P0118 “Water Temp SNSR (High)” • P011A “Water Temp SNSR”
	Inspection condition		• Starter switch: ON • Engine: started
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Inspect diagnosis code that is occurring.

Step 2	Inspection items		Inspection of thermostat
	Maintenance item		Check thermostat for valve opening temperature and valve lift
	Inspection condition		For measurement of thermostat valve opening temperature and valve lift, see shop manual.
	Requirements		Thermostat is in normal condition.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of thermostat

[Fault code]
Diagnosis code: P0148/Flash code: 22
[Monitor]
Abnormality of common rail pressure (pressure: low)
[Fault (outline)]
Plausibility
[Diagnosis check]
- Common rail pressure is monitored.

[Code generation condition]
- Common rail pressure remains below 100 bar for 30 seconds.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine stopped

[Probable cause of trouble]
- Malfunction of supply pump
- Malfunction of pressure limiter
- Airtight malfunction of injector
- Plugged fuel system
- Fuel leakage
- Malfunction of common rail pressure sensor

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (At the same time as recovery, warning lamp is extinguished and diagnosis code is cleared.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0093 “CRS (Fuel Leak)” • P0148 “CRS (Fuel Delivery)” • P0191 “CRS Pressure SNSR (Plausibility)” • P0192 “CRS Pressure SNSR (Low)” • P0193 “CRS Pressure SNSR (High)” • P0201 “Injector M/V-Cylinder 1 (Load)” • P0202 “Injector M/V-Cylinder 2 (Load)” • P0203 “Injector M/V-Cylinder 3 (Load)” • P0204 “Injector M/V-Cylinder 4 (Load)” • P0261 “Injector #1-A (Low)” • P0262 “Injector #1-A (High)” • P0263 “Injector #1-A (Plausibility)” • P0264 “Injector #2-A (Low)” • P0265 “Injector #2-A (High)” • P0266 “Injector #2-A (Plausibility)” • P0267 “Injector #3-A (Low)” • P0268 “Injector #3-A (High)” • P0269 “Injector #3-A (Plausibility)” • P0270 “Injector #4-A (Low)” • P0271 “Injector #4-A (High)” • P0272 “Injector #4-A (Plausibility)” • P0562 “Power Supply Voltage (Low)” • P0563 “Power Supply Voltage (High)” • P0607 “ECU System” • P060B “A/D Converter” • P061B “ECU Performance (Calc)” • P061C “ECU Performance (Ne)”
	Inspection condition		• Starter switch: ON • Do not start engine
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Inspect diagnosis code that is occurring.

Step 2	Inspection items		Checking of engine appearance
	Maintenance item		Check fuel system for fuel leak.
	Inspection condition		Starter switch: OFF
	Requirements		There is no fuel leak.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 6.

Step 3	Inspection items		Inspection of low pressure piping (fuel tank – supply pump)
	Maintenance item		Check suction pipe or hose for bend.
	Inspection condition		Starter switch: OFF
	Requirements		There is no bend on pipe or hose.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Correct and replace suction pipe or hose.

Step 4	Inspection items		Checking of air bleeding
	Maintenance item		Bleed air from fuel filter.
	Inspection condition		Starter switch: OFF
	Requirements		Problem is solved by bleeding air.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 5.

Step 5	Inspection items		Inspection of low pressure piping
	Maintenance item		Fuel filter
	Inspection condition		Starter switch: OFF
	Requirements		Problem is solved by replacing fuel filter.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 6.

Step 6	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from supply pump.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of supply pump

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from fuel pipe between supply pump and rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of fuel pipe

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of rail

Step 9	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from fuel injection pipes (four) between injector and rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of injection pipe

Step 10	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Replacement of injector

Step 11	Inspection items		Check inside of combustion chamber.
	Maintenance item		Check for fuel leak.
	Inspection condition		• After performing actuator test item No. B2 “Fuel Leak Check”, stop engine. • Remove glow plug, and check from glow plug mounting hole using bore scope.
	Requirements		Inside of combustion chamber is not wet.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Replacement of injector of object cylinder

Step 12	Inspection items		Replacement of rail (flow damper and pressure limiter abnormal)
	Maintenance item		–
	Inspection condition		–
	Requirements		Problem is solved by replacing rail.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 13.

Step 13	Inspection items		Replacement of supply pump
	Maintenance item		–
	Inspection condition		–
	Requirements		Problem is solved by replacing supply pump.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Replacement of injectors (four)

[Fault code]
Diagnosis code: P0182/Flash code: 41
[Monitor]
Failure of fuel temperature sensor
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Fuel temperature sensor output voltage is monitored.

[Code generation condition]
- Fuel temperature sensor output voltage remains below 0.15 V for 3 seconds. (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

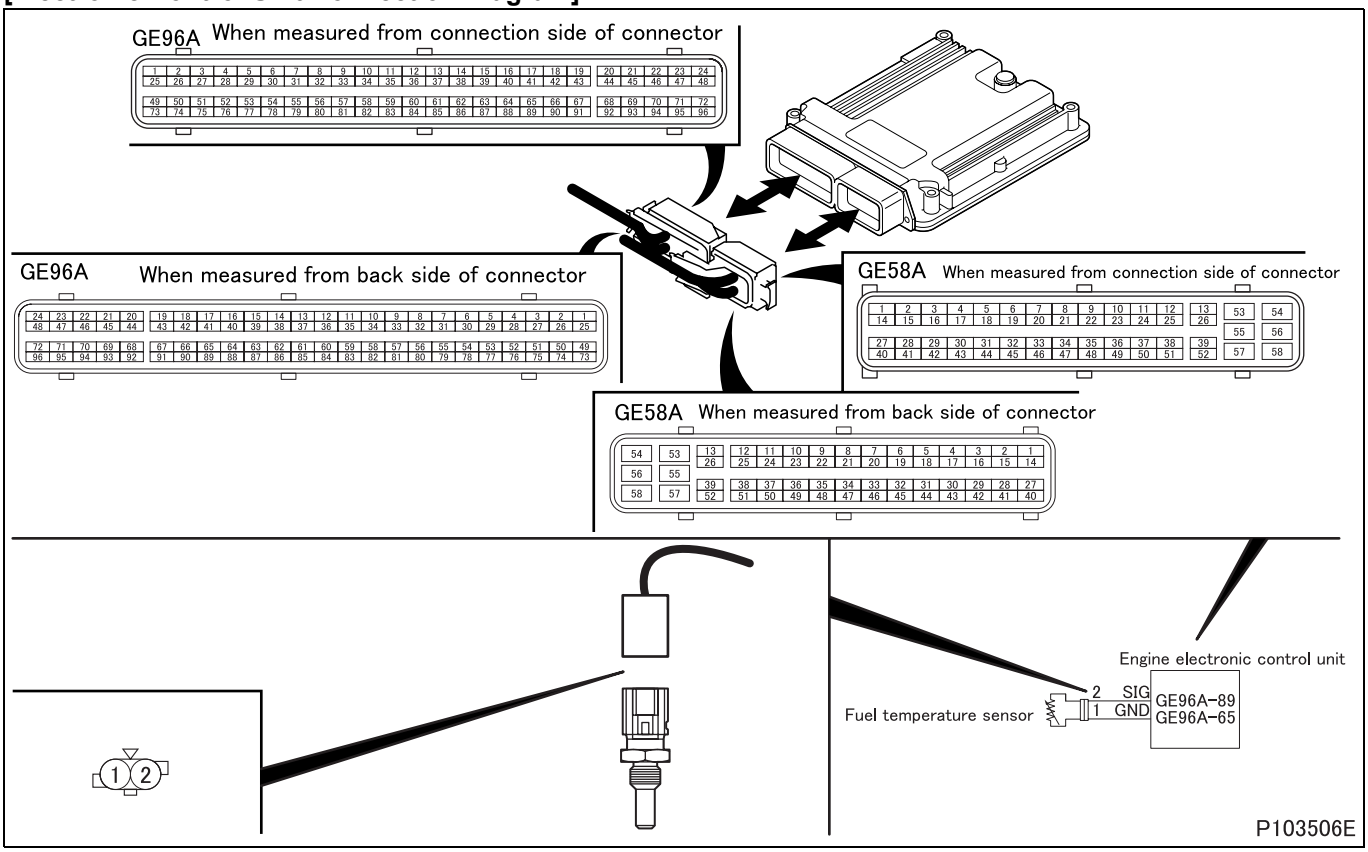
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Fuel temperature is fixed at backup value.
- Fuel system temperature is fixed at backup value.
- Related fault check is stopped.

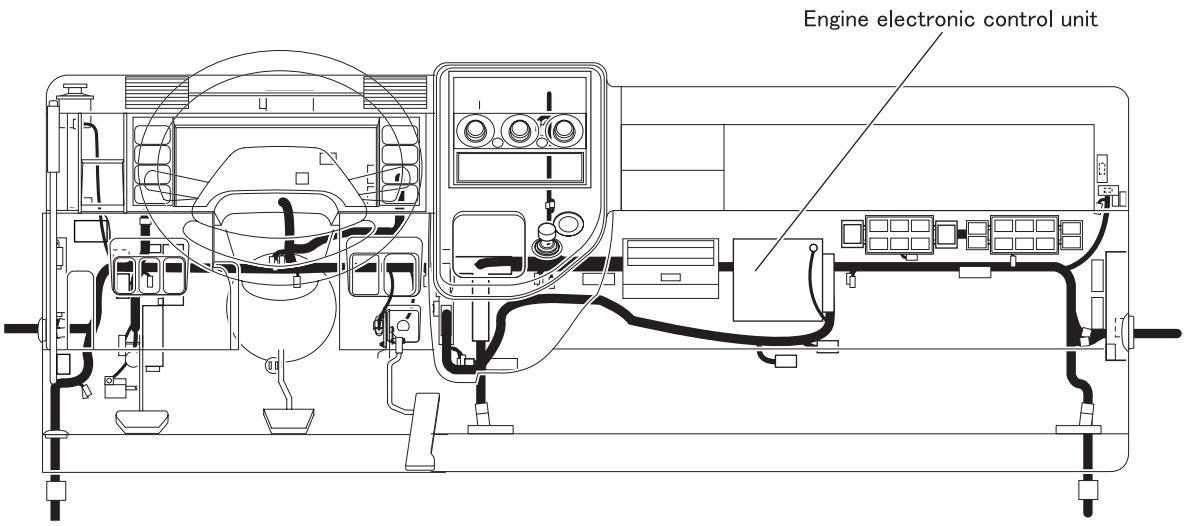
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and fuel temperature sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

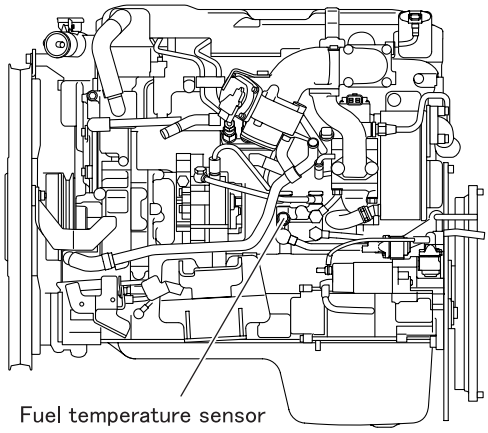
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Left side view of engine



P103632E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 33 “Fuel Temperature (inlet)” of Service Data.
	Inspection condition		–
	Requirements		• When engine is cold: Temperature is equivalent to outside temperature. • While engine is warmed up: Temperature gradually increases. • When engine is stopped after warm-up: Temperature rise up just after engine stopped, then gradually decline.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

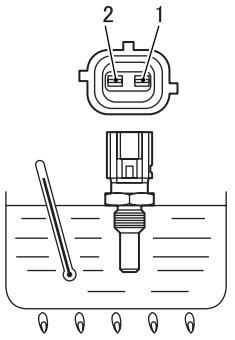
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 65 and 89.
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		• 20°C {68°F}: 2.45 $^{+0.14}_{-0.13}$ kΩ • 80°C {176°F}: 0.318 ± 0.008 kΩ • 110°C {230°F}: 0.1417 ± 0.0018 kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of fuel temperature sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 1 and 2.
	Inspection condition		Put sensor in container filled with engine oil.
	Requirements		• 20°C {68°F}: 2.45 $^{+0.14}_{-0.13}$ kΩ • 80°C {176°F}: 0.318 ± 0.008 kΩ • 110°C {230°F}: 0.1417 ± 0.0018 kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 89.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 65.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 33 “Fuel Temperature (inlet)” of Service Data.
	Inspection condition		–
	Requirements		• When engine is cold: Temperature is equivalent to outside temperature. • While engine is warmed up: Temperature gradually increases. • When engine is stopped after warm-up: Temperature rise up just after engine stopped, then gradually decline.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0183/Flash code: 41
[Monitor]
Failure of fuel temperature sensor
[Fault (outline)]
High signal range check
[Diagnosis check]
- Fuel temperature sensor output voltage is monitored.

[Code generation condition]
- Fuel temperature sensor output voltage remains above 4.8 V for 3 seconds. (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

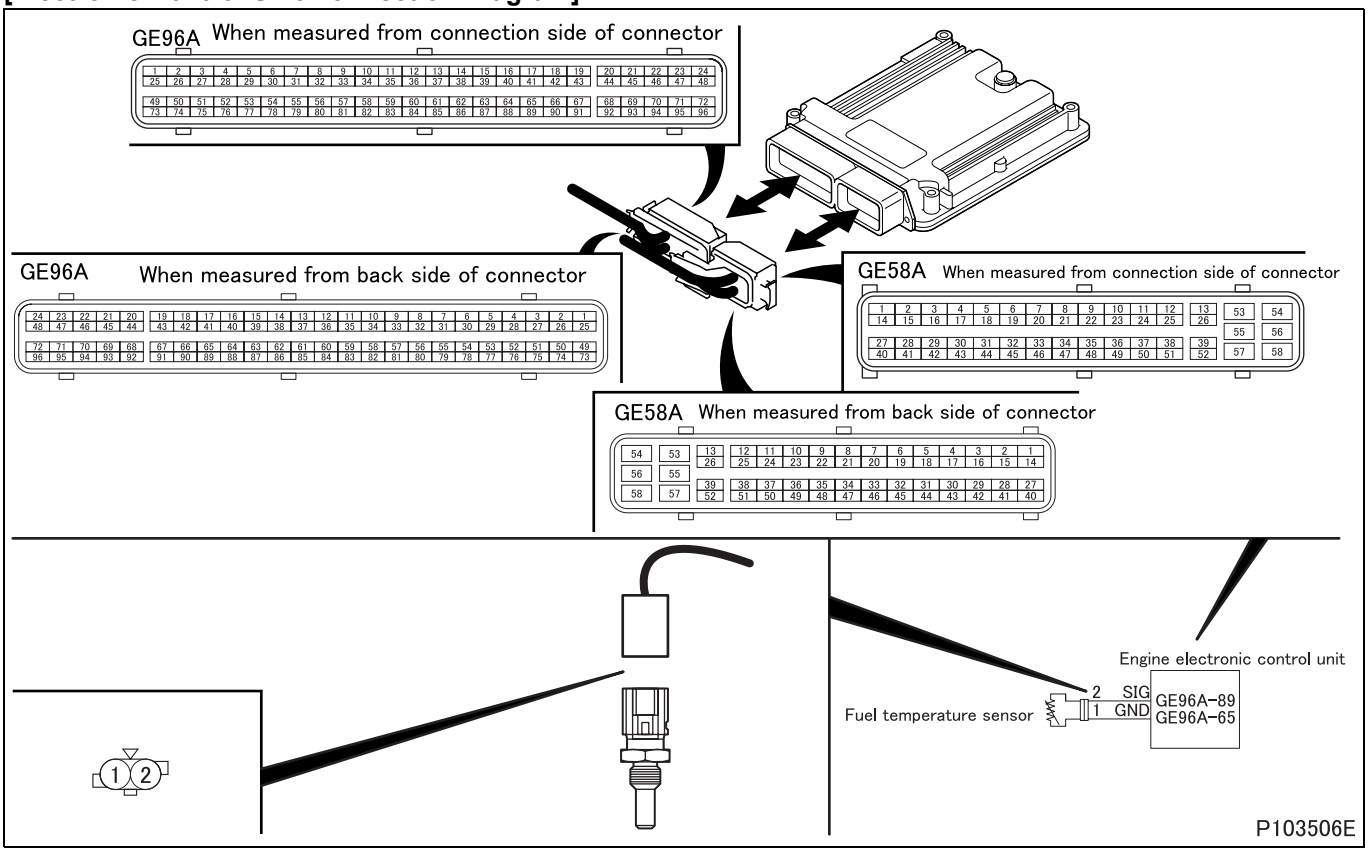
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Fuel temperature is fixed at backup value.
- Fuel system temperature is fixed at backup value.
- Related fault check is stopped.

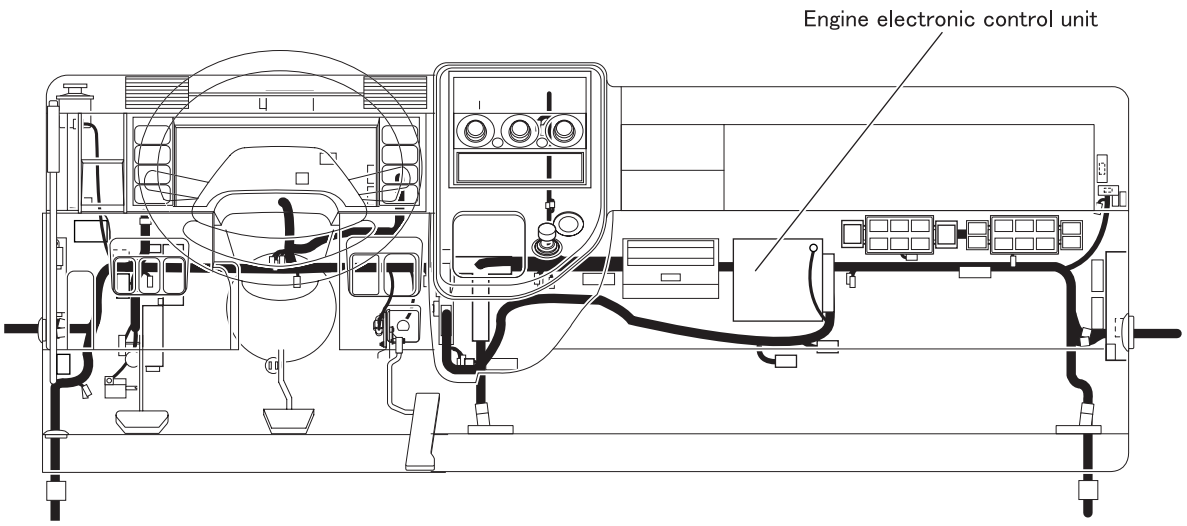
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and fuel temperature sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

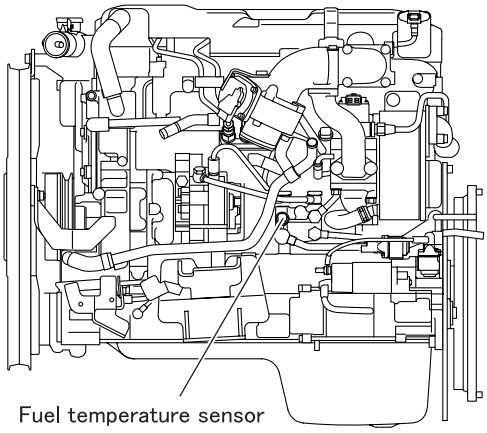
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Left side view of engine



P103632E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 33 “Fuel Temperature (inlet)” of Service Data.
	Inspection condition		–
	Requirements		• When engine is cold: Temperature is equivalent to outside temperature. • While engine is warmed up: Temperature gradually increases. • When engine is stopped after warm-up: Temperature rise up just after engine stopped, then gradually decline.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

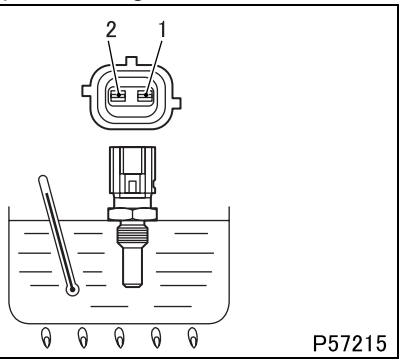
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 65 and 89.
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		• 20°C {68°F}: 2.45 $^{+0.14}_{-0.13}$ kΩ • 80°C {176°F}: 0.318 ± 0.008 kΩ • 110°C {230°F}: 0.1417 ± 0.0018 kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of fuel temperature sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 1 and 2.
	Inspection condition		Put sensor in container filled with engine oil.
	Requirements		• 20°C {68°F}: 2.45 $^{+0.14}_{-0.13}$ kΩ • 80°C {176°F}: 0.318 ± 0.008 kΩ • 110°C {230°F}: 0.1417 ± 0.0018 kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 89.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 65.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 33 “Fuel Temperature (inlet)” of Service Data.
	Inspection condition		–
	Requirements		• When engine is cold: Temperature is equivalent to outside temperature. • While engine is warmed up: Temperature gradually increases. • When engine is stopped after warm-up: Temperature rise up just after engine stopped, then gradually decline.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0191/Flash code: 11
[Monitor]
Characteristic abnormality of common rail pressure sensor
[Fault (outline)]
Offset
[Diagnosis check]
- Common rail pressure is monitored at starter switch ON.

[Code generation condition]
- Signal voltage from common rail pressure sensor remains excessively high (above 0.7 V) or low (below 0.3 V) for 3.2 seconds. (common rail pressure: above 100 bar or below –100 bar)
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the starter switch is turned from “stop” to “start” position.

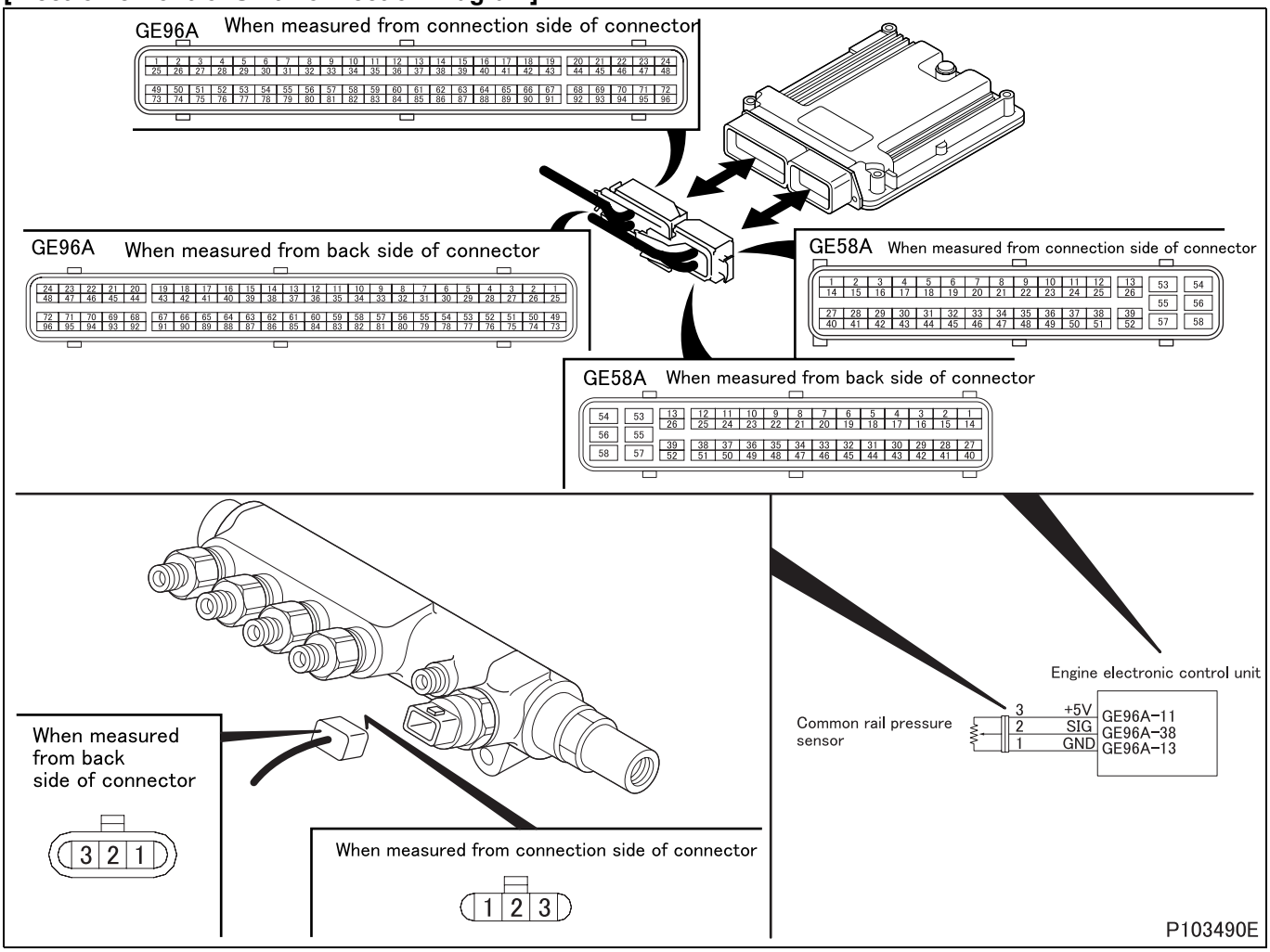
[Diagnostic requirement]
- Status of engine: stop to start
- Water temperature: above 0°C {32°F}
- Delay time after starter switch ON: more than 3.2 seconds

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.
- Injector actuator test is inhibited.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

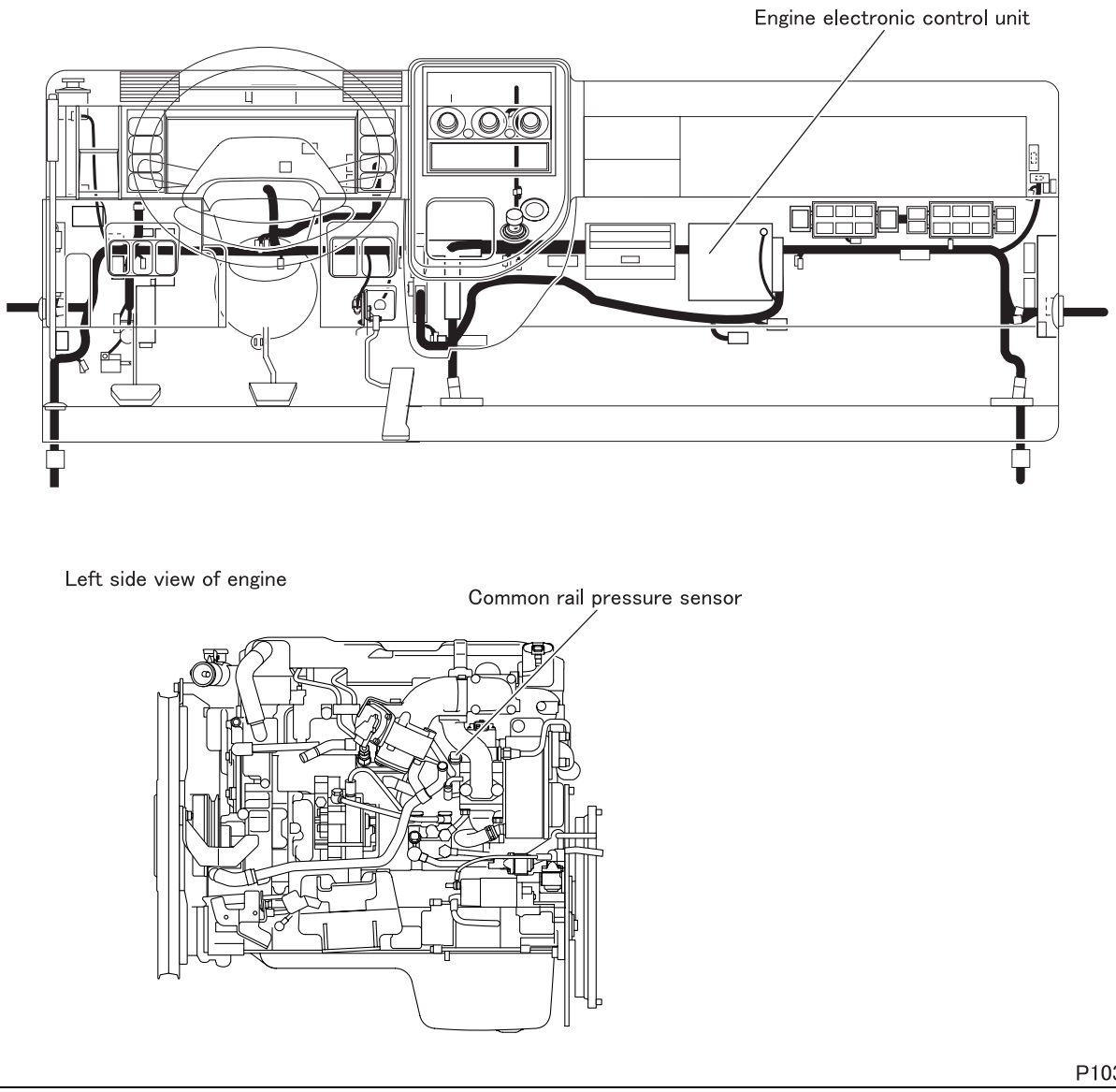
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 1B “Actual Common Rail Pressure 2” of Service Data.
	Inspection condition		Starter switch: ON
	Requirements		0%
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 38 (+) and 13 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0.5 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 11 (+) and 13 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 13 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 1 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Go to step 8.

Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 38.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of sensor, go to step 11
		NO	Modify harness.

Step 11	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 1B “Actual Common Rail Pressure 2” of Service Data.
	Inspection condition		Starter switch: ON
	Requirements		0%
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of rail

[Fault code]
Diagnosis code: P0192/Flash code: 11
[Monitor]
Failure of common rail pressure sensor
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Common rail pressure sensor output voltage after engine start is monitored.

[Code generation condition]
- Value of voltage from common rail pressure sensor remains below 0.2 V for 0.25 seconds. (common rail pressure: below –150 bar)
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

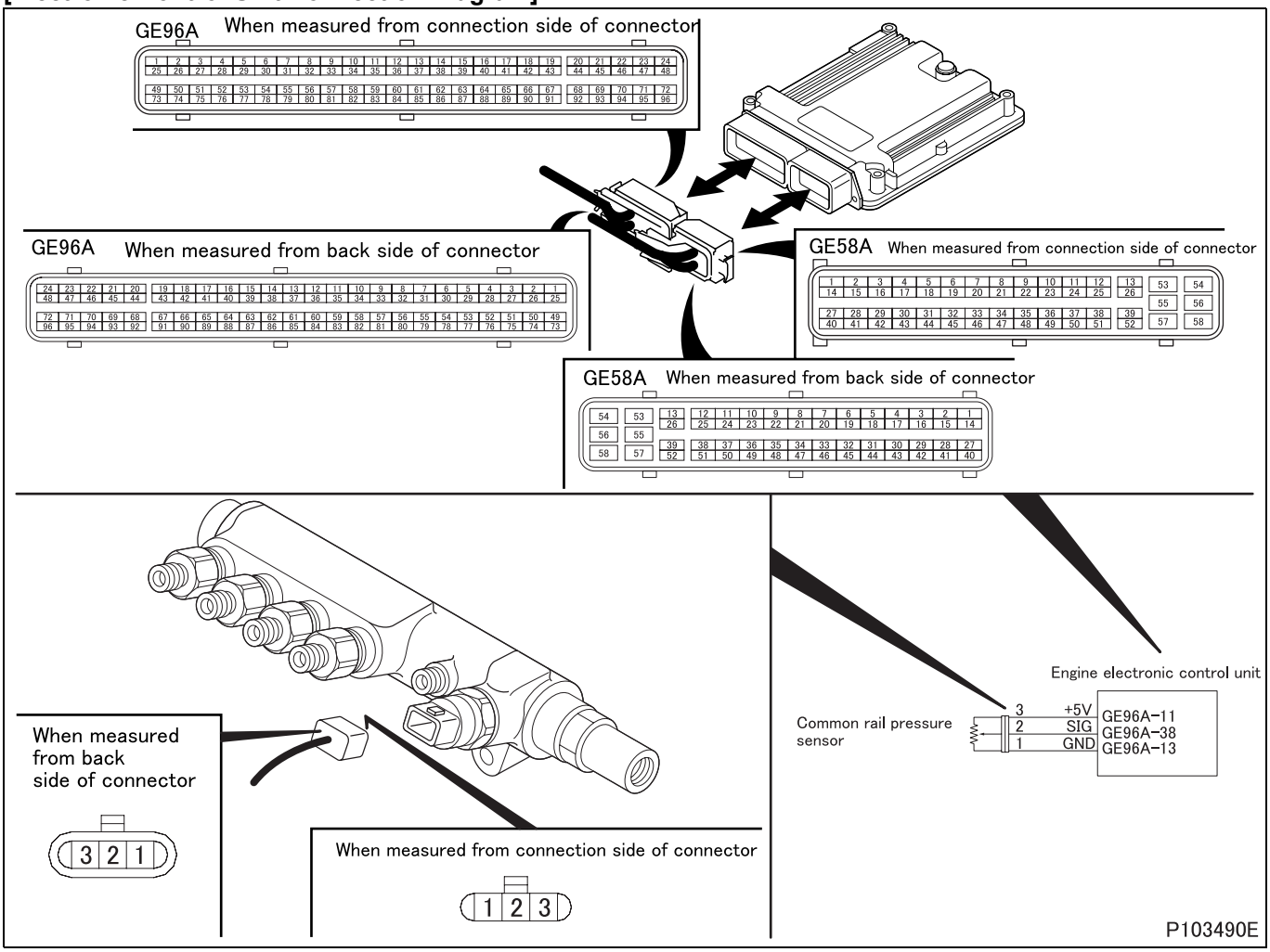
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- Common rail pressure control is switched to open loop control mode.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.
- Injector actuator test is inhibited.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

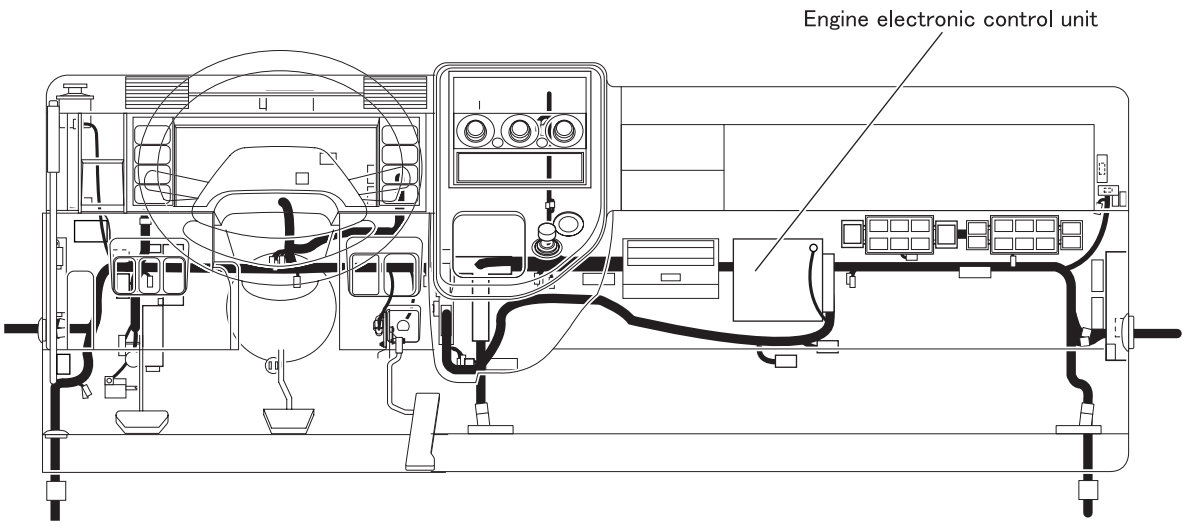
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

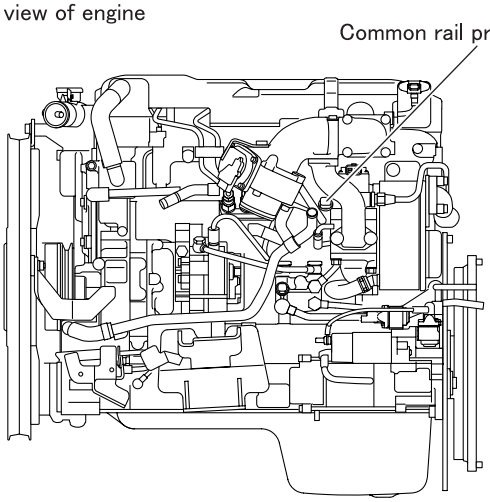
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Left side view of engine



P103618E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 0A “Reference Injection Quantity” of Service Data.
	Inspection condition		Starter switch: ON
	Requirements		0%
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 38 (+) and 13 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0.5 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 11 (+) and 13 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 13 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 1 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Go to step 8.

Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 38.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of sensor, go to step 11
		NO	Modify harness.

Step 11	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 0A “Reference Injection Quantity” of Service Data.
	Inspection condition		Starter switch: ON
	Requirements		0%
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0193/Flash code: 11
[Monitor]
Failure of common rail pressure sensor
[Fault (outline)]
High signal range check
[Diagnosis check]
- Common rail pressure sensor output voltage after engine start is monitored.

[Code generation condition]
- Value of voltage from common rail pressure sensor remains above 4.8 V for 0.25 seconds. (common rail pressure: above 2300 bar)
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

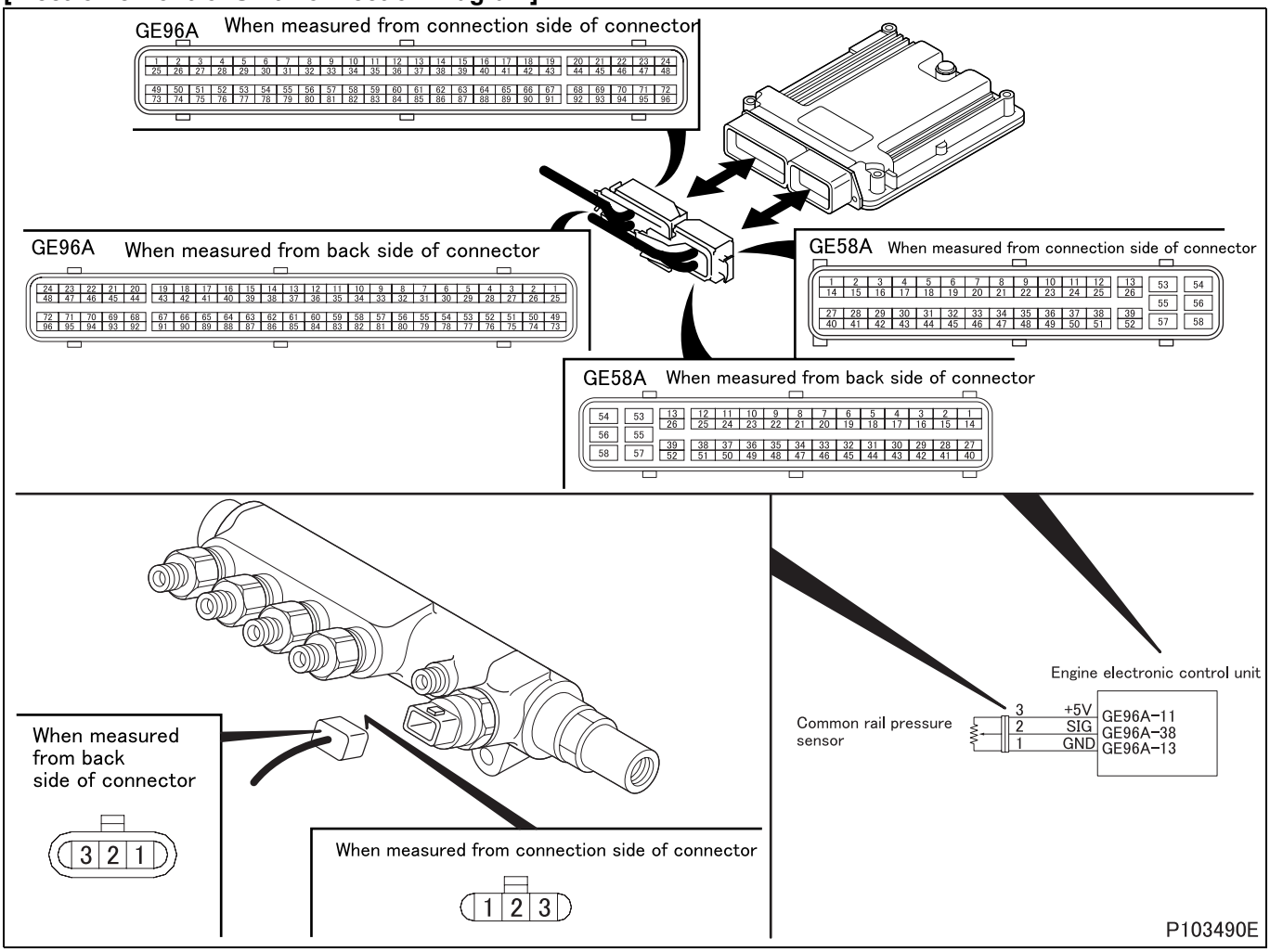
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- Common rail pressure control is switched to open loop control mode.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.
- Injector actuator test is inhibited.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

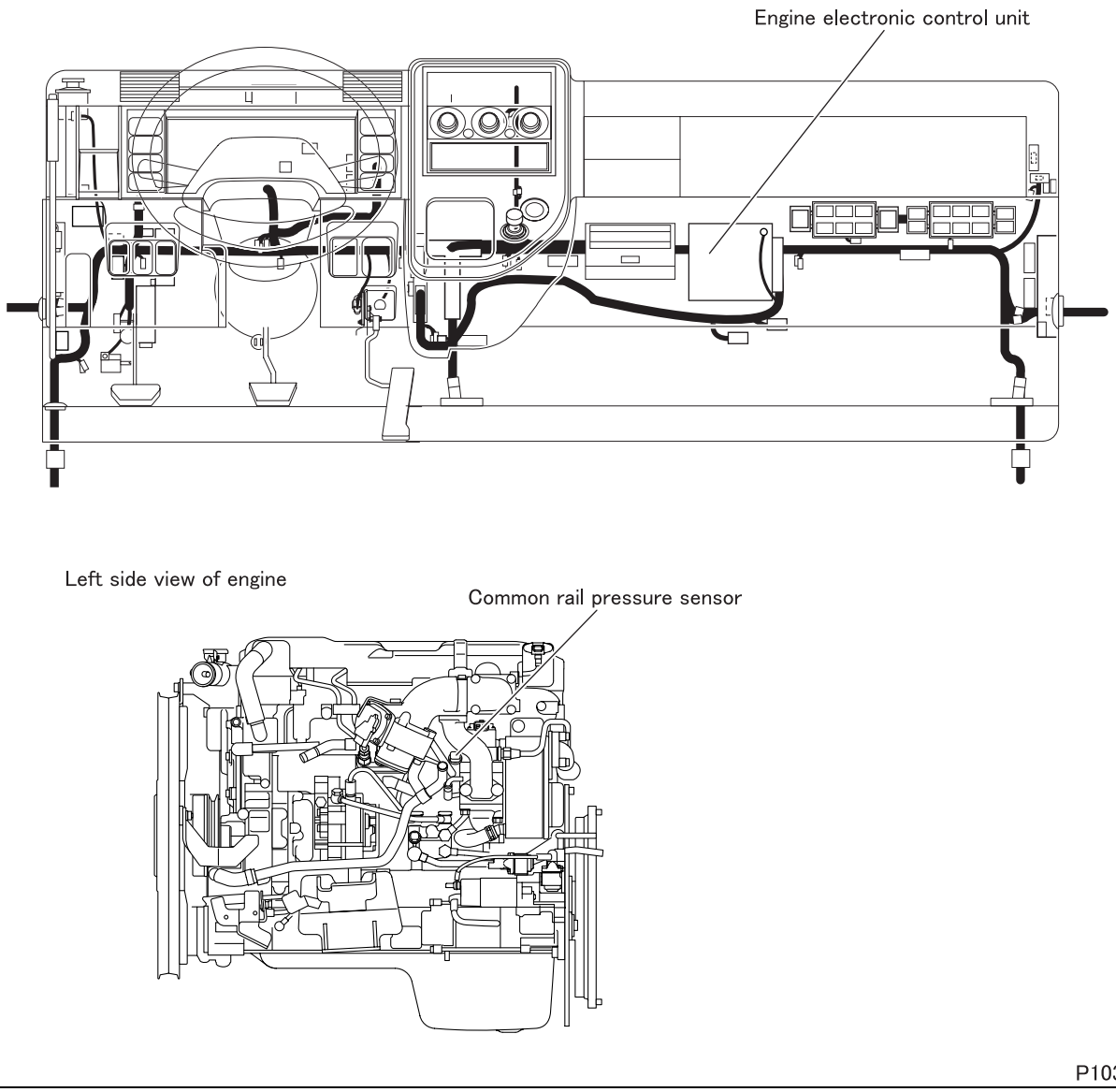
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 0A “Reference Injection Quantity” of Service Data.
	Inspection condition		Starter switch: ON
	Requirements		0%
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 38 (+) and 13 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0.5 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 11 (+) and 13 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 13 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 1 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Go to step 8.

Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 38.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of sensor, go to step 11
		NO	Modify harness.

Step 11	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 0A “Reference Injection Quantity” of Service Data.
	Inspection condition		Starter switch: ON
	Requirements		0%
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0201/Flash code: 37
[Monitor]
Failure of injector magnetic valve (No. 1 cylinder)
[Fault (outline)]
Injector open circuit (No. 1 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 1 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 1 cylinder) circuit remains open as detected for 3 cycles.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

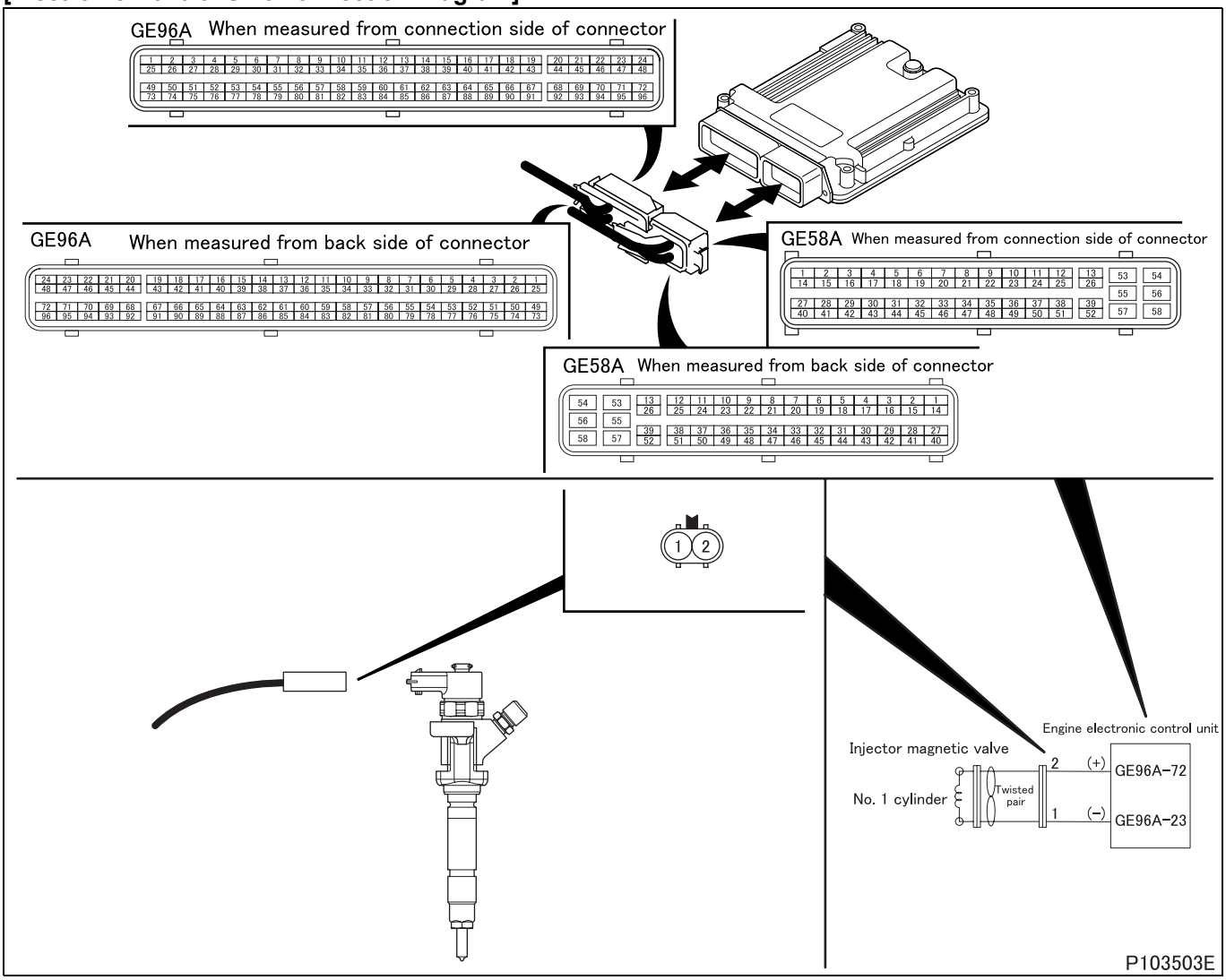
[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Short-circuit>
- Injector magnetic valve (No. 1 and No. 4 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Controller area network torque output is fixed at backup valve.
- Related fault check is stopped.

<Open-circuit>
- Injector magnetic valve (No. 1 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

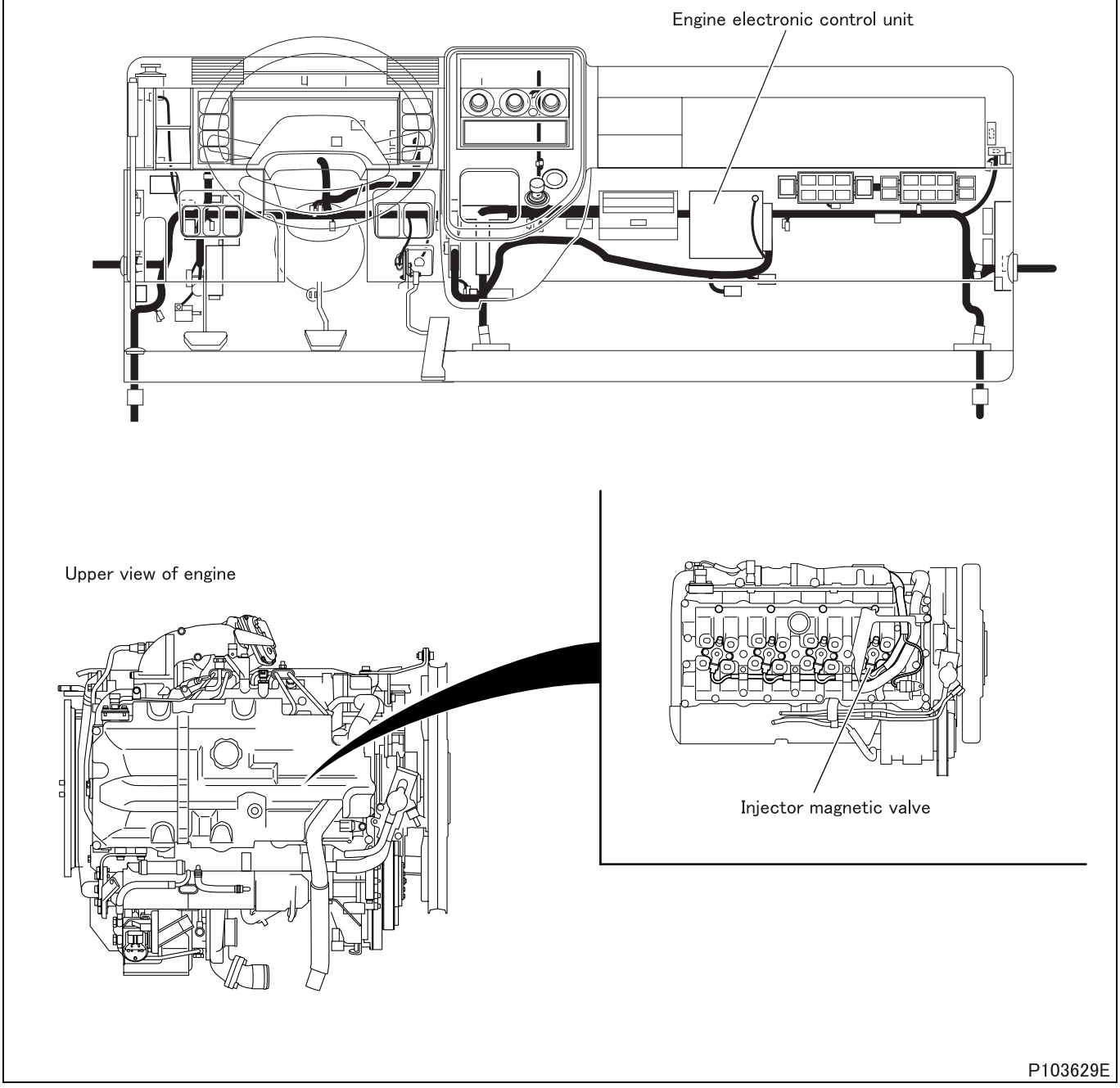
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Short-circuit: System recovers if any valid signal is input when starter switch is turned from OFF to ON (power on again of electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)
- Open-circuit: System recovers if any valid signal is input with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BB “Injector Test 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

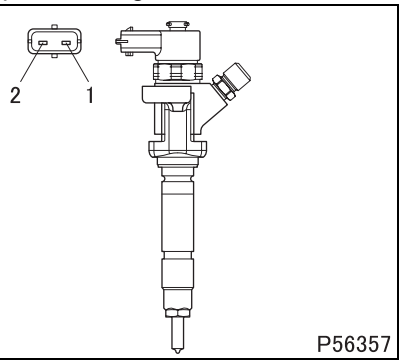
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 23 and 72.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 72.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 23.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BB “Injector Test 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0202/Flash code: 8
[Monitor]
Failure of injector magnetic valve (No. 2 cylinder)
[Fault (outline)]
Injector open circuit (No. 2 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 2 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 2 cylinder) circuit remains open as detected for 3 cycles.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

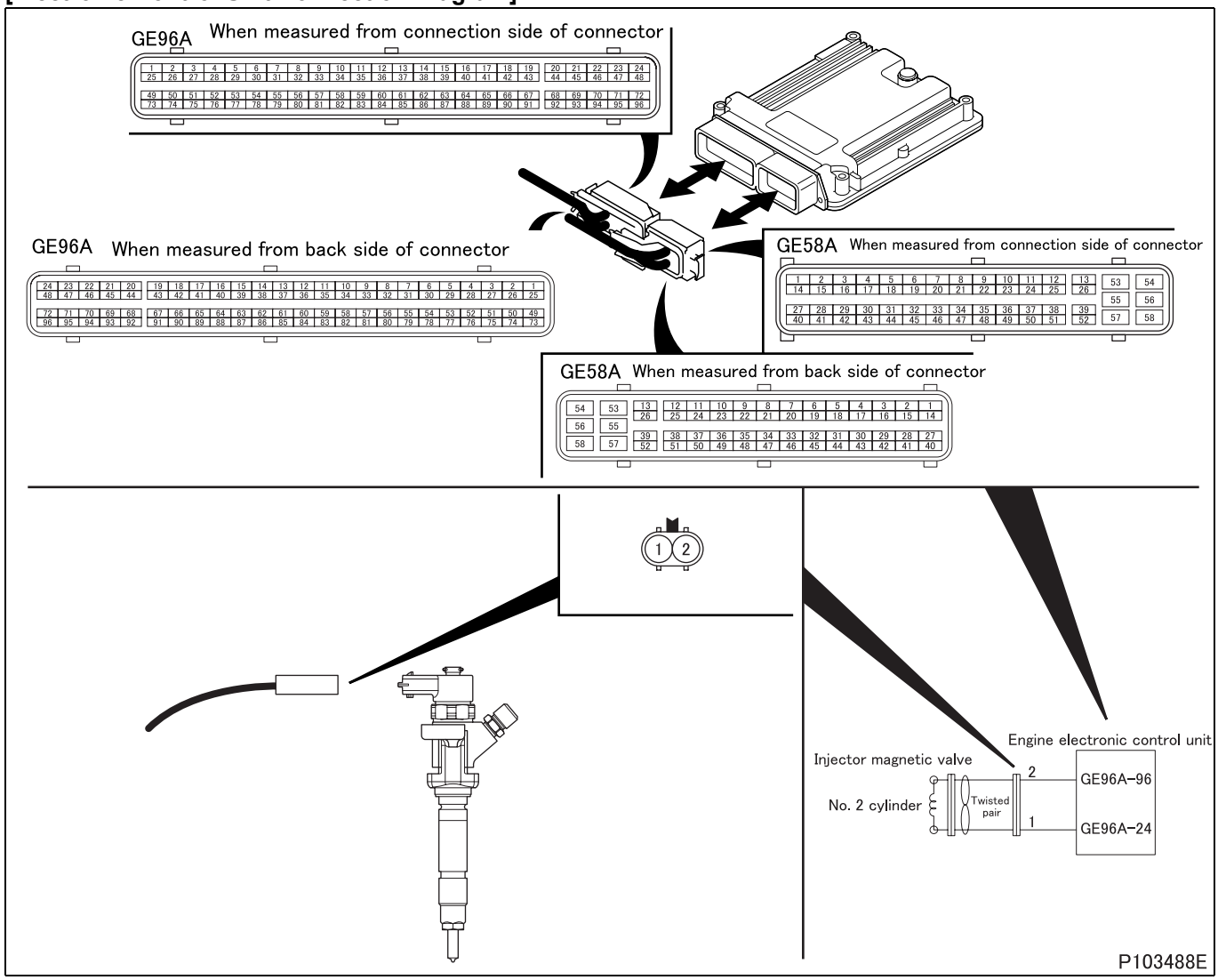
[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Short-circuit>
- Injector magnetic valve (No. 2 and No. 3 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

<Open-circuit>
- Injector magnetic valve (No. 2 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

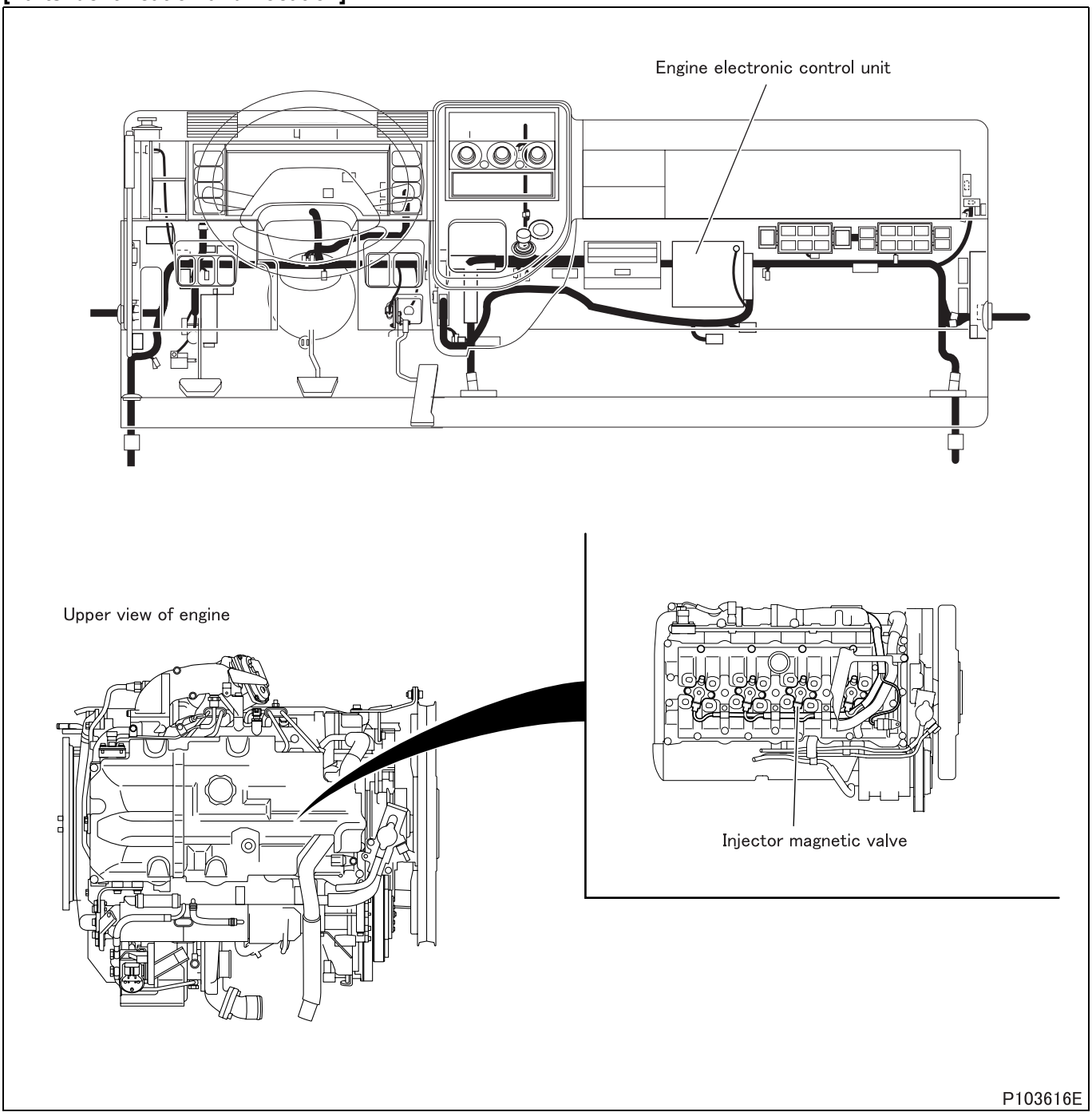
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Short-circuit: System recovers if any valid signal is input when starter switch is turned from OFF to ON (power on again of electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)
- Open-circuit: System recovers if any valid signal is input with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BD “Injector Test 3”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

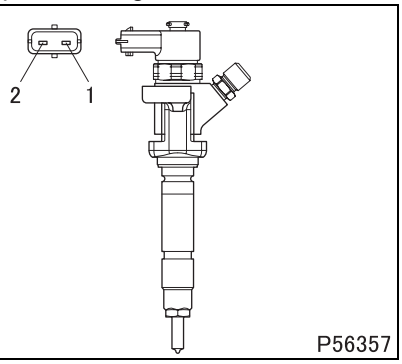
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 24 and 96.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 96.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 24.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BD “Injector Test 3”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0203/Flash code: 38
[Monitor]
Failure of injector magnetic valve (No. 3 cylinder)
[Fault (outline)]
Injector open circuit (No. 3 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 3 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 3 cylinder) circuit remains open as detected for 3 cycles.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

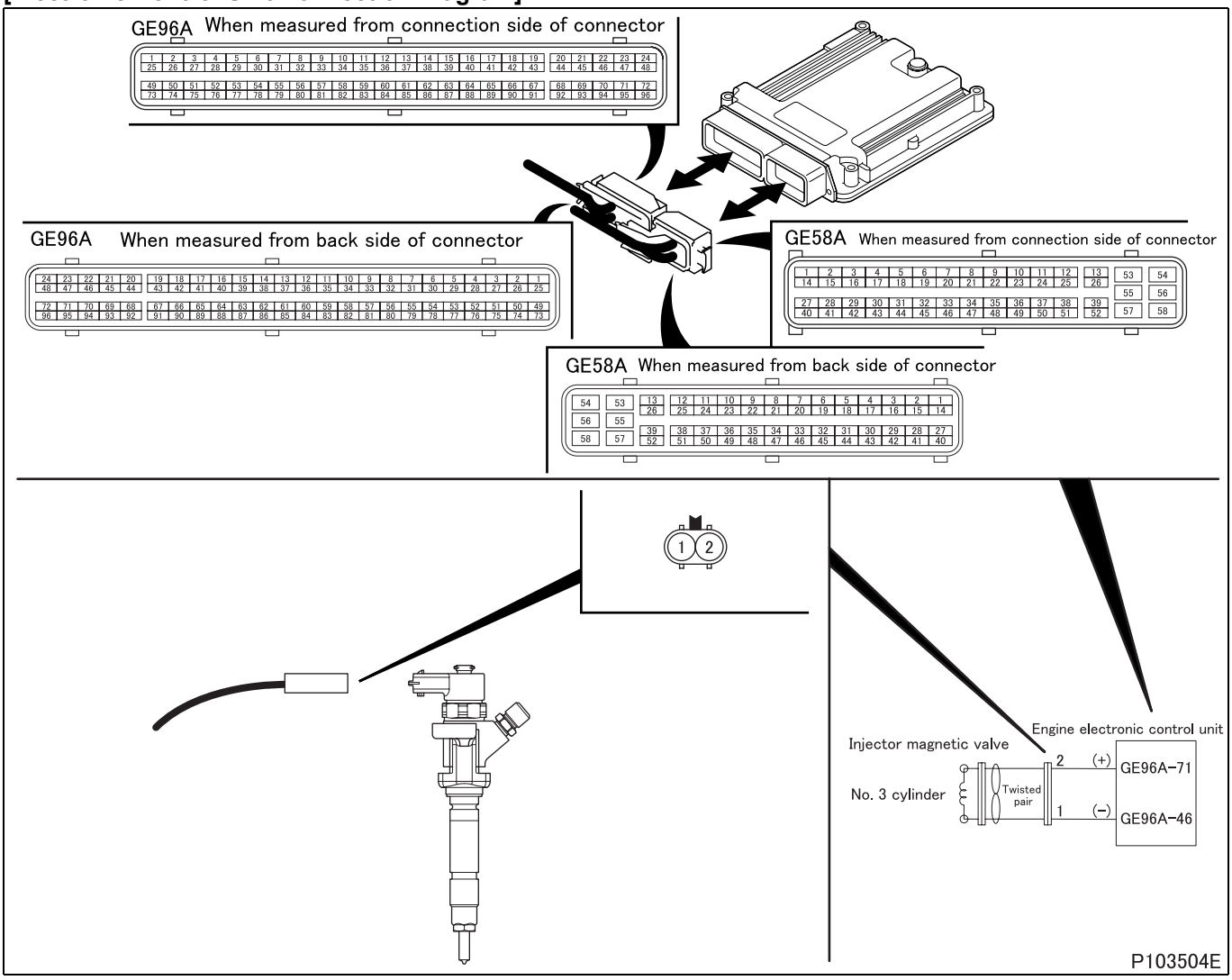
[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Short-circuit>
- Injector magnetic valve (No. 2 and No. 3 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

<Open-circuit>
- Injector magnetic valve (No. 3 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

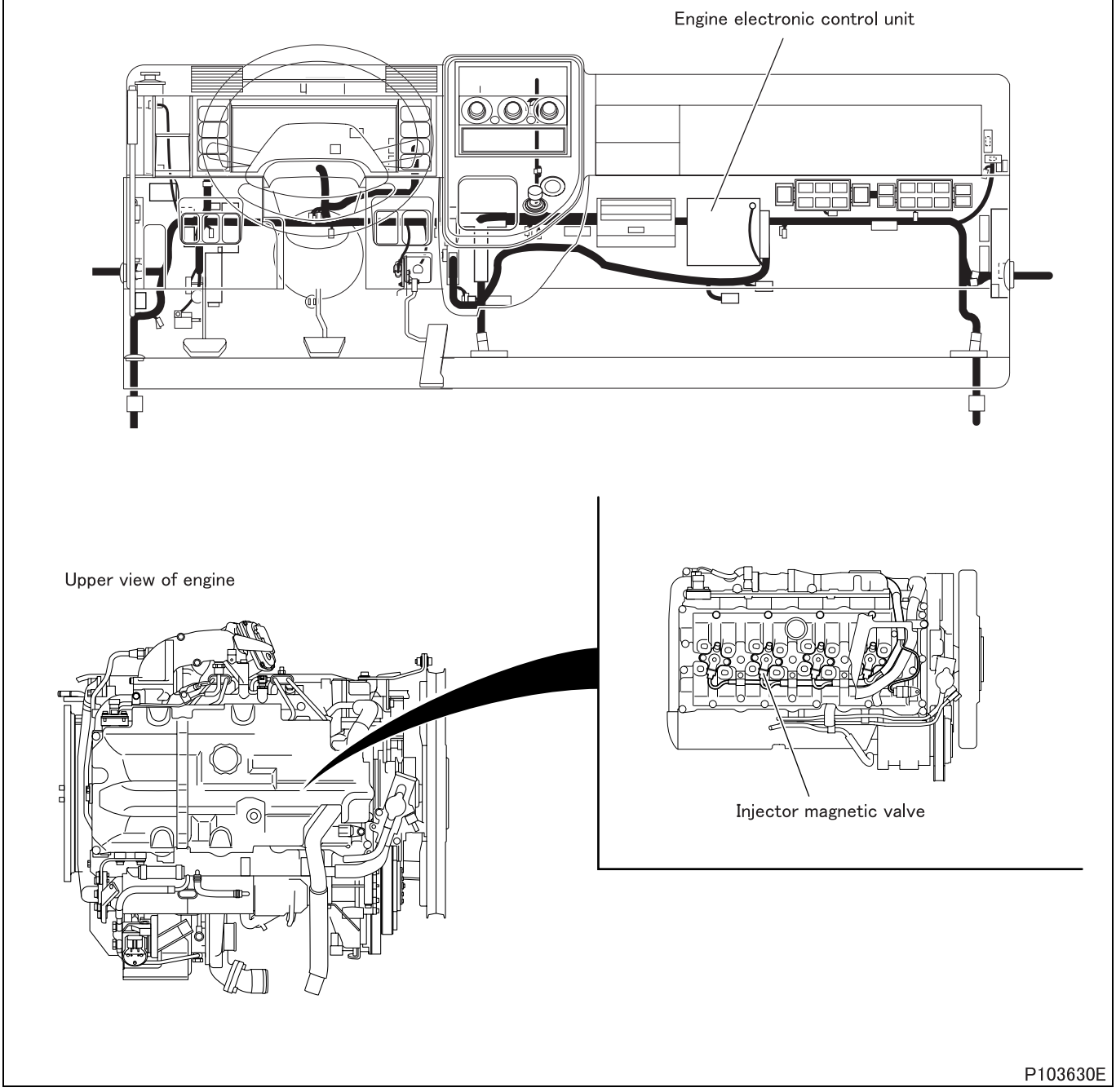
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Short-circuit: System recovers if any valid signal is input when starter switch is turned from OFF to ON (power on again of electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)
- Open-circuit: System recovers if any valid signal is input with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BE “Injector Test 4”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

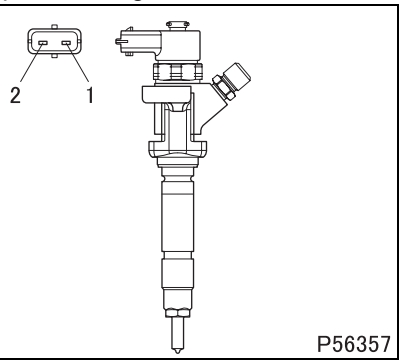
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 46 and 71.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 71.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 46.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BE “Injector Test 4”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0204/Flash code: 39
[Monitor]
Failure of injector magnetic valve (No. 4 cylinder)
[Fault (outline)]
Injector open circuit (No. 4 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 4 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 4 cylinder) circuit remains open as detected for 3 cycles.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

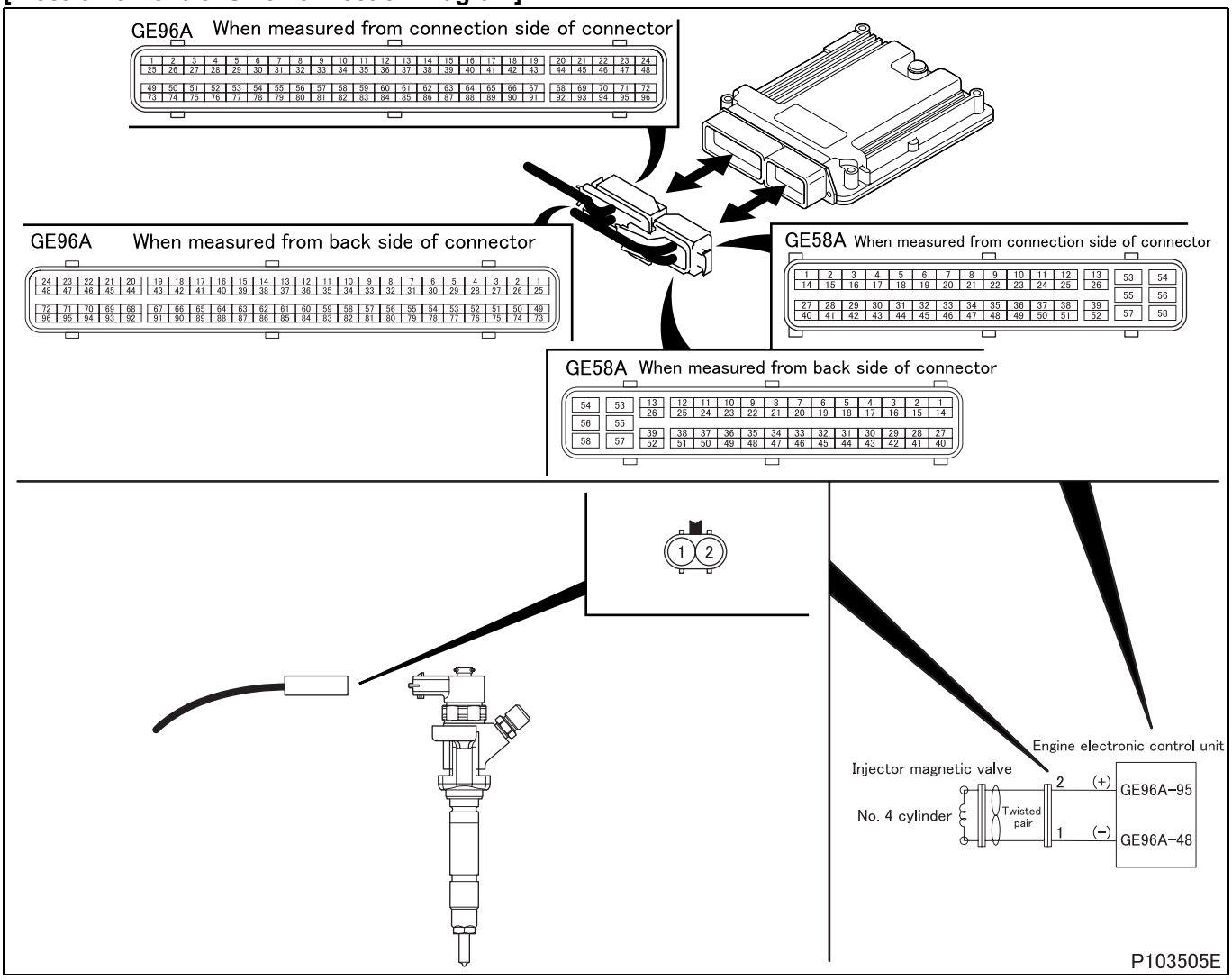
[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Short-circuit>
- Injector magnetic valve (No. 1 and No. 4 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

<Open-circuit>
- Injector magnetic valve (No. 4 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

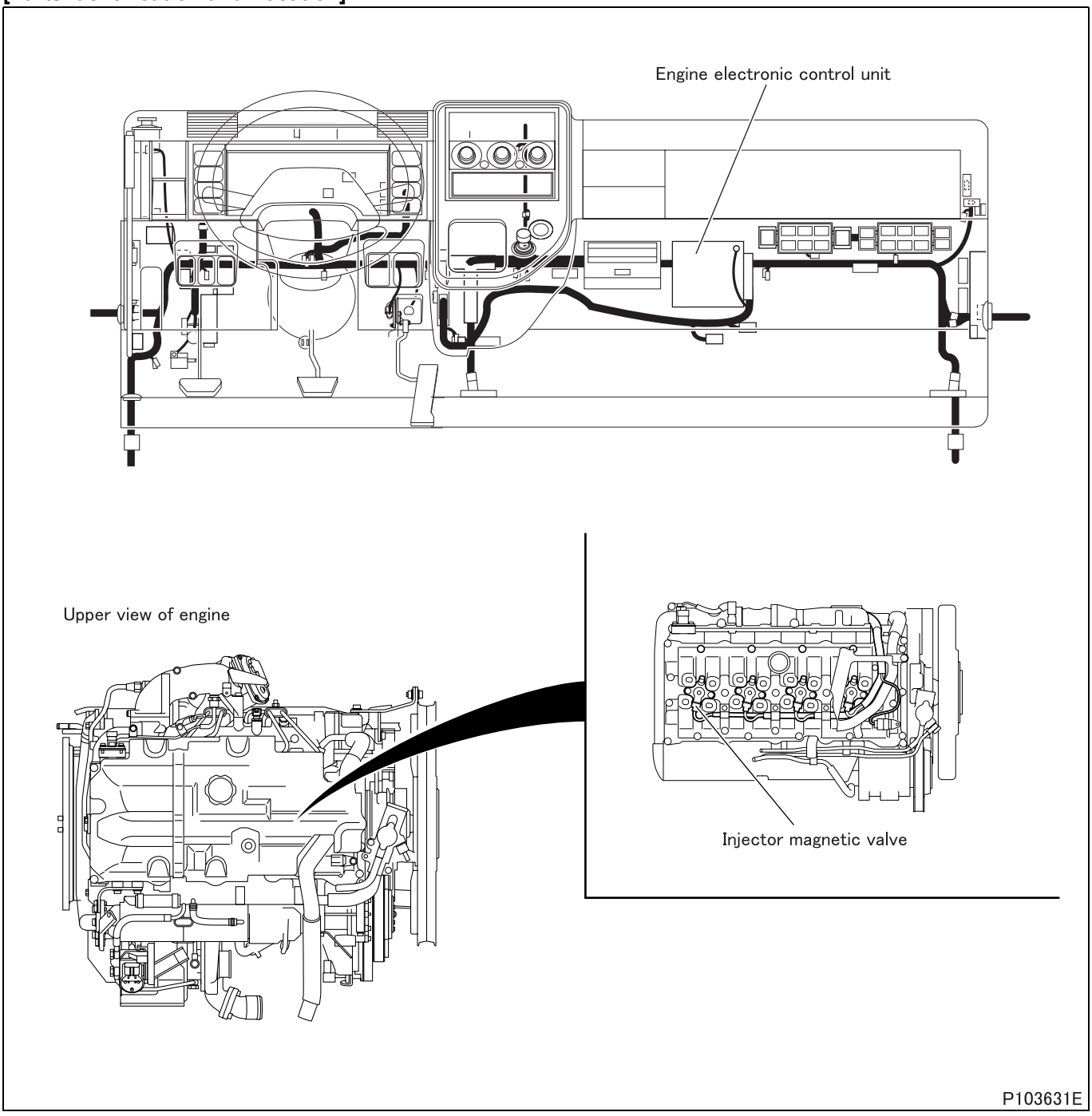
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Short-circuit: System recovers if any valid signal is input when starter switch is turned from OFF to ON (power on again of electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)
- Open-circuit: System recovers if any valid signal is input with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		• Perform actuator test item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

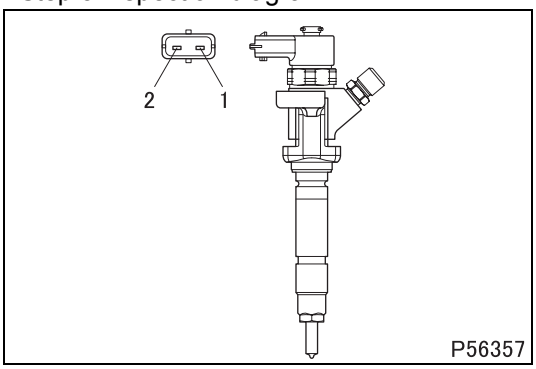
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 48 and 95.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 95.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 48.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0219/Flash code: 7
[Monitor]
Abnormality of engine speed
[Fault (outline)]
High signal range check
[Diagnosis check]
- Engine speed is monitored for abnormal increase.

[Code generation condition]
- Engine speed exceeds 3700 rpm.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine stopped

[Probable cause of trouble]
- Shifting Mistake

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Fault diagnosis]
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if this diagnosis code occurs except in red zone.
	Inspection condition		• Starter switch: ON • Engine start (condition except in red zone)
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	–

[Fault code]
Diagnosis code: P0222/Flash code: 16
[Monitor]
Failure of accelerator pedal position sensor 2
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Accelerator pedal position sensor is monitored for output within specification.

[Code generation condition]
- Voltage from accelerator pedal position sensor 2 remains below 0.5 V for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

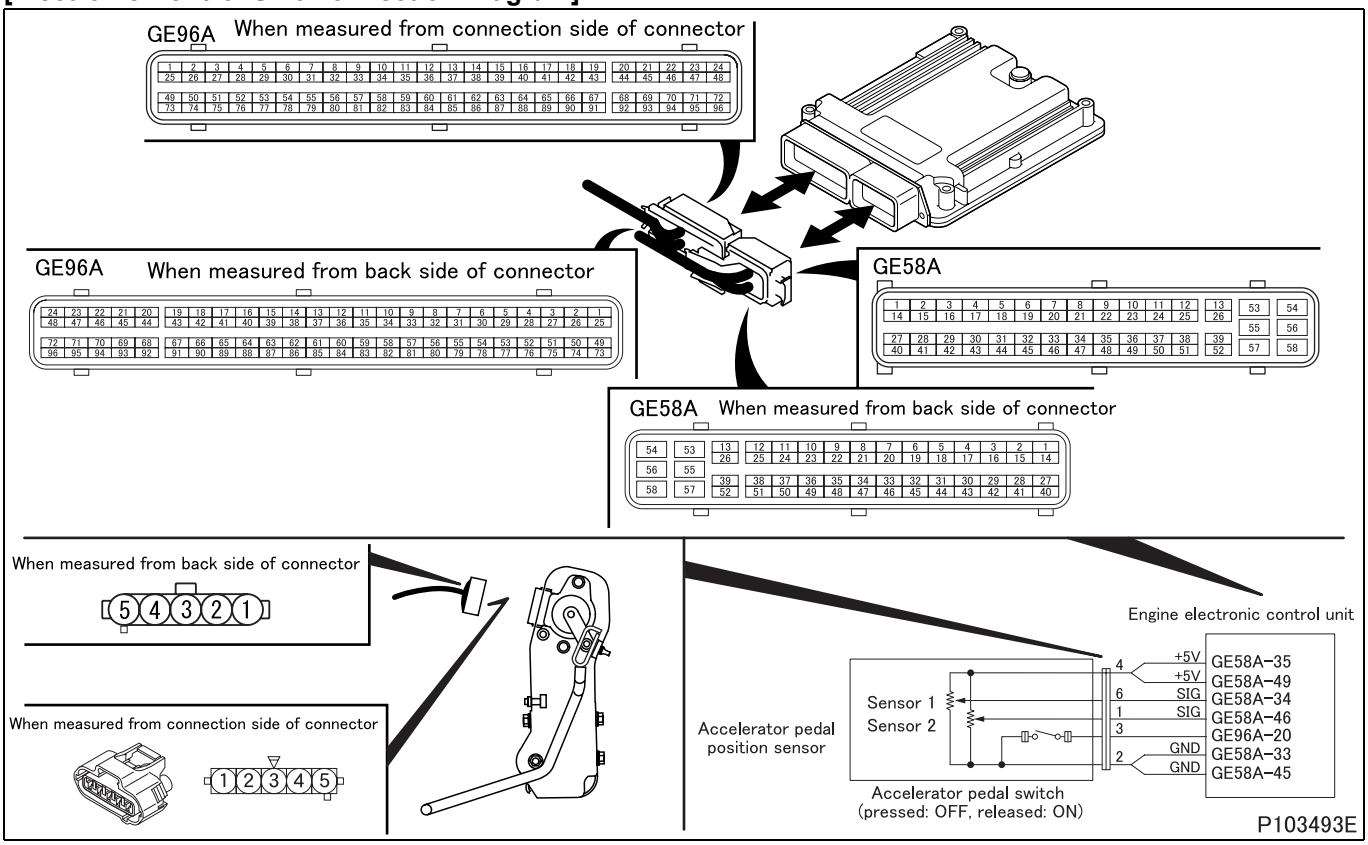
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Accelerator pedal position sensor 1 is computed with accelerator pedal position sensor 2 only.
- In-use performance counter is stopped.
- Related fault check is stopped.

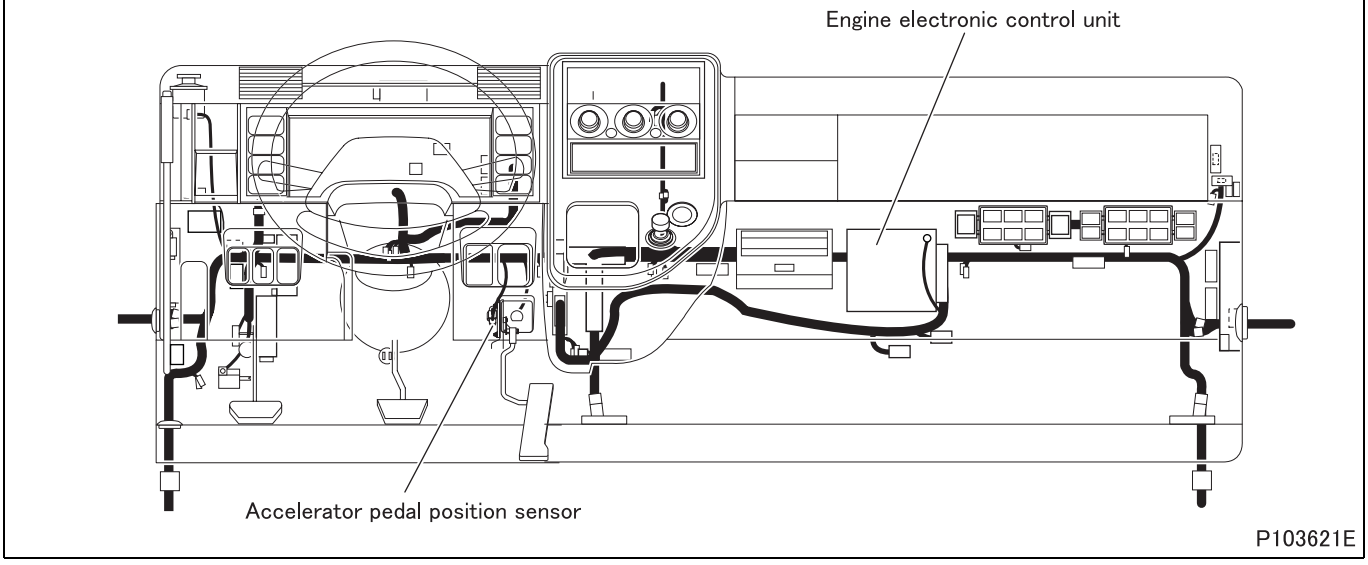
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Accelerator Pedal Position 2”. **<Multi-Use Tester used>** • Measure item No. 41 “Accelerator sensor voltage 2” of Service Data.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal not pressed: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 46 (+) and No. 45 and No. 33 (–).
	Inspection condition		• Starter switch: ON. • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		• Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 49 (+) and No. 45 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 45 (+) and No. 53 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

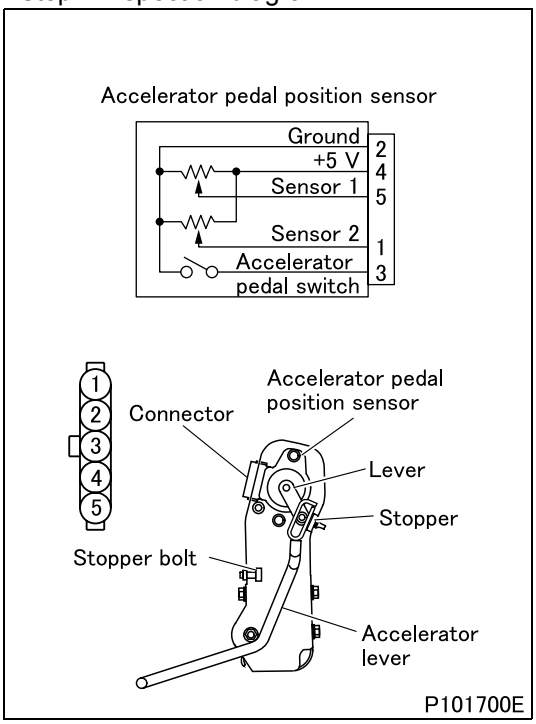
Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

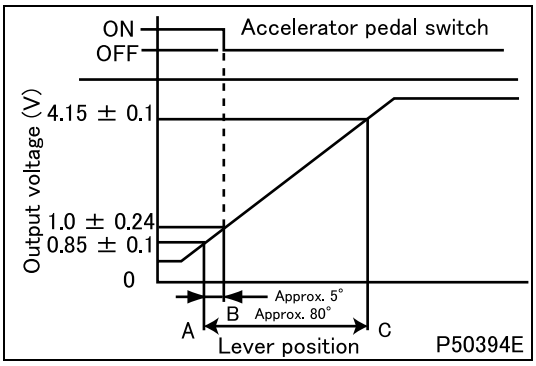
Step 7	Inspection items		Inspection of accelerator pedal position sensor 2 unit
	Maintenance item		Measure value of voltage between connector terminal No. 1 (+) and 2 (–).
	Inspection condition		Apply voltage DC 5 V across connector terminals No. 4 (+) and 2 (–).

	Requirements		• Idle position A: 0.85 ± 0.1 V
			• Accelerator switch operating position B: 1.0 ± 0.24 V
			• Full load position C: 4.15 ± 0.1 V
			  • A: When accelerator lever is in contact with stopper
			  • B: When accelerator pedal is pressed until there is no continuity between terminals 2 and 3.
			  • C: When lever is in contact with full load stopper bolt

	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Adjustment of sensor (If the measurement deviates from the standard value after adjustment, replace the sensor.) (See “INSPECTION OF ELECTRICAL PARTS” – “INSPECTION OF ACCELERATOR PEDAL POSITION SENSOR”.)

<Step 7 inspection diagram>





Step 8	Inspection items		Inspection by sensor connector
	Maintenance item		Measure value of voltage between connector terminal No. 4 (+) and 2 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 49 and sensor connector terminal No. 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 45 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 46 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Accelerator Pedal Position 2”. **<Multi-Use Tester used>** • Measure item No. 41 “Accelerator sensor voltage 2” of Service Data.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal not pressed: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0223/Flash code: 16
[Monitor]
Failure of accelerator pedal position sensor 2
[Fault (outline)]
High signal range check
[Diagnosis check]
- Accelerator pedal position sensor is monitored for output within specification.

[Code generation condition]
- Voltage from accelerator pedal position sensor 2 remains over 4.7 V for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

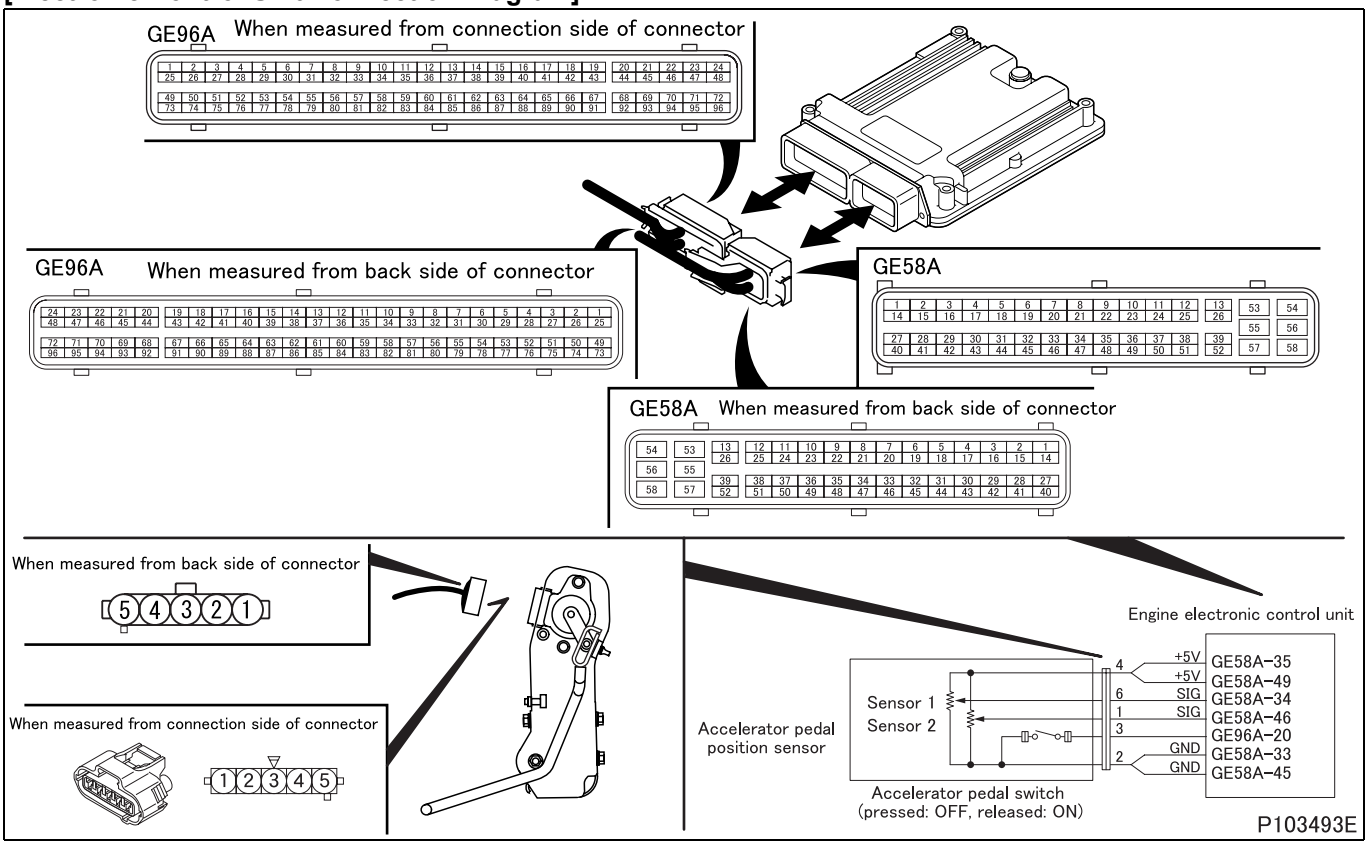
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Accelerator pedal position sensor 1 is computed with accelerator pedal position sensor 2 only.
- In-use performance counter is stopped.
- Related fault check is stopped.

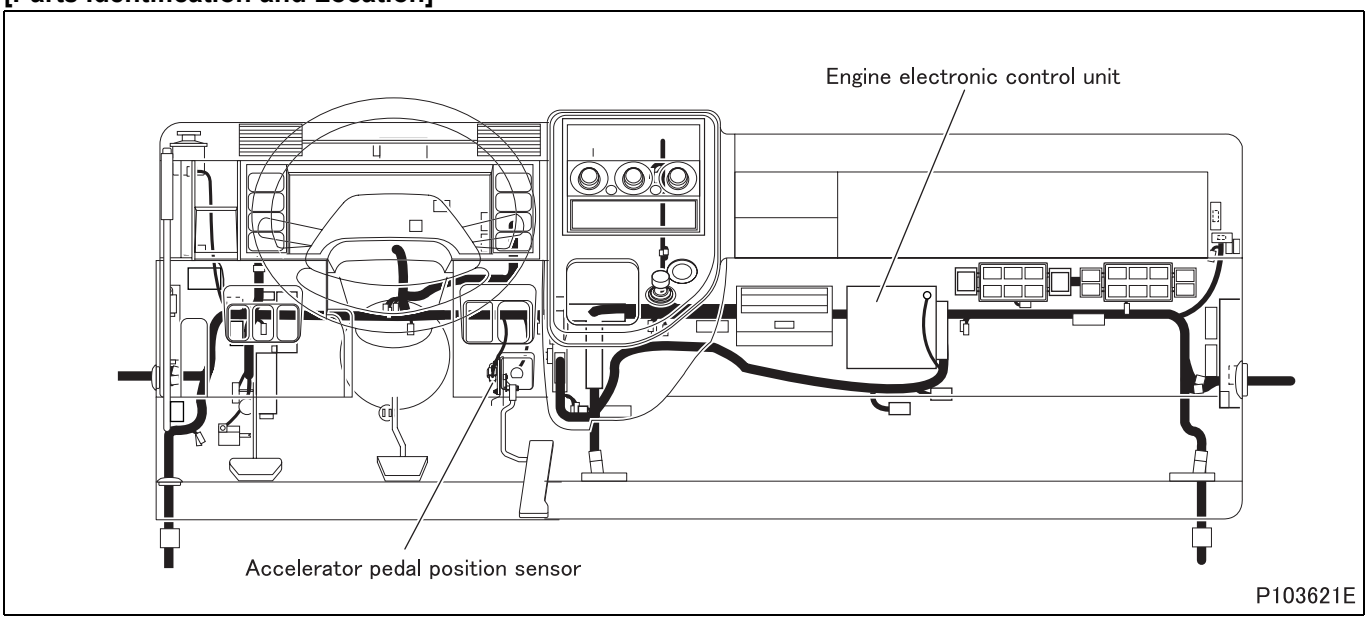
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Accelerator Pedal Position 2”. **<Multi-Use Tester used>** • Measure item No. 41 “Accelerator sensor voltage 2” of Service Data.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal not pressed: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 46 (+) and No. 45 and No. 33 (–).
	Inspection condition		• Starter switch: ON. • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		• Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 49 (+) and No. 45 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 45 (+) and No. 53 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Inspection of connector

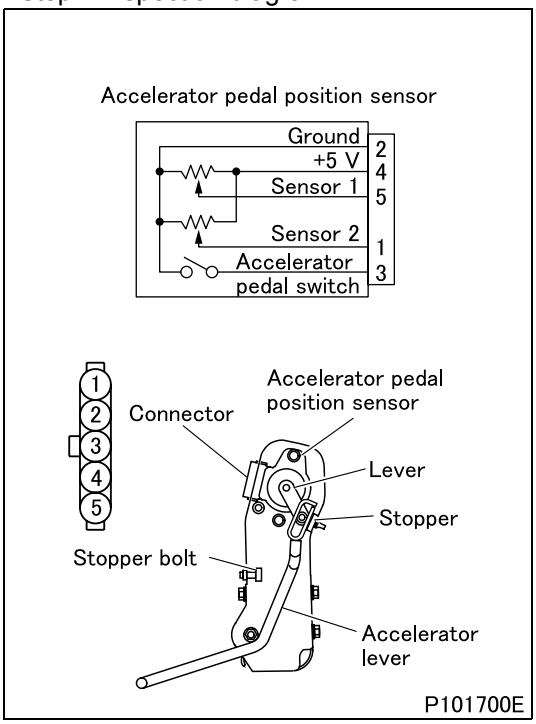
Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Inspection of connector

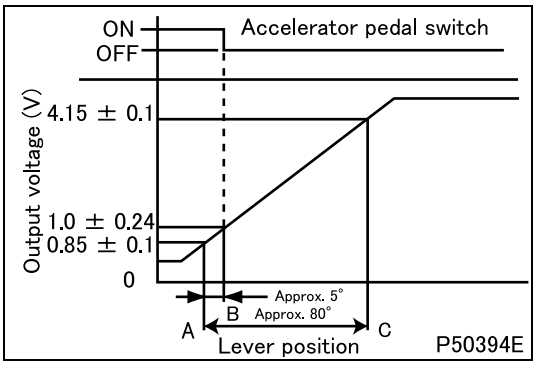
Step 7	Inspection items		Inspection of accelerator pedal position sensor 2 unit
	Maintenance item		Measure value of voltage between connector terminal No. 1 (+) and 2 (–).
	Inspection condition		Apply voltage DC 5 V across connector terminals No. 4 (+) and 2 (–).

	Requirements		• Idle position A: 0.85 ± 0.1 V
			• Accelerator switch operating position B: 1.0 ± 0.24 V
			• Full load position C: 4.15 ± 0.1 V
			  • A: When accelerator lever is in contact with stopper
			  • B: When accelerator pedal is pressed until there is no continuity between terminals 2 and 3.
			  • C: When lever is in contact with full load stopper bolt

	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Adjustment of sensor (If the measurement deviates from the standard value after adjustment, replace the sensor.) (See “INSPECTION OF ELECTRICAL PARTS” – “INSPECTION OF ACCELERATOR PEDAL POSITION SENSOR”.)

<Step 7 inspection diagram>





Step 8	Inspection items		Inspection by sensor connector
	Maintenance item		Measure value of voltage between connector terminal No. 4 (+) and 2 (–).
	Inspection condition		• Starter switch: ON • Engine is stopped. • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 49 and sensor connector terminal No. 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 45 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 46 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Accelerator Pedal Position 2”. **<Multi-Use Tester used>** • Measure item No. 41 “Accelerator sensor voltage 2” of Service Data.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal not pressed: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal not pressed: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0226/Flash code: 28
[Monitor]
Failure of intake throttle
[Fault (outline)]
- Signal range check
- Ref voltage

[Diagnosis check]
- Throttle electronic drive unit monitors intake throttle internal circuit for fault (through throttle position sensor).

[Code generation condition]
- Diagnosis code is generated under either of the following conditions.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)
- Position sensor output voltage remains out of specification (open: above 4.7 V, close: below 0.2 V) for 1 second.
- Position sensor power voltage remains below 4.1 V for 1 second.

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

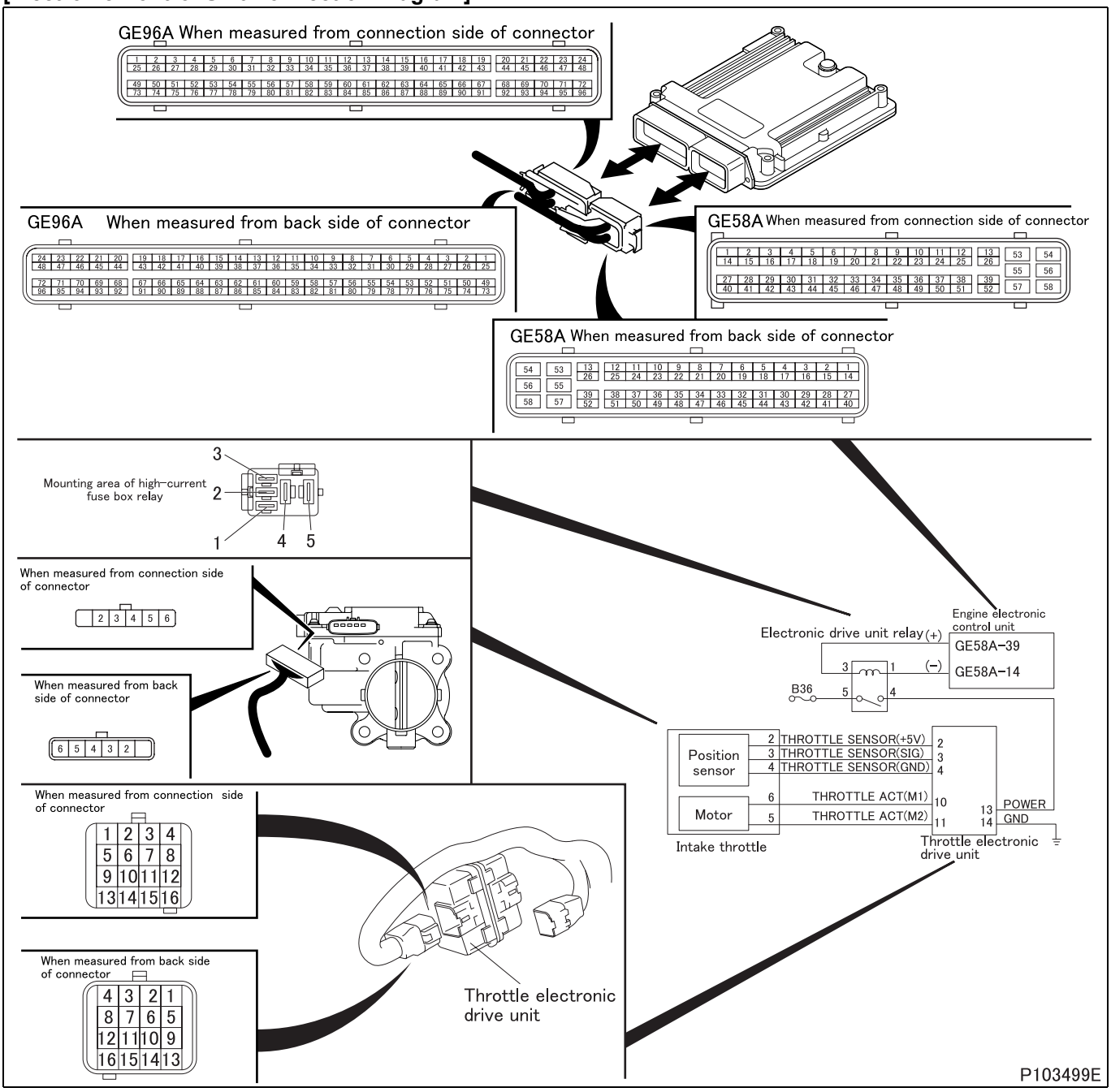
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Intake throttle actuator test is inhibited.
- Related fault check is stopped.

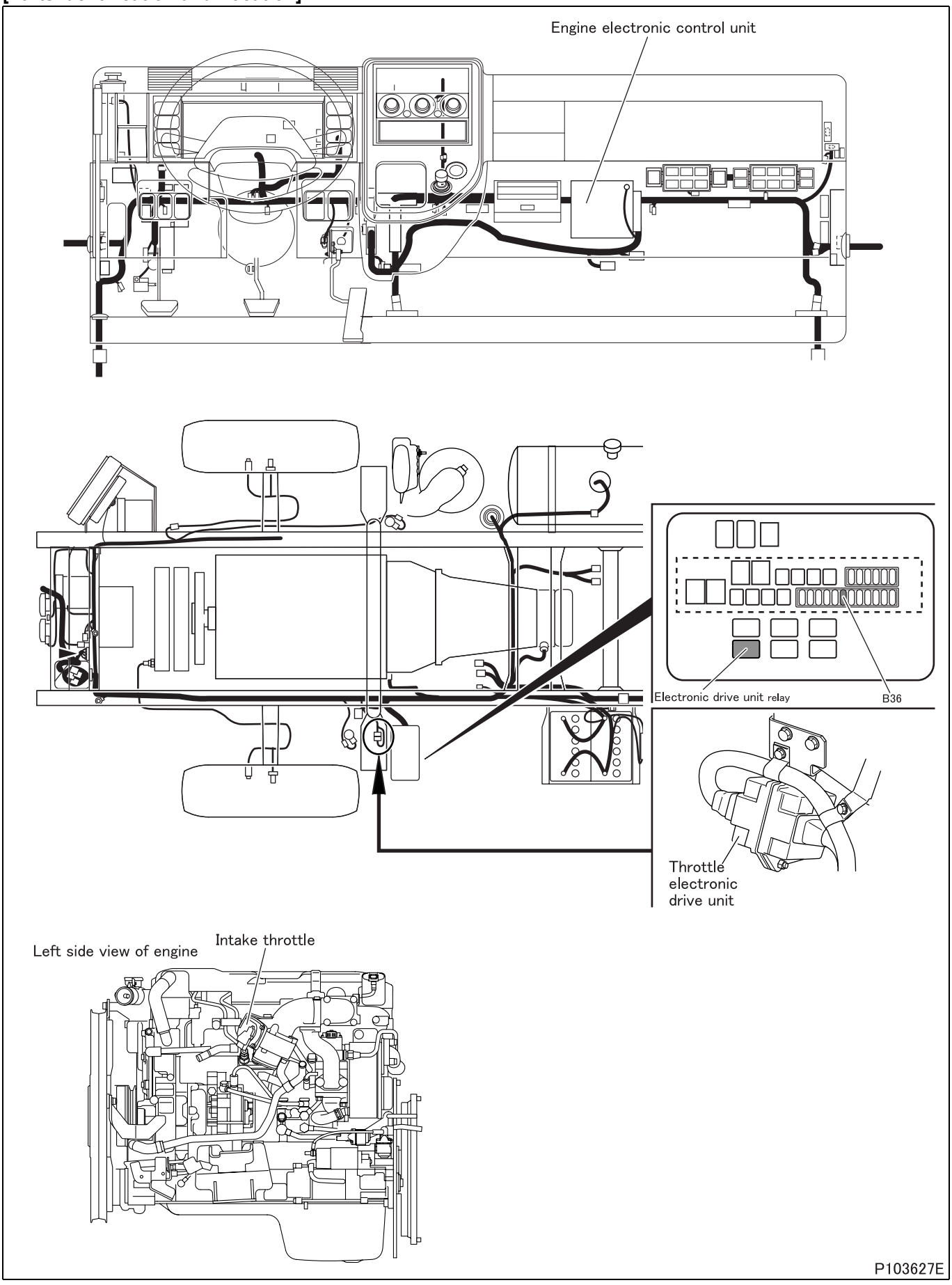
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and throttle actuator
- Malfunction of each connector
- Malfunction of throttle motor (built in throttle actuator)
- Malfunction of throttle position sensor (built in throttle actuator)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A3 “Intake Throttle 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “53: Actual Intake Throttle Position”)
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of throttle actuator connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Remove connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connecter terminal No. 13
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of relay, go to step 9.
		NO	Modify harness.

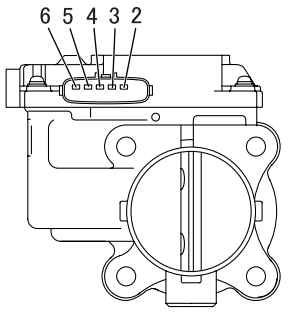
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector terminals • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor ground: terminal No. 4 - 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between connector terminal No. 10 and 11.
	Inspection condition		Remove connector and measure from harness side.
	Requirements		0.3 to 80 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and throttle actuator (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (1) : electronic drive unit connector terminal No. 10 - throttle actuator connector terminal No. 6 • Motor (2) : electronic drive unit connector terminal No. 11 - throttle actuator connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of throttle actuator unit (motor)
	Maintenance item		Measure value of resistance between connector terminal No. 5 and 6.
	Inspection condition		• Keep throttle actuator installed on vehicle. • Remove connector, and measure throttle actuator side.
	Requirements		0.3 to 80 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of throttle actuator

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of throttle actuator connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 4 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 4 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON • Perform actuator test item No. A3 “Intake Throttle 1”
	Requirements		• Valve fully closed: 0.5 V • Valve fully opened: 4.375 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.back side

Step 15	Inspection items		Inspection of harness between electronic drive unit and throttle actuator (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 2 - throttle actuator connector terminal No. 2 • Sensor (signal): electronic drive unit connector terminal No. 3 - throttle actuator connector terminal No. 3 • Sensor (ground): electronic drive unit connector terminal No. 4 - throttle actuator connector terminal No. 4
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of throttle actuator, go to step 16
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A3 “Intake Throttle 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “53: Actual Intake Throttle Position”)
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P0234/Flash code: 32, 54
[Monitor]
Overboost
[Fault (outline)]
Overboost
[Diagnosis check]
Either of the following is monitored.
<Condition (1)>
- Actual boost pressure is detected by boost pressure sensor and compared with standard pressure recorded in engine electronic control unit.

<Condition (2), (3)>
- Actual boost pressure is detected by boost pressure sensor and compared with permissible pressure recorded in engine electronic control unit (engine protection).

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Condition (1)>
- Difference between target boost pressure and actual boost pressure remains more than specified for 10 seconds (overboost status). (Warning lamp (orange) is lit and diagnosis code is displayed on third establishment of code generation condition.)

<Condition (2)>
- The remaining of actual boost pressure higher than permissible pressure recorded in engine electronic control unit for 10 seconds is repeated five times (pre-diagnosis). (Diagnosis code is displayed on first establishment of code generation condition.)

<Condition (3)>
- Status of condition (2) remaining for another 10 seconds is repeated 5 times (final diagnosis). (Warning lamp (red) is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine operating mode: normal (engine in operation)
- Water temperature: 65 to 120°C {149 to 248°F}
- Atmospheric pressure: 828 to 1100 mbar {12 to 15.95 psi}
- Intake air temperature: –7 to 60°C {19 to 140°F}
- Engine speed: 600 to 3000 rpm
- Variation in engine speed: less than 300 rpm/s
- Diesel particulate filter regeneration control: not effected
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Exhaust shutter: in order
- Exhaust gas recirculation cooler: in order
- Starter switch circuit: in order

[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Overboost>
- Engine torque is limited.
- Turbocharger is controlled to open side.

<Deviation in boost pressure>
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Related fault check is stopped.

[Probable cause of trouble]
- Boost pressure incorrectly adjusted
- Mechanical failure of turbocharger unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

<Condition (1)>
- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

<Condition (2)>
- Diagnosis code is cleared simultaneously with recovery.

<Condition (3)>
- Lamp is extinguished and code is cleared simultaneously with recovery.

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Acutuator (Open)” • P0046 “VGT Acutuator (Performance)” • P0047 “VGT Acutuator (Low)” • P0069 “Boost Press SNSR (Correlation)” • P0236 “Boost Press SNSR (Plausi)” • P0237 “Boost Press SNSR (Low)” • P0238 “Boost Press SNSR (High)” • P0401 “EGR Flow (Insufficient)” • P0402 “EGR Flow (Excessive)” • P0403 “EGR1 (Acutuator Circuit)” • P0404 “EGR System” • P0409 “EGR1 (Position Sensor)” • P0562 “Power Supply Voltage (Low)” • P0563 “Power Supply Voltage (High)” • P0600 “CAN Communication” • P0607 “ECU System” • P060B “A/D Converter” • P061B “ECU Performance (Calc)” • P061C “ECU Performance (Ne)” • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)” • P2002 “DPF MFF” • P2228 “Atm Press SNSR (Low)” • P2229 “Atm Press SNSR (High)” • P2263 “VGT System” • P2413 “EGR System” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF” • P2457 “EGR Cooler Performance”
	Inspection condition		Starter switch: ON Do not start engine.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 2.

Step 2	Inspection items		Check of exhaust system
	Maintenance item		Front pipe, diesel particulate filter, tail pipe
	Inspection condition		Starter switch: OFF
	Requirements		Blocked
	Inspection result (Is the judging standard satisfied?)	YES	Clean or replace parts.
		NO	Go to step 3.

Step 3	Inspection items		Check of turbocharger appearance
	Maintenance item		Appearance of turbocharger
	Inspection condition		Starter switch: OFF
	Requirements		Air cylinder binds.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of turbocharger
		NO	Go to step 4.

Step 4	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake MAP”. **<Multi-Use Tester used>** • Measure item No. 21 “Boost Pressure” of Service Data.
	Inspection condition		For boost pressure measurement and correction data calculation, see Gr15.
	Requirements		Boost pressure is normal.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of turbocharger

[Fault code]
Diagnosis code: P0236/Flash code: 32
[Monitor]
Characteristic abnormality of boost pressure sensor
[Fault (outline)]
- Offset and gain drift (High)
- Offset and gain drift (Low)

[Diagnosis check]
Boost pressure is monitored with engine in the following conditions.
<Low speed operation>
- Engine speed: 800 rpm
- Intake throttle opening: 14% or more

<High speed operation>
- Engine speed: 2100 rpm
- Intake throttle opening: 60% or more
- Turbocharger opening: 50% or more

[Code generation condition]
<Low speed operation>
- Boost pressure: Remains at 1125 mbar {16.31 psi} or higher for 10 consecutive seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

<High speed operation>
- Boost pressure: Remains at 1300 mbar {18.85 psi} or lower for 10 consecutive seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
<High speed operation>
- Engine operating mode: normal (engine in operation)
- Engine speed: less than 800 rpm
- Fuel injection quantity: below 25 mg/cyc
- Intake throttle valve opening: more than 14%
- Air flow sensor: in order
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Exhaust gas recirculation flow rate and exhaust gas recirculation valve operation: in order
- Atmospheric pressure sensor: normal in output signal
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Exhaust gas recirculation cooler: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- Injector: in order
- MPROP (rail pressure control valve): in order
- Fuel feed when engine is idling: in order
- Exhaust shutter 3-way magnetic valve: in order

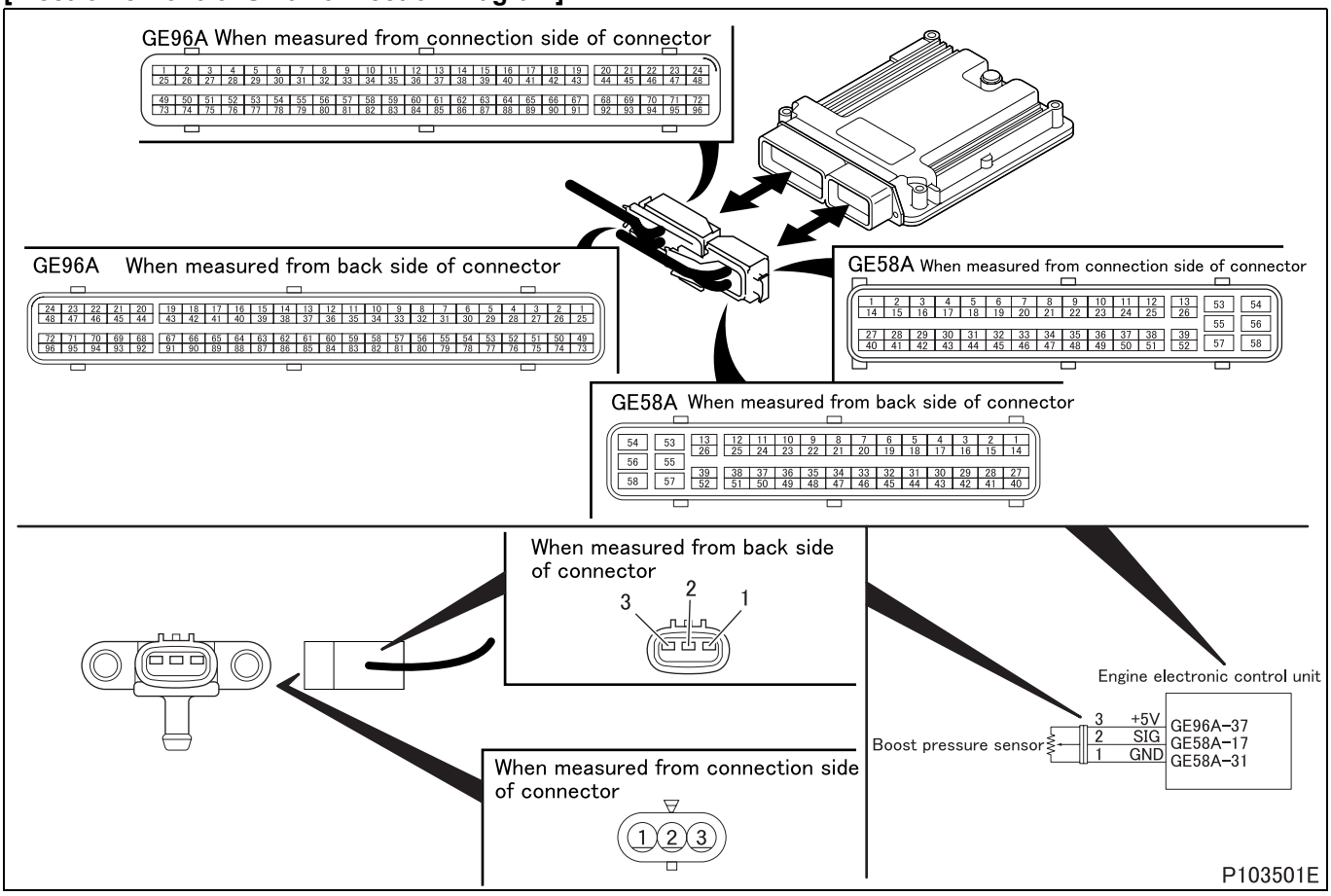
<Low speed operation>
- Engine operating mode: normal (engine in operation)
- Engine speed: more than 2100 rpm
- Fuel injection quantity: above 67 mg/cyc
- Intake throttle valve opening: more than 60%
- Turbocharger position: more than 40%
- Air flow sensor: in order
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Exhaust gas recirculation flow rate and exhaust gas recirculation valve operation: in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: normal in output signal
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Exhaust gas recirculation cooler: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- Injector: in order
- MPROP (rail pressure control valve): in order
- Fuel feed when engine is idling: in order
- Exhaust shutter 3-way magnetic valve: in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Related fault check is stopped.

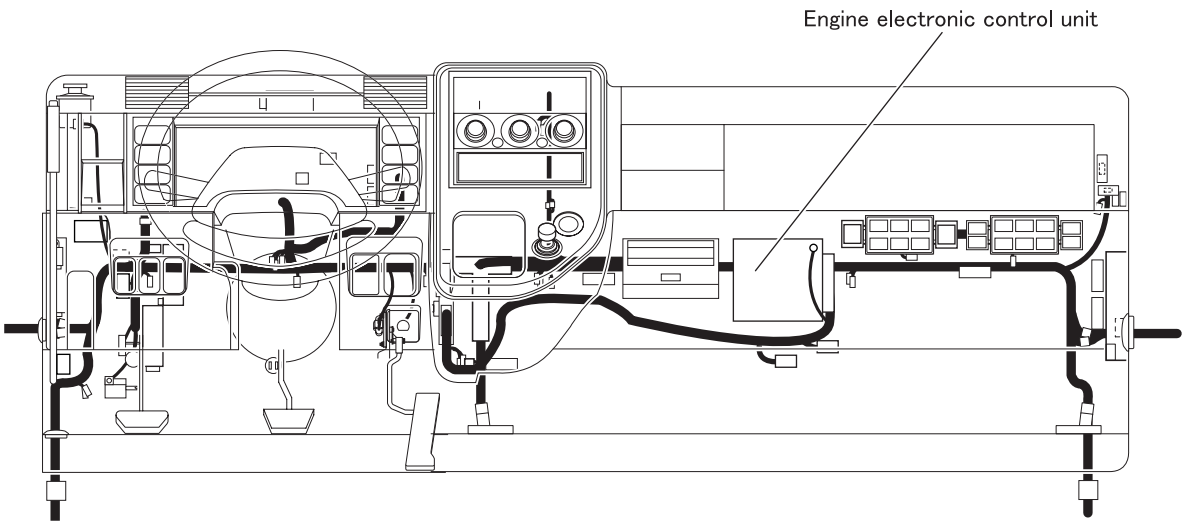
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

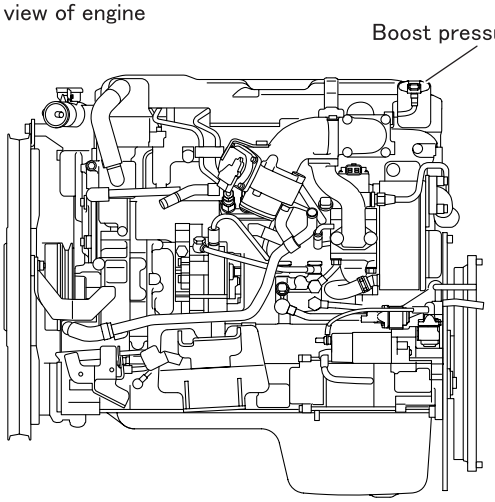
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Left side view of engine



P103628E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake MAP”. **<Multi-Use Tester used>** • Measure item No. 21 “Boost Pressure” of Service Data.
	Inspection condition		Starter switch ON (engine stationary) → After engine has started, press accelerator pedal.
	Requirements		Coincides with atmospheric pressure → Gradually increases
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 34 (+) and 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Engine started
	Requirements		0.5 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 37 (+) and 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

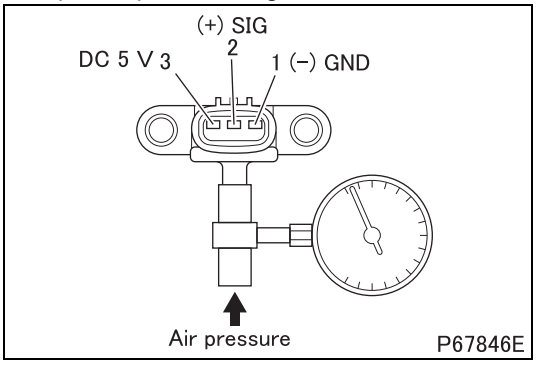
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 14 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure voltage developing across connector terminal No. 2 (+) and 1 (–) when air pressure (gauge pressure) is gradually applied.
	Inspection condition		Apply voltage DC 5 V across connector terminals No. 3 (+) and 1 (–).
	Requirements		• 99 kPa {14 psi, 1.0 kgf/cm^2}: Approx. 2.5 V • 232.3 kPa {34 psi, 2.4 kgf/cm^2}: Approx. 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 1 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 37.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 14.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 34.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake MAP”. **<Multi-Use Tester used>** • Measure item No. 21 “Boost Pressure” of Service Data.
	Inspection condition		Starter switch ON (engine stationary) → After engine has started, press accelerator pedal.
	Requirements		Coincides with atmospheric pressure → Gradually increases
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0237/Flash code: 32
[Monitor]
Failure of boost pressure sensor
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Boost sensor output voltage is monitored.

[Code generation condition]
- Boost sensor output voltage remains below 0.098 V for 1 second. (sensor pressure: 400 mbar {5.8 psi} or less)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

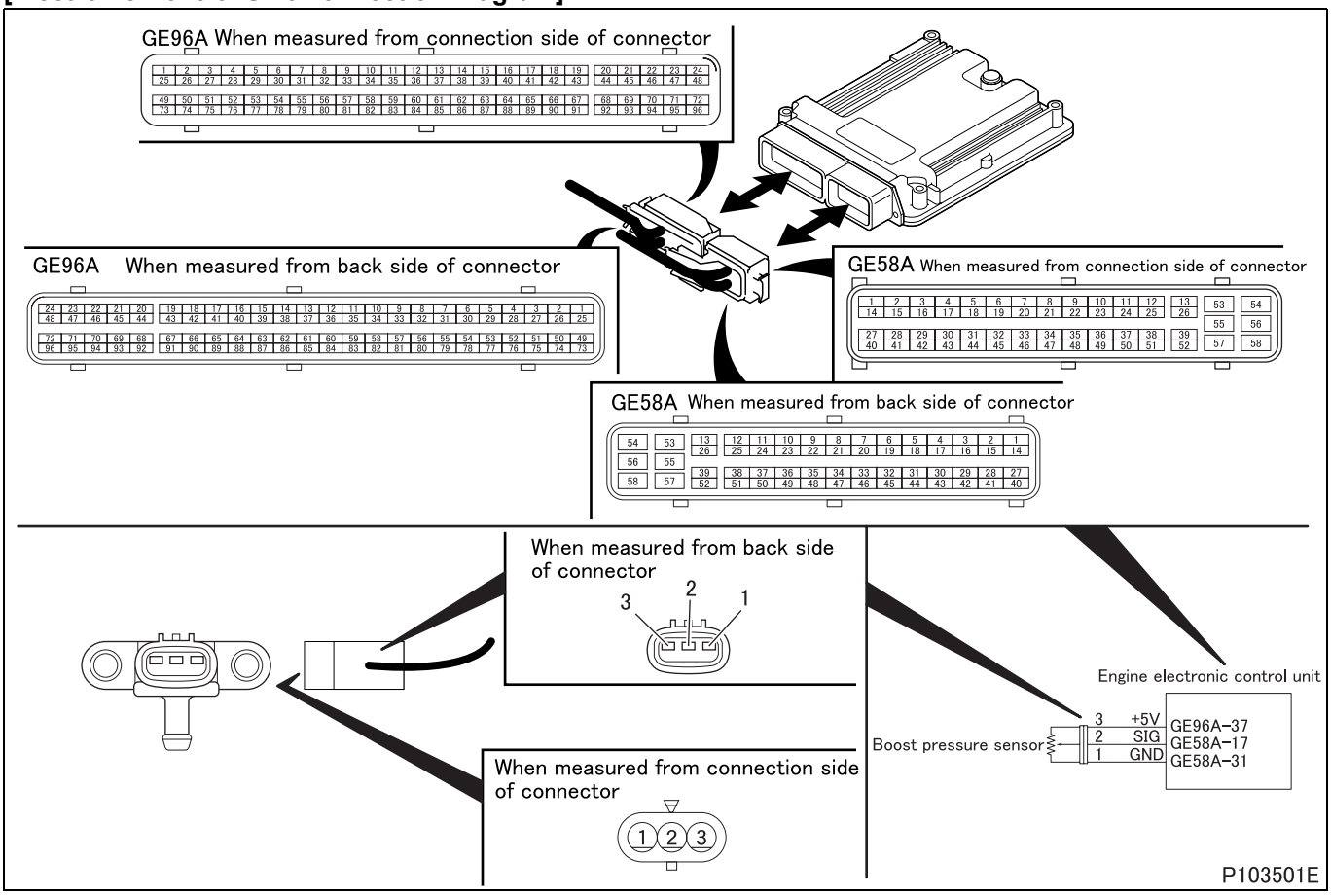
[Diagnostic requirement]
- Fault diagnosis starts when one of the following requirements are met (The diagnosis does not start when both requirements are simultaneously met.).
  - Engine speed: less than 500 rpm
  - Fuel injection quantity: below 5 mg/cyc

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Particulate matter deposit computation is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

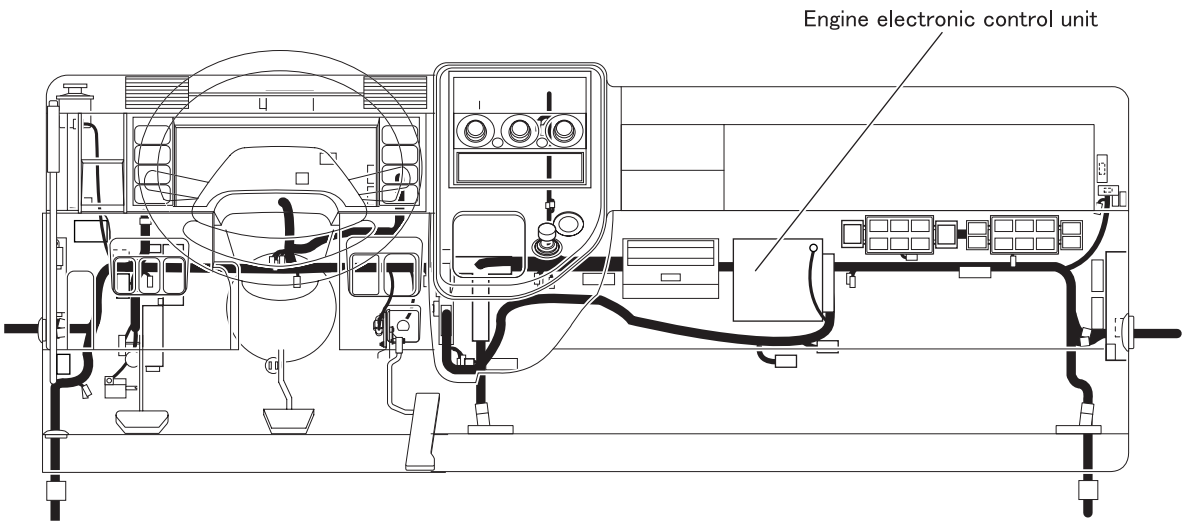
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

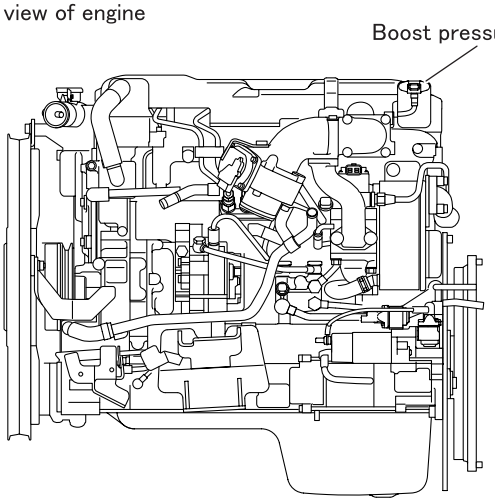
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Left side view of engine



P103628E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake MAP”. **<Multi-Use Tester used>** • Measure item No. 21 “Boost Pressure” of Service Data.
	Inspection condition		Starter switch ON (engine stationary) → After engine has started, press accelerator pedal.
	Requirements		Coincides with atmospheric pressure → Gradually increases
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 34 (+) and 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Engine started
	Requirements		0.5 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 37 (+) and 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

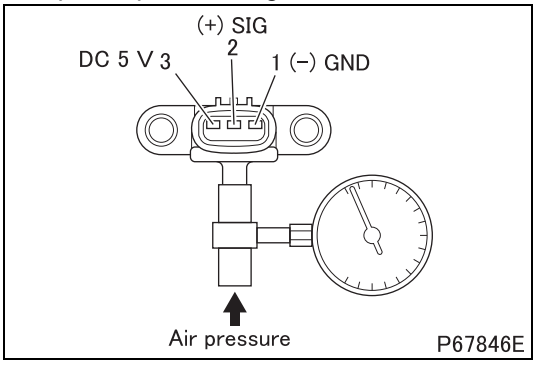
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 14 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure voltage developing across connector terminal No. 2 (+) and 1 (–) when air pressure (gauge pressure) is gradually applied.
	Inspection condition		Apply voltage DC 5 V across connector terminals No. 3 (+) and 1 (–).
	Requirements		• 99 kPa {14 psi, 1.0 kgf/cm^2}: Approx. 2.5 V • 232.3 kPa {34 psi, 2.4 kgf/cm^2}: Approx. 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 1 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 37.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 14.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 34.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake MAP”. **<Multi-Use Tester used>** • Measure item No. 21 “Boost Pressure” of Service Data.
	Inspection condition		Starter switch ON (engine stationary) → After engine has started, press accelerator pedal.
	Requirements		Coincides with atmospheric pressure → Gradually increases
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0238/Flash code: 32
[Monitor]
Failure of boost pressure sensor
[Fault (outline)]
High signal range check
[Diagnosis check]
- Boost sensor output voltage is monitored.

[Code generation condition]
- Boost sensor output voltage remains over 4.87 V for 1 second. (sensor pressure: 3533 mbar {51.23 psi} or more)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

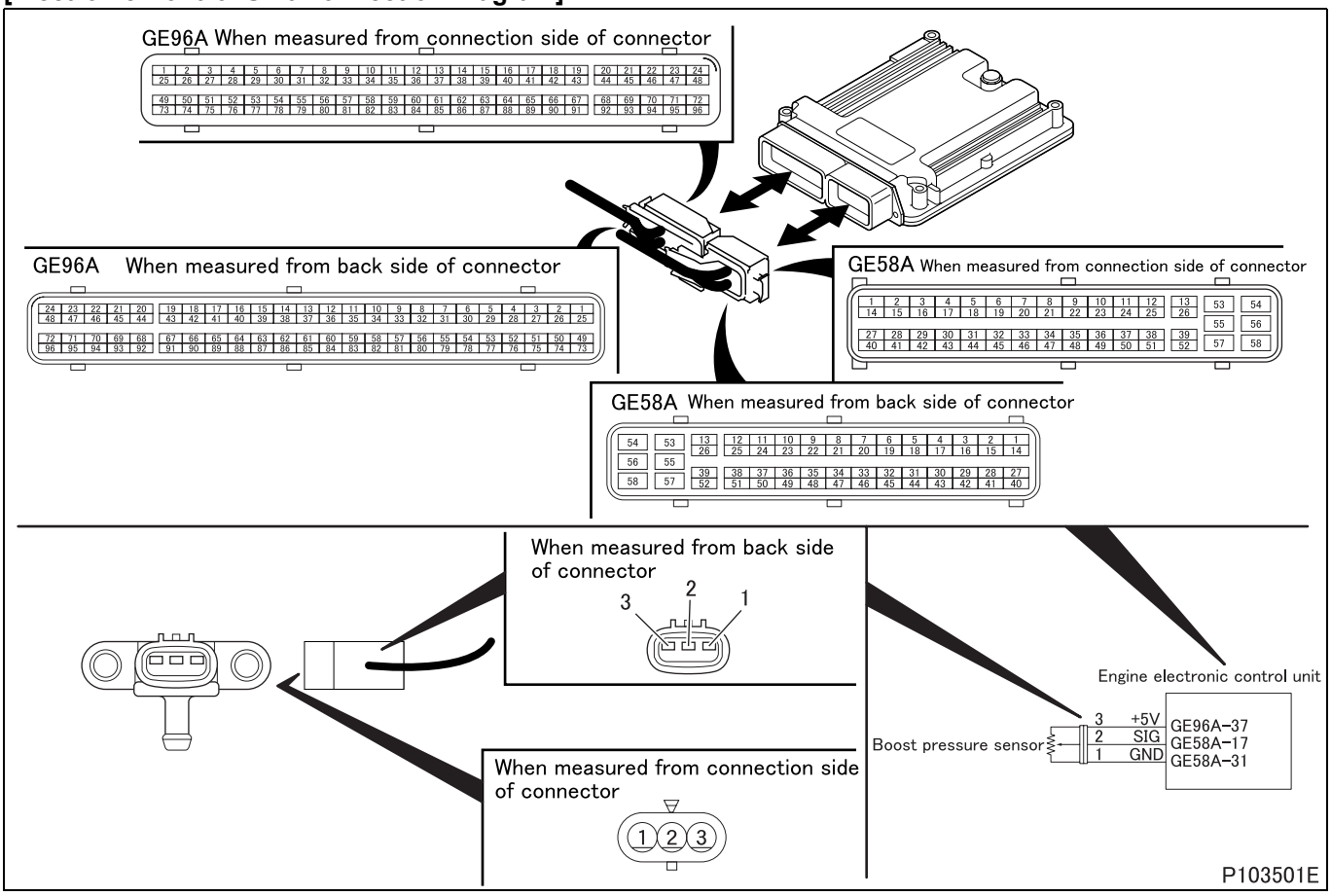
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Particulate matter deposit computation is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

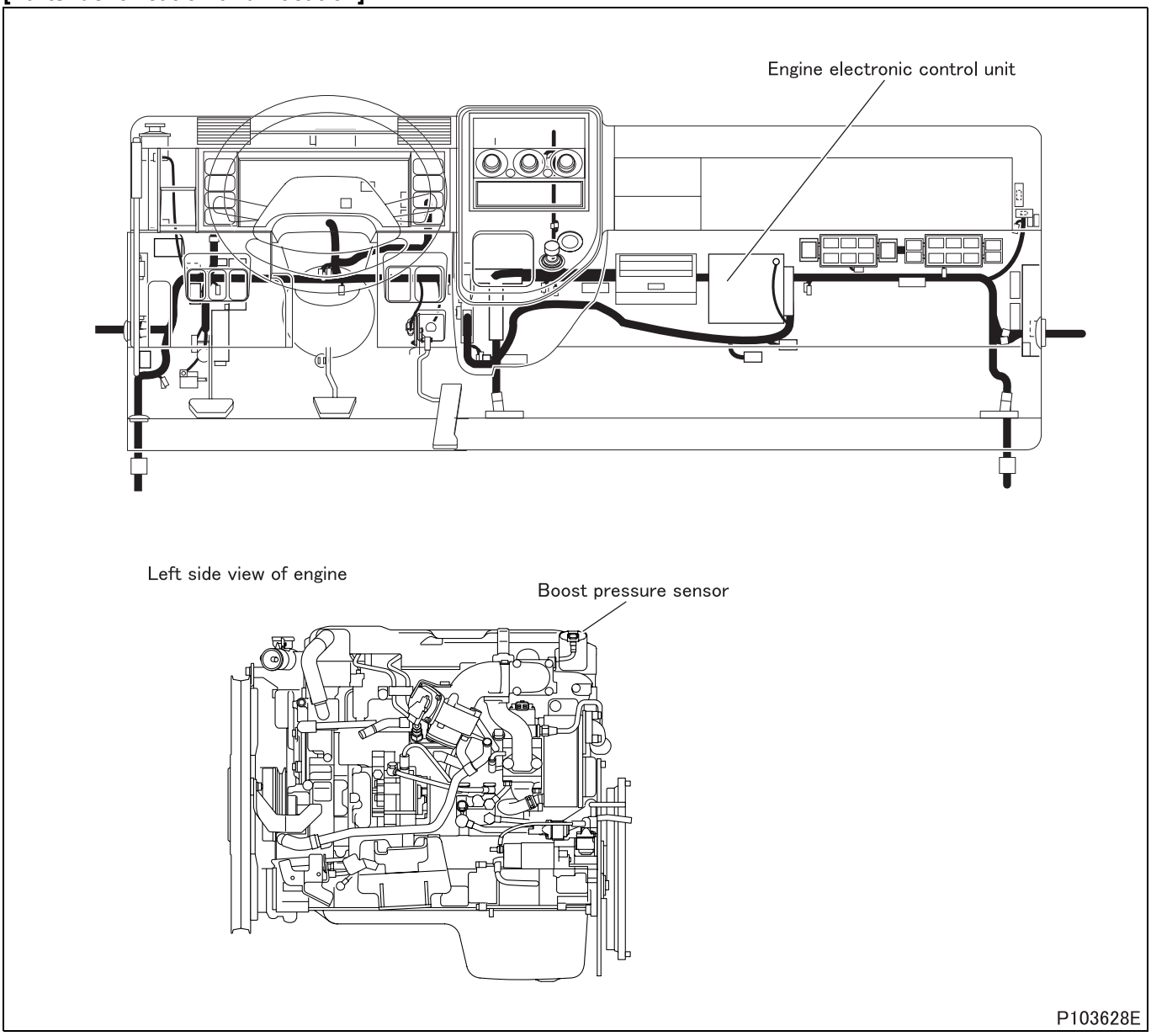
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake MAP”. **<Multi-Use Tester used>** • Measure item No. 21 “Boost Pressure” of Service Data.
	Inspection condition		Starter switch ON (engine stationary) → After engine has started, press accelerator pedal.
	Requirements		Coincides with atmospheric pressure → Gradually increases
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 34 (+) and 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Engine started
	Requirements		0.5 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 37 (+) and 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

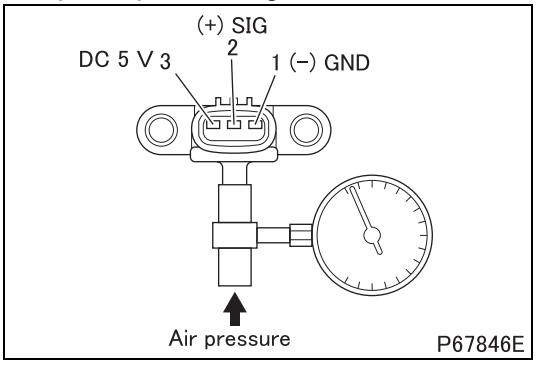
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 14 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure voltage developing across connector terminal No. 2 (+) and 1 (–) when air pressure (gauge pressure) is gradually applied.
	Inspection condition		Apply voltage DC 5 V across connector terminals No. 3 (+) and 1 (–).
	Requirements		• 99 kPa {14 psi, 1.0 kgf/cm^2}: Approx. 2.5 V • 232.3 kPa {34 psi, 2.4 kgf/cm^2}: Approx. 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 1 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 37.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 14.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 34.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake MAP”. **<Multi-Use Tester used>** • Measure item No. 21 “Boost Pressure” of Service Data.
	Inspection condition		Starter switch ON (engine stationary) → After engine has started, press accelerator pedal.
	Requirements		Coincides with atmospheric pressure → Gradually increases
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0251/Flash code: 36
[Monitor]
Valve opening of common rail safety valve (DBV)
[Fault (outline)]
Common rail pressure (maximum)
[Diagnosis check]
- Safety valve (DBV) was activated after abnormal rise in common rail pressure.

[Code generation condition]
- Common rail pressure exceeded 190 MPa {27560 psi, 1937 kgf/cm^2} once, then dropped and stabilized at a level near a safety valve (DBV) operating pressure of 80 MPa {11604 psi, 816 kgf/cm^2}.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.

[Probable cause of trouble]
- Airtight malfunction of injector
- Malfunction of supply pump
- Plugged fuel system
- Malfunction of pressure limiter
- Malfunction of common rail pressure sensor

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (At the same time as recovery, warning lamp is extinguished and diagnosis code is cleared.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0192 “CRS Pressure SNSR (Low)” • P0193 “CRS Pressure SNSR (High)” • P0201 “Injector M/V-Cylinder 1 (Load)” • P0202 “Injector M/V-Cylinder 2 (Load)” • P0203 “Injector M/V-Cylinder 3 (Load)” • P0204 “Injector M/V-Cylinder 4 (Load)” • P0253 “Common Rail Pressure Defect” • P0605 “ECU System (Hardware)” • P0607 “ECU System”
	Inspection condition		• Starter switch: ON • Engine: stopped
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 2.

Step 2	Inspection items		Checking of engine appearance
	Maintenance item		Check fuel system for fuel leak.
	Inspection condition		Starter switch: OFF
	Requirements		There is fuel leak.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 6.

Step 3	Inspection items		Inspection of low pressure piping (fuel tank – supply pump)
	Maintenance item		Check suction pipe or hose for bend.
	Inspection condition		Starter switch: OFF
	Requirements		There is no bend on hose.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Correct and replace suction pipe or hose.

Step 4	Inspection items		Checking of air bleeding
	Maintenance item		Bleed air from fuel filter.
	Inspection condition		Starter switch: OFF
	Requirements		Problem is solved by bleeding air.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection
		NO	Go to step 5.

Step 5	Inspection items		Inspection of low pressure piping
	Maintenance item		Fuel filter
	Inspection condition		Starter switch: OFF
	Requirements		Problem is solved by replacing fuel filter.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection
		NO	Go to step 6.

Step 6	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”
	Inspection condition		Rail pressure is increased for a certain period of time (6 seconds). • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		There is no leak from supply pump.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of supply pump

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”
	Inspection condition		Rail pressure is increased for a certain period of time (6 seconds). • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		There is no leak from fuel pipe between supply pump and rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of fuel pipe

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”
	Inspection condition		Rail pressure is increased for a certain period of time (6 seconds). • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		There is no leak from rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of rail

Step 9	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”
	Inspection condition		Rail pressure is increased for a certain period of time (6 seconds). • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		There is no leak from fuel injection pipes (four) between injector and rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of injection pipe

Step 10	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”
	Inspection condition		Rail pressure is increased for a certain period of time (6 seconds). • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Replacement of injector

Step 11	Inspection items		Check inside of combustion chamber.
	Maintenance item		Check for fuel leak.
	Inspection condition		• After performing actuator test item No. B2 “Fuel Leak Check”, stop engine. • Remove glow plug, and check from glow plug mounting hole using bore scope.
	Requirements		Inside of combustion chamber is not wet.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Replacement of injector of object cylinder

Step 12	Inspection items		Replacement of rail (flow damper and pressure limiter abnormal)
	Maintenance item		–
	Inspection condition		–
	Requirements		Problem is solved by replacing rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	–

Step 13	Inspection items		Replacement of supply pump
	Maintenance item		–
	Inspection condition		–
	Requirements		Problem is solved by replacing supply pump.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Replacement of injectors (four)

[Fault code]
Diagnosis code: P0253/Flash code: 22
[Monitor]
Rail pressure is abnormal (to low) during opening of safety valve (DBV).
[Fault (outline)]
Common rail pressure (minimum)
[Diagnosis check]
- Safety valve (DBV) is monitored for abnormal drop in operating pressure during opening of DBV (diagnosis code P0251).

[Code generation condition]
- Common rail pressure remains below 50 MPa {7253 psi, 510 kgf/cm^2} for 100 consecutive seconds. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the limp mode control is activated.

[Diagnostic requirement]
- After diagnosis code P0191, P0192, P0193 occurs.

[Control effected by electronic control unit during fault]
- Engine stopped

[Probable cause of trouble]
- Malfunction of safety valve (DBV)

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (At the same time as recovery, warning lamp is extinguished and diagnosis code is cleared.)

[Fault diagnosis]
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0251 “Common Rail Pressure Defect”
	Inspection condition		• Starter switch: ON • Engine: stopped
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Replacement of rail

[Fault code]
Diagnosis code: P0254/Flash code: 23
[Monitor]
Rail pressure is abnormal (to high) during opening of safety valve (DBV).
[Fault (outline)]
- Pressure shock
- Not open
- Common rail pressure (maximum)

[Diagnosis check]
- Safety valve (DBV) is monitored for abnormal drop in operating pressure during opening of DBV (diagnosis code P0251).

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Condition (1)>
- Actual common rail pressure remains over 195 MPa {28286 psi, 1988 kgf/cm^2} for 2 consecutive seconds. (Diagnosis code is displayed on first establishment of code generation condition.)

<Condition (2)>
- Actual common rail pressure remains over 195 MPa {28286 psi, 1988 kgf/cm^2} for 10 consecutive seconds. (Warning lamp (red) is lit and diagnosis code is displayed on first establishment of code generation condition.)

<Condition (3)>
- Common rail pressure remains at 126 MPa {18277 psi, 1285 kgf/cm^2} or higher for 100 consecutive seconds. (Warning lamp (red) is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
<Condition (1), (2)>
- Fault diagnosis is performed only once during the driving cycle.

<Condition (3)>
- Fault diagnosis is performed each time when the limp mode control is activated.

[Diagnostic requirement]
<When common rail pressure exceeds 195 MPa {28286 psi, 1988 kgf/cm^2}>
–
<When common rail pressure exceeds 126 MPa {18277 psi, 1285 kgf/cm^2}>
- After diagnosis code P0191, P0192, P0193 occurs.

[Control effected by electronic control unit during fault]
Electronic control unit varies in the way of control by the status of warning lamp.
<Warning lamp (red) lit>
- Engine stopped

<Warning lamp extinguished (diagnosis code only)>
- Diesel particulate filter regeneration is stopped.

[Probable cause of trouble]
- Malfunction of safety valve (DBV)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

<Condition (1)>
- Diagnosis code is cleared simultaneously with recovery.

<Condition (2)>
- Lamp is extinguished and code is cleared simultaneously with recovery.

<Condition (3)>
- Lamp is extinguished and code is cleared simultaneously with recovery.

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0251 “Common Rail Pressure Defect”
	Inspection condition		• Starter switch: ON • Engine: stopped
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Replacement of rail

[Fault code]
Diagnosis code: P0261/Flash code: 37
[Monitor]
Failure of injector magnetic valve (No. 1 cylinder)
[Fault (outline)]
Injector short circuit (No. 1 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 1 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 1 cylinder) circuit remains shorted to ground as detected for 3 consecutive cycles. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

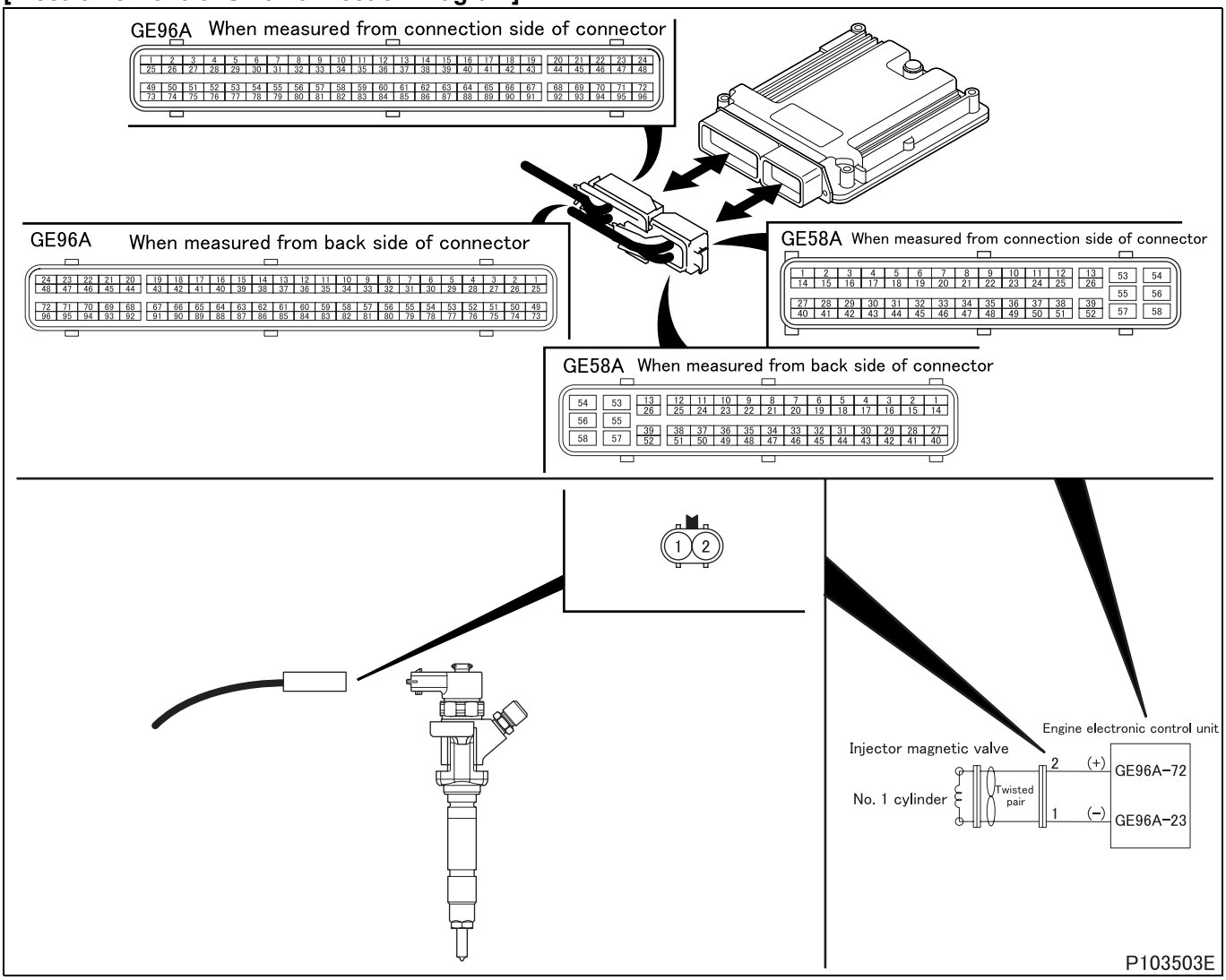
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 1 and No. 4 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

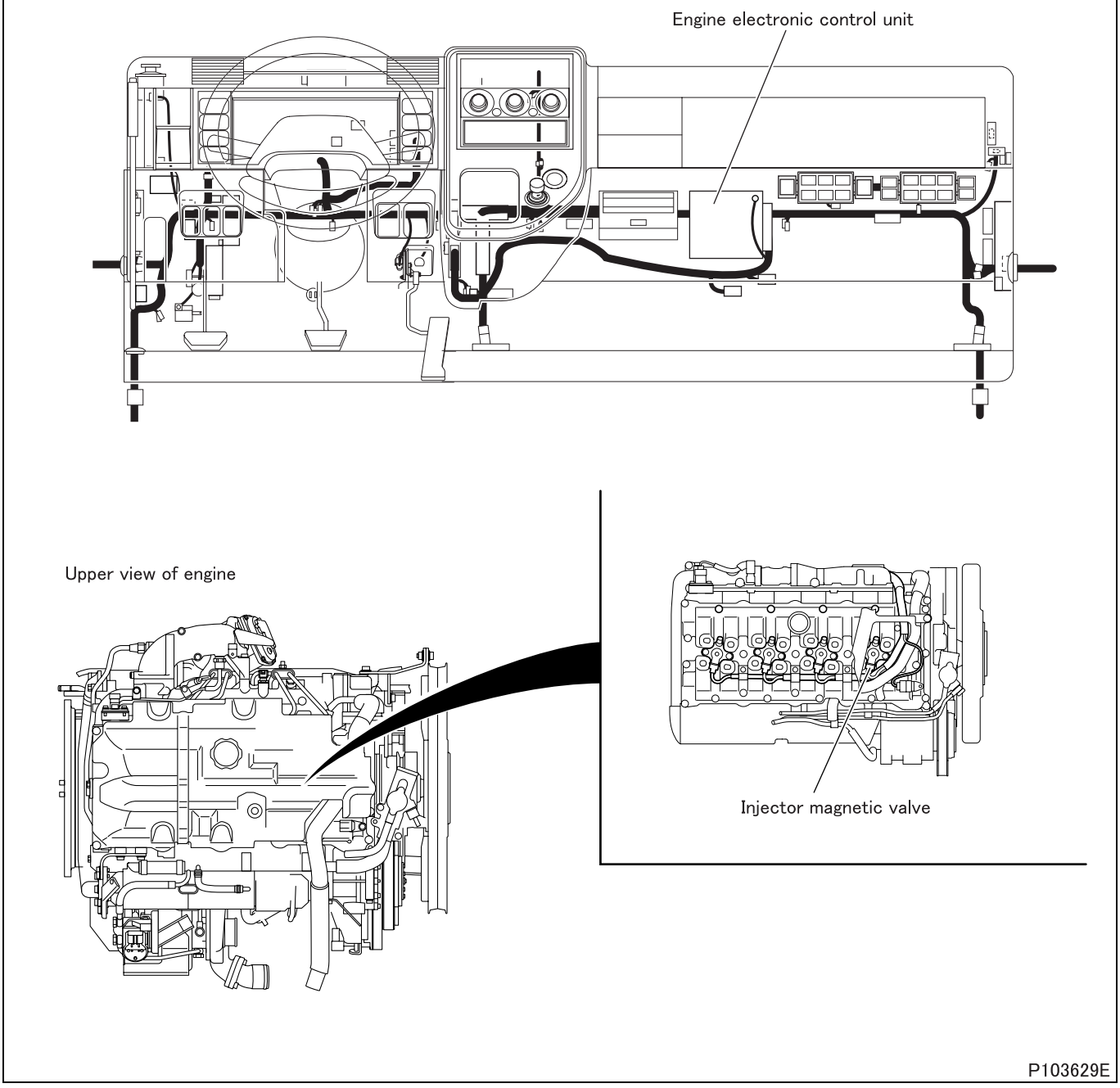
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BB “Injector Test 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

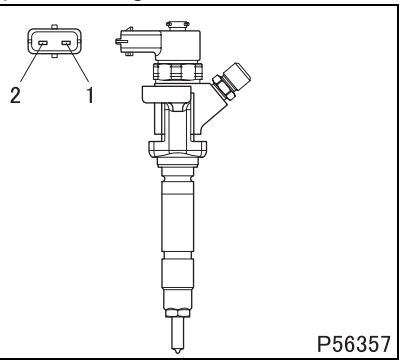
Step 2	Inspection items		Inspection by electronic drive unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 23 and 72.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 72.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 23.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BB “Injector Test 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0262/Flash code: 37
[Monitor]
Failure of injector magnetic valve (No. 1 cylinder)
[Fault (outline)]
Injector short circuit (No. 1 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 1 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 1 cylinder) circuit remains shorted to power supply as detected for 3 consecutive cycles. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

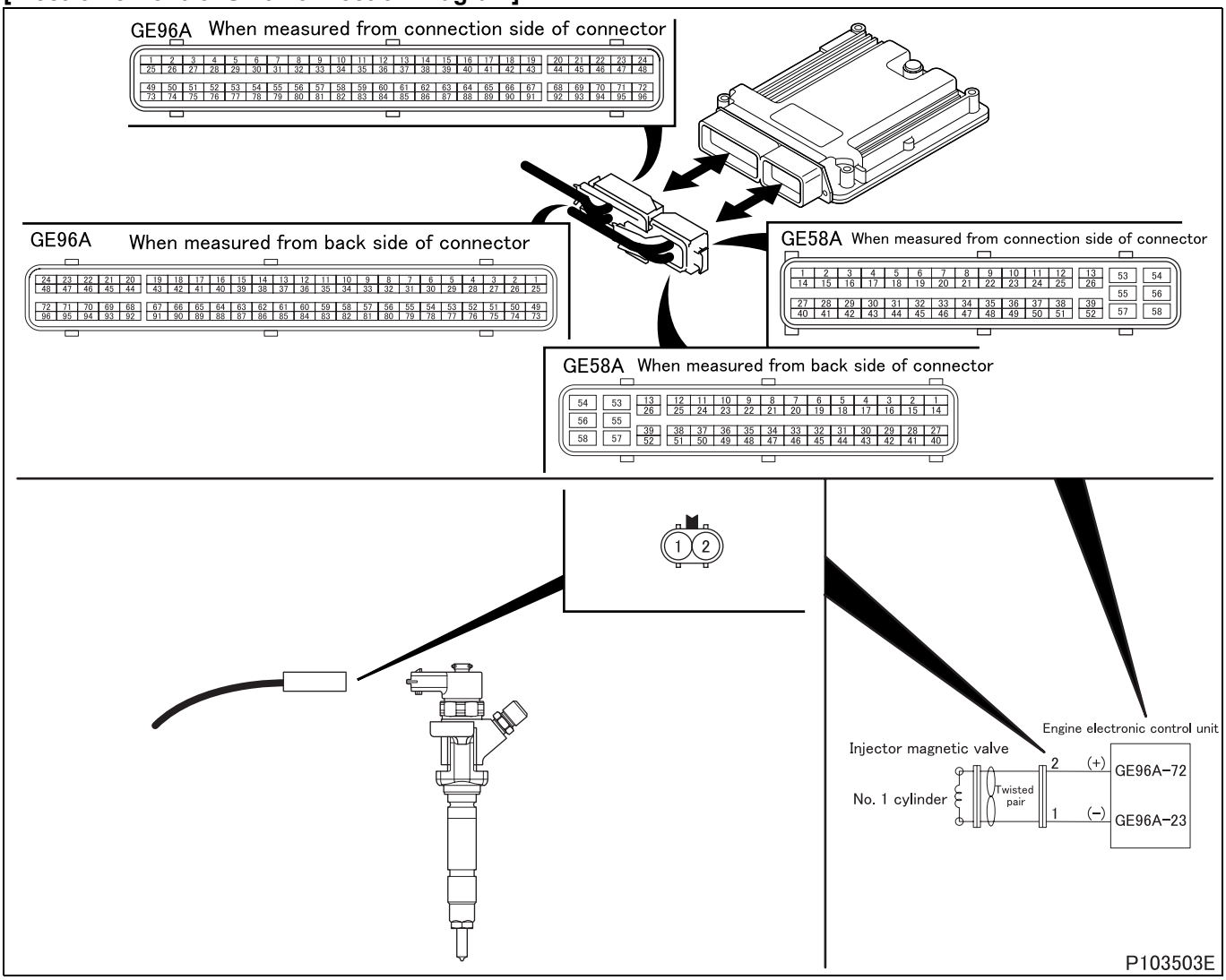
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 1 and No. 4 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

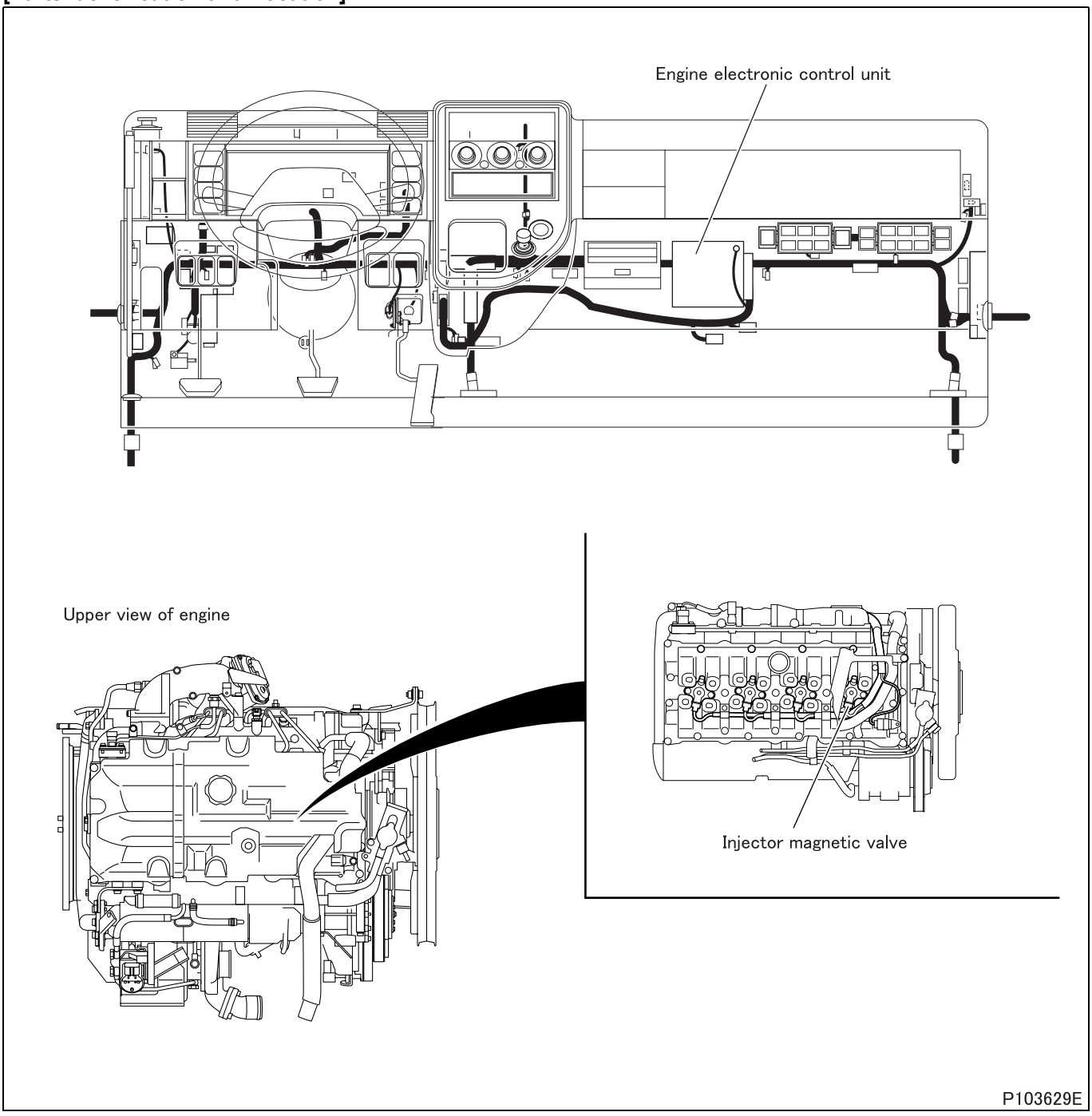
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BB “Injector Test 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

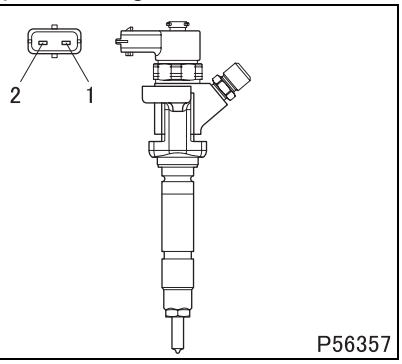
Step 2	Inspection items		Inspection by electronic drive unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 23 and 72.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 72.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 23.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BB “Injector Test 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0263/Flash code: 53
[Monitor]
Abnormality in cylinder balance correction
[Fault (outline)]
Cylinder balancing out of range
[Diagnosis check]
- Check is made to determine if variation to correct in injection quantity between cylinders is excessive.

[Code generation condition]
- Corrected fuel injection quantity remains 5 mg/cycle or more for 10 consecutive seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Water temperature: above 65°C {149°F}
- PTO status: OFF
- Cylinder balance: closed loop control

<Under closed loop control>
  - Engine speed: 630 to 820 rpm
  - Fuel injection quantity: 2 to 99 mg/cyc

- Engine operating mode: normal (engine in operation)
- Time till above conditions were met: more than 10 seconds
- The fuel balancing compensation (FBC) value for a cylinder deviates by 5 mg/cyc larger than that for any other cylinders.
- Fuel Balancing Compensation (FBC) monitor: in order
- Water temperature sensor: in order
- Engine speed sensor: in order
- Cylinder recognition sensor: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0261 “Injector #1-A (Low)” • P0262 “Injector #1-A (High)” • P0264 “Injector #2-A (Low)” • P0265 “Injector #2-A (High)” • P0267 “Injector #3-A (Low)” • P0268 “Injector #3-A (High)” • P0270 “Injector #4-A (Low)” • P0271 “Injector #4-A (High)”
	Inspection condition		• Starter switch: ON • Engine: started
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of injector (No. 1 cylinder)
		NO	Inspect diagnosis code that is occurring.

[Fault code]
Diagnosis code: P0264/Flash code: 8
[Monitor]
Failure of injector magnetic valve (No. 2 cylinder)
[Fault (outline)]
Injector short circuit (No. 2 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 2 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 2 cylinder) circuit remains shorted to ground as detected for 3 consecutive cycles. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

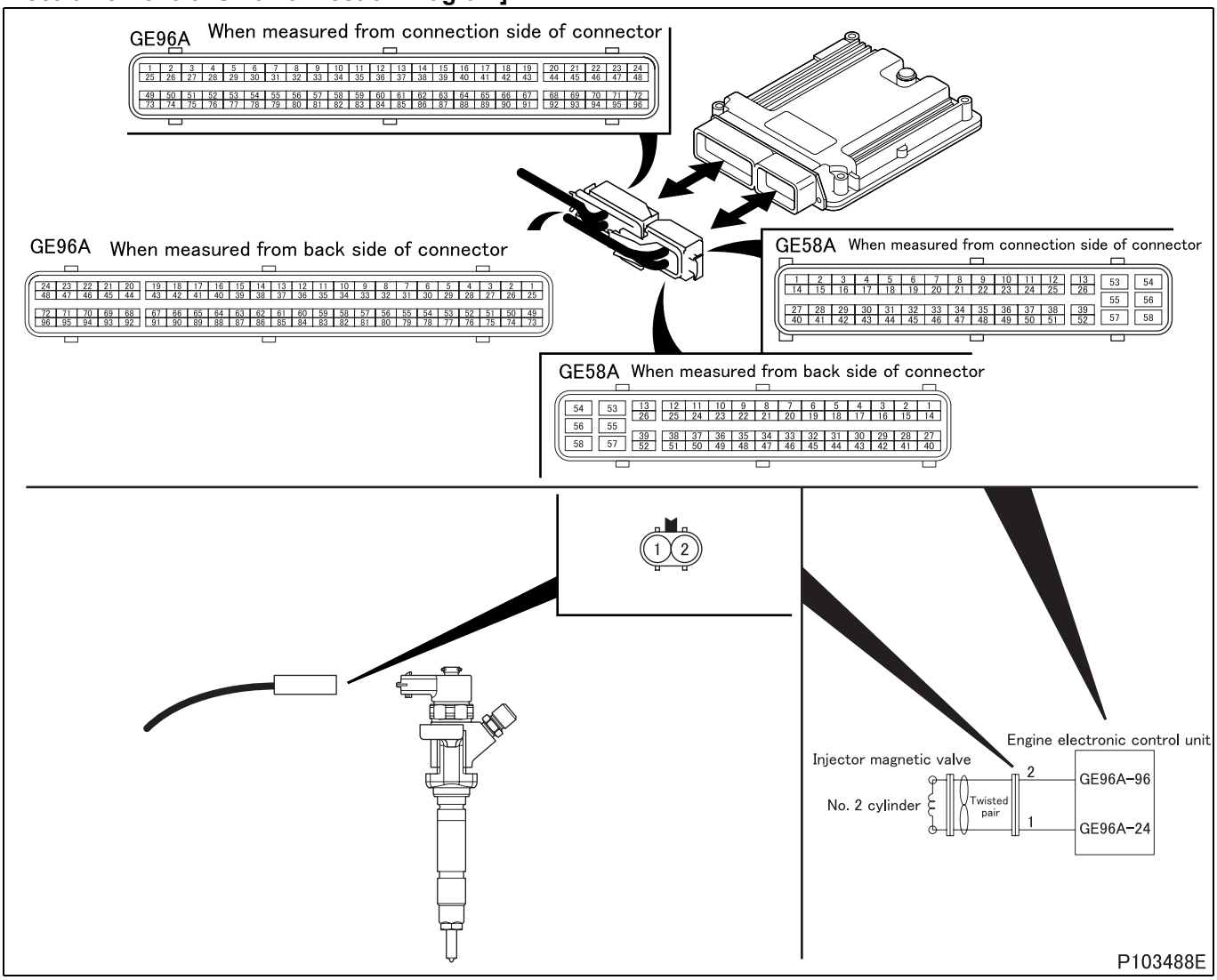
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 2 and No. 3 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

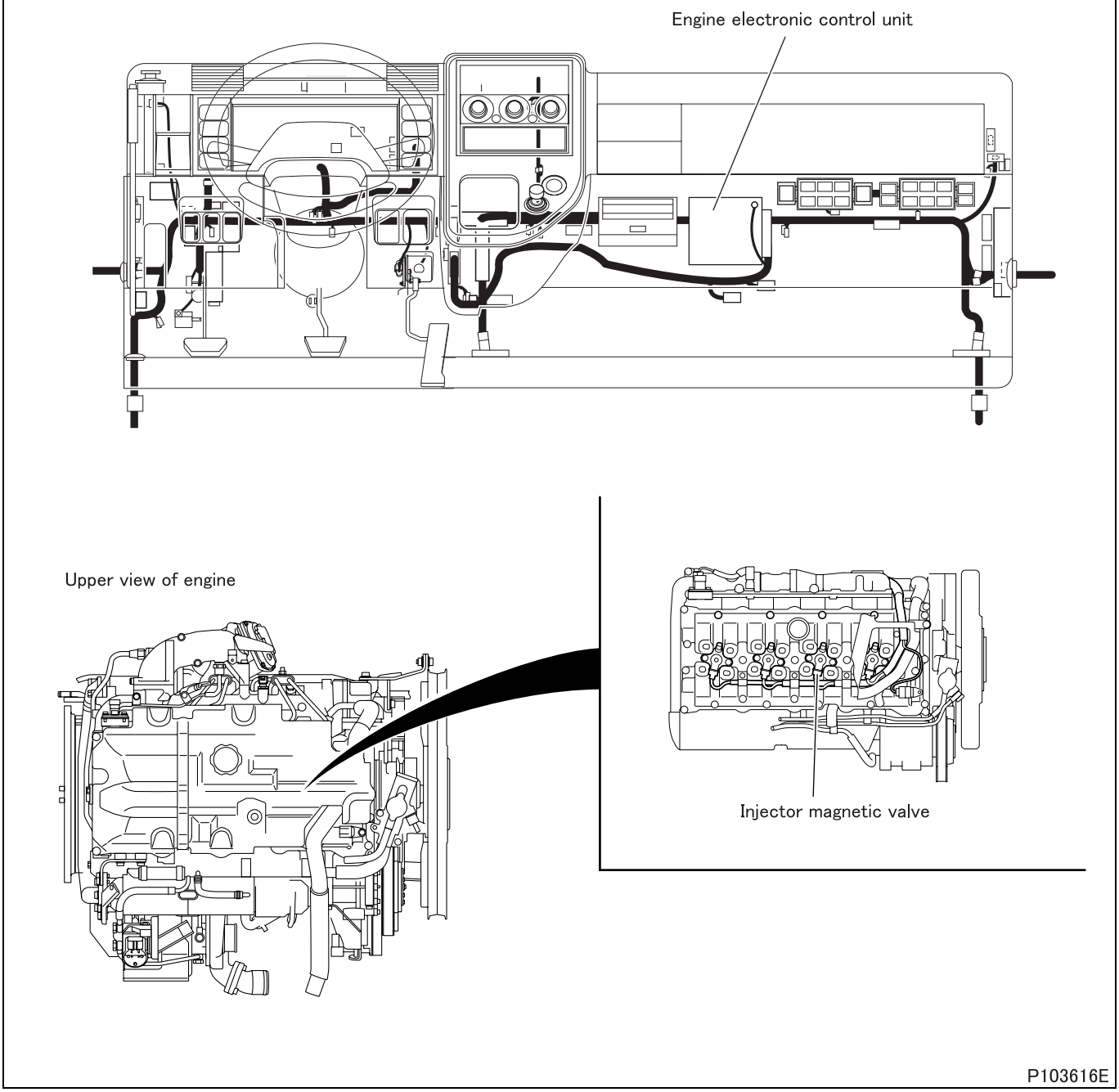
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BD “Injector Test 3”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

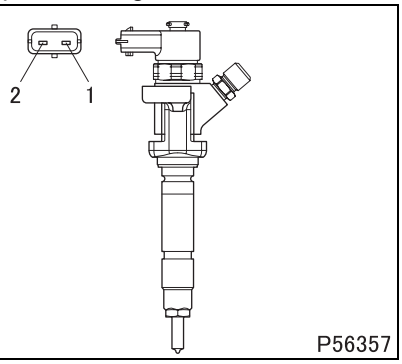
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 24 and 96.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 96.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 24.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BD “Injector Test 3”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0265/Flash code: 8
[Monitor]
Failure of injector magnetic valve (No. 2 cylinder)
[Fault (outline)]
Injector short circuit (No. 2 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 2 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 2 cylinder) circuit remains shorted to power supply as detected for 3 consecutive cycles.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

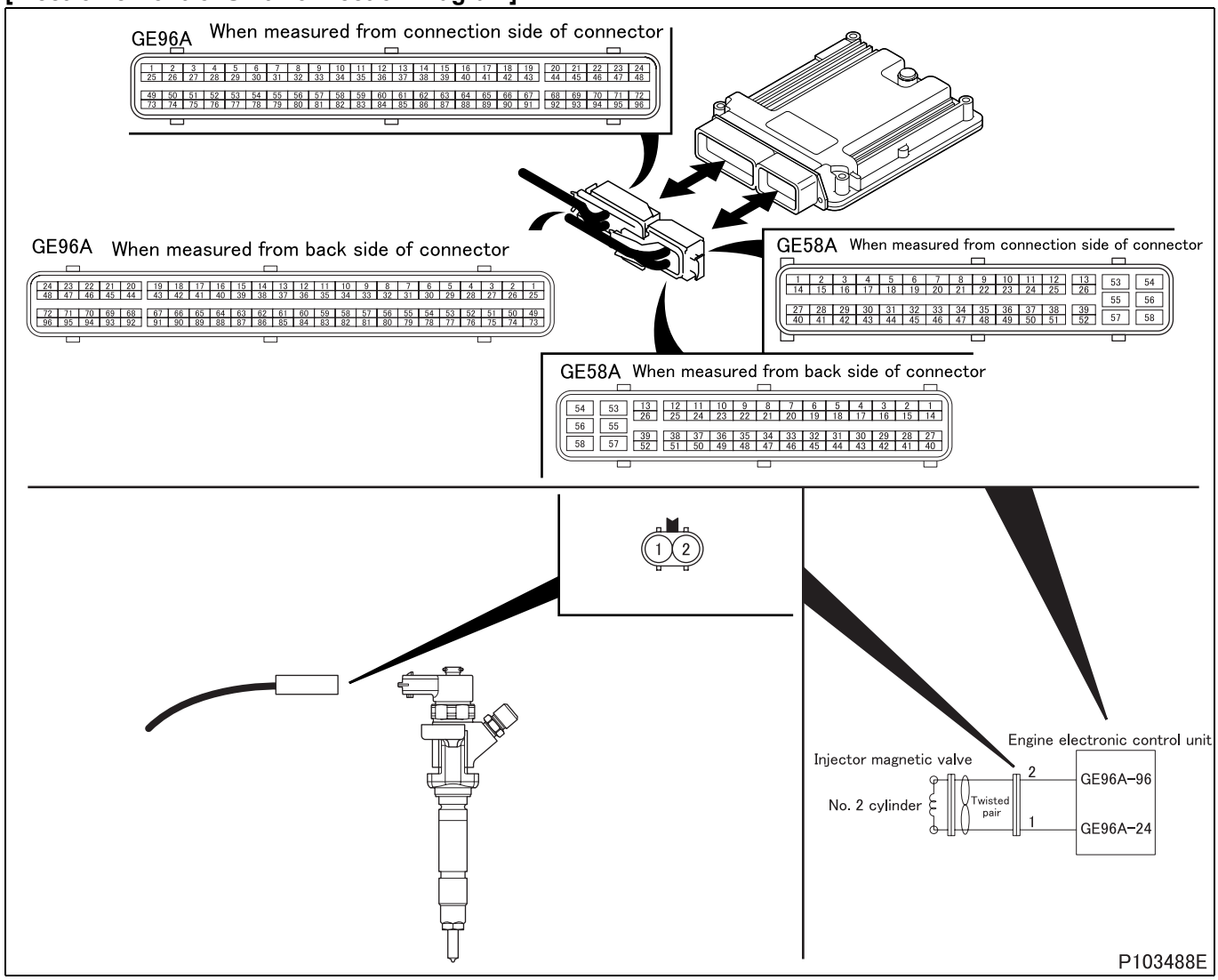
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 2 and No. 3 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

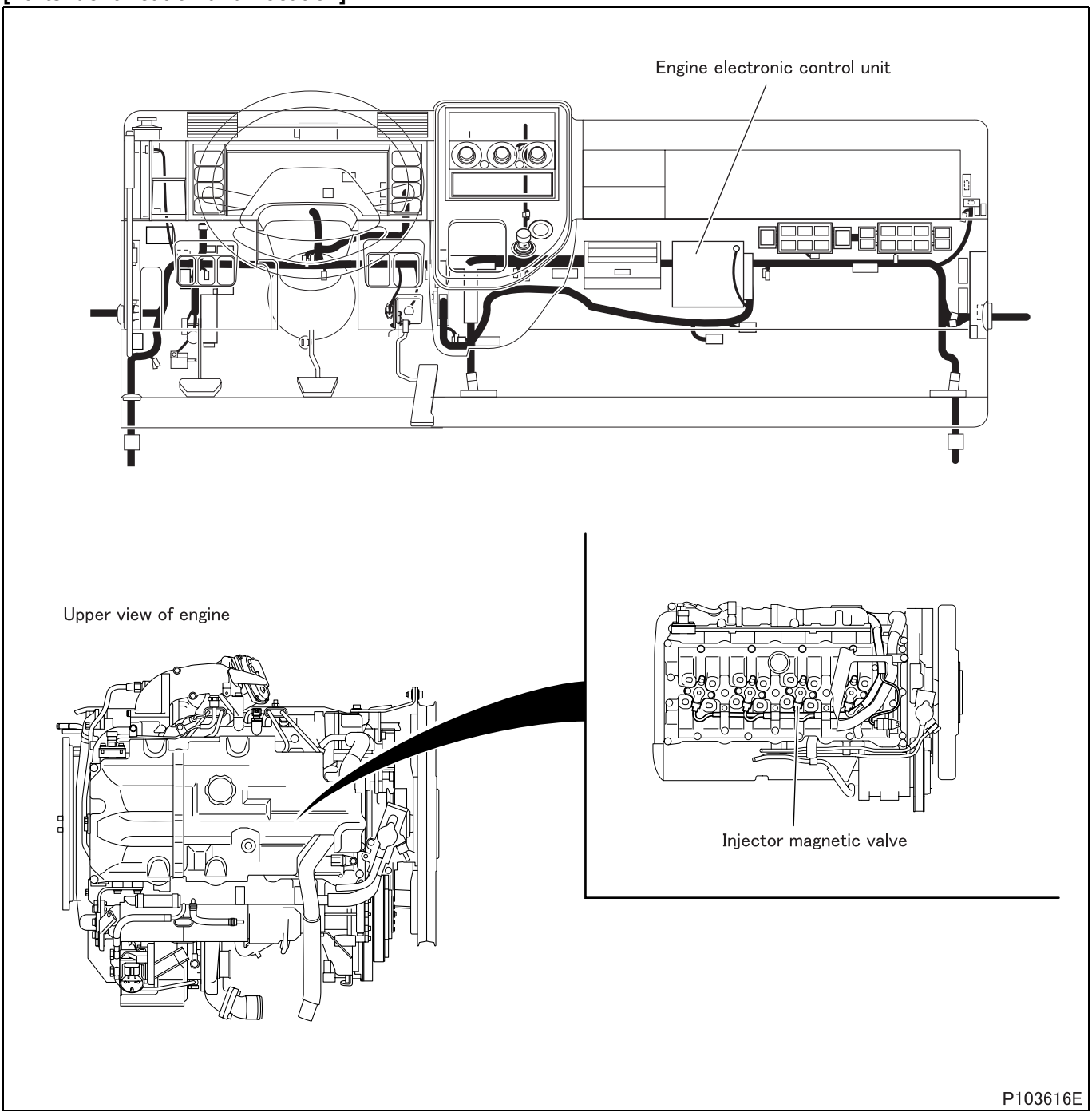
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BD “Injector Test 3”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

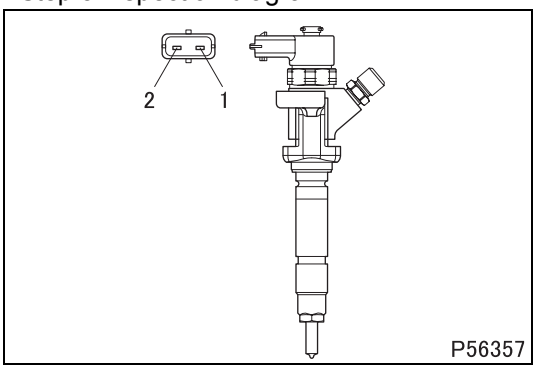
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 24 and 96.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 96.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 24.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BD “Injector Test 3”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0266/Flash code: 53
[Monitor]
Abnormality in cylinder balance correction
[Fault (outline)]
- Cylinder balancing out of range
- Sensor signal range check
- Ref voltage

[Diagnosis check]
- Check is made to determine if variation to correct in injection quantity between cylinders is excessive.

[Code generation condition]
- Corrected fuel injection quantity remains 5 mg/cycle or more for 10 consecutive seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Water temperature: above 65°C {149°F}
- PTO status: OFF
- Cylinder balance: closed loop control

<Under closed loop control>
  - Engine speed: 630 to 820 rpm
  - Fuel injection quantity: 2 to 99 mg/cyc
- Engine operating mode: normal (engine in operation)
- Time till above conditions were met: more than 10 seconds
- The fuel balancing compensation (FBC) value for a cylinder deviates by 5 mg/cyc larger than that for any other cylinders.
- Fuel Balancing Compensation (FBC) monitor: in order
- Injector ignition: in order
- Water temperature sensor: in order
- Engine speed sensor: in order
- Cylinder recognition sensor: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0261 “Injector #1-A (Low)” • P0262 “Injector #1-A (High)” • P0264 “Injector #2-A (Low)” • P0265 “Injector #2-A (High)” • P0267 “Injector #3-A (Low)” • P0268 “Injector #3-A (High)” • P0270 “Injector #4-A (Low)” • P0271 “Injector #4-A (High)”
	Inspection condition		• Starter switch: ON • Engine: started
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of injector (No. 2 cylinder)
		NO	Inspect diagnosis code that is occurring.

[Fault code]
Diagnosis code: P0267/Flash code: 38
[Monitor]
Failure of injector magnetic valve (No. 3 cylinder)
[Fault (outline)]
Injector short circuit (No. 3 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 3 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 3 cylinder) circuit remains shorted to ground as detected for 3 consecutive cycles. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

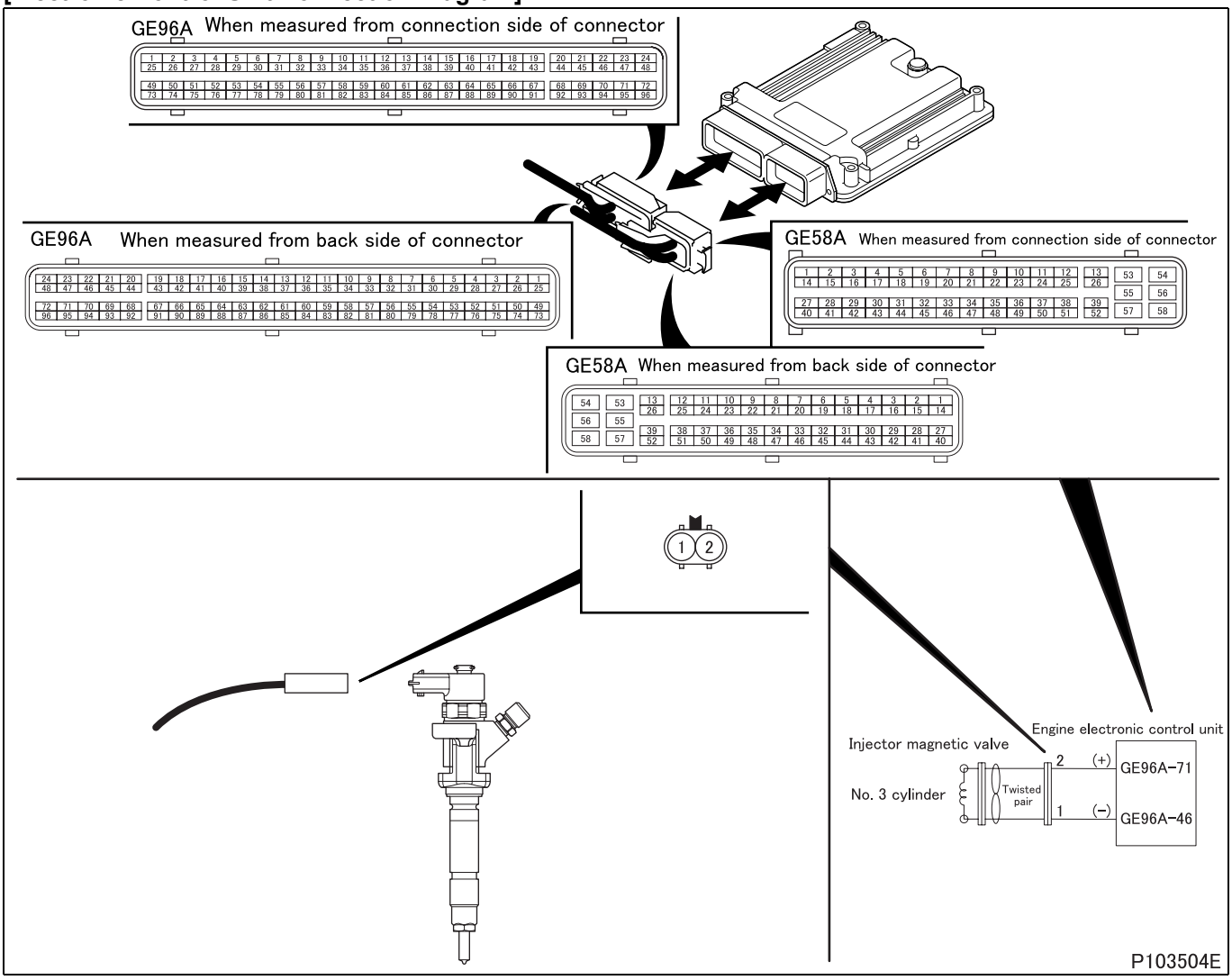
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 2 and No. 3 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

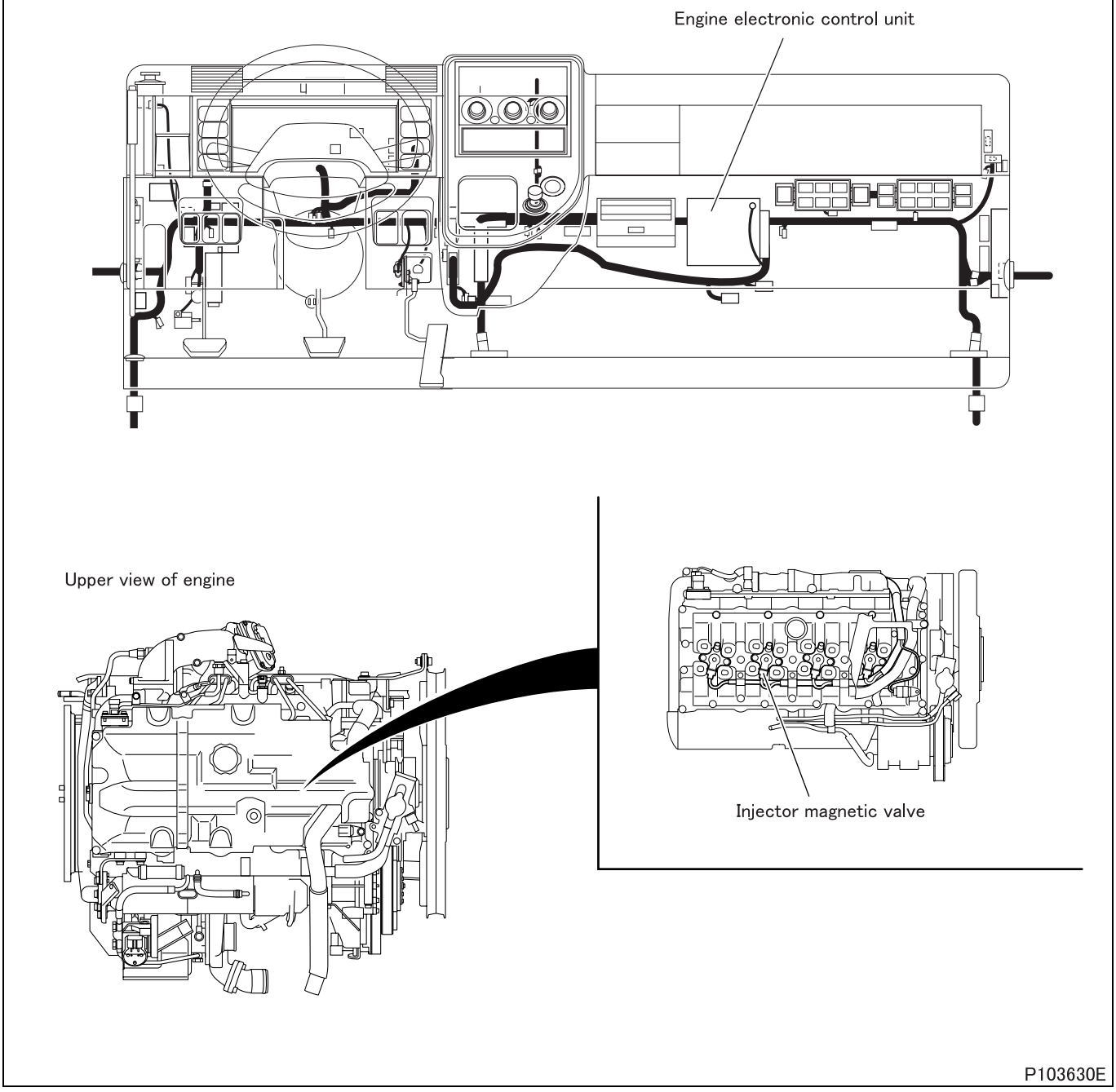
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BE “Injector Test 4”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

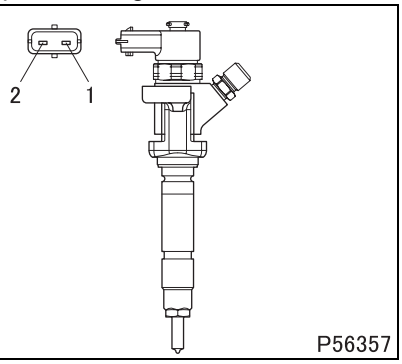
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 46 and 71.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 71.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 46.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BE “Injector Test 4”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P0268/Flash code: 38
[Monitor]
Failure of injector magnetic valve (No. 3 cylinder)
[Fault (outline)]
Injector short circuit (No. 3 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 3 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 3 cylinder) circuit remains shorted to power supply as detected for 3 consecutive cycles.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

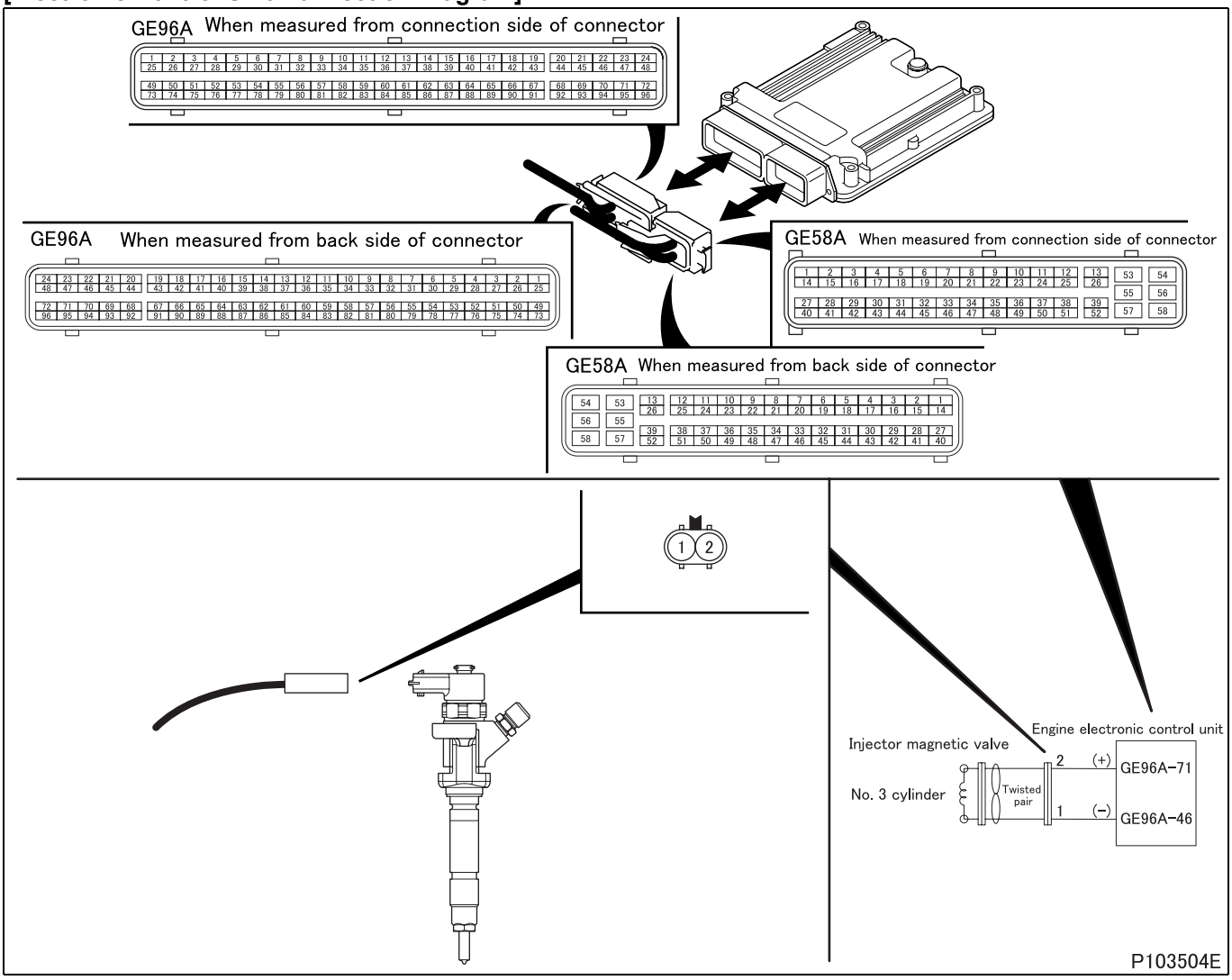
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 2 and No. 3 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

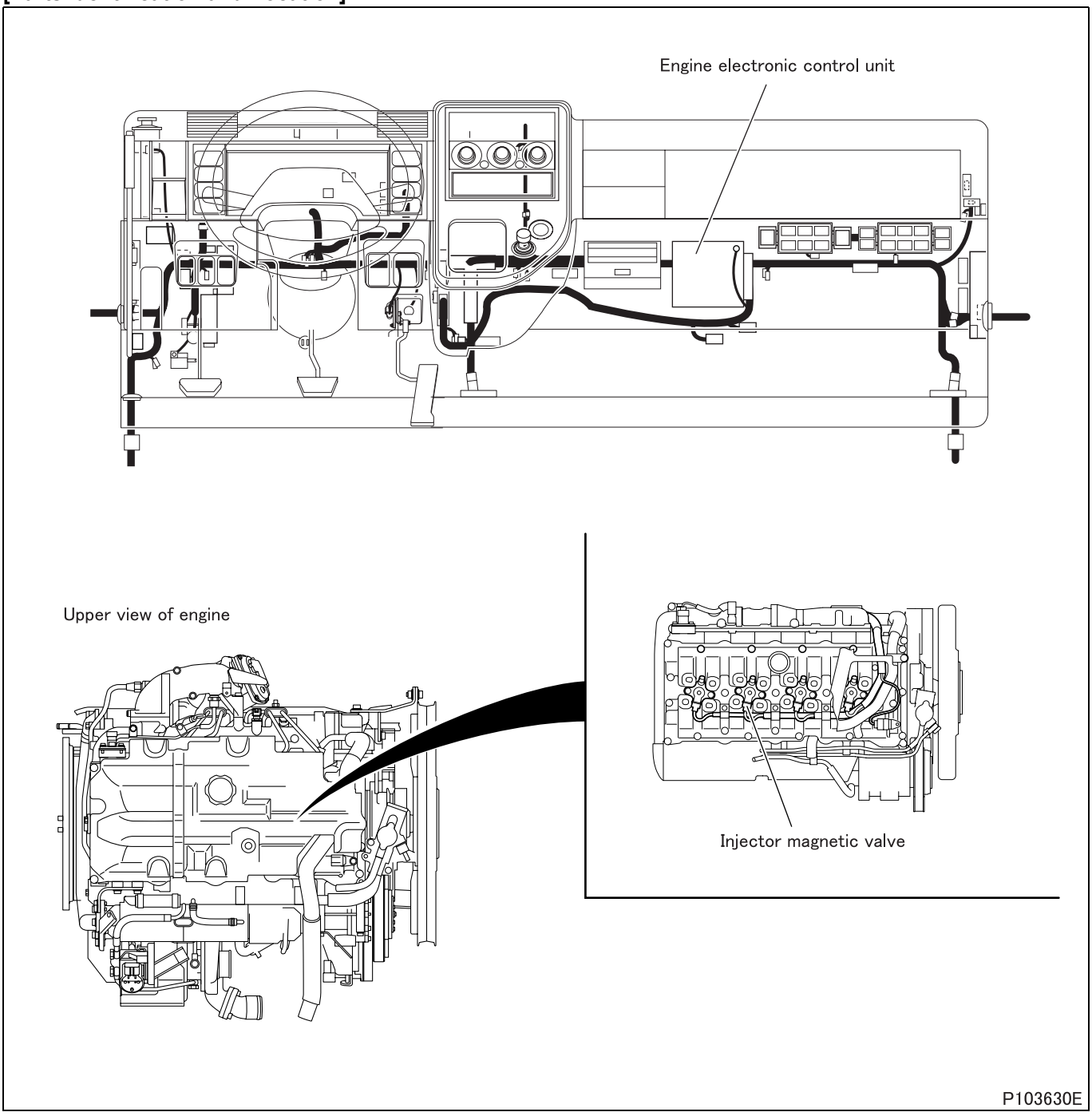
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BE “Injector Test 4”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

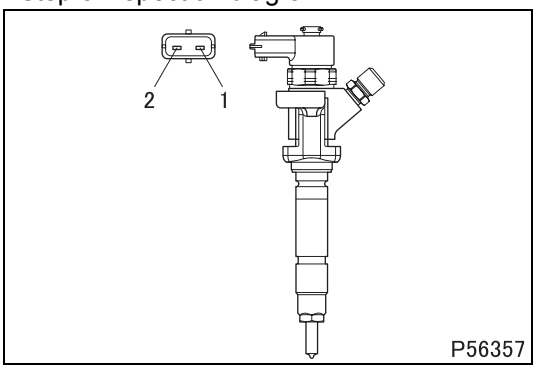
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 46 and 71.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 71.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 46.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BE “Injector Test 4”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P0269/Flash code: 53
[Monitor]
Abnormality in cylinder balance correction
[Fault (outline)]
Cylinder balancing out of range
[Diagnosis check]
- Check is made to determine if variation to correct in injection quantity between cylinders is excessive.

[Code generation condition]
- Corrected fuel injection quantity remains 5 mg/cycle or more for 10 consecutive seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Water temperature: above 65°C {149°F}
- PTO status: OFF
- Cylinder balance: closed loop control

<Under closed loop control>
  - Engine speed: 630 to 820 rpm
  - Fuel injection quantity: 2 to 99 mg/cyc

- Engine operating mode: normal (engine in operation)
- Time till above conditions were met: more than 10 seconds
- The fuel balancing compensation (FBC) value for a cylinder deviates by 5 mg/cyc larger than that for any other cylinders.
- Fuel Balancing Compensation (FBC) monitor: in order
- Injector ignition: in order
- Water temperature sensor: in order
- Engine speed sensor: in order
- Cylinder recognition sensor: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0261 “Injector #1-A (Low)” • P0262 “Injector #1-A (High)” • P0264 “Injector #2-A (Low)” • P0265 “Injector #2-A (High)” • P0267 “Injector #3-A (Low)” • P0268 “Injector #3-A (High)” • P0270 “Injector #4-A (Low)” • P0271 “Injector #4-A (High)”
	Inspection condition		• Starter switch: ON • Engine: started
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of injector (No. 3 cylinder)
		NO	Inspect diagnosis code that is occurring.

[Fault code]
Diagnosis code: P0270/Flash code: 39
[Monitor]
Failure of injector magnetic valve (No. 4 cylinder)
[Fault (outline)]
Injector short circuit (No. 4 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 4 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 4 cylinder) circuit remains shorted to ground as detected for 3 consecutive cycles. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

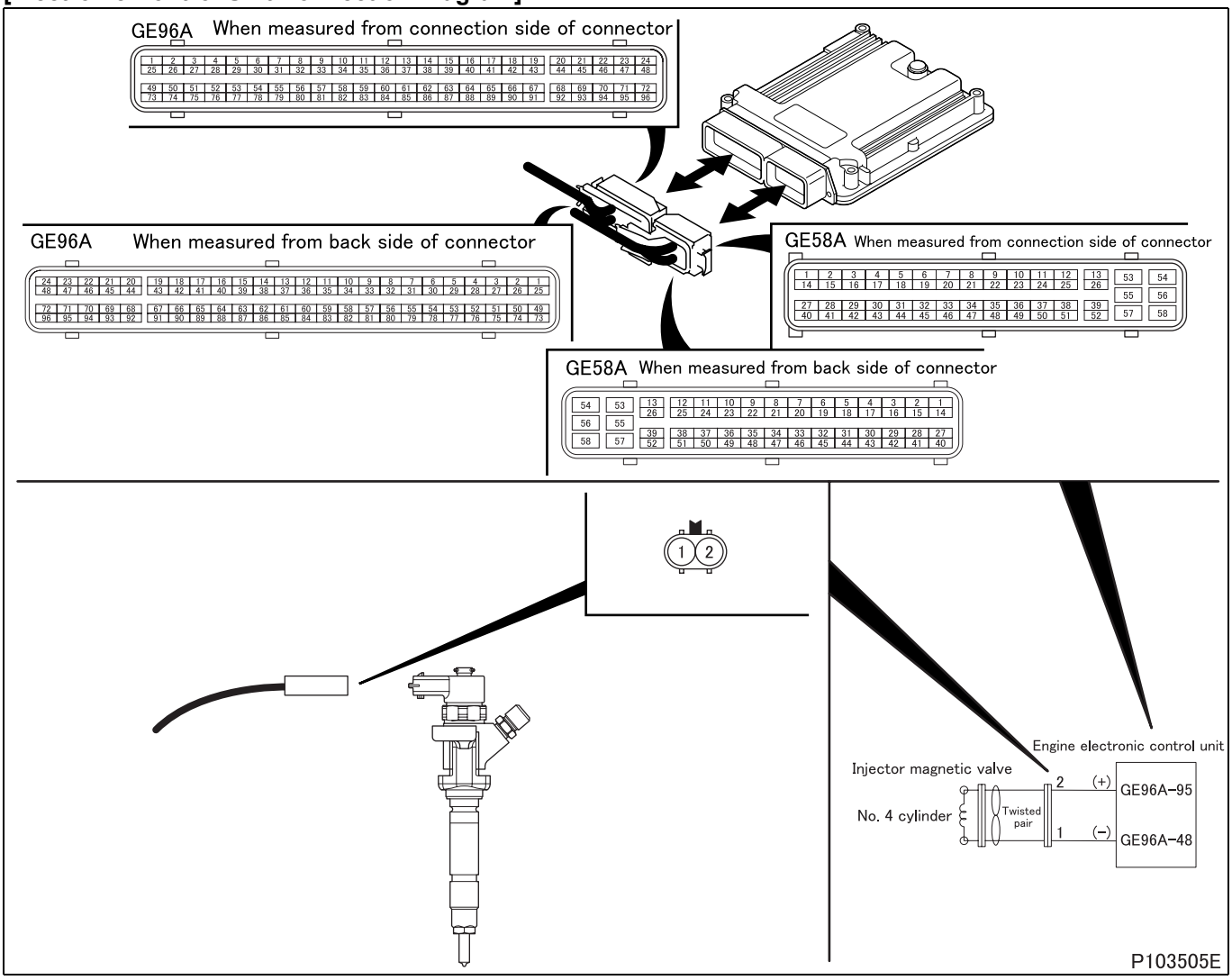
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 1 and No. 4 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

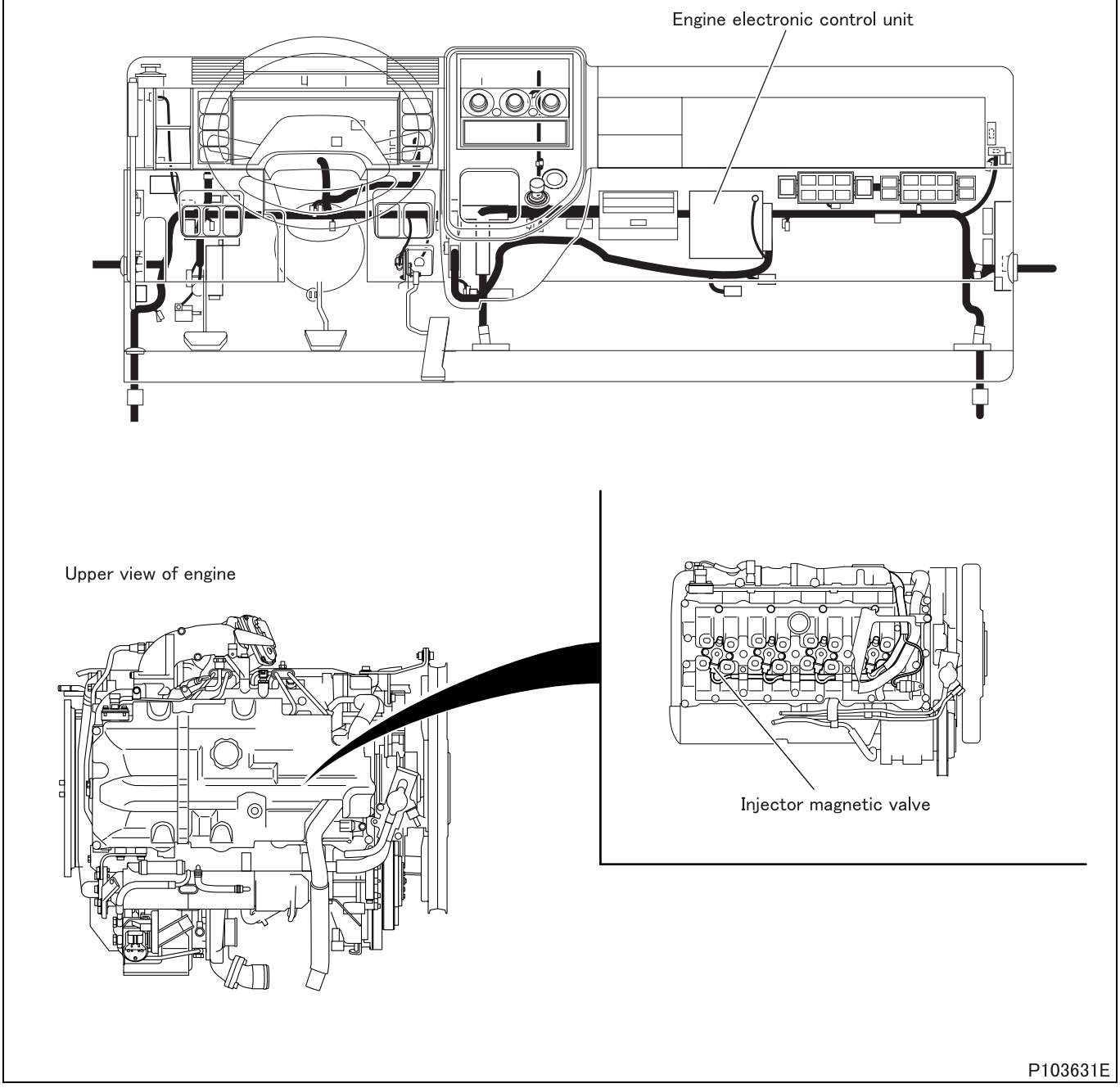
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BC “Injector Test 2”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

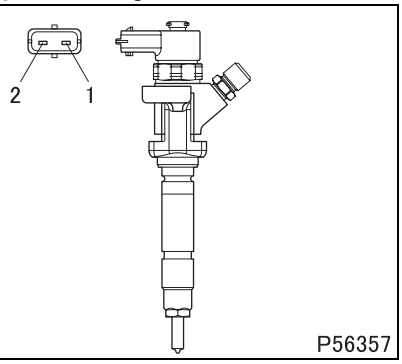
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 48 and 95.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 95.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 48.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BC “Injector Test 2”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0271/Flash code: 39
[Monitor]
Failure of injector magnetic valve (No. 4 cylinder)
[Fault (outline)]
Injector short circuit (No. 4 cylinder)
[Diagnosis check]
- Injector magnetic valve (No. 4 cylinder) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 4 cylinder) circuit remains shorted to power supply as detected for 3 consecutive cycles.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

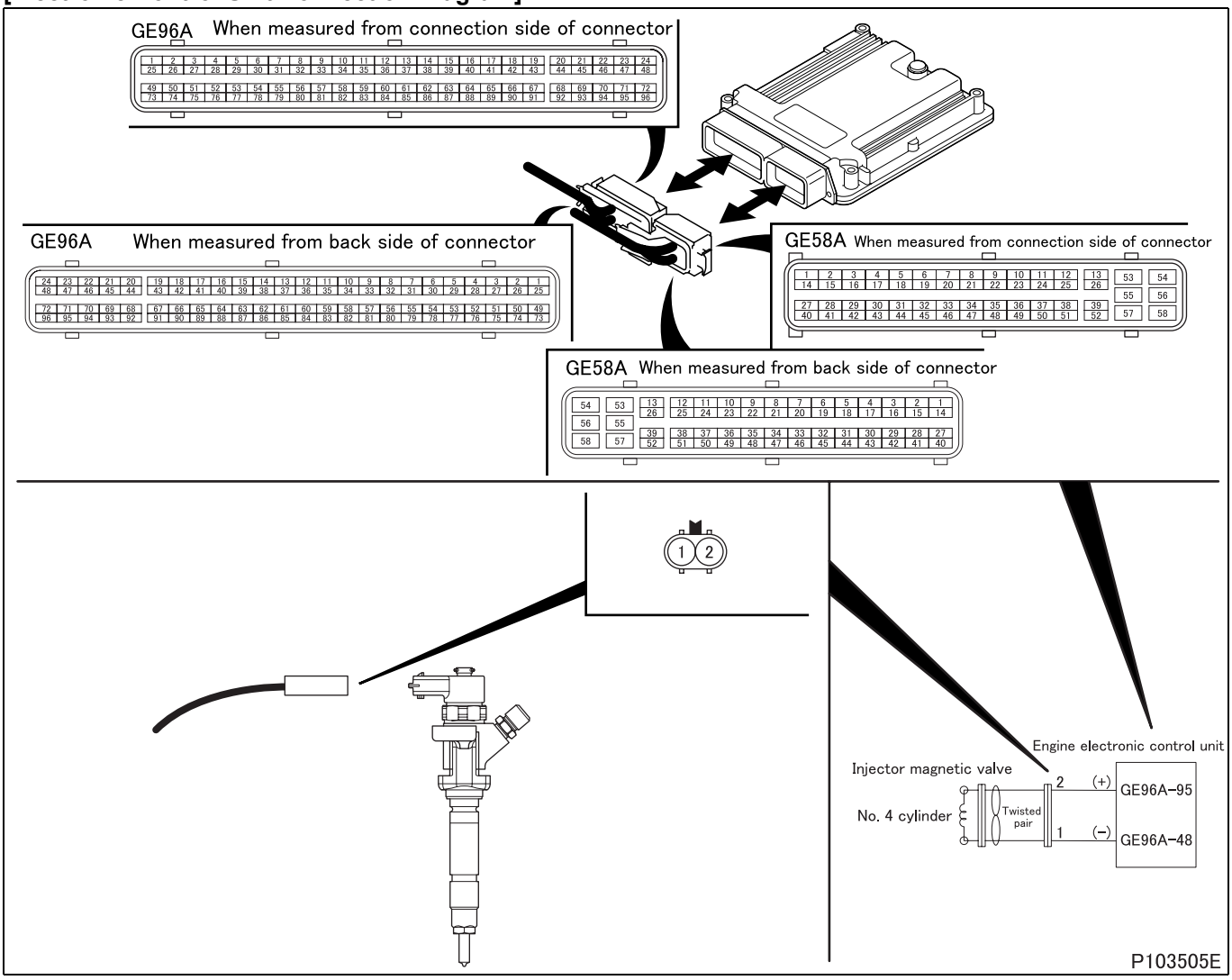
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 1 and No. 4 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

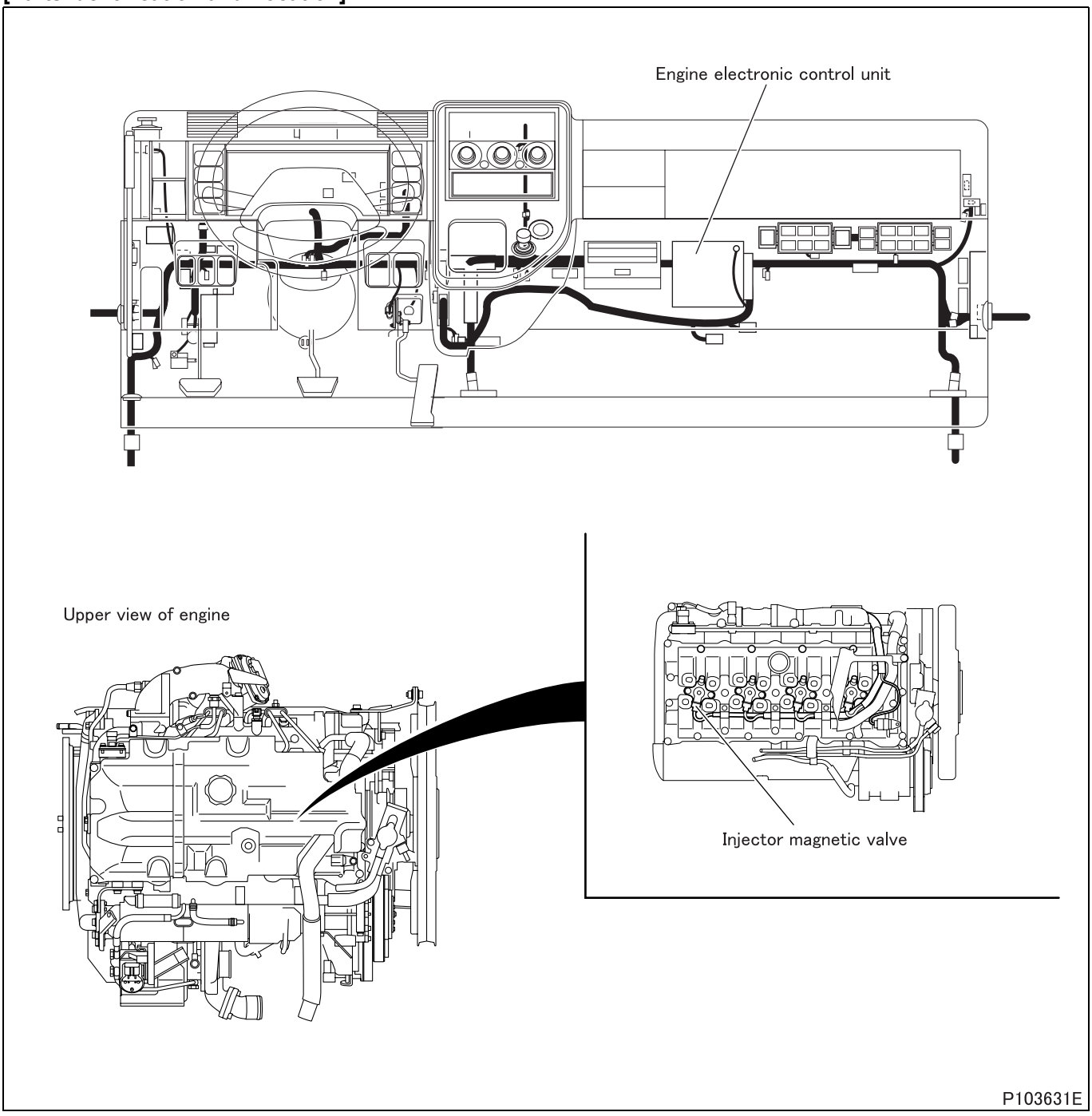
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BC “Injector Test 2”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

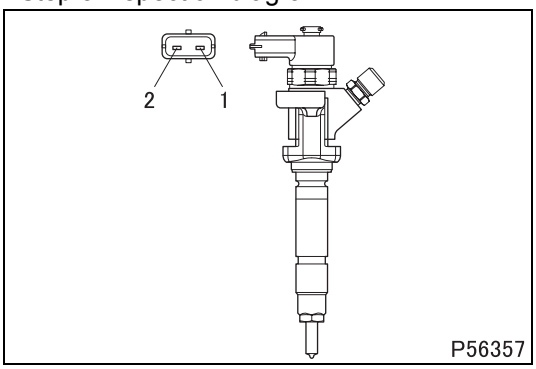
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 48 and 95.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 95.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between injector magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 48.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. BC “Injector Test 2”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0272/Flash code: 53
[Monitor]
Abnormality in cylinder balance correction
[Fault (outline)]
Cylinder balancing out of range
[Diagnosis check]
- Check is made to determine if variation to correct in injection quantity between cylinders is excessive.

[Code generation condition]
- Corrected fuel injection quantity remains 5 mg/cycle or more for 10 consecutive seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Water temperature: above 65°C {149°F}
- PTO status: OFF
- Cylinder balance: closed loop control

<Under closed loop control>
  - Engine speed: 630 to 820 rpm
  - Fuel injection quantity: 2 to 99 mg/cyc

- Engine operating mode: normal (engine in operation)
- Time till above conditions were met: more than 10 seconds
- The fuel balancing compensation (FBC) value for a cylinder deviates by 5 mg/cyc larger than that for any other cylinders.
- Fuel Balancing Compensation (FBC) monitor: in order
- Injector ignition: in order
- Water temperature sensor: in order
- Engine speed sensor: in order
- Cylinder recognition sensor: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0261 “Injector #1-A (Low)” • P0262 “Injector #1-A (High)” • P0264 “Injector #2-A (Low)” • P0265 “Injector #2-A (High)” • P0267 “Injector #3-A (Low)” • P0268 “Injector #3-A (High)” • P0270 “Injector #4-A (Low)” • P0271 “Injector #4-A (High)”
	Inspection condition		• Starter switch: ON • Engine: started
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of injector (No. 4 cylinder)
		NO	Inspect diagnosis code that is occurring.

[Fault code]
Diagnosis code: P0299/Flash code: 32
[Monitor]
Underboost
[Fault (outline)]
Underboost
[Diagnosis check]
- Actual boost pressure is detected by boost pressure sensor and compared with standard pressure recorded in engine electronic control unit.

[Code generation condition]
- Difference between target boost pressure and actual boost pressure remains less than specified for 10 seconds (underboost status)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine operating mode: normal (engine in operation)
- Water temperature: 65 to 120°C {149 to 248°F}
- Atmospheric pressure: 828 to 1100 mbar {12 to 15.95 psi}
- Intake air temperature: –7 to 60°C {19 to 140°F}
- Engine speed: 600 to 3000 rpm
- Variation in engine speed: less than 300 rpm/s
- Diesel particulate filter regeneration control: not effected
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Exhaust shutter: in order
- Exhaust gas recirculation cooler: in order
- Starter switch circuit: in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Related fault check is stopped.

[Probable cause of trouble]
- Boost pressure incorrectly adjusted
- Mechanical failure of turbocharger unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Acutuator (Open)” • P0046 “VGT Acutuator (Performance)” • P0047 “VGT Acutuator (Low)” • P0069 “Boost Press SNSR (Correlation)” • P0237 “Boost Press SNSR (Low)” • P0238 “Boost Press SNSR (High)” • P0401 “EGR Flow (Insufficient)” • P0402 “EGR Flow (Excessive)” • P0403 “EGR1 (Acutuator Circuit)” • P0409 “EGR1 (Position Sensor)” • P0562 “Power Supply Voltage (Low)” • P0563 “Power Supply Voltage (High)” • P0600 “CAN Communication” • P0607 “ECU System” • P060B “A/D Converter” • P061B “ECU Performance (Calc)” • P061C “ECU Performance (Ne)” • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)” • P2002 “DPF MFF” • P2228 “Atm Press SNSR (Low)” • P2229 “Atm Press SNSR (High)” • P2263 “VGT System” • P2413 “EGR System” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF” • P2457 “EGR Cooler Performance”
	Inspection condition		• Starter switch: ON • Do not start engine.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 2.

Step 2	Inspection items		Check of exhaust system
	Maintenance item		Front pipe, diesel particulate filter, tail pipe (See Gr15.)
	Inspection condition		Starter switch: OFF
	Requirements		Blocked
	Inspection result (Is the judging standard satisfied?)	YES	Clean or replace parts.
		NO	Go to step 3.

Step 3	Inspection items		Check of turbocharger appearance
	Maintenance item		Appearance of turbocharger (See Gr15.)
	Inspection condition		Starter switch: OFF
	Requirements		Turbine vane binds.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of turbocharger
		NO	Go to step 4.

Step 4	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake MAP”. **<Multi-Use Tester used>** • Measure item No. 21 “Boost Pressure” of Service Data.
	Inspection condition		For boost pressure measurement and correction data calculation, see Gr15.
	Requirements		Coincides with atmospheric pressure → Gradually increases
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of turbocharger

[Fault code]
Diagnosis code: P0300/Flash code: 45
[Monitor]
Cylinder misfire (multiple cylinders)
[Fault (outline)]
Misfire multiple cylinders
[Diagnosis check]
- Misfire is detected at two or more cylinders

[Code generation condition]
- Misfire in one cylinder is detected after another.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Misfire in one cylinder

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector
- Malfunction of electronic control unit
- Malfunction of fuel
- Malfunction of engine compression pressure

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0301/Flash code: 45
[Monitor]
Cylinder misfire (individual cylinders)
[Fault (outline)]
Misfire individual cylinder 1
[Diagnosis check]
- Misfire at No. 1 cylinder is detected.

[Code generation condition]
- Misfire has been detected for a total of 250 times.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine speed: 600 to 900 rpm
- Fuel injection quantity: 3 to 25 mg/cyc
- Water temperature: above 64°C {147°F}
- Vehicle speed: less than 2 km/h {1.24 MPH}
- Engine operating mode: normal (engine in operation)
- PTO status: OFF
- Water temperature sensor: in order
- Engine speed sensor: in order
- Cylinder recognition sensor: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Vehicle speed sensor: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector
- Malfunction of electronic control unit
- Malfunction of fuel
- Malfunction of engine compression pressure

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0302/Flash code: 45
[Monitor]
Cylinder misfire (individual cylinders)
[Fault (outline)]
Misfire individual cylinder 2
[Diagnosis check]
- Misfire at No. 2 cylinder is detected.

[Code generation condition]
- Misfire has been detected for a total of 250 times. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine speed: 600 to 900 rpm
- Fuel injection quantity: 3 to 25 mg/cyc
- Water temperature: above 64°C {147°F}
- Vehicle speed: less than 2 km/h {1.24 MPH}
- Engine operating mode: normal (engine in operation)
- PTO status: OFF
- Water temperature sensor: in order
- Engine speed sensor: in order
- Cylinder recognition sensor: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Vehicle speed sensor: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector
- Malfunction of electronic control unit
- Malfunction of fuel
- Malfunction of engine compression pressure

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0303/Flash code: 45
[Monitor]
Cylinder misfire (individual cylinders)
[Fault (outline)]
Misfire individual cylinder 3
[Diagnosis check]
- Misfire at No. 3 cylinder is detected.

[Code generation condition]
- Misfire has been detected for a total of 250 times. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine speed: 600 to 900 rpm
- Fuel injection quantity: 3 to 25 mg/cyc
- Water temperature: above 64°C {147°F}
- Vehicle speed: less than 2 km/h {1.24 MPH}
- Engine operating mode: normal (engine in operation)
- PTO status: OFF
- Water temperature sensor: in order
- Engine speed sensor: in order
- Cylinder recognition sensor: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Vehicle speed sensor: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector
- Malfunction of electronic control unit
- Malfunction of fuel
- Malfunction of engine compression pressure

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0304/Flash code: 45
[Monitor]
Cylinder misfire (individual cylinders)
[Fault (outline)]
Misfire individual cylinder 4
[Diagnosis check]
- Misfire at No. 4 cylinder is detected.

[Code generation condition]
- Misfire has been detected for a total of 250 times. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine speed: 600 to 900 rpm
- Fuel injection quantity: 3 to 25 mg/cyc
- Water temperature: above 64°C {147°F}
- Vehicle speed: less than 2 km/h {1.24 MPH}
- Engine operating mode: normal (engine in operation)
- PTO status: OFF
- Water temperature sensor: in order
- Engine speed sensor: in order
- Cylinder recognition sensor: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Vehicle speed sensor: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector
- Malfunction of electronic control unit
- Malfunction of fuel
- Malfunction of engine compression pressure

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0335/Flash code: 15
[Monitor]
Failure of engine speed sensor
[Fault (outline)]
No pulse check
[Diagnosis check]
- Engine speed sensor output signal during engine operation is monitored.

[Code generation condition]
- No signal is received from engine speed sensor during engine operation.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

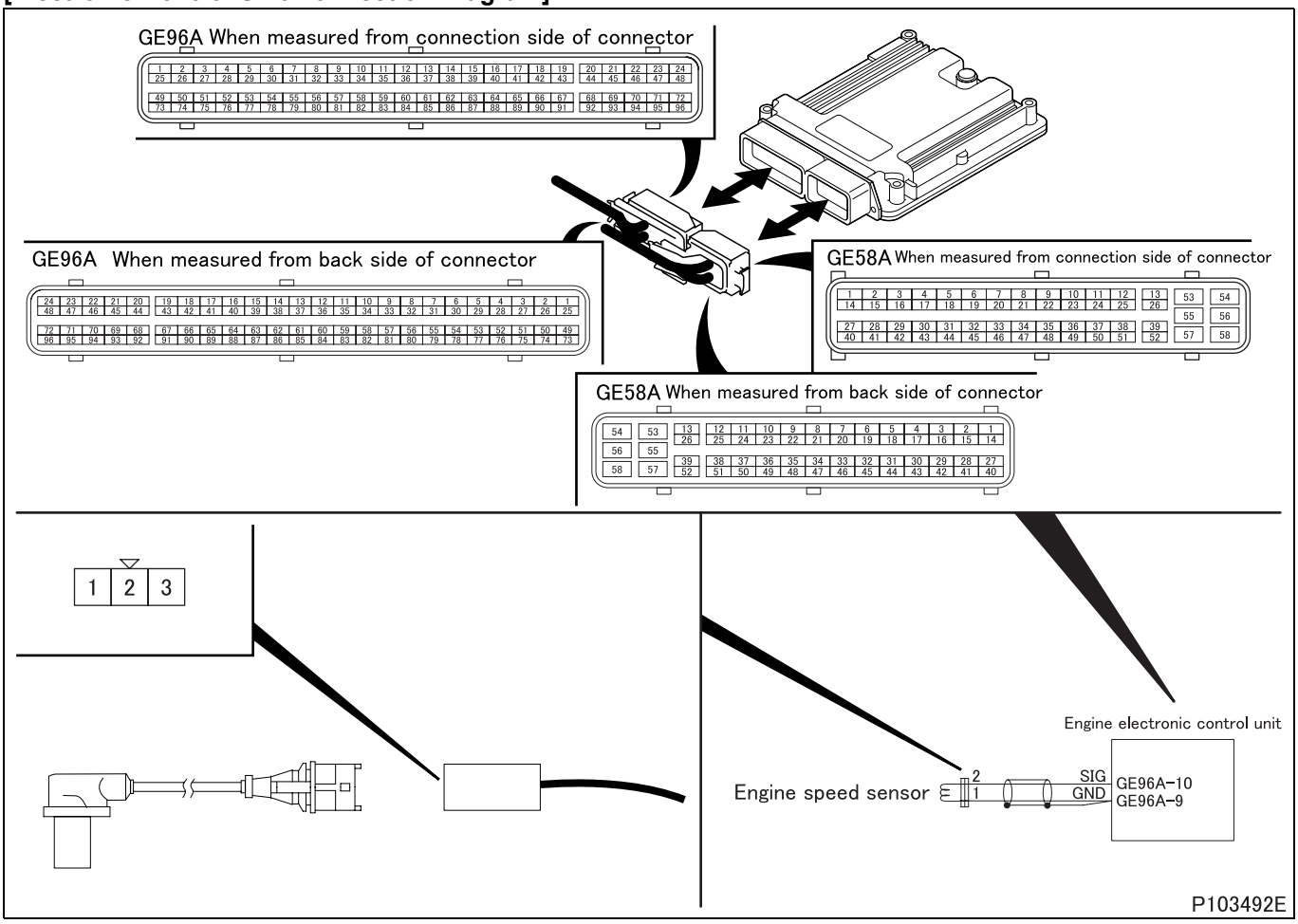
[Diagnostic requirement]
- Engine operating mode: normal (engine in operation)

[Control effected by electronic control unit during fault]
- Control is effected using cylinder recognition sensor only.
- Misfire detection is stopped.
- Engine torque is limited.
- Auto cruise control stopped
- Related fault check is stopped.

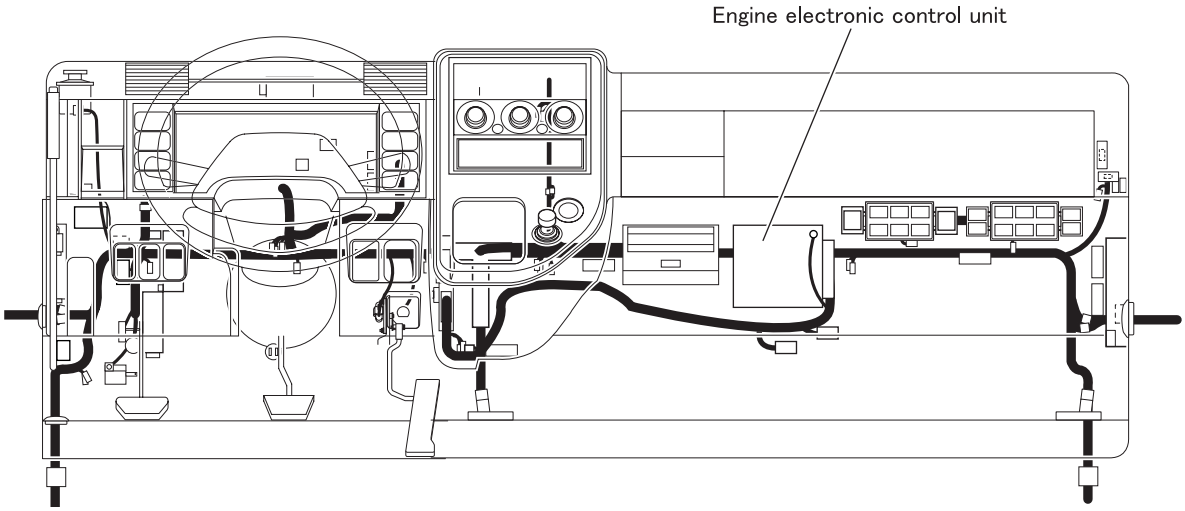
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and engine speed sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

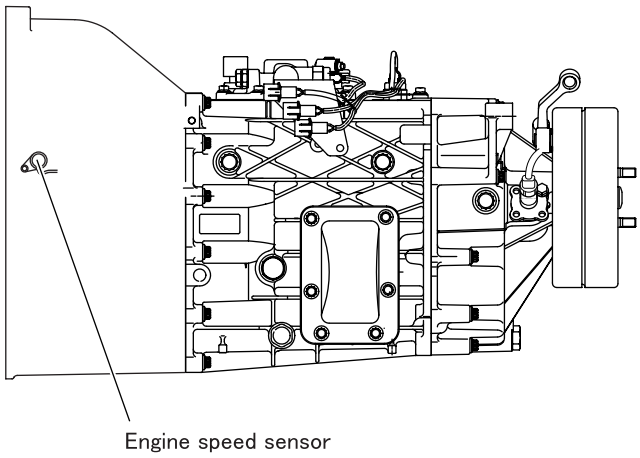
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Left side view of transmission



P103620E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Ne” . **<Multi-Use Tester used>** • Measure item No. 01 “Engine Revolution” of Service Data.
	Inspection condition		–
	Requirements		Same indication as tachometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

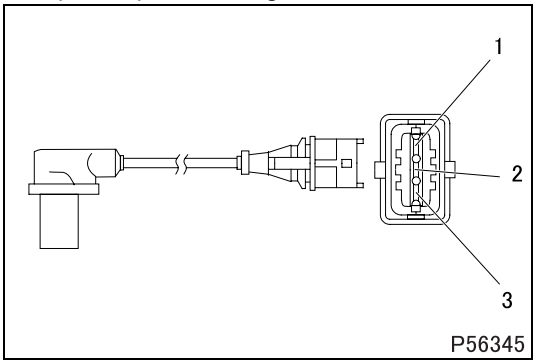
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 9 and 10.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		860 ± 86 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of engine speed sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of engine speed sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		860 ± 86 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 10.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 9.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Ne”. **<Multi-Use Tester used>** • Measure item No. 01 “Engine Revolution” of Service Data.
	Inspection condition		–
	Requirements		Same indication as tachometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0339/Flash code: 15
[Monitor]
Failure of engine speed sensor
[Fault (outline)]
Abnormality of pulse count
[Diagnosis check]
- Output pulses from engine speed sensor during engine operation are counted on basis of output signal from normal cylinder recognition sensor.

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Condition (1)>
- Engine speed output from engine speed sensor remains over 6000 rpm for 10 seconds.
  (Warning lamp (red) is lit and diagnosis code is displayed on first establishment of code generation condition.)

<Condition (2)>
- Engine speed remains below 300 rpm for 6 seconds during backup.
  (Warning lamp (orange) is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine operating mode: starting
- Engine speed: more than 500 rpm
- Engine speed: less than 400 rpm

[Control effected by electronic control unit during fault]
Electronic control unit varies in the way of control by the color of warning lamp.
<Warning lamp: Orange>
- Effects no special control.

<Warning lamp: Red>
- Control is effected using cylinder recognition sensor only.
- Misfire detection is stopped.
- Engine torque is limited.
- Auto cruise control stopped
- Related fault check is stopped.

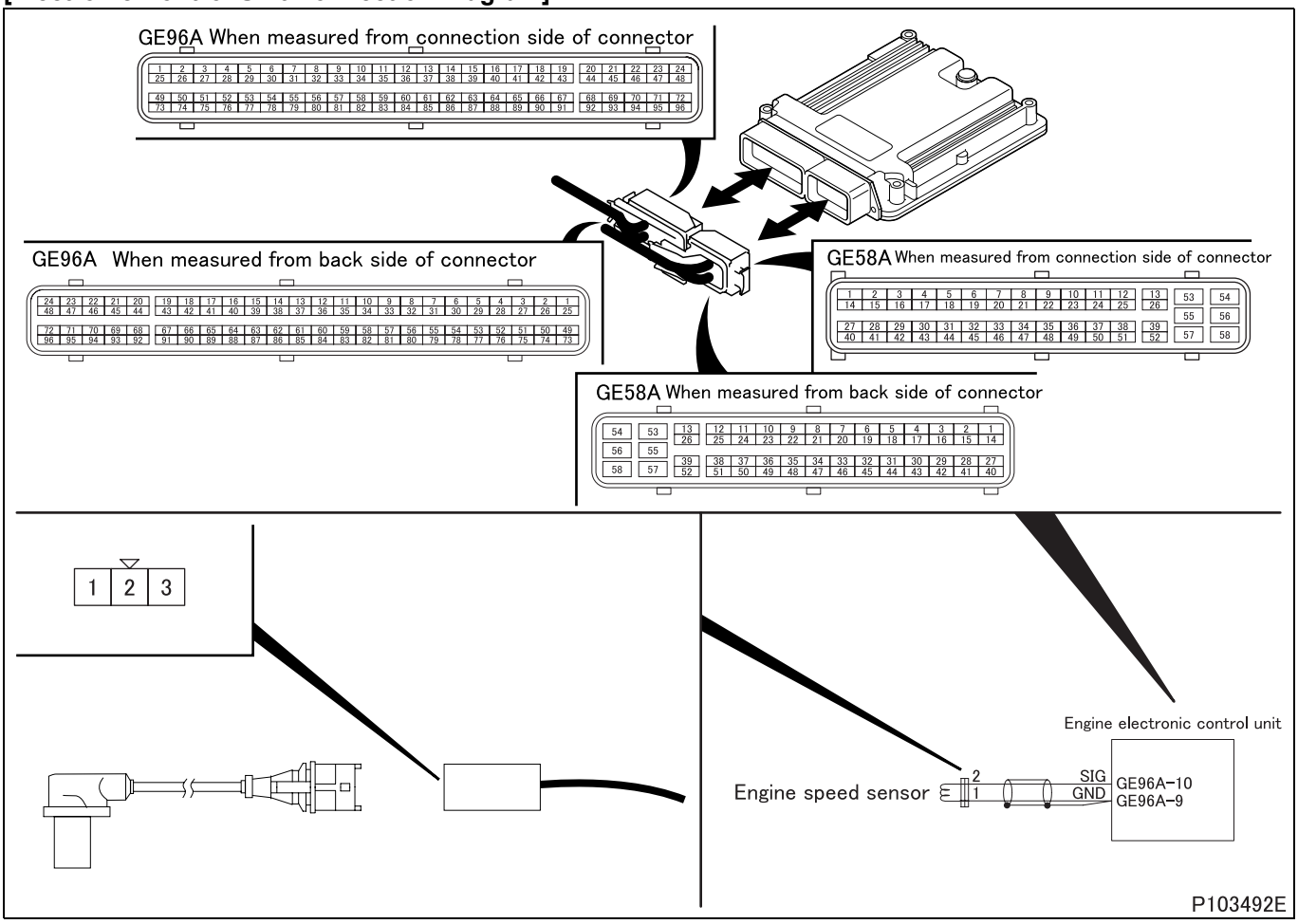
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and engine speed sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

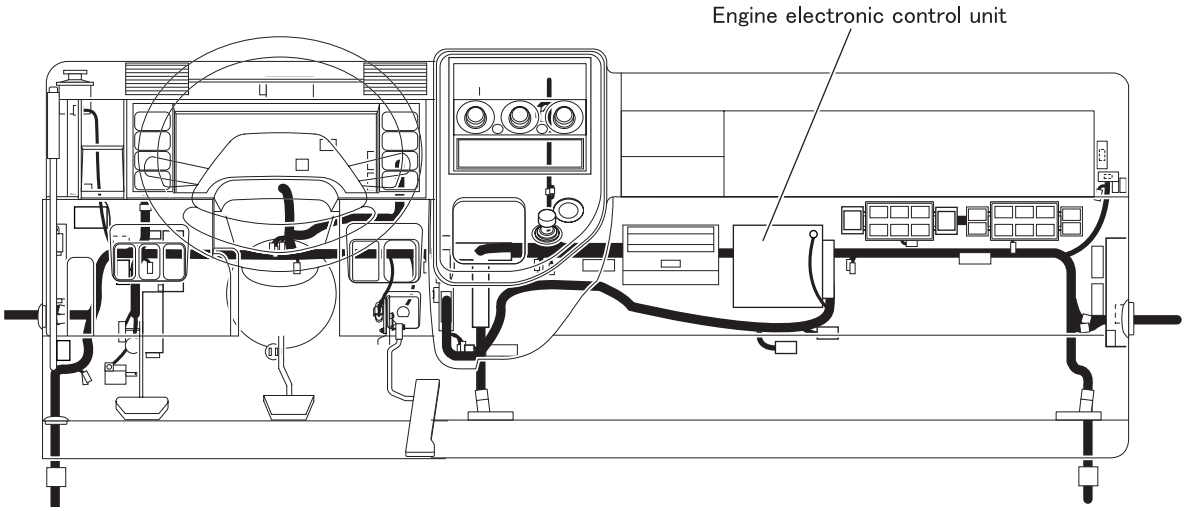
<Condition (1)>
- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

<Condition (2)>
- Lamp is extinguished and code is cleared simultaneously with recovery.

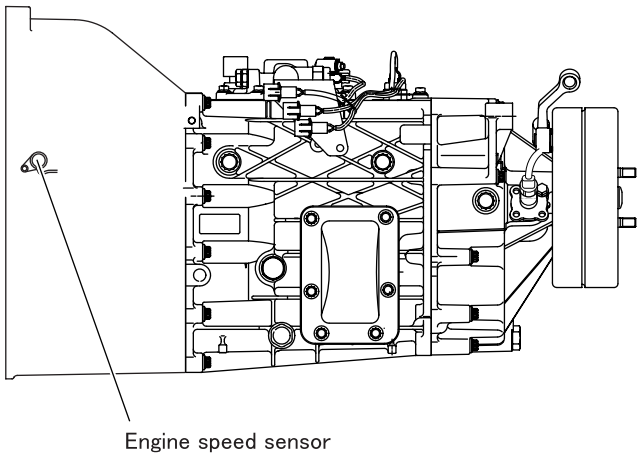
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Left side view of transmission



P103620E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Ne”. **<Multi-Use Tester used>** • Measure item No. 01 “Engine Revolution” of Service Data.
	Inspection condition		–
	Requirements		Same indication as tachometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

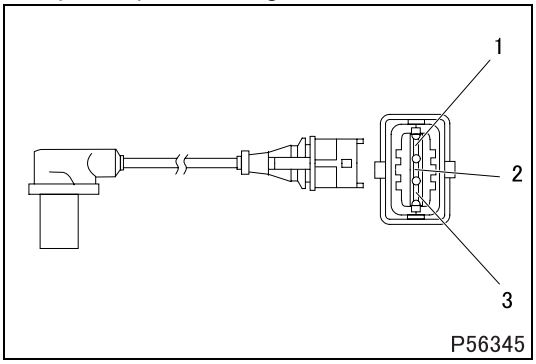
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 9 and 10.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		860 ± 86 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of engine speed sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of engine speed sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		860 ± 86 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 10.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 9.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Ne”. **<Multi-Use Tester used>** • Measure item No. 01 “Engine Revolution” of Service Data.
	Inspection condition		–
	Requirements		Same indication as tachometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0340/Flash code: 12
[Monitor]
Failure of cylinder recognition sensor
[Fault (outline)]
No pulse check
[Diagnosis check]
- Output pulses from engine speed sensor are counted to check pulse output from cylinder recognition sensor during engine operation.

[Code generation condition]
- No pulse is output from cylinder recognition sensor despite more than 132 pulses from engine speed sensor at engine start. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

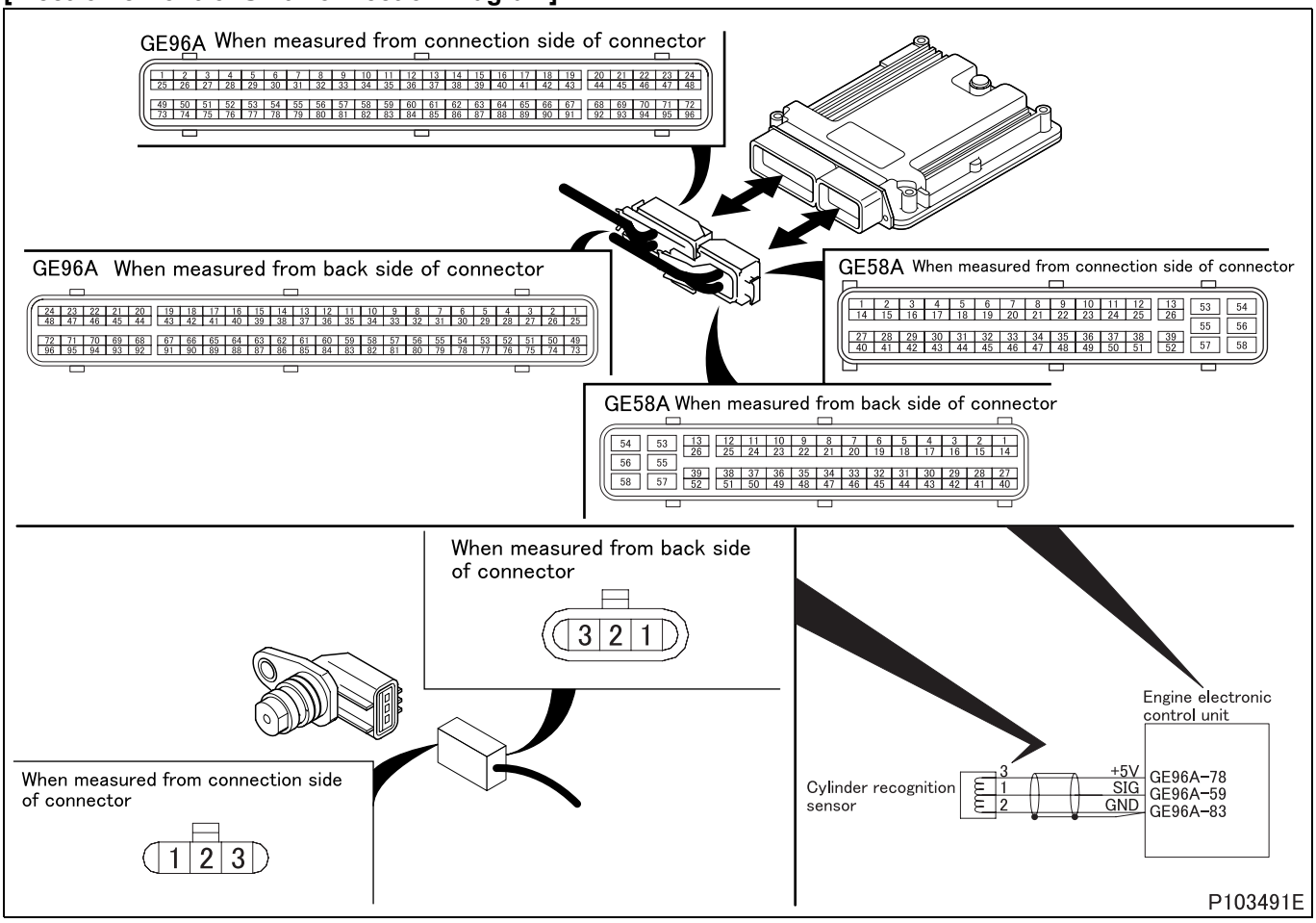
[Diagnostic requirement]
- Starter switch: ON
- Engine speed: more than 20 rpm

[Control effected by electronic control unit during fault]
- Control is effected with engine speed sensor only.
- Misfire detection is stopped.
- Auto cruise control stopped
- Related fault check is stopped.

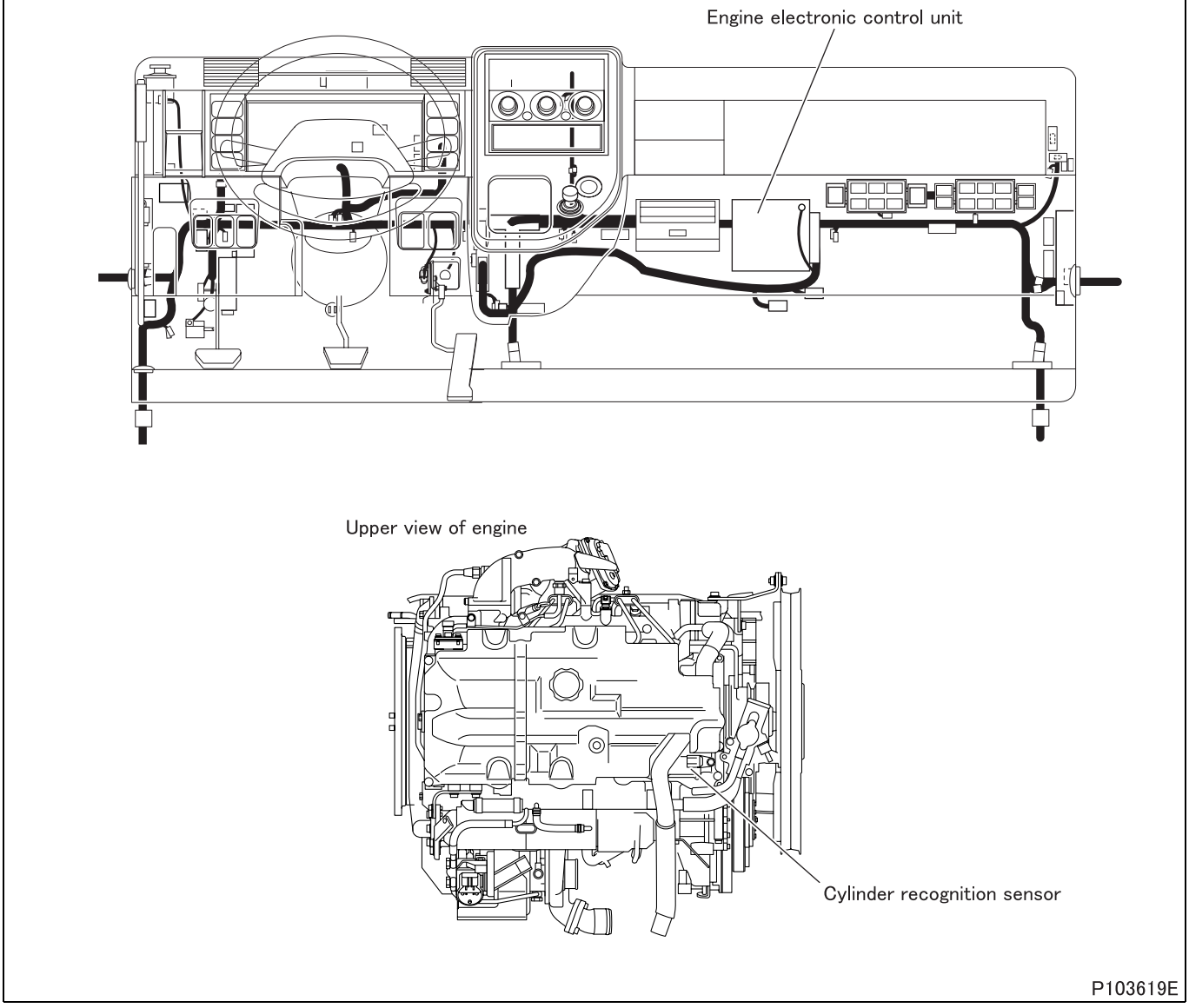
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and engine speed sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Ne”. **<Multi-Use Tester used>** • Measure item No. 01 “Engine Revolution” of Service Data.
	Inspection condition		–
	Requirements		Same indication as tachometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 59 (+) and 83 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		1 V or more
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 78 (+) and 83 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

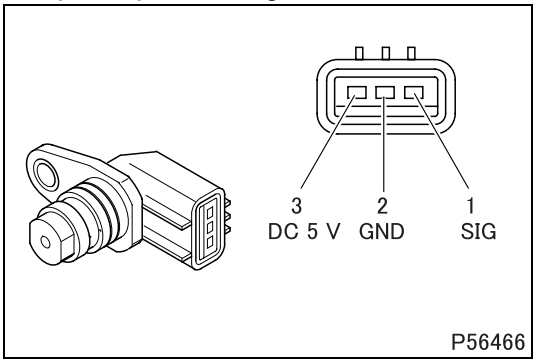
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 83 (+) and 53 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 2 and 3.
	Inspection condition		–
	Requirements		200 to 1800 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between sensor connector terminal No. 3 (+) and 2 (–).
	Inspection condition		• Remove connector and measure from harness side. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 78.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 83.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 59.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Ne”. **<Multi-Use Tester used>** • Measure item No. 01 “Engine Revolution” of Service Data.
	Inspection condition		–
	Requirements		Same indication as tachometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0344/Flash code: 12
[Monitor]
Failure of cylinder recognition sensor
[Fault (outline)]
Abnormality of pulse count
[Diagnosis check]
- Output pulses from cylinder recognition sensor during engine operation are counted.

[Code generation condition]
- Number of output pulses from cylinder recognition sensor at engine start exceeds 240.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

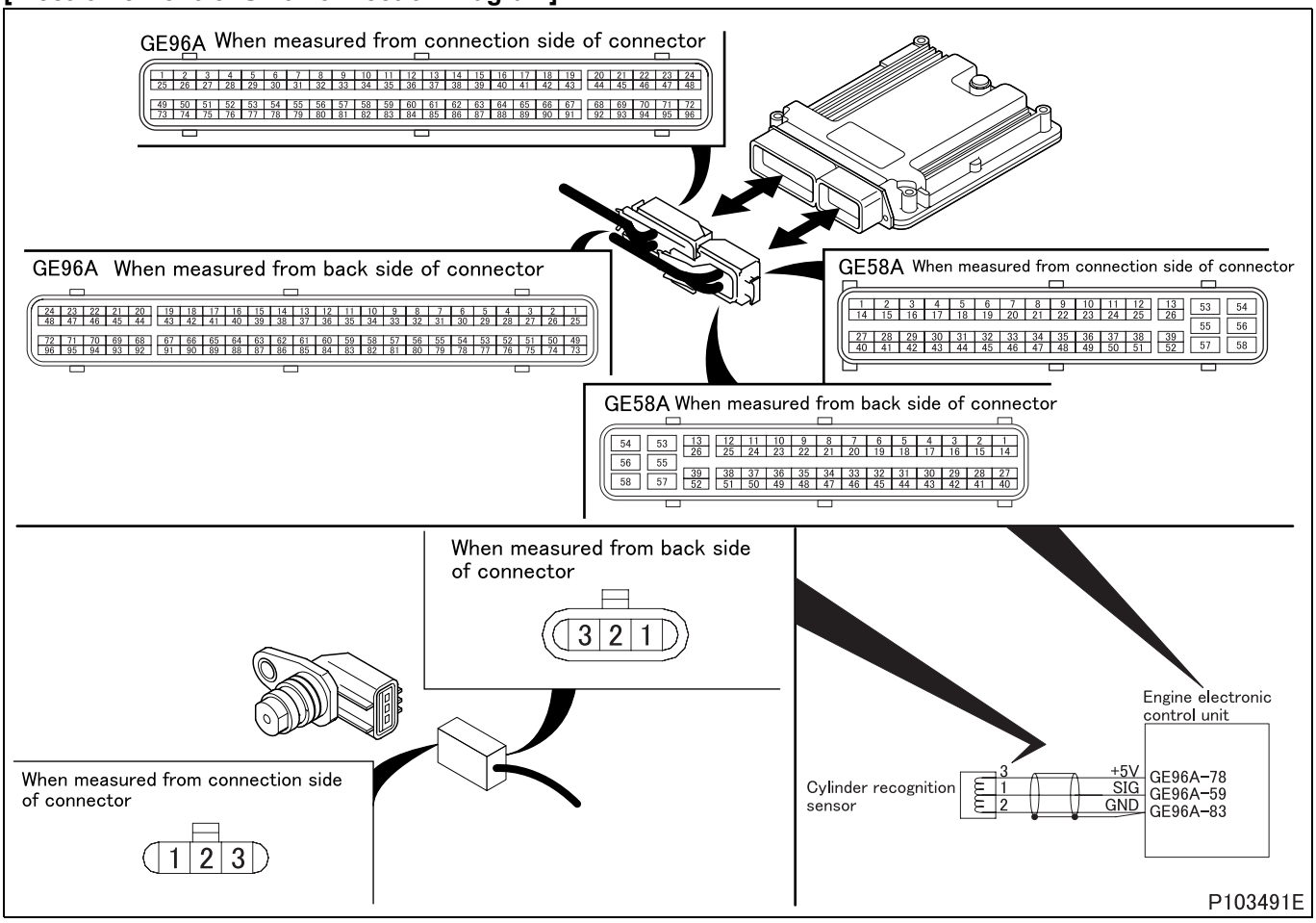
[Diagnostic requirement]
- Starter switch: ON
- Engine speed: more than 20 rpm

[Control effected by electronic control unit during fault]
- Control is effected with engine speed sensor only.
- Misfire detection is stopped.
- Auto cruise control stopped
- Related fault check is stopped.

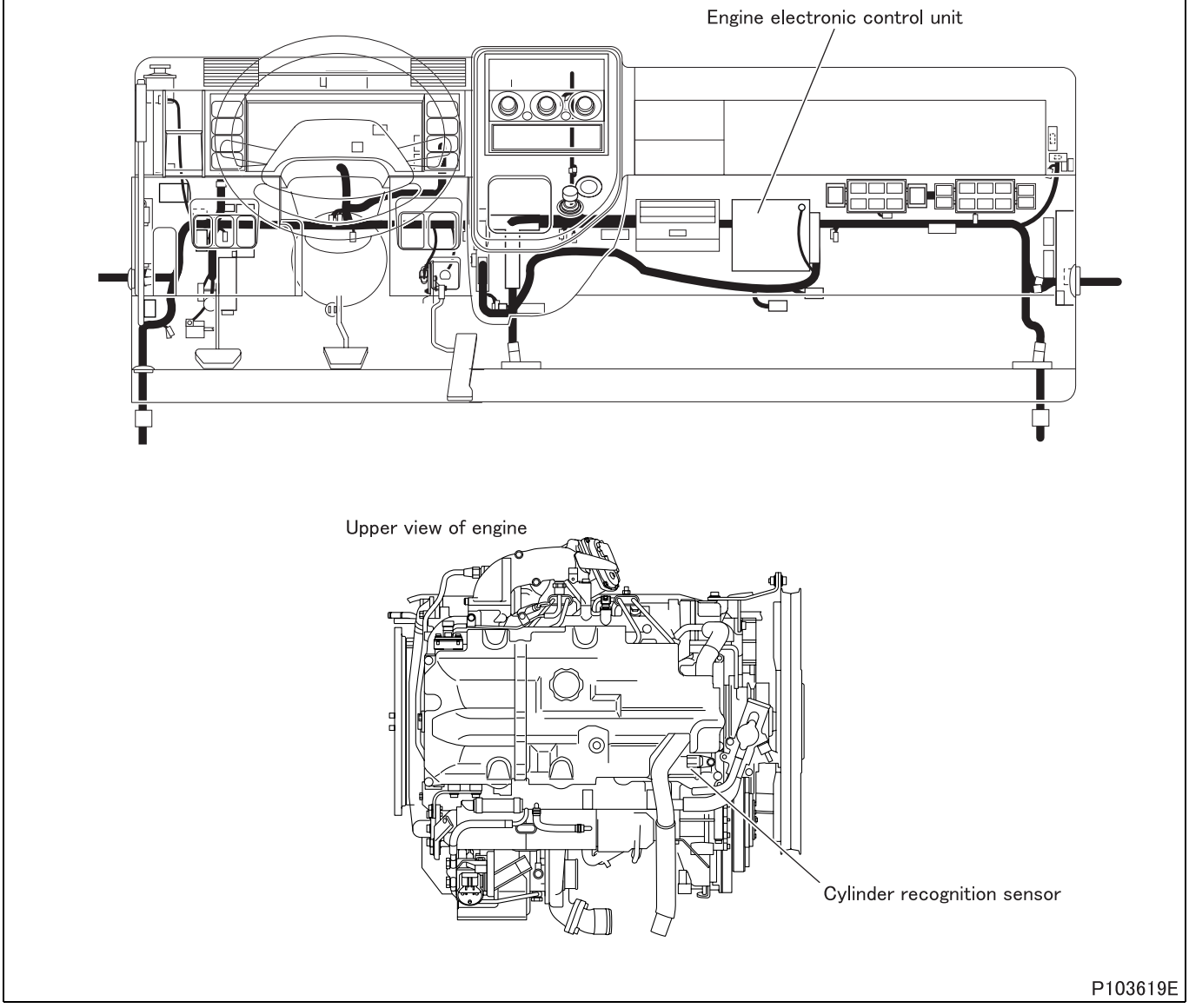
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Ne”. **<Multi-Use Tester used>** • Measure item No. 01 “Engine Revolution” of Service Data.
	Inspection condition		–
	Requirements		Same indication as tachometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 59 (+) and 83 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		1 V or more
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 78 (+) and 83 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

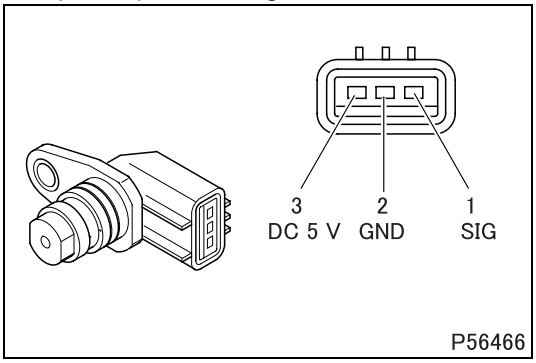
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 83 (+) and 53 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 2 and 3.
	Inspection condition		–
	Requirements		200 to 1800 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between sensor connector terminal No. 3 (+) and 2 (–).
	Inspection condition		• Remove connector and measure from harness side. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 78.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 83.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 59.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Ne”. **<Multi-Use Tester used>** • Measure item No. 01 “Engine Revolution” of Service Data.
	Inspection condition		–
	Requirements		Same indication as tachometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0381/Flash code: 26
[Monitor]
Failure of preheating indicator lamp
[Fault (outline)]
- Short circuit battery
- Short circuit ground
- Open circuit
- Overload

[Diagnosis check]
- Preheating indicator lamp circuit is monitored for fault.

[Code generation condition]
- Preheating indicator lamp circuit remains open, shorted or overcurrent as detected for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.
- Fault diagnosis is performed each time when the control is halted.

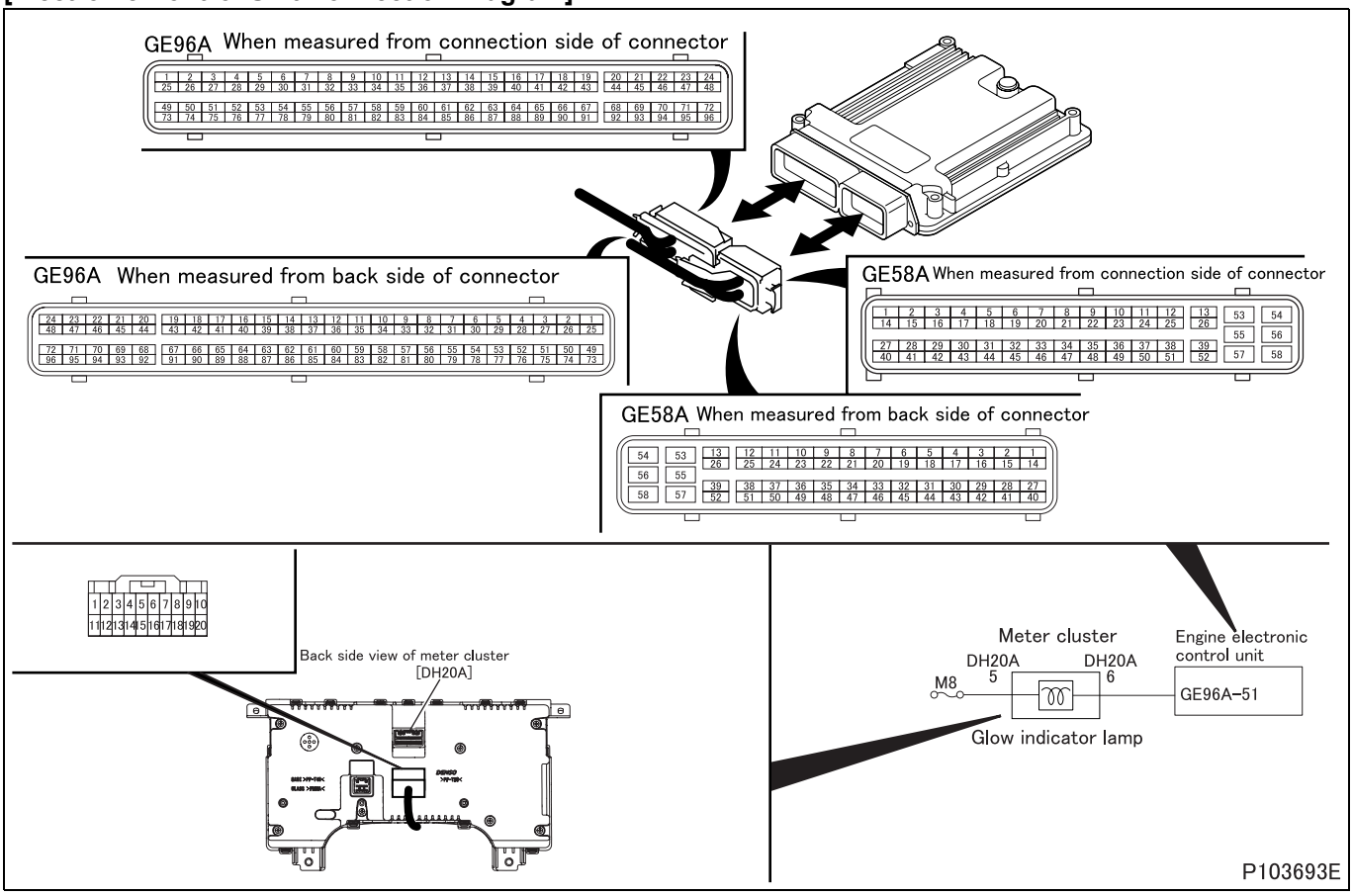
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

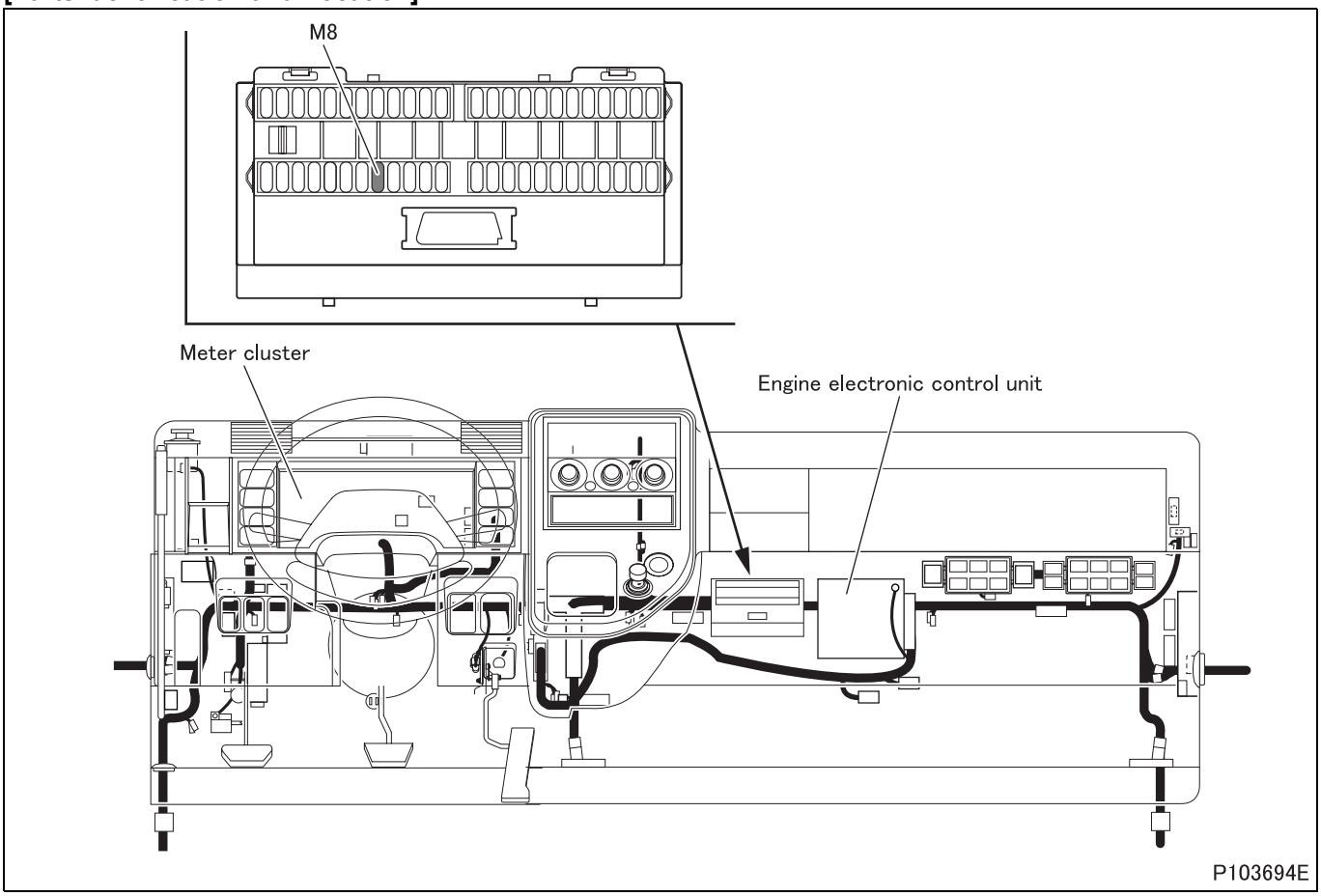
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and meter cluster (preheating indicator lamp)
- Malfunction of each connector
- Malfunction of meter cluster (preheating indicator lamp)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform item No. AD “Glow Indicator Lamp” of Service Data.
	Inspection condition		Starter switch: ON
	Requirements		Lamp illuminates for six seconds.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Ground connector (GE96A) terminal No. 51.
	Inspection condition		Measure from back side of connector of harness with harness connected
	Requirements		Lamp illuminates.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between fuse and meter cluster
	Maintenance item		Check circuit between fuse M8 and meter cluster connector (DH20A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between meter cluster and electronic control unit
	Maintenance item		Check circuit between meter cluster connector (DH20A) terminal No. 6 and electronic control unit connector (GE96A) terminal No. 51
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of meter cluster
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of meter cluster or lamp
		NO	Modify connector.

[Fault code]
Diagnosis code: P0383/Flash code: 26
<FE83>
[Monitor]
Failure of preheating control
[Fault (outline)]
Short circuit ground
[Diagnosis check]
- Diesel particulate filter indicator lamp circuit is monitored for preheater in operation.

[Code generation condition]
- Preheating control circuit remains shorted to ground as detected for 0.2 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is halted.

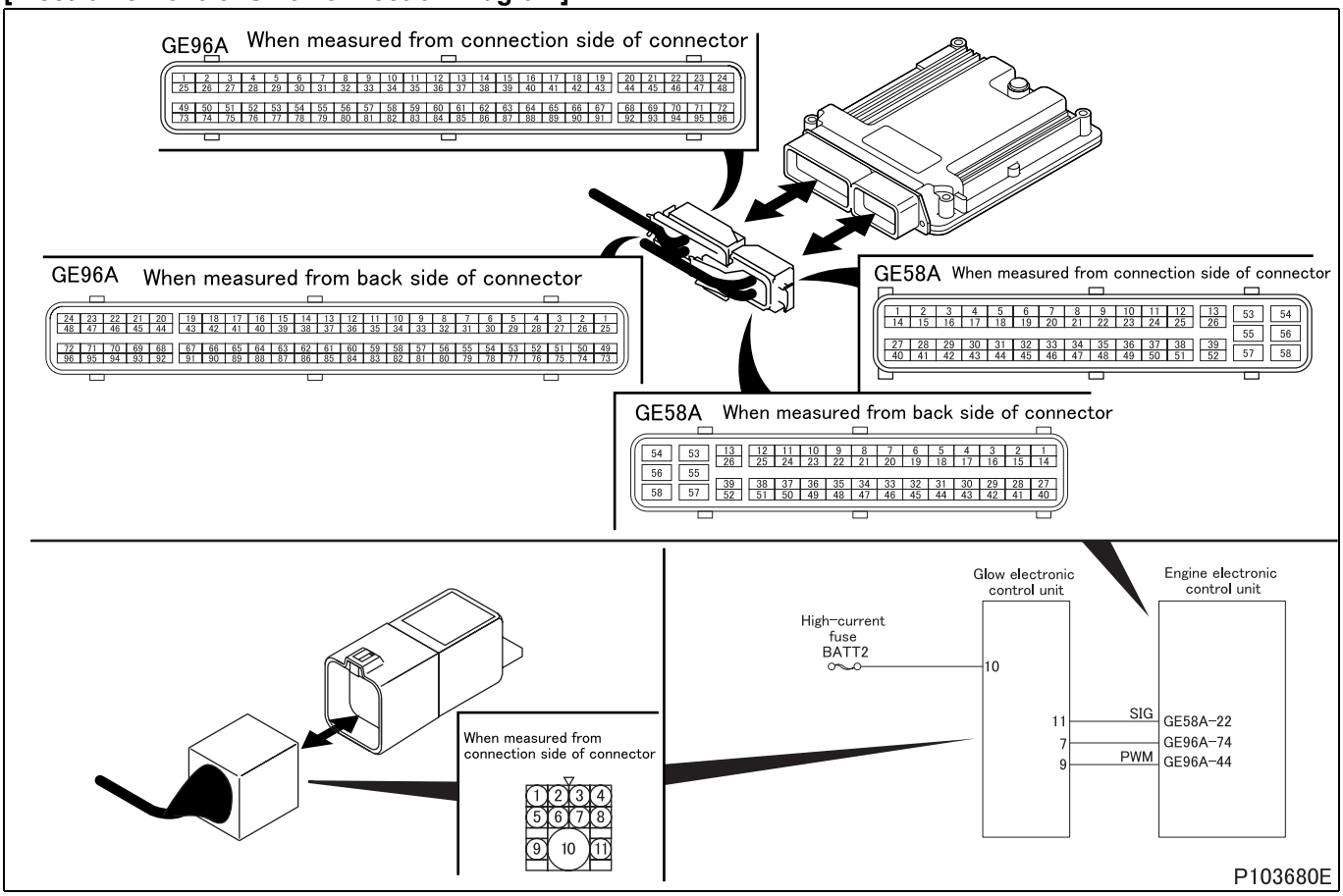
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

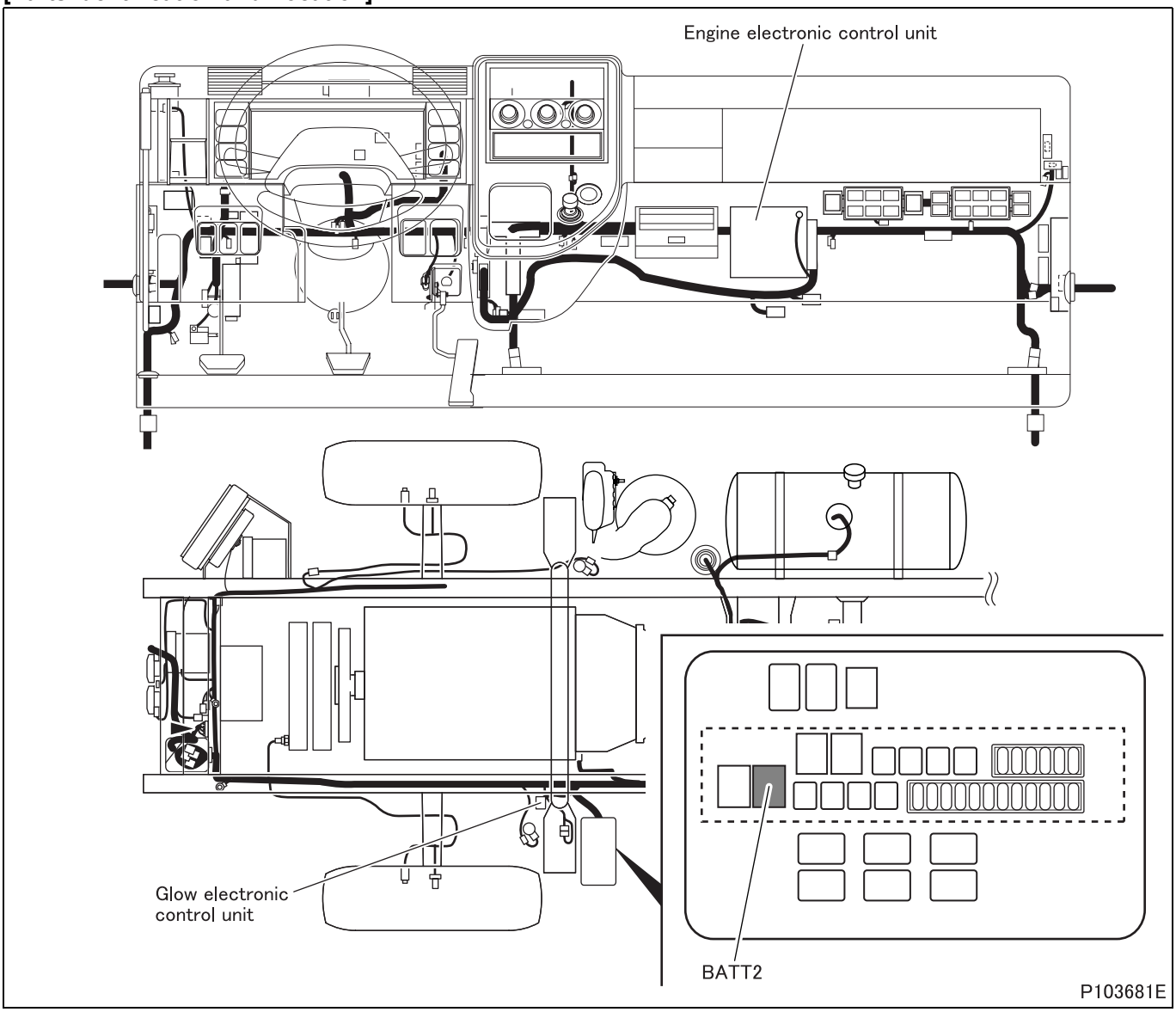
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and glow electronic control unit
- Malfunction of each connector
- Malfunction of glow electronic control unit
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

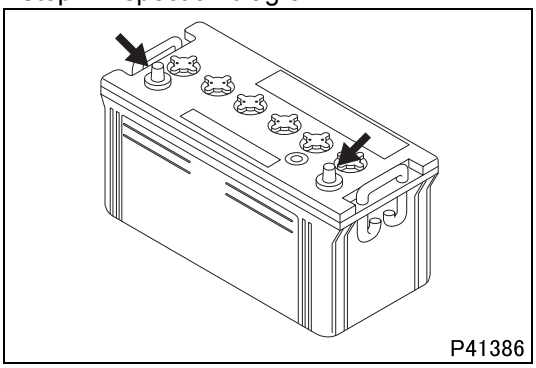
Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B5 “GCU (GLOW PLUG)”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0MPH}) • Starter switch: ON • Engine: stopped
	Requirements		Power ON to glow plug
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of high-current fuse (BATT2)
	Maintenance item		Check open circuit of high-current fuse (BATT2)
	Inspection condition		–
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Replacement of fuse

Step 3	Inspection items		Inspection of harness between glow electronic control unit and high-current fuse (BATT2)
	Maintenance item		Check circuit between glow electronic control unit connector terminal No. 10 and high-current fuse (BATT2).
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify harness.

Step 4	Inspection items		Inspection of battery
	Maintenance item		Measure value of voltage between battery terminals (+) and (–).
	Inspection condition		–
	Requirements		8 to 16 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Inspection of battery (See Gr54.)

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between glow electronic control unit and engine electronic control unit
	Maintenance item		Check circuit between following connector terminals. • Fault information circuit: glow electronic control unit terminal No. 11 - engine electronic control unit (GE58A) terminal No. 22 • Power supply circuit: glow electronic control unit terminal No. 7 - engine electronic control unit (GE96A) terminal No. 74 • Operating signal circuit: glow electronic control unit terminal No. 9 - engine electronic control unit (GE96A) terminal No. 44
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of glow electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of glow electronic control unit, go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of engine electronic control unit
		NO	Modify connector.

<Except FE83>
[Monitor]
Failure of preheating control
[Fault (outline)]
Short circuit ground
[Diagnosis check]
- Glow drive relay circuit is monitored for fault when glow drive relay is operated.

[Code generation condition]
- Glow drive relay circuit remains shorted to ground as detected for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is halted.

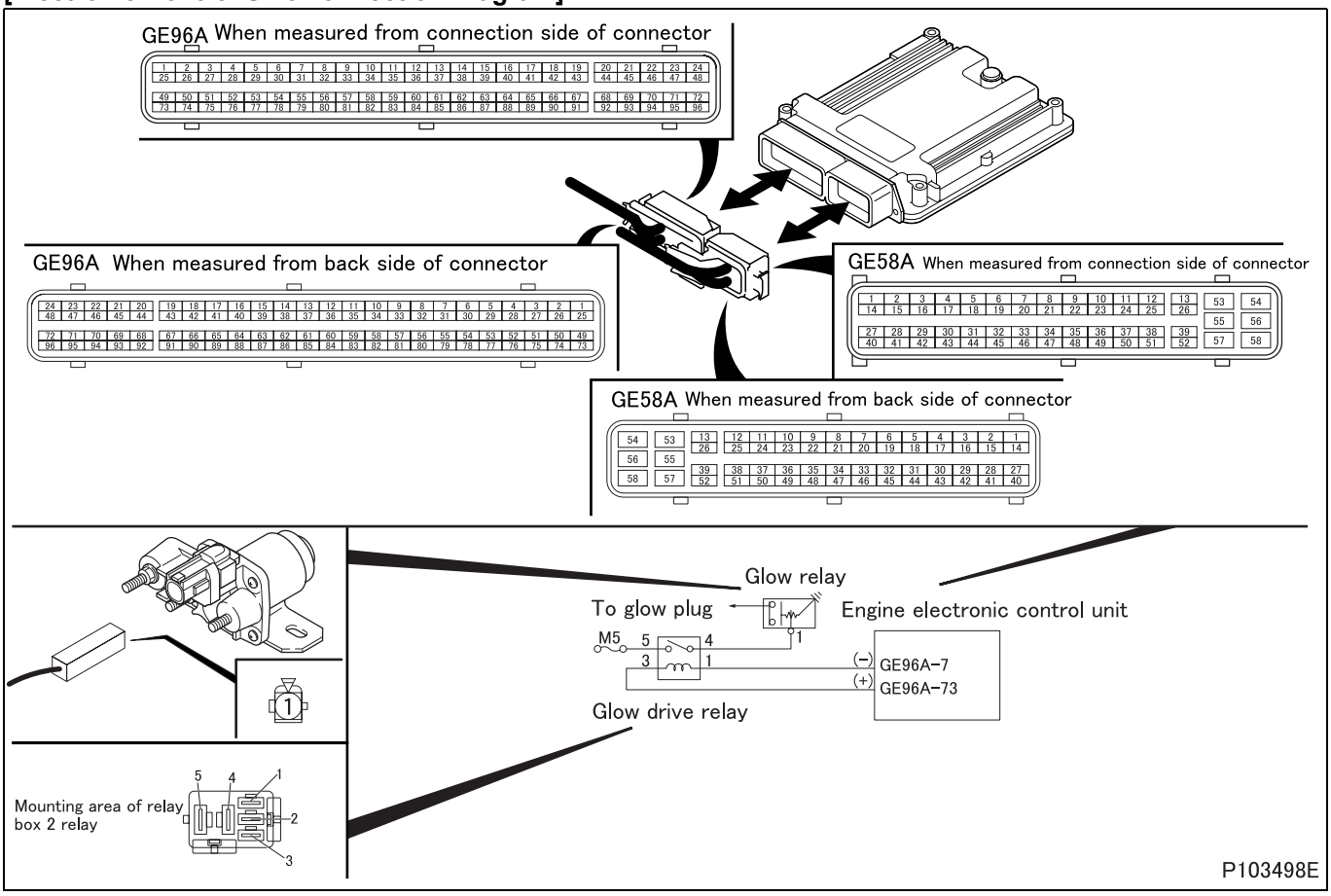
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

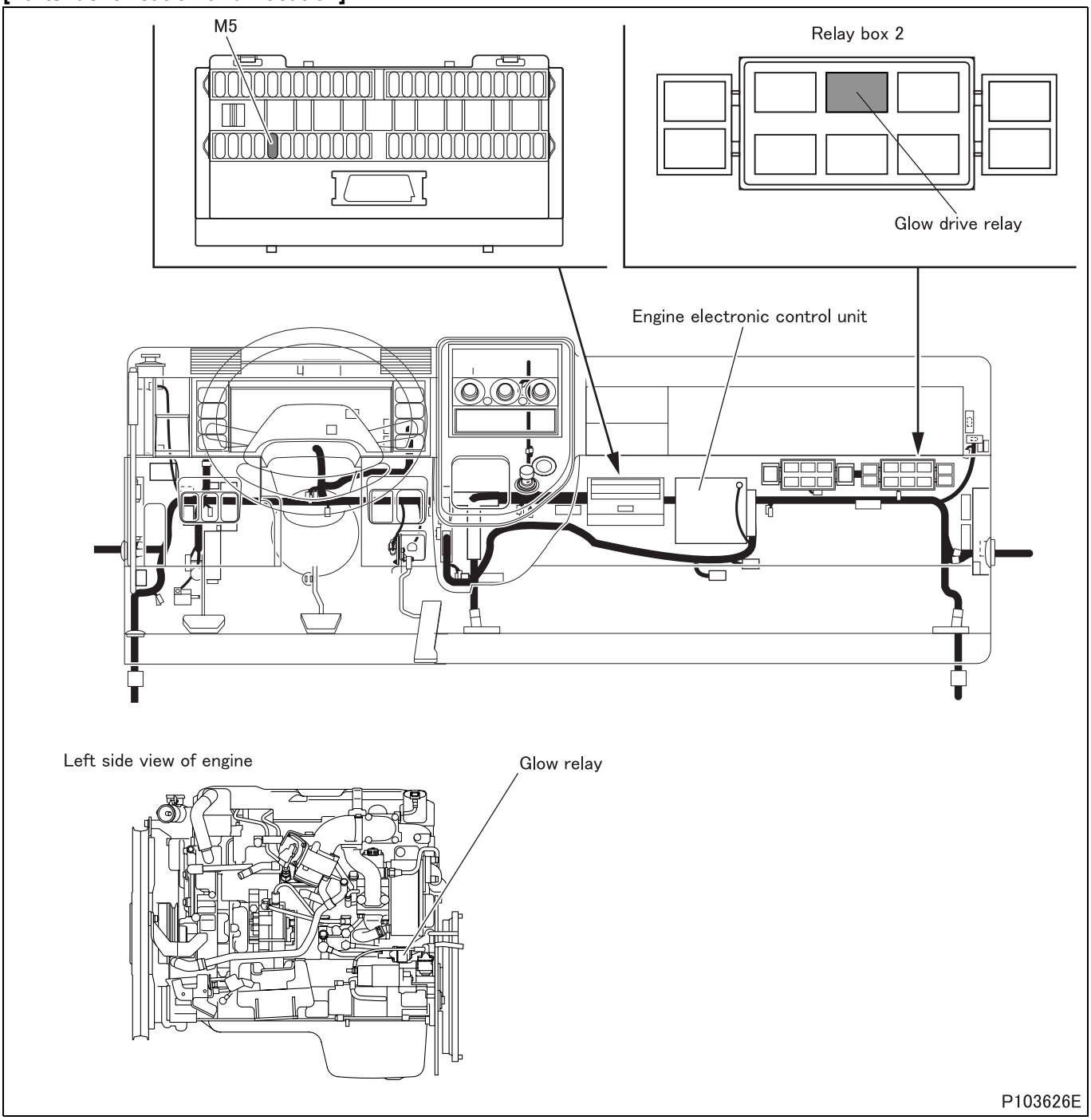
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and glow drive relay
- Malfunction of each connector
- Malfunction of glow drive relay
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AC “Relay for Glow Relay”
	Inspection condition		–
	Requirements		Relay operation sound is noted.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

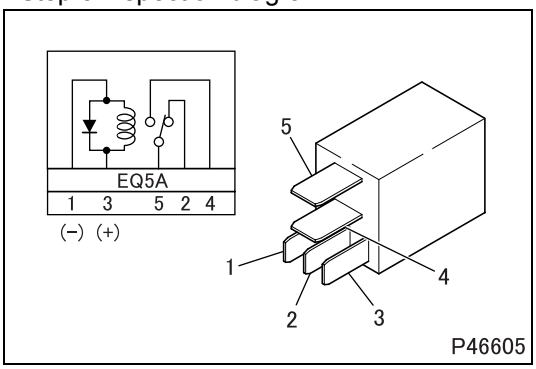
Step 2	Inspection items		Inspection of electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 73 (+) and 7 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Perform actuator test item No. AC “Relay for Glow Relay”
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 4 and 5 when relay operates.
	Inspection condition		Apply battery voltage across terminals No. 3 (+) and 1 (–)
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of relay

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between relay and electronic control unit (power supply)
	Maintenance item		Check circuit between relay connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 73.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between relay and electronic control unit (ground)
	Maintenance item		Check circuit between relay connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 7.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AC “Relay for Glow Relay”
	Inspection condition		–
	Requirements		Relay operation sound is noted.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0384/Flash code: 26
<FE83>
[Monitor]
Failure of preheating control
[Fault (outline)]
Short circuit battery
[Diagnosis check]
- Diesel particulate filter indicator lamp circuit is monitored for preheater in operation.

[Code generation condition]
- Preheating control circuit remains shorted to power supply as detected for 0.5 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

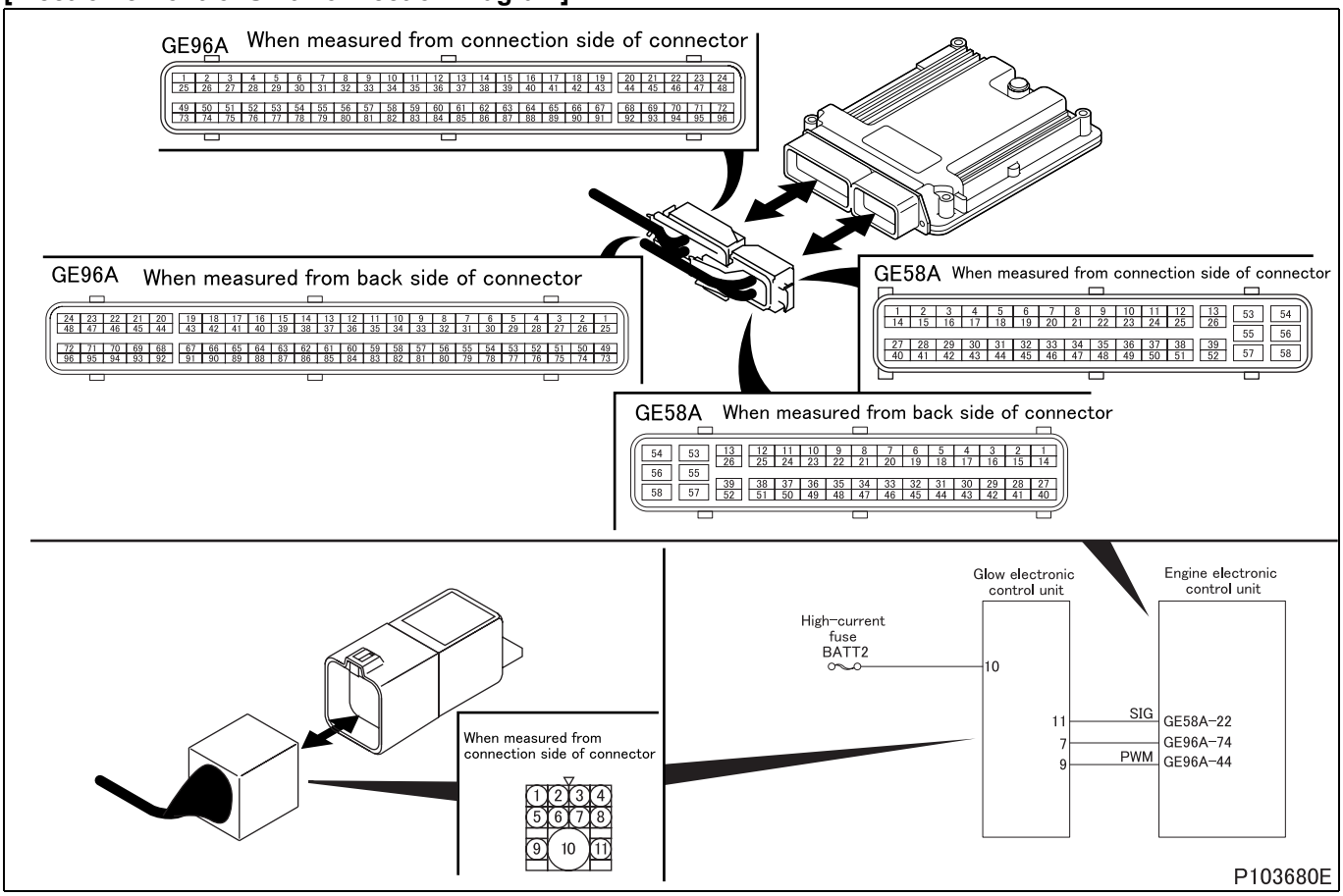
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

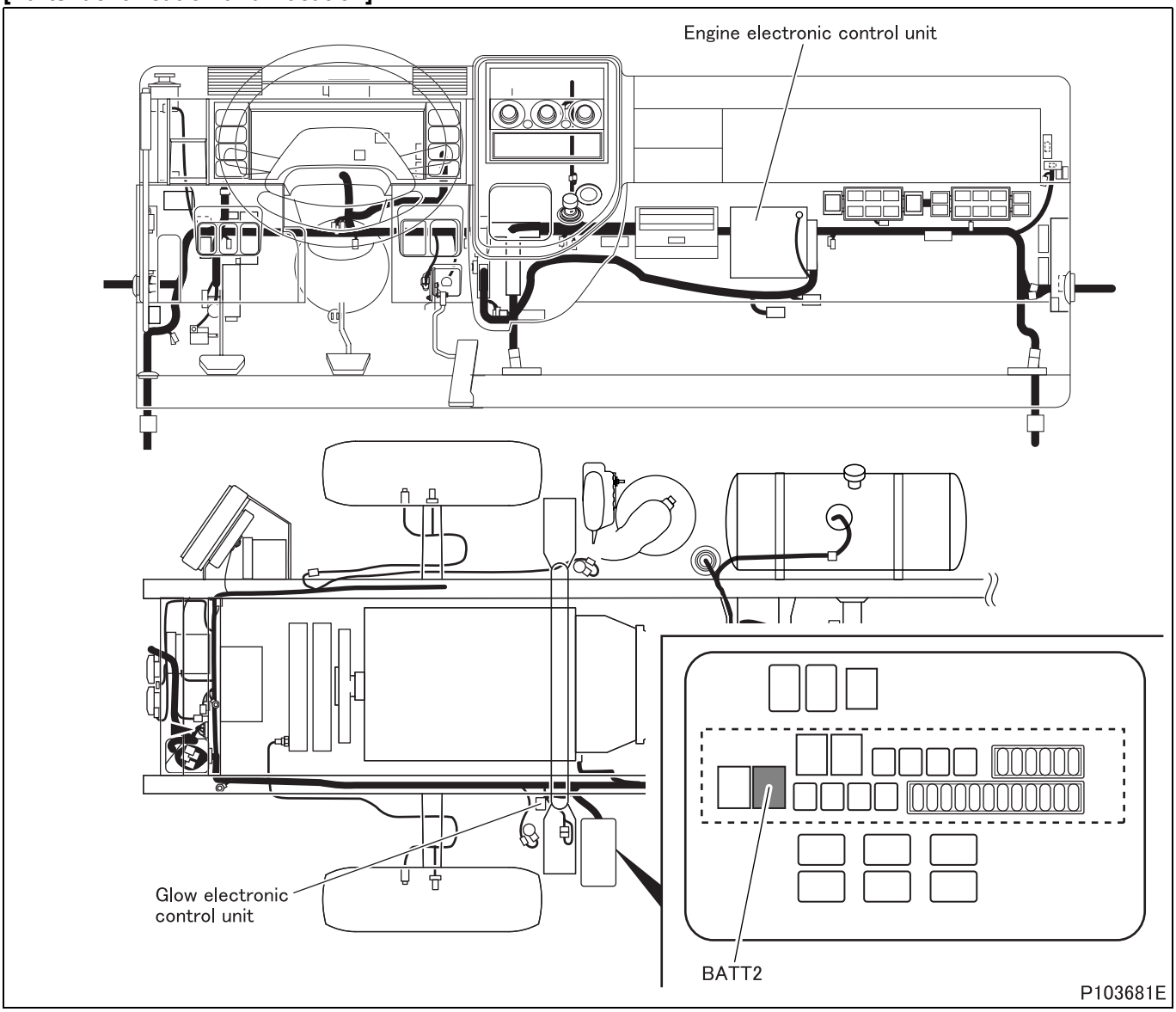
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and glow electronic control unit
- Malfunction of each connector
- Malfunction of glow electronic control unit
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

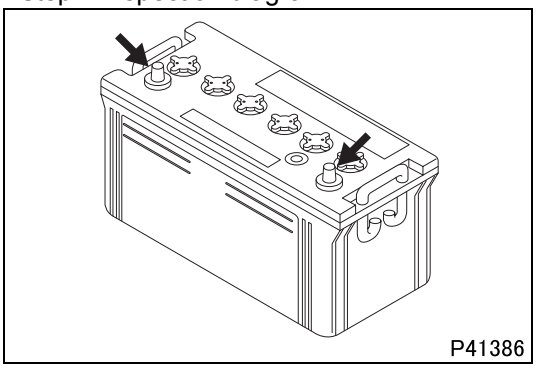
Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B5 “GCU (GLOW PLUG)”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0MPH}) • Starter switch: ON • Engine: stopped
	Requirements		Power ON to glow plug
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of high-current fuse (BATT2)
	Maintenance item		Check open circuit of high-current fuse (BATT2)
	Inspection condition		–
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Replacement of fuse

Step 3	Inspection items		Inspection of harness between glow electronic control unit and high-current fuse (BATT2)
	Maintenance item		Check circuit between glow electronic control unit connector terminal No. 10 and high-current fuse (BATT2).
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify harness.

Step 4	Inspection items		Inspection of battery
	Maintenance item		Measure value of voltage between battery terminals (+) and (–).
	Inspection condition		–
	Requirements		8 to 16 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Inspection of battery (See Gr54.).

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between glow electronic control unit and engine electronic control unit
	Maintenance item		Check circuit between following connector terminals. • Fault information circuit: glow electronic control unit terminal No. 11 - engine electronic control unit (GE58A) terminal No. 22 • Power supply circuit: glow electronic control unit terminal No. 7 - engine electronic control unit (GE96A) terminal No. 74 • Operating signal circuit: glow electronic control unit terminal No. 9 - engine electronic control unit (GE96A) terminal No. 44
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of glow electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of glow electronic control unit, go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of engine electronic control unit
		NO	Modify connector.

<Except FE83>
[Monitor]
Failure of preheating control
[Fault (outline)]
Short circuit battery
[Diagnosis check]
- Glow drive relay circuit is monitored for fault when glow drive relay is operated.

[Code generation condition]
- Glow drive relay circuit remains shorted to power supply as detected for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

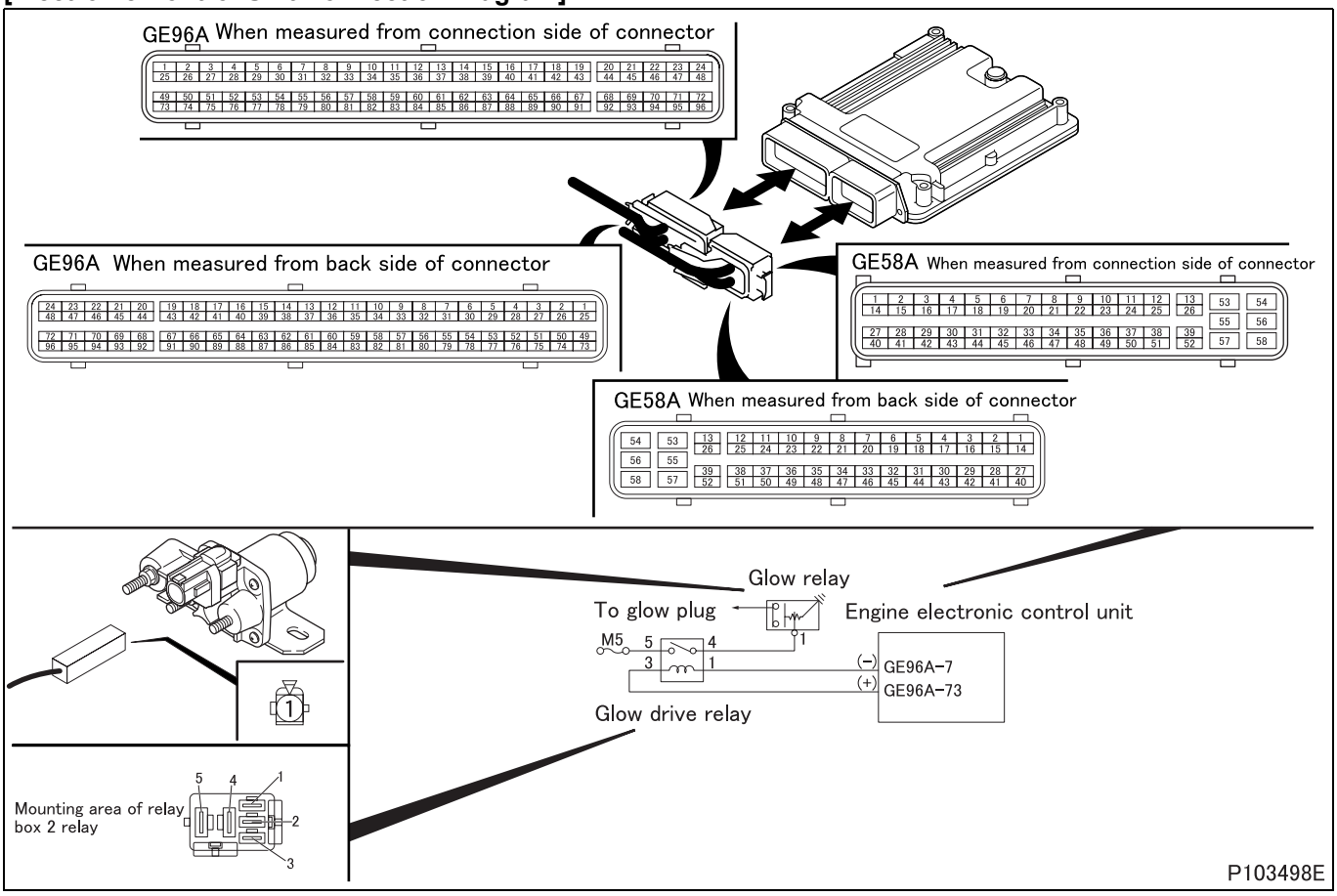
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

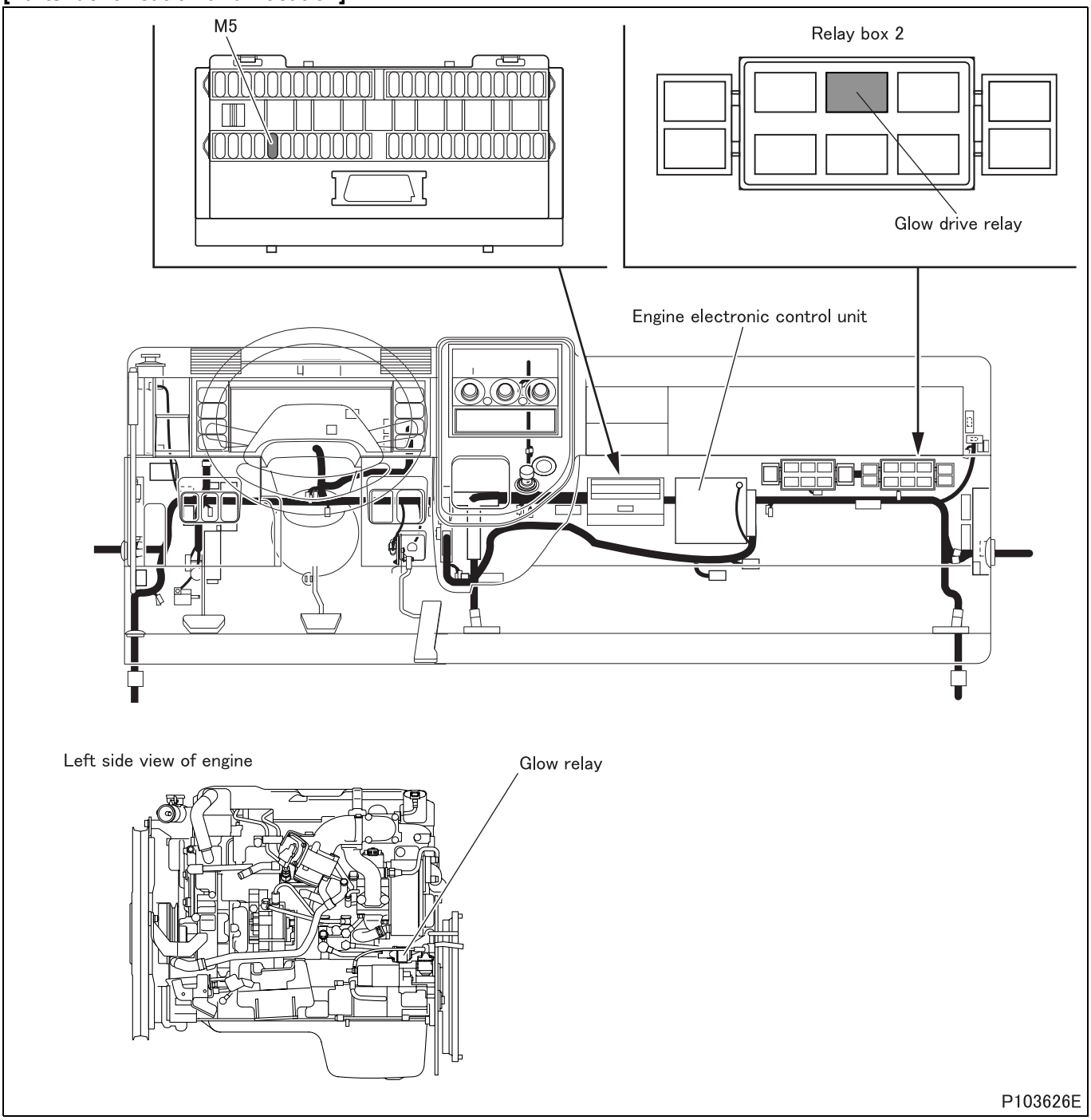
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and glow drive relay
- Malfunction of each connector
- Malfunction of glow drive relay
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AC “Relay for Glow Relay”
	Inspection condition		–
	Requirements		Relay operation sound is noted.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

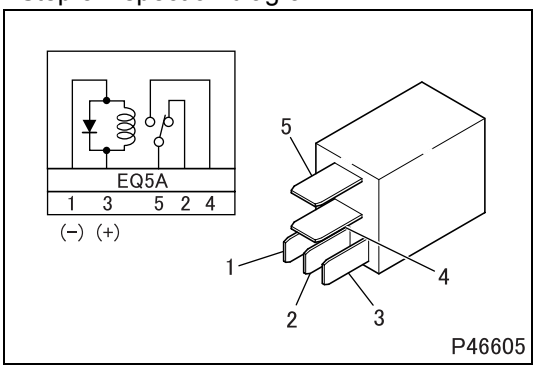
Step 2	Inspection items		Inspection of electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 73 (+) and 7 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Perform actuator test item No. AC “Relay for Glow Relay “
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 4 and 5 when relay operates.
	Inspection condition		Apply battery voltage across terminals No. 3 (+) and 1 (–)
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of relay

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between relay and electronic control unit (power supply)
	Maintenance item		Check circuit between relay connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 73.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between relay and electronic control unit (ground)
	Maintenance item		Check circuit between relay connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 7.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AC “Relay for Glow Relay”
	Inspection condition		–
	Requirements		Relay operation sound is noted.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0401/Flash code: 2
[Monitor]
Insufficient air flow rate in exhaust gas recirculation system
[Fault (outline)]
- Exhaust gas recirculation system insufficient flow
- Exhaust gas recirculation mass flow too low

[Diagnosis check]
Either of the following is monitored.
<Condition (1)>
- λ value computed by engine electronic control unit is compared with pre-mapped specified valve.

<Condition (2)>
- Exhaust gas recirculation flow rate (rate at which gas flows through exhaust gas recirculation valve) calculated by engine electronic control unit is compared with pre-mapped specified value.

[Code generation condition]
When either of the following is determined (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.).
<Condition (1)>
- Difference between target λ value and computed λ value remains less than specified for 4 seconds.

<Condition (2)>
- Computed exhaust gas recirculation flow rate remains below specified value for 10 seconds.

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
<Condition (1)>
- Exhaust gas recirculation control: closed loop
- Water temperature: 65 to 120°C {149 to 248°F}
- Atmospheric pressure: 828 to 1100 mbar {12 to 15.95 psi}
- Intake air temperature: –7 to 65°C {19 to 149°F}
- Diesel particulate filter regeneration control: not effected
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Air flow sensor: in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Boost air temperature sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Exhaust gas recirculation cooler: in order
- Starter switch circuit: in order
- Fuel feed when engine is idling: in order

<Condition (2)>
- Water temperature: 65 to 120°C {149 to 248°F}
- Atmospheric pressure: 828 to 1100 mbar {12 to 15.95 psi}
- Intake air temperature: –7 to 65°C {19 to 149°F}
- Exhaust gas recirculation valve: closed
- Diesel particulate filter regeneration control: not effected
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Air flow sensor: in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Boost air temperature sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Exhaust gas recirculation cooler: in order
- Starter switch circuit: in order
- Fuel feed when engine is idling: in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

[Probable cause of trouble]
- Exhaust gas recirculation valve stuck (remains fully closed)
- Plugged exhaust gas recirculation pipe and hose
- Plugged exhaust gas recirculation cooler

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0403 “EGR1 (Actuator Circuit)” • P0409 “EGR1 (Position Sensor)” • P0562 “Power Supply Voltage (Low)” • P0563 “Power Supply Voltage (High)” • P0600 “CAN Communication” • P0607 “ECU System” • P060B “A/D Converter” • P061B “ECU Performance (Calc)” • P061C “ECU Performance (Ne)” • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)” • P2413 “EGR System”
	Inspection condition		• Starter switch: ON • Do not start engine
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Inspection of exhaust gas recirculation system (exhaust gas recirculation pipe, exhaust gas recirculation cooler, exhaust gas recirculation valve)

[Fault code]
Diagnosis code: P0402/Flash code: 2
[Monitor]
Excessive air flow rate in exhaust gas recirculation system
[Fault (outline)]
- Exhaust gas recirculation system excessive flow
- Exhaust gas recirculation mass flow too high

[Diagnosis check]
Either of the following is monitored.
<Condition (1)>
- λ value computed by engine electronic control unit is compared with pre-mapped specified valve.

<Condition (2)>
- Exhaust gas recirculation flow rate (rate at which gas flows through exhaust gas recirculation valve) calculated by engine electronic control unit is compared with pre-mapped specified value.

[Code generation condition]
When either of the following is determined (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.).
<Condition (1)>
- Difference between target λ value and computed λ value remains more than specified for 4 seconds.

<Condition (2)>
- Computed exhaust gas recirculation flow rate remains more than specified value for 10 seconds.

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
<Condition (1)>
- Exhaust gas recirculation control: closed loop
- Water temperature: 65 to 120°C {149 to 248°F}
- Atmospheric pressure: 828 to 1100 mbar {12 to 15.95 psi}
- Intake air temperature: –7 to 65°C {19 to 149°F}
- Diesel particulate filter regeneration control: not effected
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Air flow sensor: in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Boost air temperature sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Exhaust gas recirculation cooler: in order
- Starter switch circuit: in order
- Fuel feed when engine is idling: in order

<Condition (2)>
- Water temperature: 65 to 120°C {149 to 248°F}
- Atmospheric pressure: 828 to 1100 mbar {12 to 15.95 psi}
- Intake air temperature: –7 to 65°C {19 to 149°F}
- Exhaust gas recirculation valve: closed
- Diesel particulate filter regeneration control: not effected
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Air flow sensor: in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Boost air temperature sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Exhaust gas recirculation cooler: in order
- Starter switch circuit: in order
- Fuel feed when engine is idling: in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

[Probable cause of trouble]
- Exhaust gas recirculation valve stuck (remains fully open)
- Exhaust gas recirculation pipe and hose broken
- Exhaust gas recirculation cooler broken

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0403 “EGR1 (Actuator Circuit)” • P0409 “EGR1 (Position Sensor)” • P0562 “Power Supply Voltage (Low)” • P0563 “Power Supply Voltage (High)” • P0600 “CAN Communication” • P0607 “ECU System” • P060B “A/D Converter” • P061B “ECU Performance (Calc)” • P061C “ECU Performance (Ne)” • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)” • P2413 “EGR System”
	Inspection condition		• Starter switch: ON • Do not start engine
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Inspection of exhaust gas recirculation system (exhaust gas recirculation pipe, exhaust gas recirculation cooler, exhaust gas recirculation valve)

[Fault code]
Diagnosis code: P0403/Flash code: 2, 67
[Monitor]
Failure of exhaust gas recirculation system
[Fault (outline)]
- Circuit
- Plausibility

[Diagnosis check]
- Exhaust gas recirculation electronic drive unit monitors built-in motor of exhaust gas recirculation valve for circuit fault and sends fault information to engine electronic control unit through controller area network communication.
- Monitoring by exhaust gas recirculation electronic drive unit is performed from initial operational status of motor at starter switch ON.

[Code generation condition]
When either of the following is determined (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)
- Motor circuit remains open or shorted as detected by electronic drive unit for 2 seconds.
- Exhaust gas recirculation valve keeps operating 95% or more for 3 seconds.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

[Diagnostic requirement]
- Controller area network communication in order

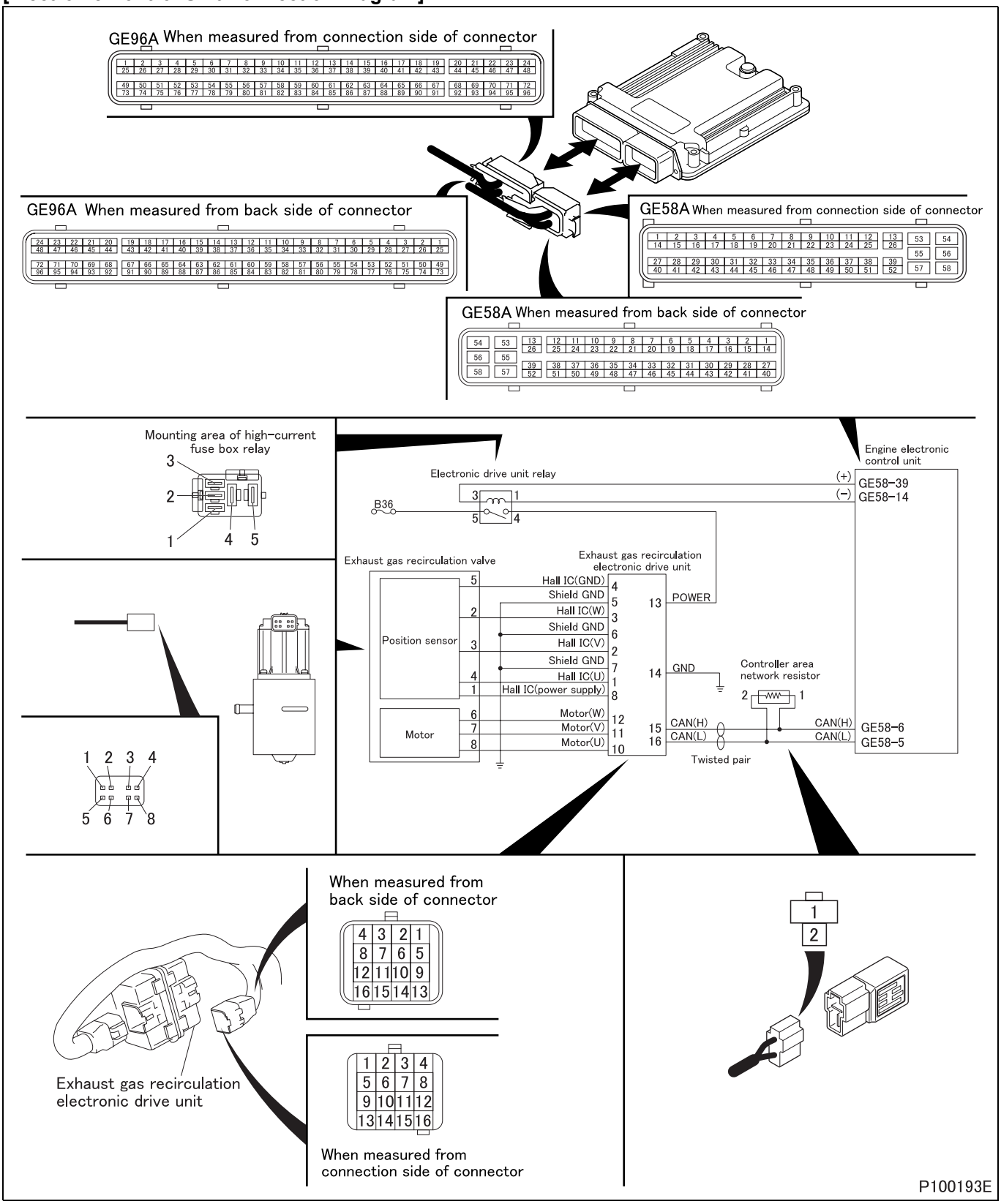
[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Power supply circuit>
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

<Motor circuit>
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Post injection is inhibited.
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

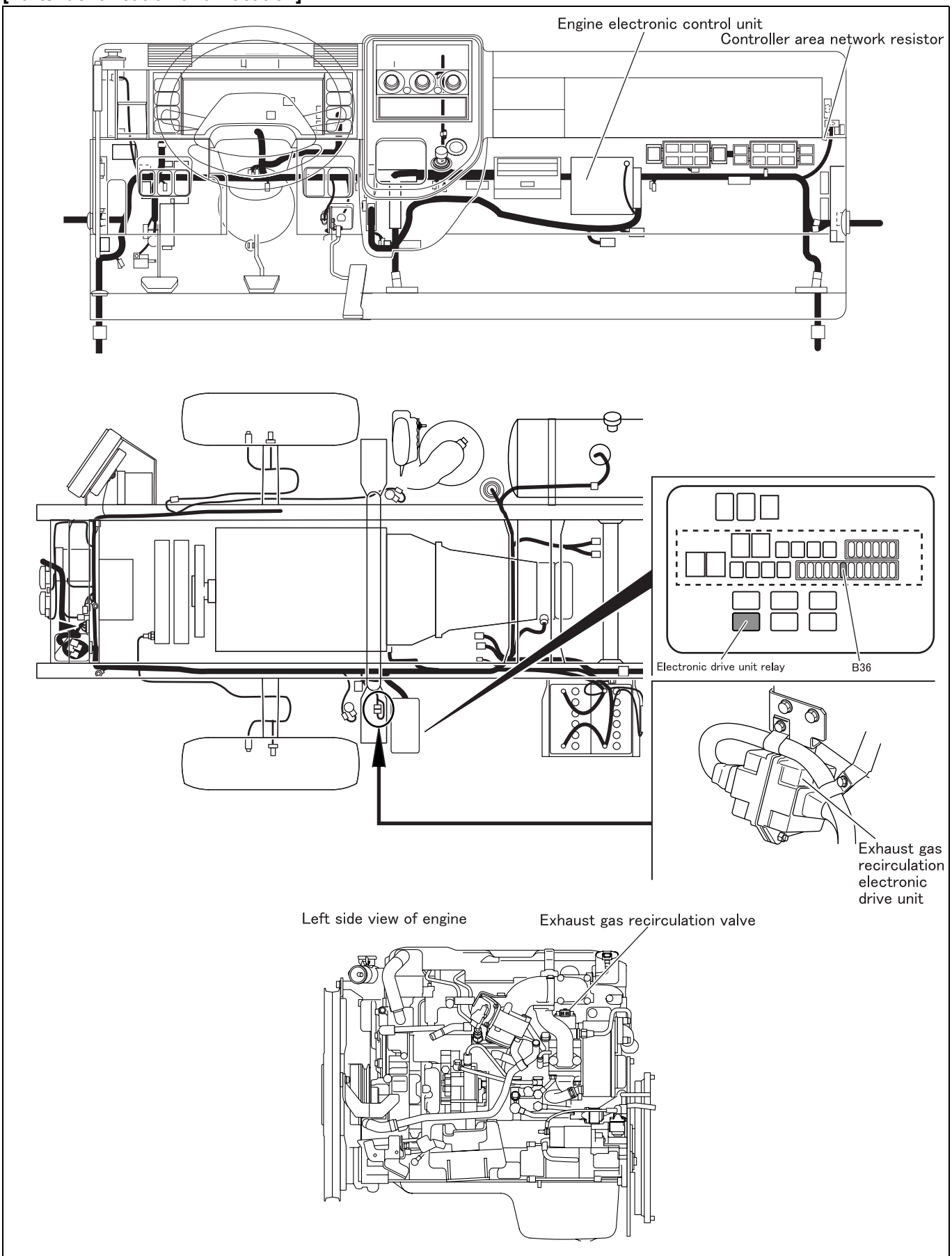
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and exhaust gas recirculation valve
- Malfunction of each connector
- Malfunction of exhaust gas recirculation motor (built in exhaust gas recirculation valve)
- Malfunction of exhaust gas recirculation position sensor (built in exhaust gas recirculation valve)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A0 “EGR 1”
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “51: Actual EGR Valve Position”) **NOTE** • **As initial operational check of exhaust gas recirculation valve is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of exhaust gas recirculation valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Inspect diagnosis code that is occurring.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Remove connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of electronic drive unit relay, go to step 9
		NO	Modify harness.

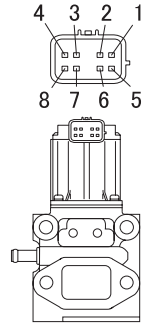
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor shield ground (U): terminal No. 5 - 14 • Sensor shield ground (V): terminal No. 6 - 14 • Sensor shield ground (W): terminal No. 7 - 14 • Sensor ground: terminal No. 4 - 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between following connector terminals. • Between U - V: 10 - 11 • Between U - W: 10 - 12 • Between V - W: 11 - 12
	Inspection condition		–
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and exhaust gas recirculation valve (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (U): electronic drive unit connector terminal No. 10 - exhaust gas recirculation valve connector terminal No. 8 • Motor (V): electronic drive unit connector terminal No. 11 - exhaust gas recirculation valve connector terminal No. 7 • Motor (W): electronic drive unit connector terminal No. 12 - exhaust gas recirculation valve connector terminal No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of exhaust gas recirculation valve unit (motor)
	Maintenance item		Measure value of resistance between following exhaust gas recirculation valve connector terminals • Between U - V: 8 - 7 • Between U - W: 8 - 6 • Between V - W: 7 - 6
	Inspection condition		• Keep exhaust gas recirculation valve installed on vehicle. • Remove harness connector, and measure exhaust gas recirculation valve side.
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of exhaust gas recirculation valve

<Step 12 inspection diagram>



P68994

Step 13	Inspection items		Inspection of exhaust gas recirculation valve connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 1 (+) and 5 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		10 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure value of voltage between following electronic drive unit connector terminals • U signal output: terminal 1 (+) - 4 (–) • V signal output: terminal 2 (+) - 4 (–) • W signal output: terminal 3 (+) - 4 (–)
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON • Perform actuator test item No. A0 “EGR 1”
	Requirements		8 to 11 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and exhaust gas recirculation valve (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 8 - exhaust gas recirculation valve connector terminal No. 1 • Sensor (U): electronic drive unit connector terminal No. 1 - exhaust gas recirculation valve connector terminal No. 4 • Sensor (V): electronic drive unit connector terminal No. 2 - exhaust gas recirculation valve connector terminal No. 3 • Sensor (W): electronic drive unit connector terminal No. 3 - exhaust gas recirculation valve connector terminal No. 2 • Sensor (ground): electronic drive unit connector terminal No. 4 - exhaust gas recirculation valve connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of exhaust gas recirculation valve, go to step 16
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A0 “EGR 1” **NOTE** • **As initial operational check of exhaust gas recirculation valve is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “51: Actual EGR Valve Position”)
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P0404/Flash code: 67
[Monitor]
Failure of exhaust gas recirculation valve
[Fault (outline)]
- Circuit
- Open valve

[Diagnosis check]
- Exhaust gas recirculation electronic drive unit monitors for sticking of built-in motor and opening status by exhaust gas recirculation valve for circuit fault and sends fault information to engine electronic control unit through controller area network communication.
- Exhaust gas recirculation electronic drive unit determines valve condition according to valve position detected through position sensor.

[Code generation condition]
Diagnosis code is generated under either of the following conditions. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)
- Motor circuit remains stuck as detected by electronic drive unit for 2 seconds.
- Actual valve position remains 10 mm {0.39 in.} or more apart from target full opening position for 10 seconds.

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Power supply circuit>
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

<Valve opening>
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Post injection is inhibited.
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

[Probable cause of trouble]
- Failure of exhaust gas recirculation system

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0403 “EGR1 (Actuator Circuit)” • P0404 “EGR System” • P0605 “ECU System (Hardware)” • P0607 “ECU System” • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)” • P1632 “CAN (EGR1 Time out)” • U0001 “High Speed CAN Communication” • U0002 “High Speed CAN Communication”
	Inspection condition		• Starter switch: ON • Engine: stopped
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Replacement of exhaust gas recirculation valve

[Fault code]
Diagnosis code: P0409/Flash code: 67
[Monitor]
Failure of exhaust gas recirculation valve
[Fault (outline)]
- Low signal range check
- High signal range check

[Diagnosis check]
- Exhaust gas recirculation electronic drive unit monitors exhaust gas recirculation valve internal circuit for fault (through throttle position sensor).

[Code generation condition]
- Position sensor output voltage remains 0 V (low pulse) or 8 to 11 V (high pulse) for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

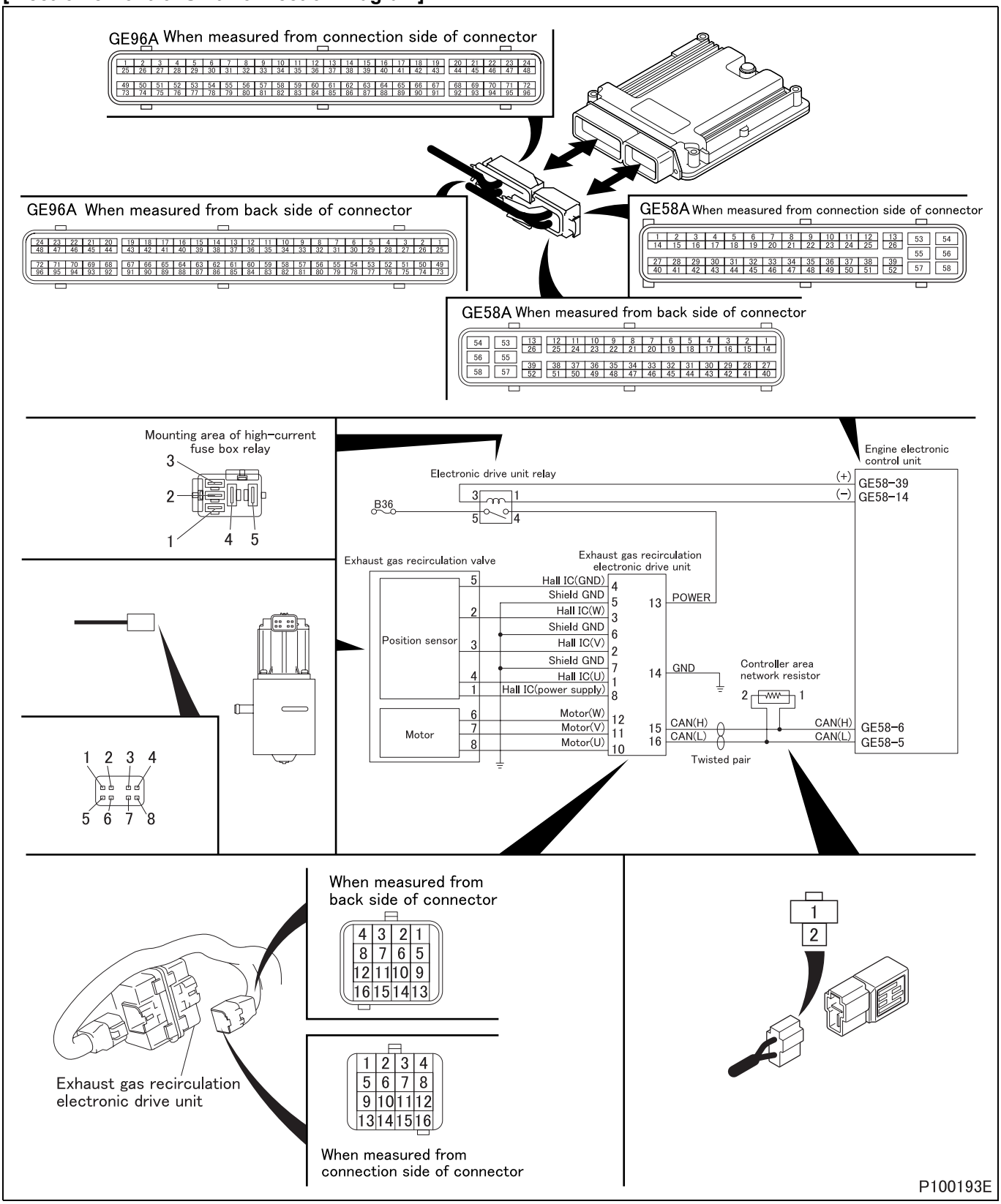
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

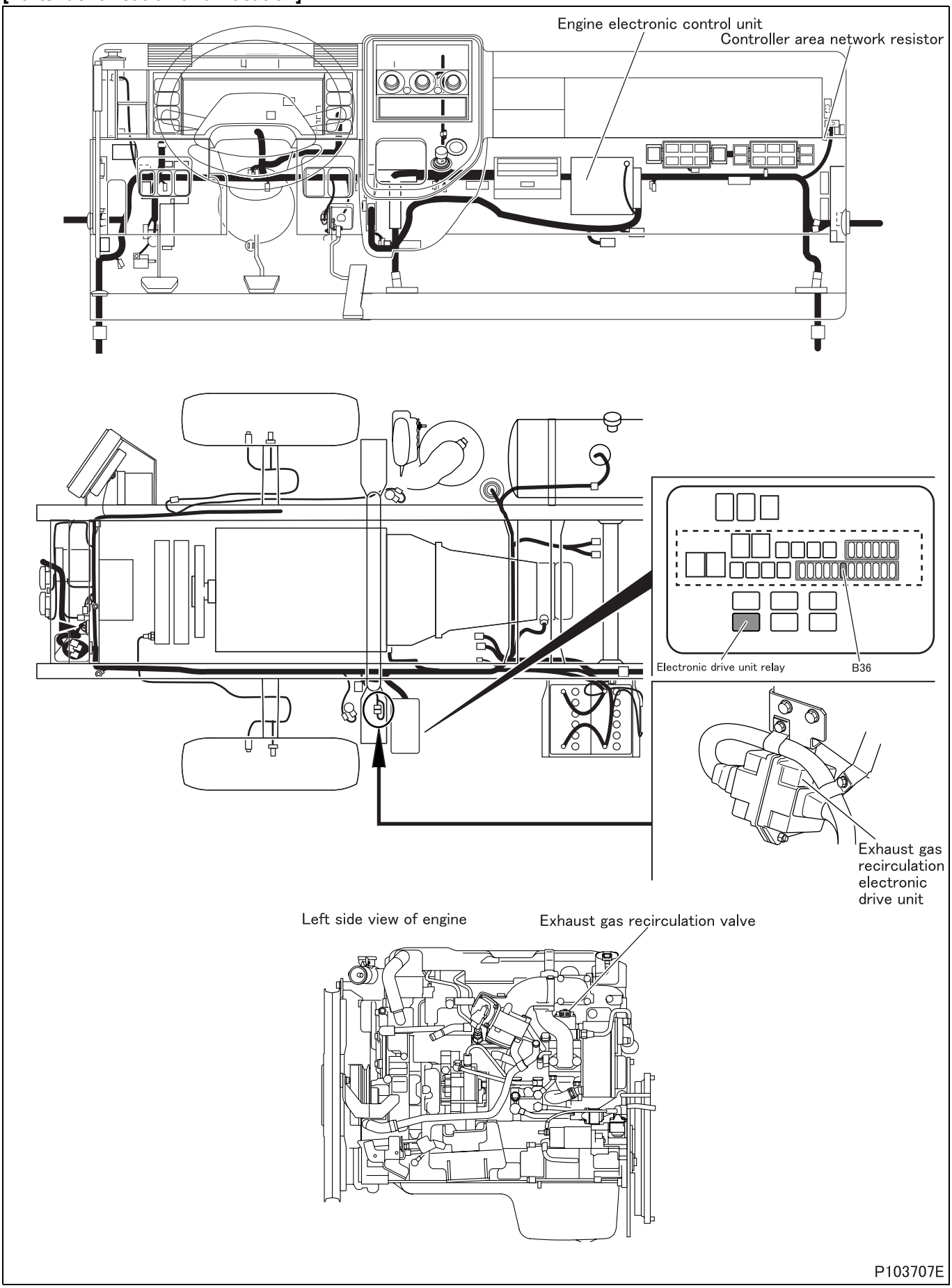
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and exhaust gas recirculation valve (position sensor)
- Malfunction of each connector
- Malfunction of electronic drive unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A0 “EGR 1” **NOTE** • **As initial operational check of exhaust gas recirculation valve is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “51: Actual EGR Valve Position”)
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of exhaust gas recirculation valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Inspect diagnosis code that is occurring.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Remove connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of electronic drive unit relay, go to step 9
		NO	Modify harness.

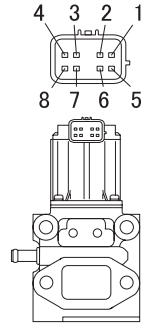
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor shield ground (U): terminal No. 5 - 14 • Sensor shield ground (V): terminal No. 6 - 14 • Sensor shield ground (W): terminal No. 7 - 14 • Sensor ground: terminal No. 4 - 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between following connector terminals. • Between U - V: 10 - 11 • Between U - W: 10 - 12 • Between V - W: 11 - 12
	Inspection condition		–
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and exhaust gas recirculation valve (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (U): electronic drive unit connector terminal No. 10 - exhaust gas recirculation valve connector terminal No. 8 • Motor (V): electronic drive unit connector terminal No. 11 - exhaust gas recirculation valve connector terminal No. 7 • Motor (W): electronic drive unit connector terminal No. 12 - exhaust gas recirculation valve connector terminal No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of exhaust gas recirculation valve unit (motor)
	Maintenance item		Measure value of resistance between following exhaust gas recirculation valve connector terminals • Between U - V: 8 - 7 • Between U - W: 8 - 6 • Between V - W: 7 - 6
	Inspection condition		• Keep exhaust gas recirculation valve installed on vehicle. • Remove harness connector, and measure exhaust gas recirculation valve side.
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of exhaust gas recirculation valve

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of exhaust gas recirculation valve connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 1 (+) and 5 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		10 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure value of voltage between following electronic drive unit connector terminals • U signal output: terminal 1 (+) - 4 (–) • V signal output: terminal 2 (+) - 4 (–) • W signal output: terminal 3 (+) - 4 (–)
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON • Perform Multi-Use Tester actuator test item No. A0 “EGR 1”
	Requirements		8 to 11 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and exhaust gas recirculation valve (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 8 - exhaust gas recirculation valve connector terminal No. 1 • Sensor (U): electronic drive unit connector terminal No. 1 - exhaust gas recirculation valve connector terminal No. 4 • Sensor (V): electronic drive unit connector terminal No. 2 - exhaust gas recirculation valve connector terminal No. 3 • Sensor (W): electronic drive unit connector terminal No. 3 - exhaust gas recirculation valve connector terminal No. 2 • Sensor (ground): electronic drive unit connector terminal No. 4 - exhaust gas recirculation valve connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of exhaust gas recirculation valve, go to step 16.
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A0 “EGR 1” **NOTE** • **As initial operational check of exhaust gas recirculation valve is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester. (check with service data “51: Actual EGR Valve Position”)
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P0426/Flash code: 42
[Monitor]
Characteristic abnormality of catalytic temperature sensor
[Fault (outline)]
Gain and offset drift
[Diagnosis check]
- Catalytic temperature sensor and DPF temperature sensor 1 are compared.

[Code generation condition]
- Difference in temperature output remains excessively high (over 150°C {302°F}) or low (below –150°C {–238°F}) for 10 seconds <Relative check> and 20 seconds <Separate check>. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Diesel particulate filter regeneration control: not effected
- Engine running time: more than 300 seconds
- Time after diesel particulate filter regeneration control was effected: more than 1500 seconds
- Engine speed and load: logical output is 1
- Time till above conditions were met: more than 30 seconds
- Catalytic temperature sensor: normal in output signal
- DPF temperature sensor 1: normal in output signal
- DPF temperature sensor 2: normal in output signal
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of catalytic temperature sensor

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0427/Flash code: 42
[Monitor]
Failure of catalytic temperature sensor
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Catalytic temperature sensor output voltage is monitored.

[Code generation condition]
- Catalytic temperature sensor output voltage remains below 0.36 V for 3 seconds. (sensor temperature: 1000°C {1832°F} or more)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

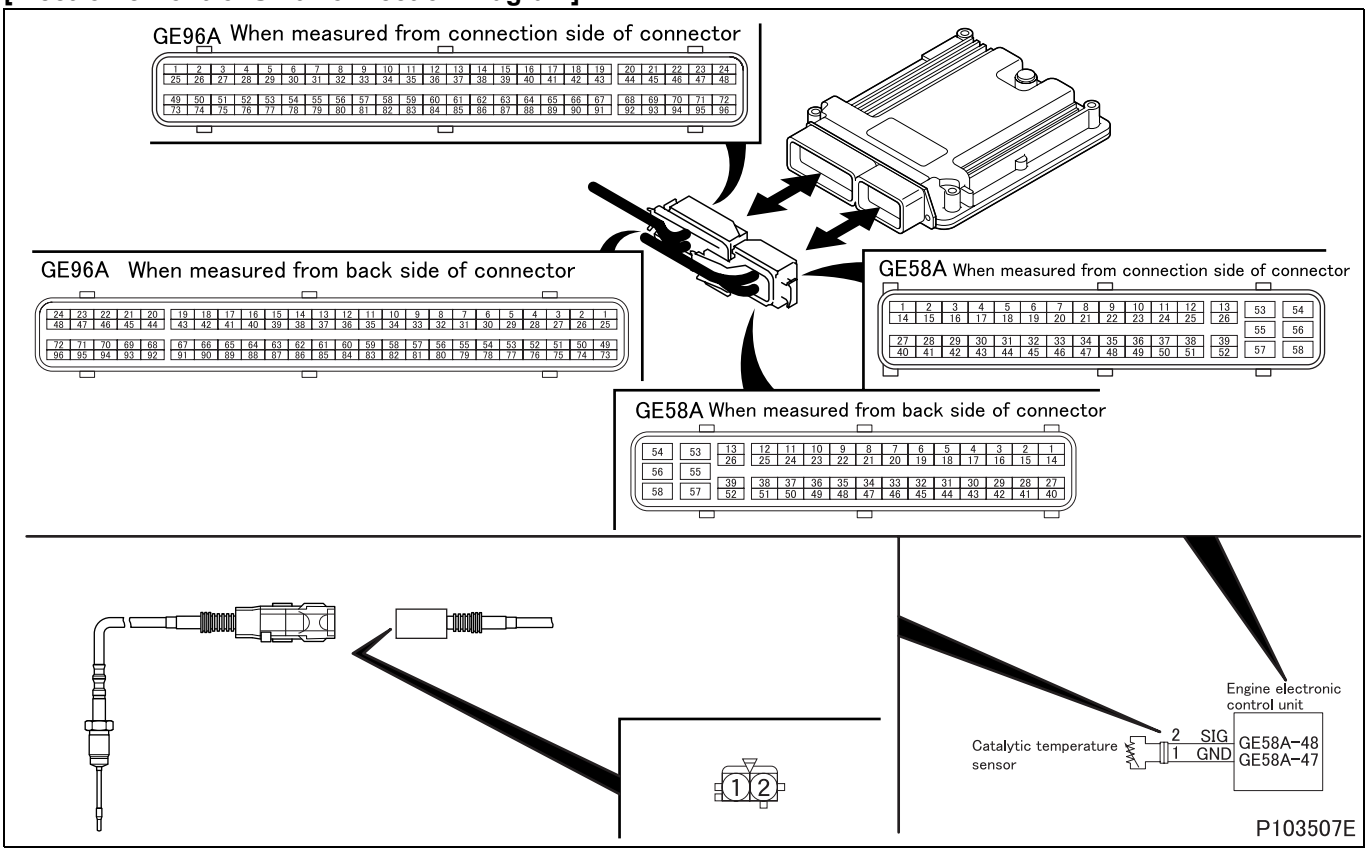
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

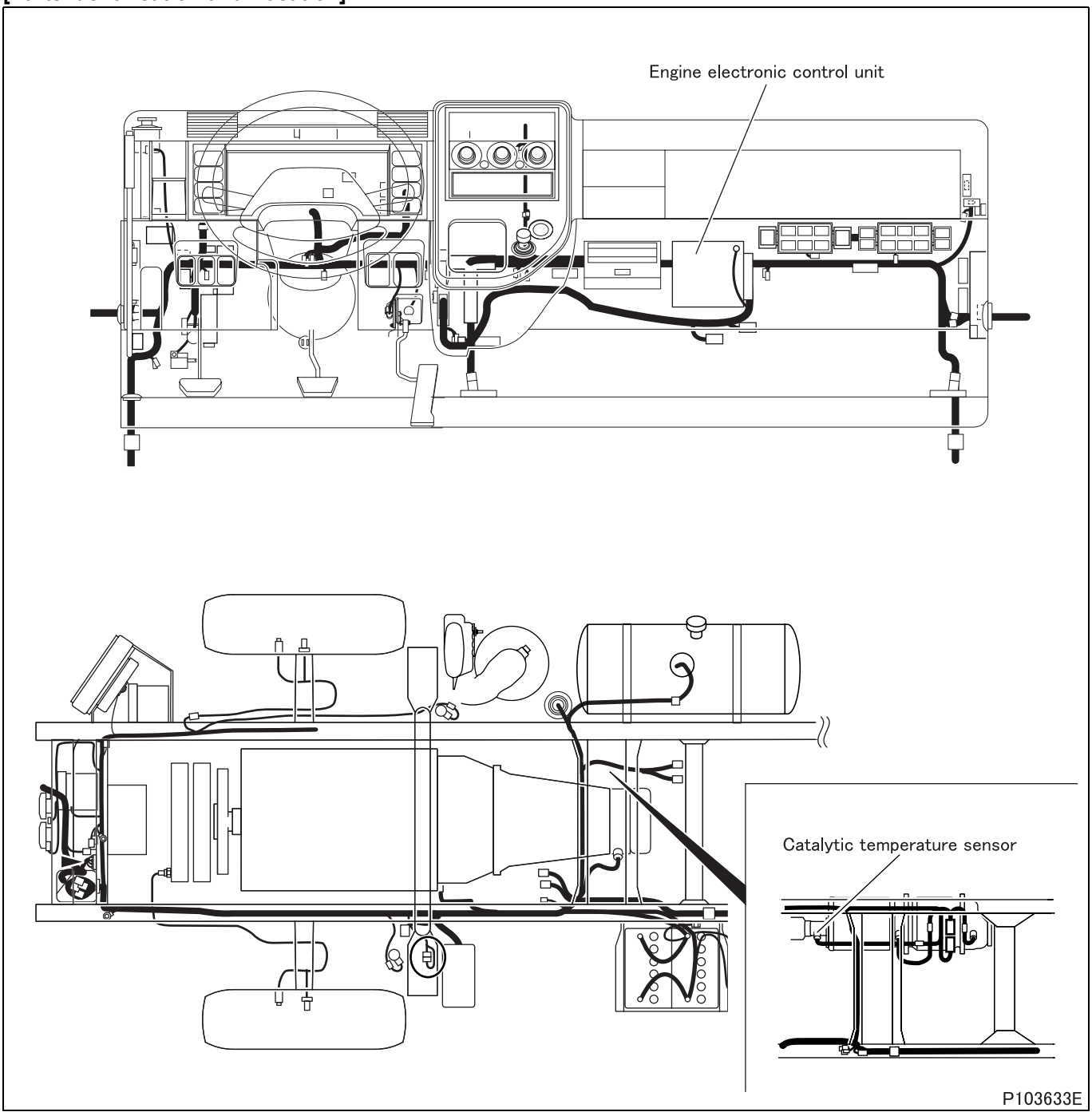
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit
- Malfunction of catalytic temperature sensor

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “OXI CAT Temperature”. **<Multi-Use Tester used>** • Measure item No. 24 “OXI CAT Temperature” of Service Data.
	Inspection condition		While engine is warmed up
	Requirements		Temperature gradually increases.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

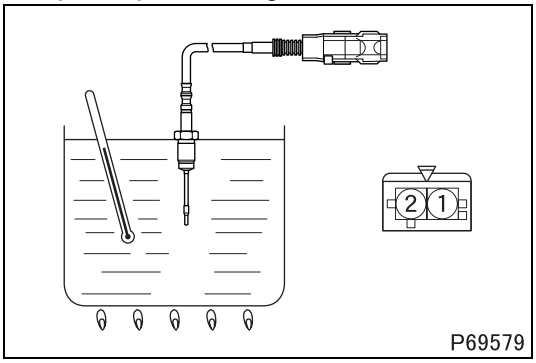
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE58A) terminal No. 48 and 47.
	Inspection condition		• Starter switch: OFF • Disconnect electronic control unit from harness and measure at vehicle-side connector half.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of catalytic temperature sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put catalytic temperature sensor in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 39 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 68 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “OXI CAT Temperature”. **<Multi-Use Tester used>** • Measure item No. 24 “OXI CAT Temperature” of Service Data.
	Inspection condition		While engine is warmed up
	Requirements		Temperature gradually increases.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0428/Flash code: 42
[Monitor]
Failure of catalytic temperature sensor
[Fault (outline)]
High signal range check
[Diagnosis check]
- Catalytic temperature sensor output voltage is monitored.

[Code generation condition]
- Catalytic temperature sensor output voltage remains over 4.93 V for 30 seconds when engine speed is set at 1000 to 5000 rpm. (sensor temperature: 40°C {118°F} or less) (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

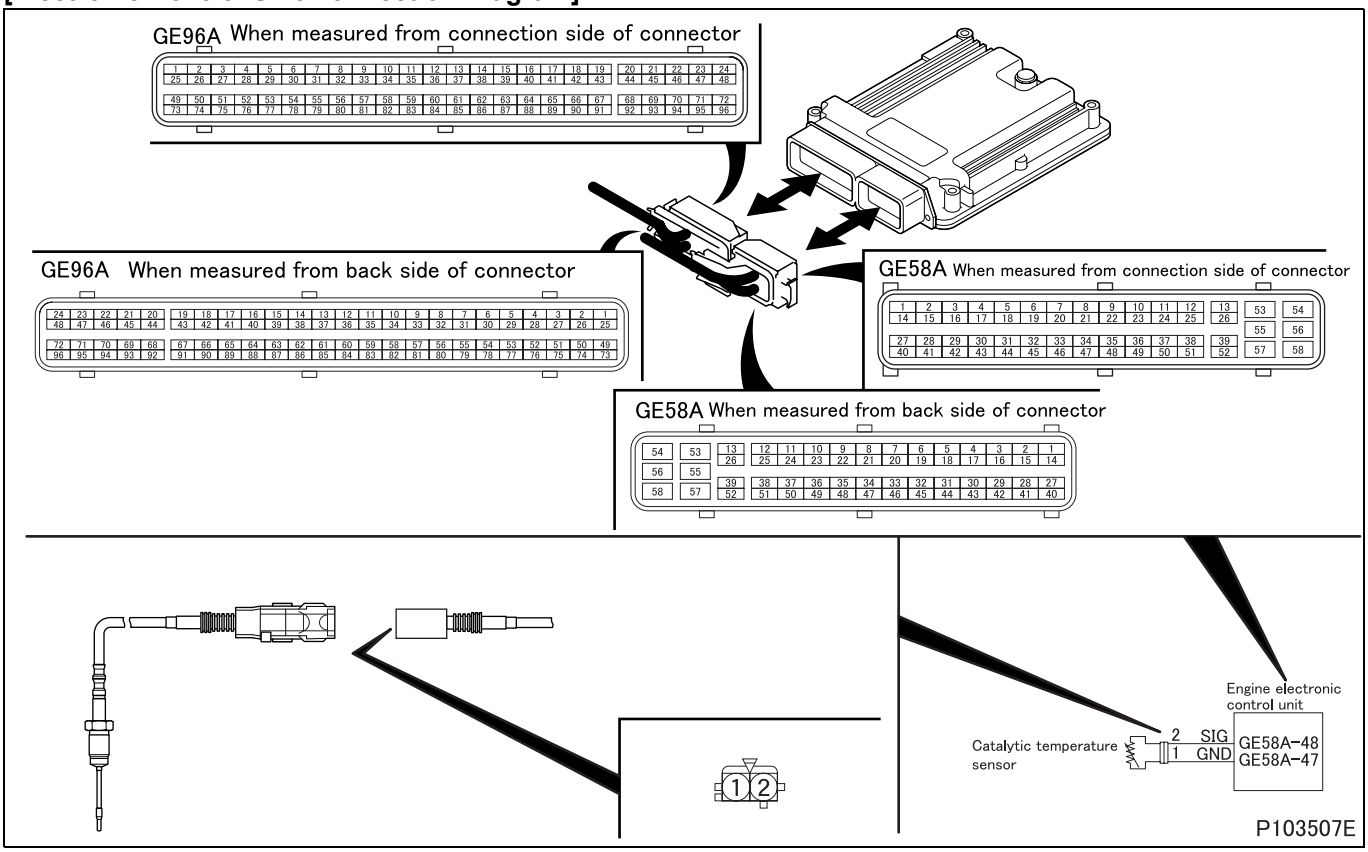
[Diagnostic requirement]
- Engine speed: 1000 to 5000 rpm
- Fuel injection quantity: 30 to 200 mg/cyc
- Water temperature: above –7°C {19°F}

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

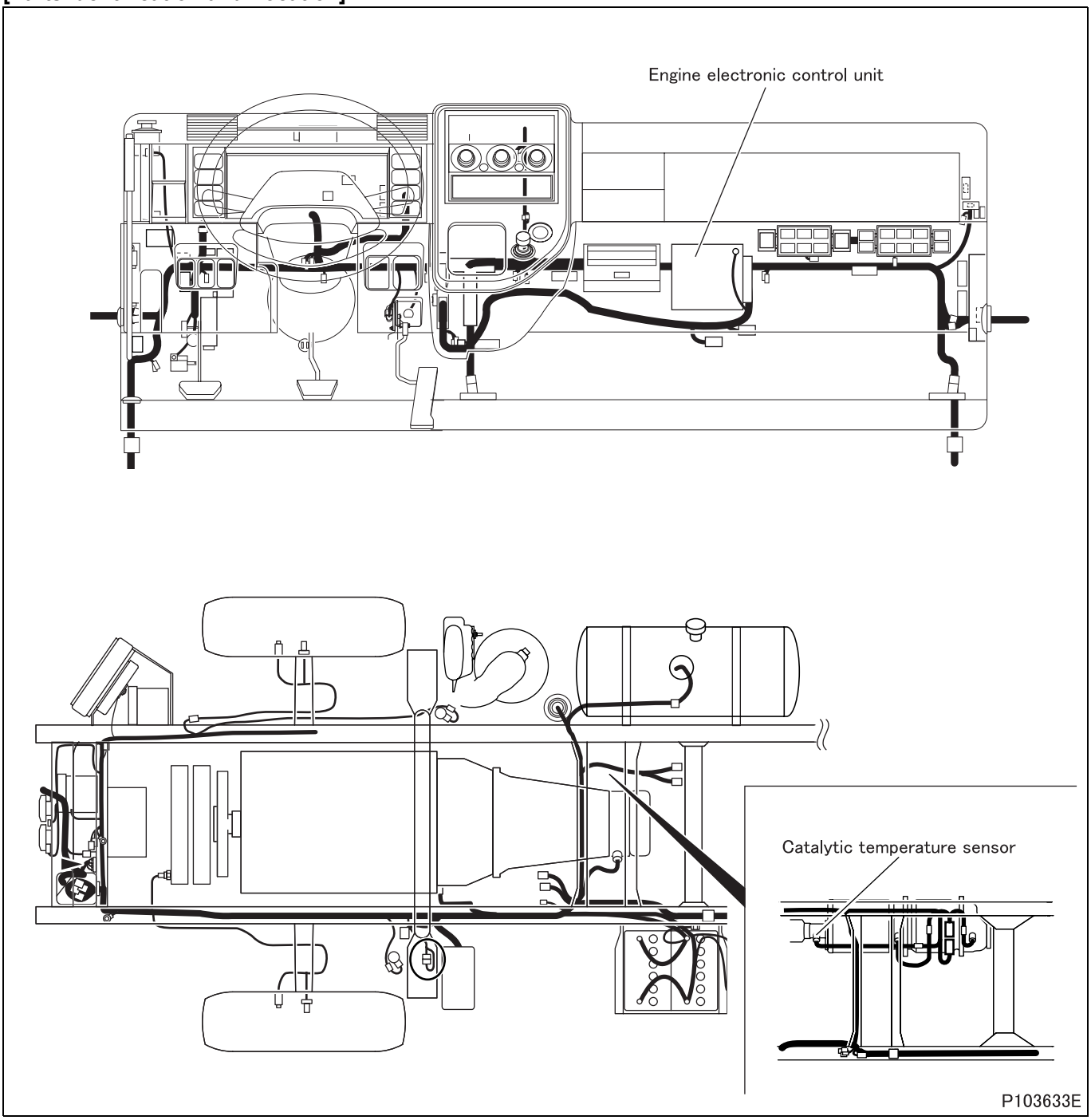
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit
- Malfunction of catalytic temperature sensor

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “OXI CAT Temperature”. **<Multi-Use Tester used>** • Measure item No. 24 “OXI CAT Temperature” of Service Data.
	Inspection condition		While engine is warmed up
	Requirements		Temperature gradually increases.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

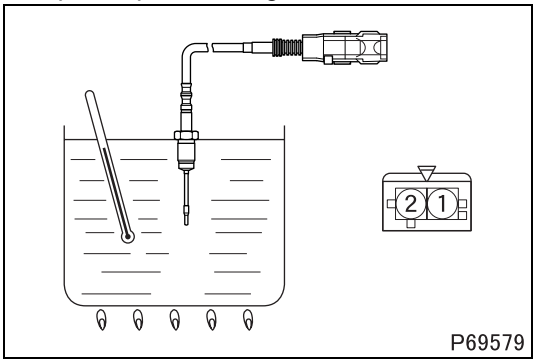
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE58A) terminal No. 48 and 47.
	Inspection condition		• Starter switch: OFF • Disconnect electronic control unit from harness and measure at vehicle-side connector half.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of catalytic temperature sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put catalytic temperature sensor in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 39 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 68 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “OXI CAT Temperature”. **<Multi-Use Tester used>** • Measure item No. 24 “OXI CAT Temperature” of Service Data.
	Inspection condition		While engine is warmed up
	Requirements		Temperature gradually increases.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0470/Flash code: 92
[Monitor]
Characteristic abnormality of DPF absolute pressure sensor and DPF pressure sensor (DIFF)
[Fault (outline)]
- Gain drift
- Offset and gain drift

[Diagnosis check]
- Relative check of DPF absolute pressure sensor and DPF pressure sensor (DIFF)

[Code generation condition]
- Difference in output between DPF pressure sensor (DIFF) and DPF absolute pressure sensor remains more than specified for 10 seconds. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine speed: 500 to 3000 rpm
- Air flow rate: 80 to 650 kg/hr
- Water temperature: 0 to 110°C {32 to 230°F}
- Fuel injection quantity: 15 to 100 mg/cyc
- Atmospheric pressure: 900 to 1050 mbar {13.05 to 15.22 psi}
- Intake air temperature: 0 to 60°C {32 to 140°F}
- Air flow sensor: in order
- Atmospheric pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- DPF absolute pressure sensor: normal in output signal
- DPF pressure sensor (DIFF): normal in output signal
- DPF temperature sensor 1: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Relative check of DPF absolute pressure sensor

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of DPF absolute pressure sensor and DPF pressure sensor (DIFF)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0471/Flash code: 98
[Monitor]
Failure of DPF absolute pressure sensor
[Fault (outline)]
Offset drift
[Diagnosis check]
- Difference in pressure output between atmospheric pressure sensor and DPF absolute pressure sensor is monitored for deviation from specified value after engine start.

[Code generation condition]
- Difference in pressure output between atmospheric pressure sensor and DPF absolute pressure sensor exceeds 10 kPa {1.5 psi, 0.1 kgf/cm^2} after engine run.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

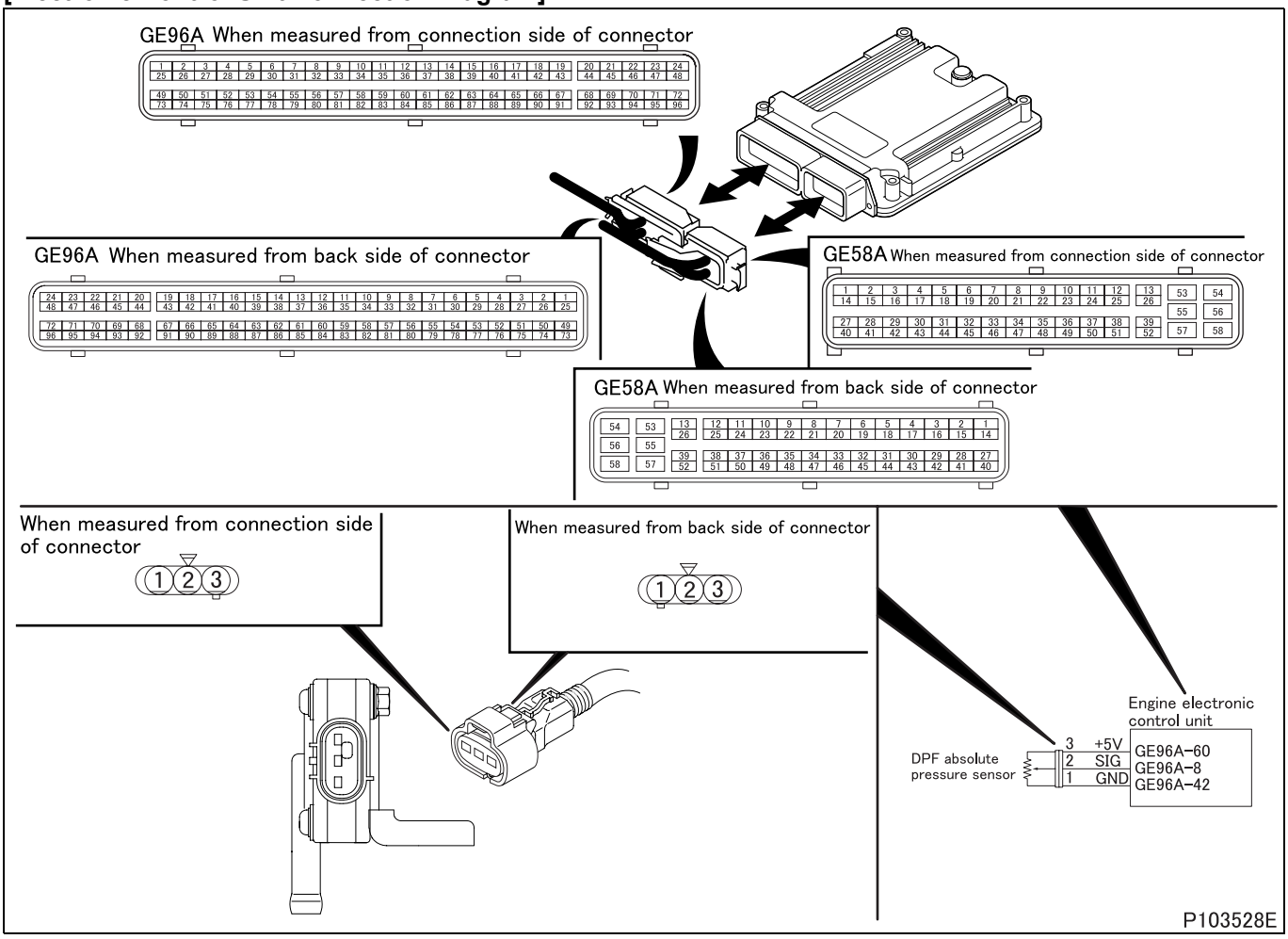
[Diagnostic requirement]
- Engine status: after-run

[Control effected by electronic control unit during fault]
- Pressure before ceramic diesel particulate filter is fixed at backup value.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.
- Malfunction of DPF absolute pressure sensor

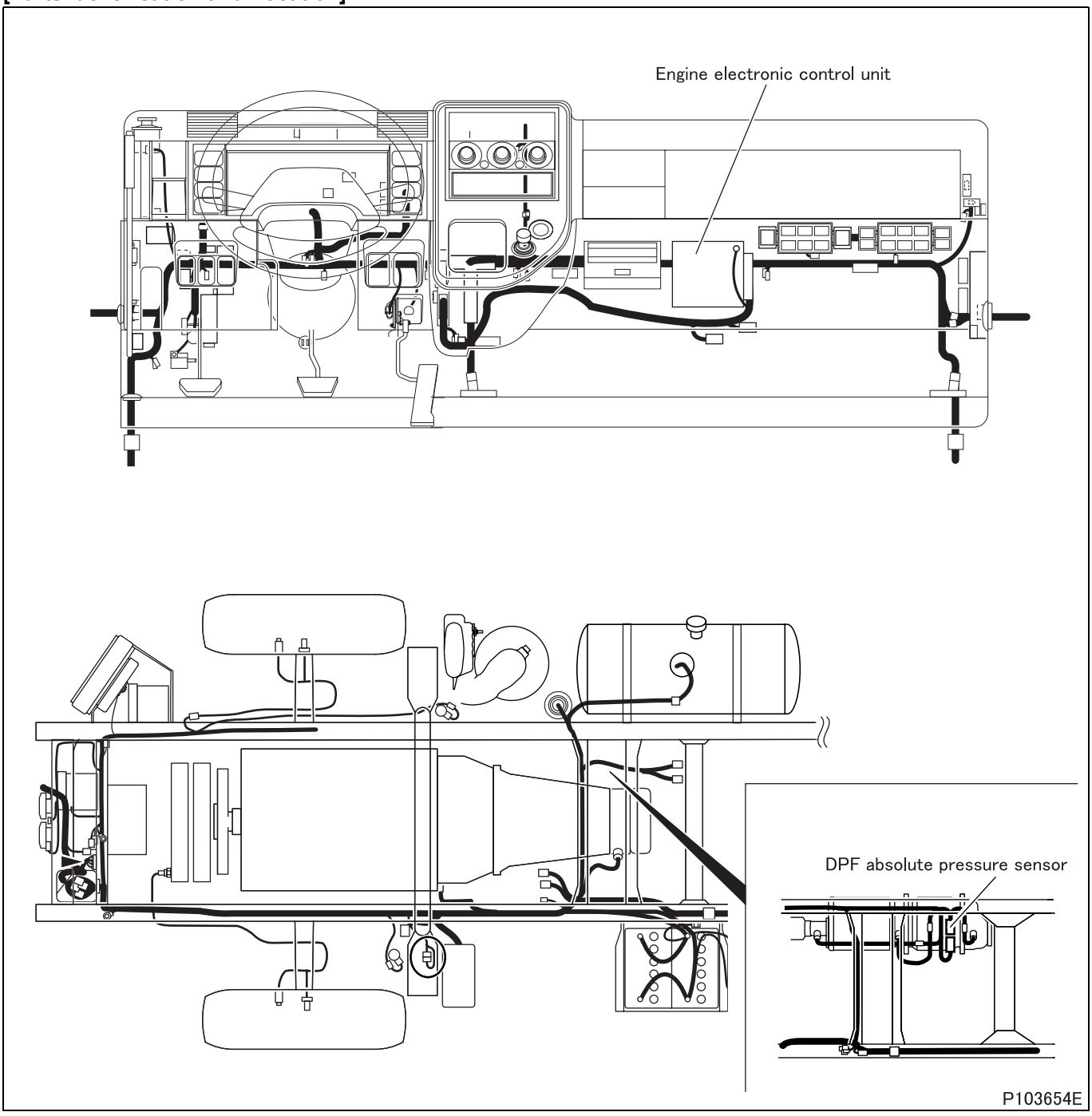
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- High pressure side (upper stream) pressure hose slipped off or clogged
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Starter switch: ON Engine: stopped
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 23 “Exhaust gas pressure” of Service Data.
	Inspection condition		–
	Requirements		0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 8 (+) and 42 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		1.875 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 4.

Step 4	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 60 (+) and 42 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 6.

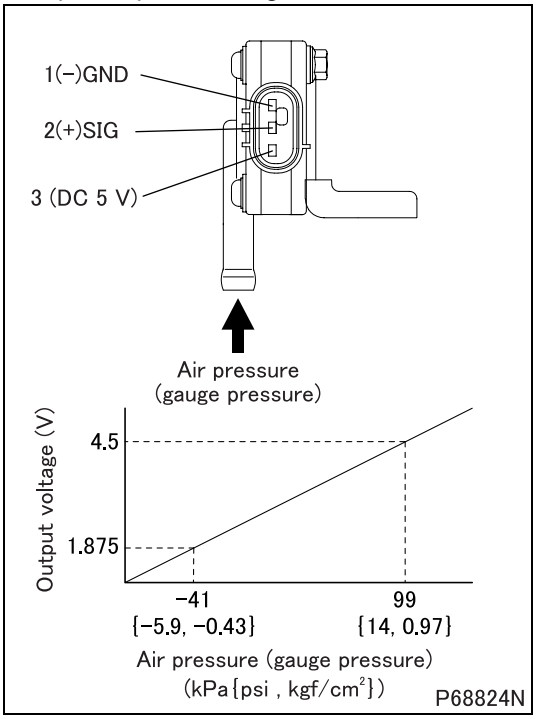
Step 5	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 42 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 8	Inspection items		Inspection of DPF absolute pressure sensor unit
	Maintenance item		Measure value of voltage between terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across connector terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 41 ± 3.2 kPa {5.9 ± 0.5 psi, 0.43 ± 0.03 kgf/cm^2}: 1.875 V • 99 ± 3.2 kPa {14 ± 0.5 psi, 1.0 ± 0.03 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of sensor

<Step 8 inspection diagram>



Step 9	Inspection items		Inspection by sensor connector
	Maintenance item		Measure value of voltage between terminal No. 3 (+) and 1 (–)
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Go to step 10.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 60 and sensor connector terminal No. 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 42 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 8 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify harness.

Step 13	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 23 “Exhaust gas pressure” of Service Data.
	Inspection condition		–
	Requirements		0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0472/Flash code: 98
[Monitor]
Failure of DPF absolute pressure sensor
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Output voltage of DPF absolute pressure sensor is monitored.

[Code generation condition]
- Output voltage of DPF absolute pressure sensor remains below 0.2 V for 1 second. (sensor pressure: –29 kPa {–4.2 psi, –0.3 kgf/cm^2} or less)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

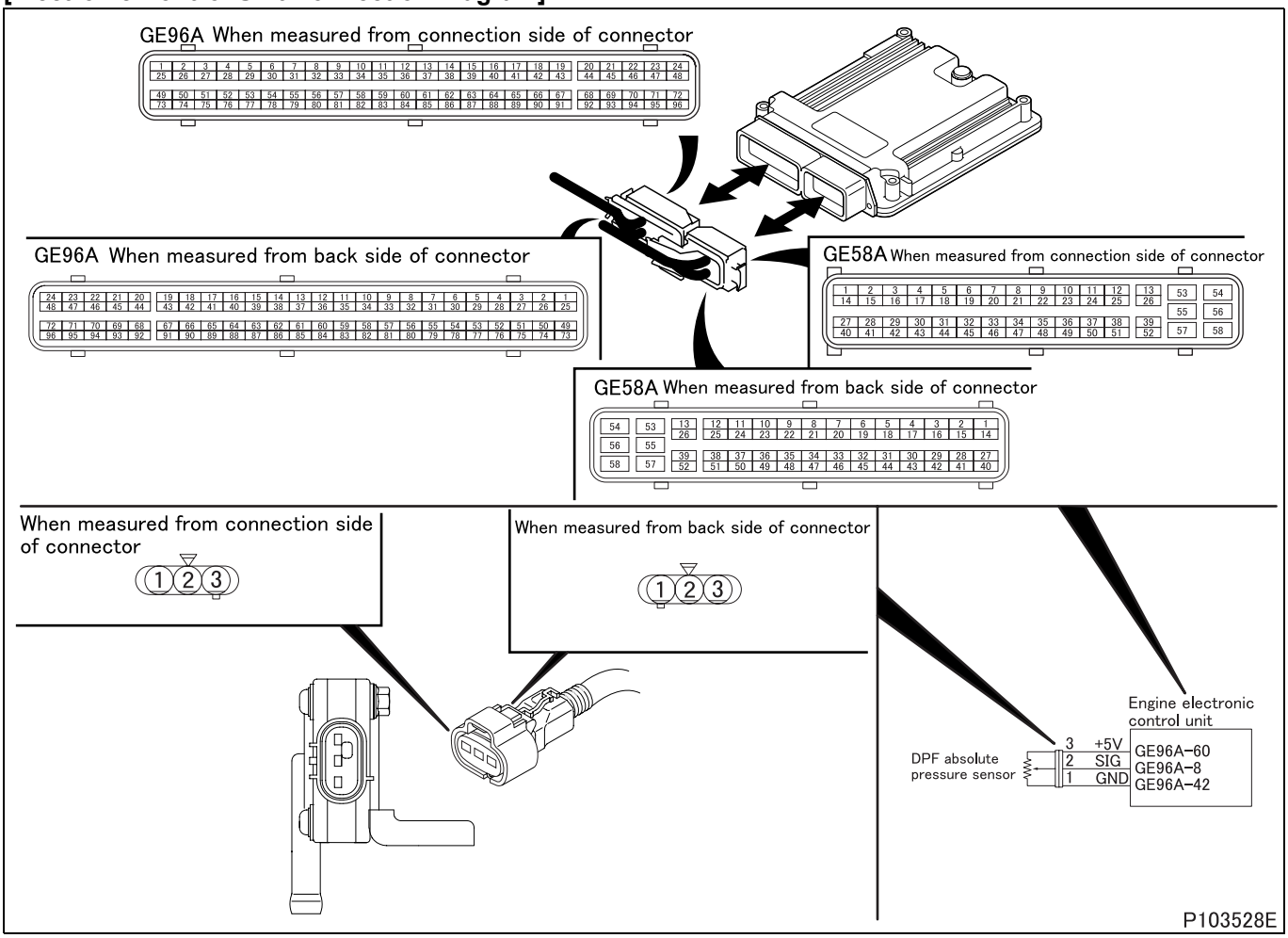
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Pressure before ceramic diesel particulate filter is fixed at backup value.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

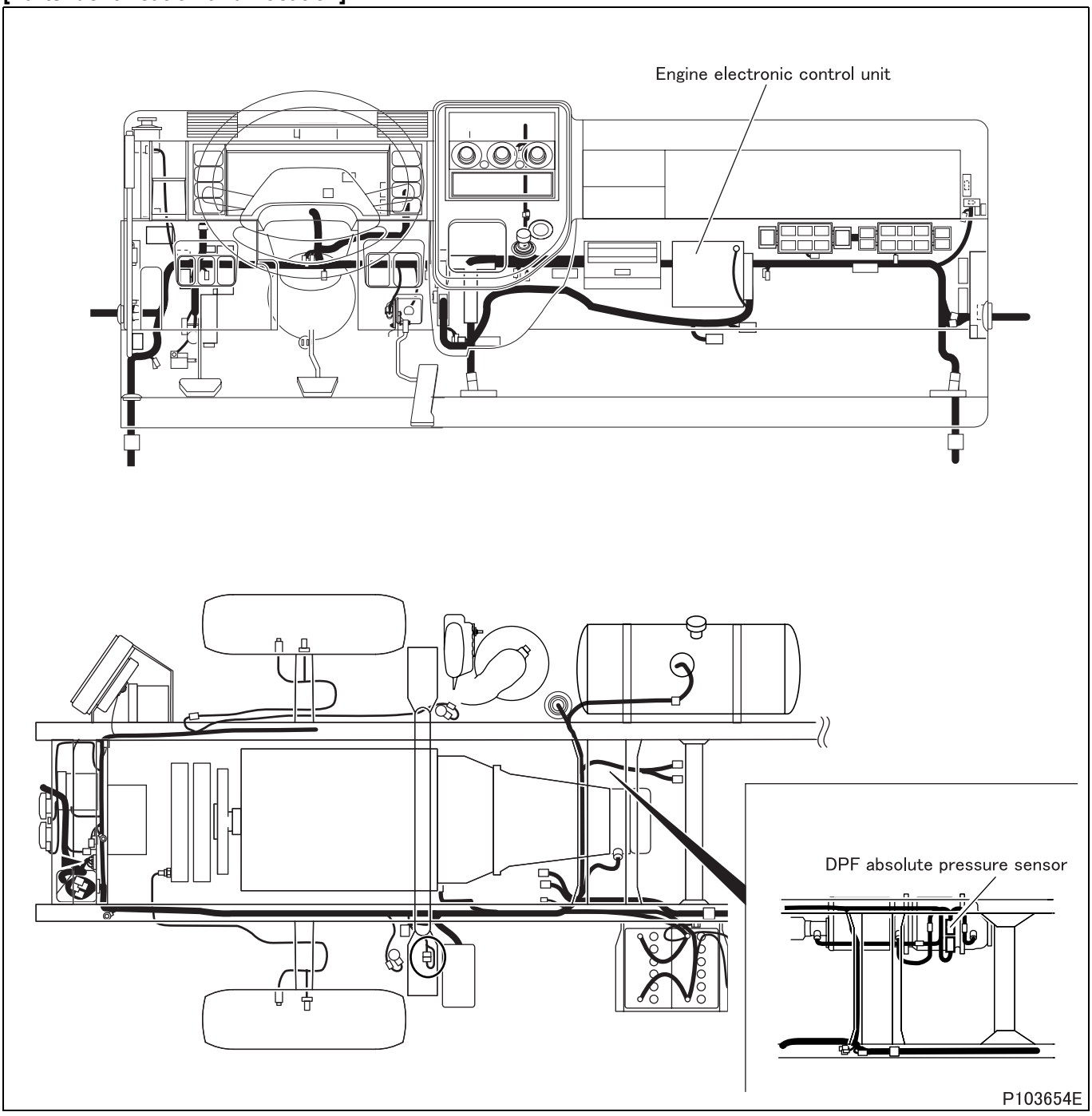
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Starter switch: ON Engine: stopped
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 23 “Exhaust gas pressure” of Service Data.
	Inspection condition		–
	Requirements		0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 8 (+) and 42 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		1.875 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 4.

Step 4	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 60 (+) and 42 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 6.

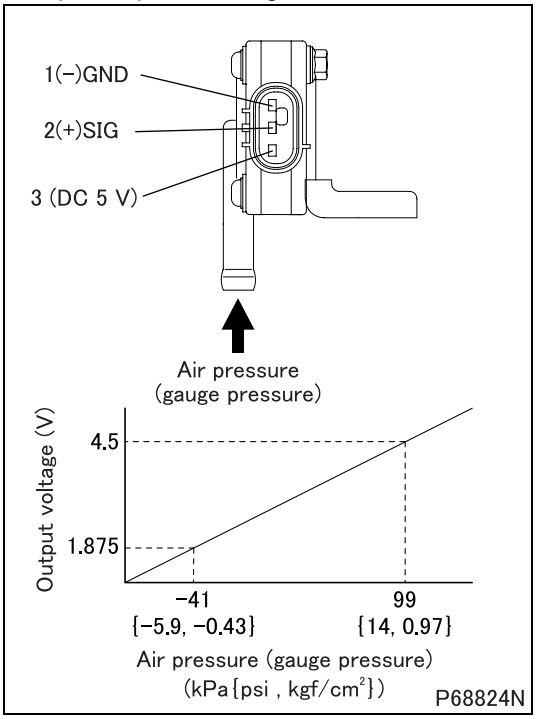
Step 5	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 42 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 8	Inspection items		Inspection of DPF absolute pressure sensor unit
	Maintenance item		Measure value of voltage between terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across connector terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 41 ± 3.2 kPa {5.9 ± 0.5 psi, 0.43 ± 0.03 kgf/cm^2}: 1.875 V • 99 ± 3.2 kPa {14 ± 0.5 psi, 1.0 ± 0.03 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of sensor

<Step 8 inspection diagram>



Step 9	Inspection items		Inspection by sensor connector
	Maintenance item		Measure value of voltage between terminal No. 3 (+) and 1 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Go to step 10.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 60 and sensor connector terminal No. 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 42 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 8 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify harness.

Step 13	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 23 “Exhaust gas pressure” of Service Data.
	Inspection condition		–
	Requirements		0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0473/Flash code: 98
[Monitor]
Failure of DPF absolute pressure sensor
[Fault (outline)]
High signal range check
[Diagnosis check]
- Output voltage of DPF absolute pressure sensor is monitored.

[Code generation condition]
- Output voltage of DPF absolute pressure sensor remains over 4.8 V for 1 second. (sensor pressure: 216 kPa {31 psi, 2.2 kgf/cm^2} or more)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

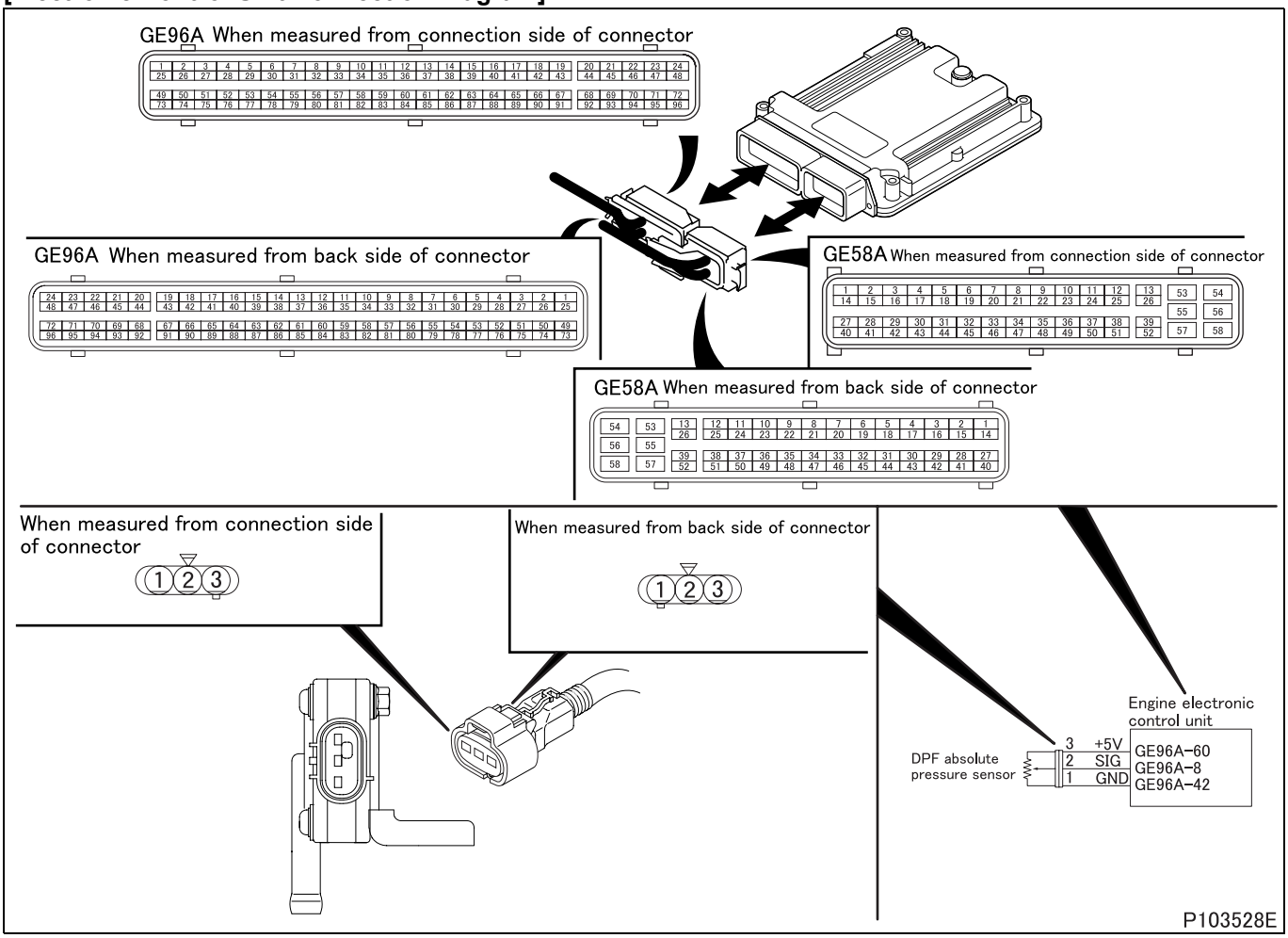
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Pressure before ceramic diesel particulate filter is fixed at backup value.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

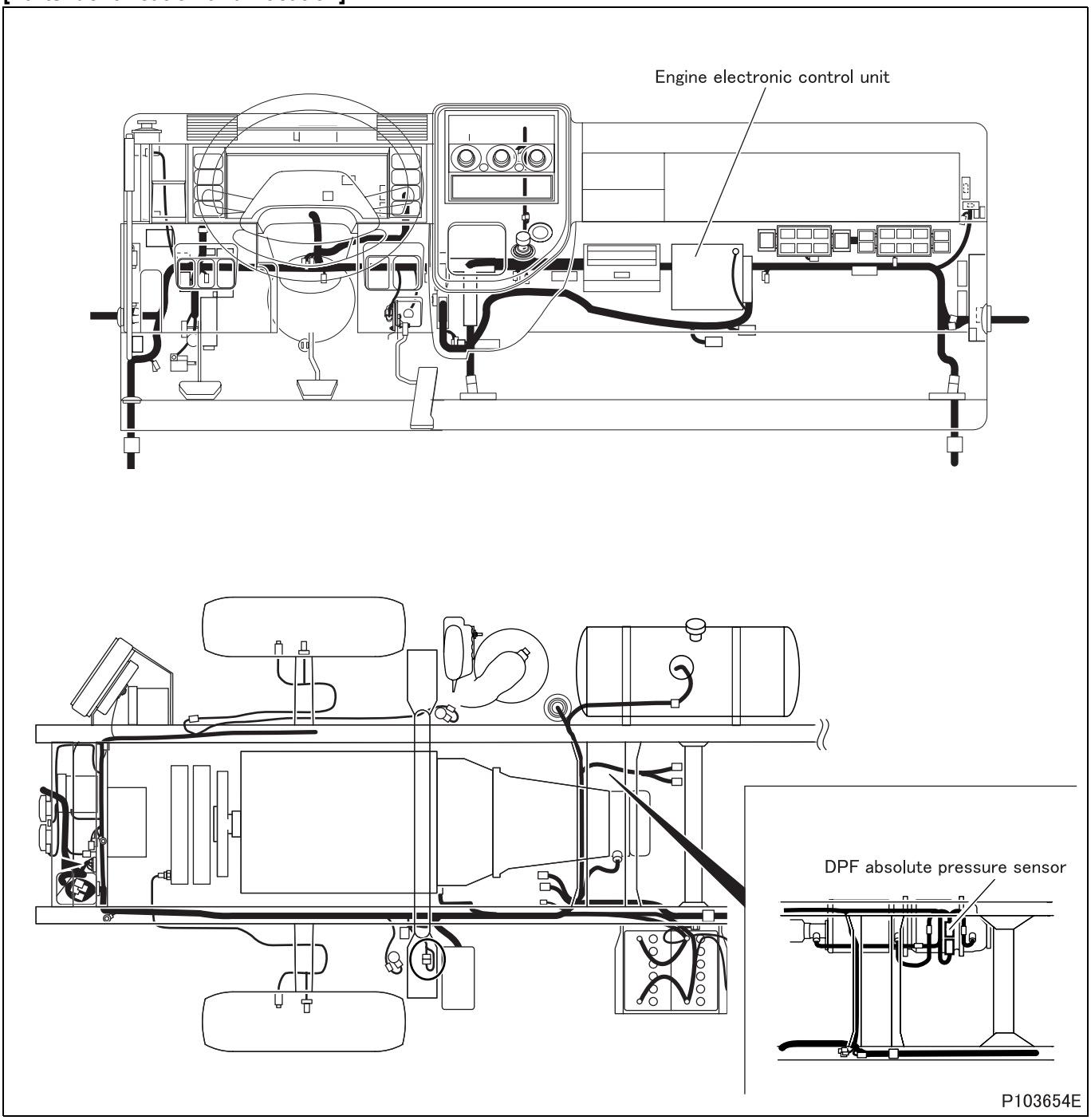
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Starter switch: ON Engine: stopped
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 23 “Exhaust gas pressure” of Service Data.
	Inspection condition		–
	Requirements		0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 8 (+) and 42 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		1.875 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 4.

Step 4	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 60 (+) and 42 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 6.

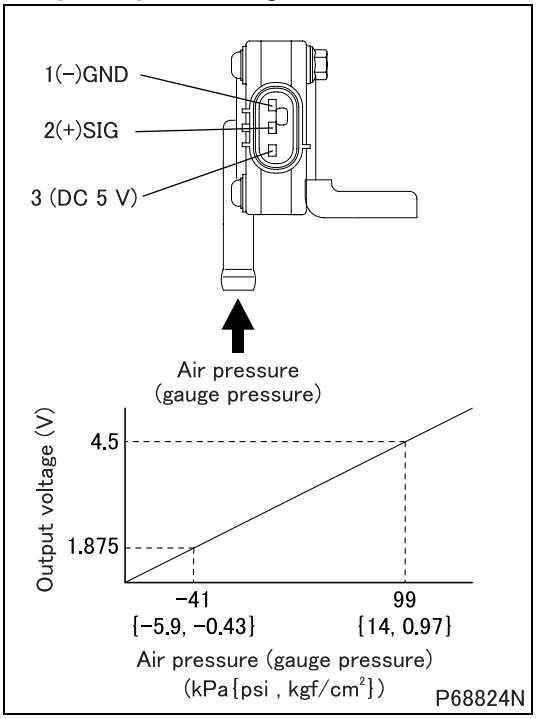
Step 5	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 42 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 8	Inspection items		Inspection of DPF absolute pressure sensor unit
	Maintenance item		Measure value of voltage between terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across connector terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 41 ± 3.2 kPa {5.9 ± 0.5 psi, 0.43 ± 0.03 kgf/cm^2}: 1.875 V • 99 ± 3.2 kPa {14 ± 0.5 psi, 1.0 ± 0.03 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of sensor

<Step 8 inspection diagram>



Step 9	Inspection items		Inspection by sensor connector
	Maintenance item		Measure value of voltage between terminal No. 3 (+) and 1 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Go to step 10.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 60 and sensor connector terminal No. 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 42 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 8 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify harness.

Step 13	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 23 “Exhaust gas pressure” of Service Data.
	Inspection condition		–
	Requirements		0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0476/Flash code: 93
[Monitor]
Failure of exhaust brake
[Fault (outline)]
Valve stuck open/shut
[Diagnosis check]
- Air flow sensor output (intake air flow rate) is monitored for valve being stuck in that state when commanded to open or close by engine electronic control unit.

[Code generation condition]
Diagnosis code is generated under either of the following conditions. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)
<When valve is commanded to open>
- Intake air flow rate remains less than specified for 5 seconds.

<When valve is commanded to close>
- Intake air flow rate remains more than specified for 5 seconds.

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

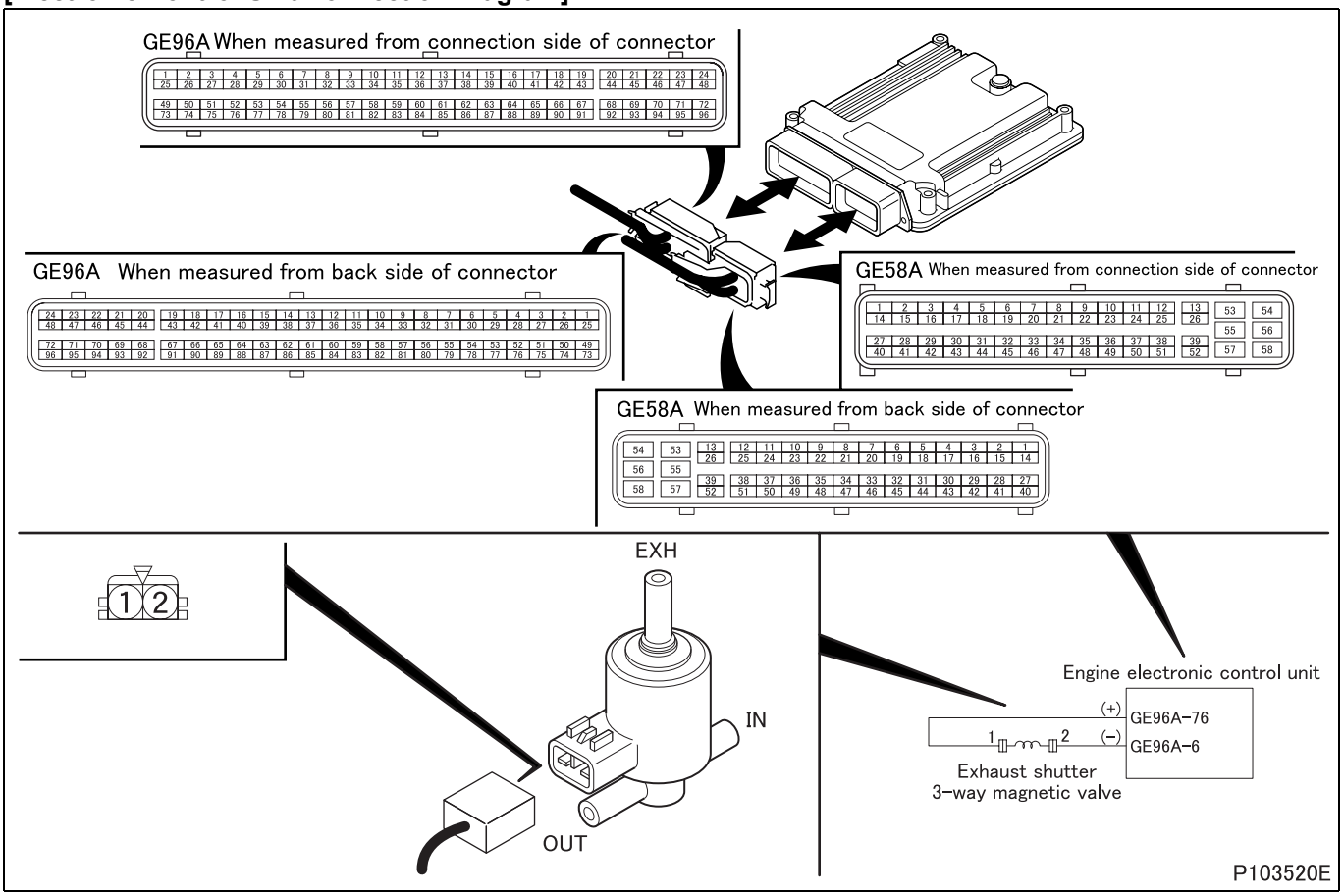
[Diagnostic requirement]
- Engine operating mode: normal (engine in operation)
- Engine speed: 1250 to 2750 rpm
- Accelerator pedal position: less than 2%
- Water temperature: 64 to 100°C {147 to 212°F}
- Intake air temperature: –7 to 60°C {19 to 140°F}
- Boost pressure: more than 750 rpm
- Exhaust gas recirculation valve position: 0 to 2 mm {0 to 0.079 in.}
- Air flow sensor: in order
- Accelerator pedal position sensor: in order
- Exhaust gas recirculation flow rate and exhaust gas recirculation valve operation: in order
- Exhaust gas recirculation valve position sensor: in order
- Battery voltage: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Exhaust shutter 3-way magnetic valve: in order
- Intake air temperature sensor: in order
- Sensor 5 V power supply: in order

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

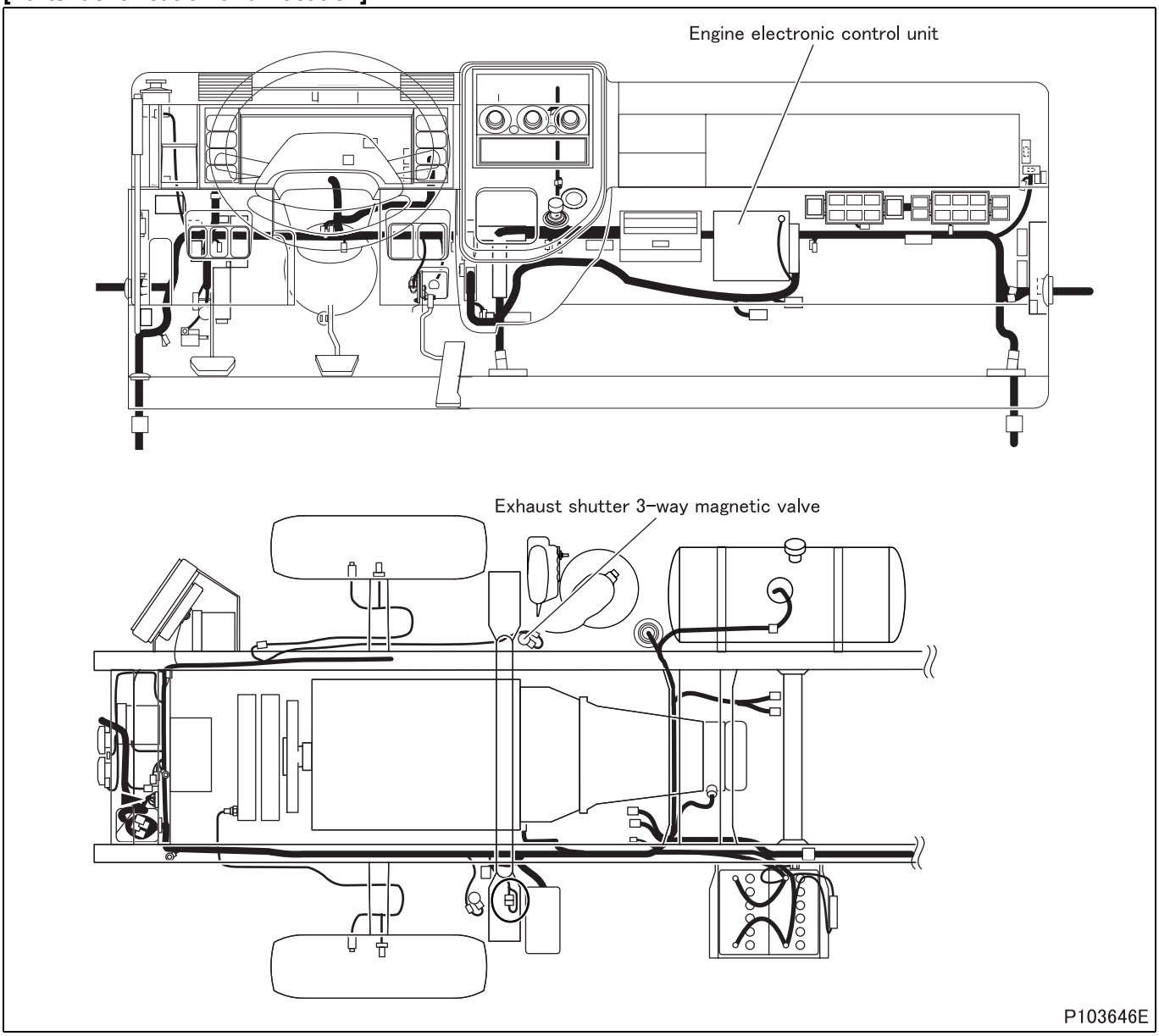
[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and exhaust shutter 3-way magnetic valve
- Malfunction of each connector
- Malfunction of exhaust shutter 3-way magnetic valve
- Malfunction of electronic control unit
- Malfunction of exhaust shutter unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

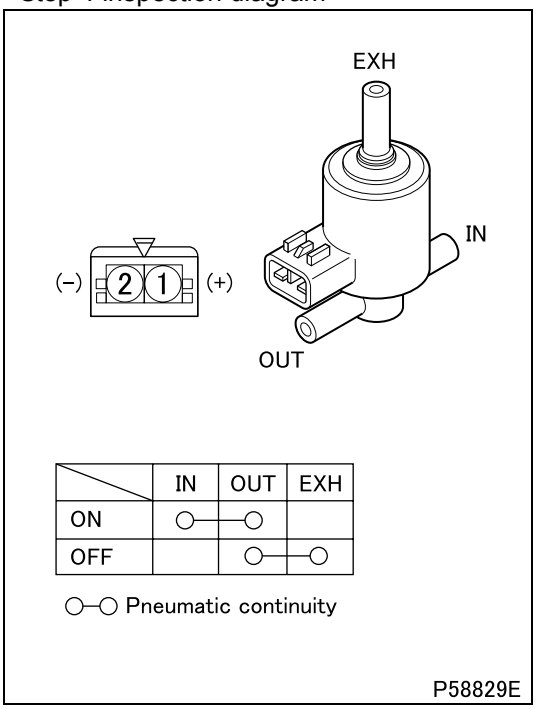
Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 6 and 76.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		48 Ω or more
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of exhaust shutter 3-way magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of exhaust shutter 3-way magnetic valve unit
	Maintenance item		Measure minimum operating voltage when 3-way magnetic valve operates (judge by operation sound).
	Inspection condition		Gradually increase from zero the voltage applied to terminals No. 1 (+) and 2 (–).
	Requirements		11 V or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of 3-way magnetic valve

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 76.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 1 and chassis ground.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 6.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AA “Auxiliary Brake M/V 1”
	Inspection condition		Starter switch: ON
	Requirements		3-way magnetic valve operation sound is noted.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0489/Flash code: 67
[Monitor]
Failure of exhaust gas recirculation system
[Fault (outline)]
Power out of range
[Diagnosis check]
- Exhaust gas recirculation electronic drive unit monitors power supply voltage of electronic drive unit and sends fault information to engine electronic control unit through controller area network communication.

[Code generation condition]
- Voltage of exhaust gas recirculation electronic drive unit remains below 7 V for 13 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

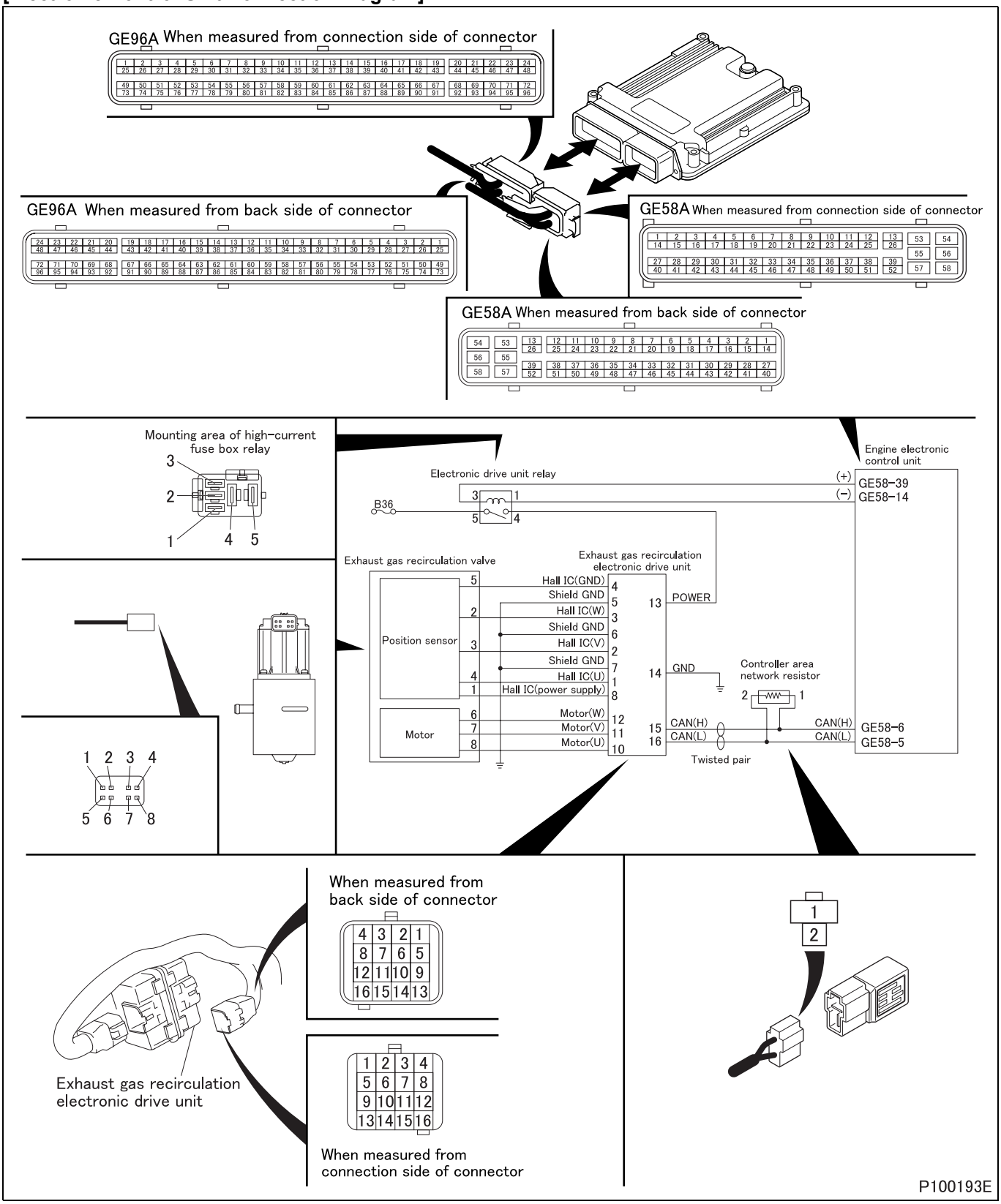
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Related fault check is stopped.

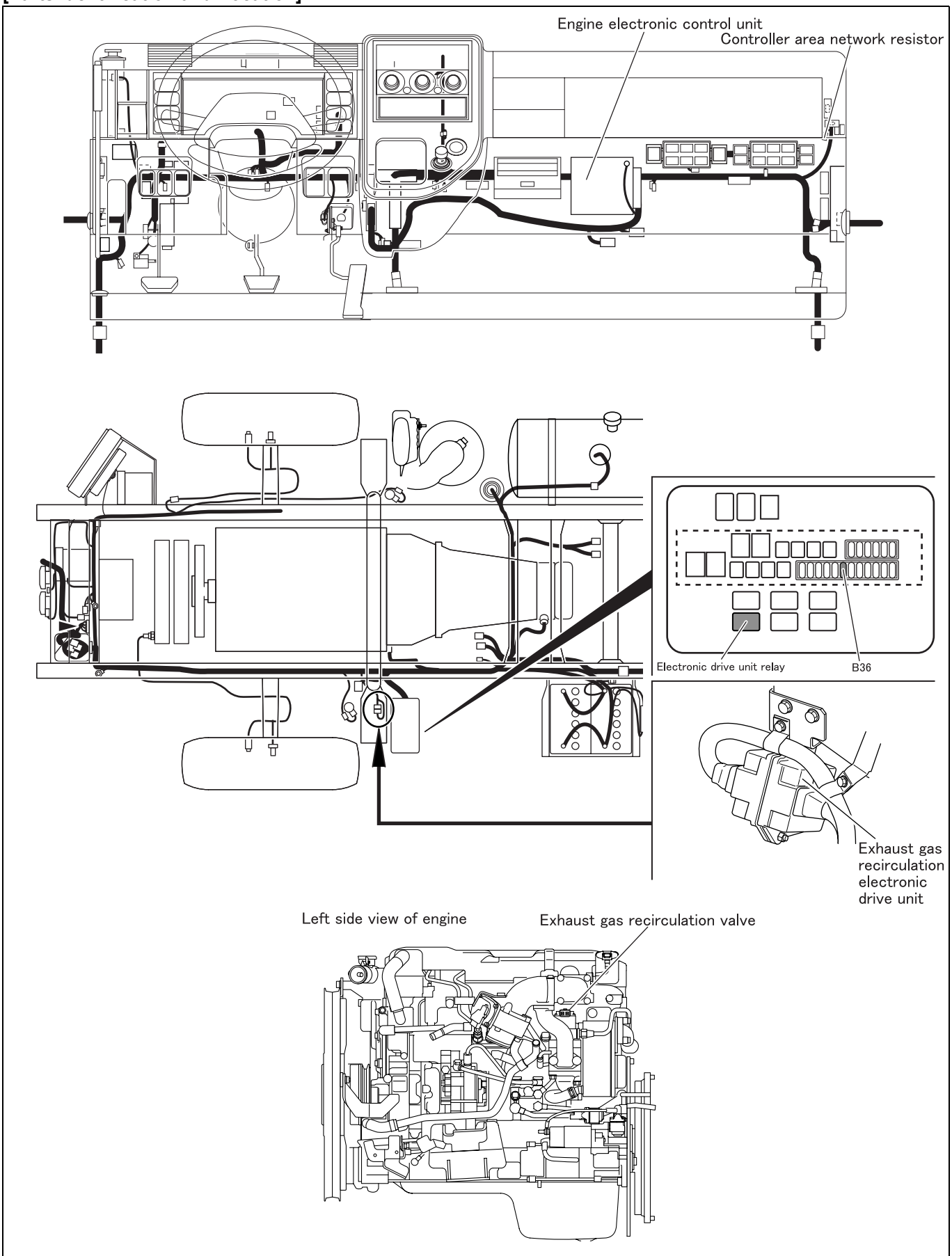
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and battery
- Malfunction of each connector
- Malfunction of battery
- Malfunction of electronic drive unit relay
- Malfunction of electronic drive unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)” • P0688 “EDU Relay (Over Load)”
	Inspection condition		• Starter switch: ON • Engine: stopped
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Remove connector and measure from harness side. • Perform actuator test item No. AF “EDU Relay”
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 4.

Step 4	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B36 and relay connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of electronic drive unit relay, go to step 7
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between electronic drive unit connector terminal No. 14 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic drive unit
		NO	Modify harness.

[Fault code]
Diagnosis code: P0490/Flash code: 67
[Monitor]
Failure of exhaust gas recirculation system
[Fault (outline)]
Power out of range
[Diagnosis check]
- Exhaust gas recirculation electronic drive unit monitors power supply voltage of electronic control drive unit and sends fault information to engine electronic control unit through controller area network communication.

[Code generation condition]
- Voltage of exhaust gas recirculation electronic drive unit remains over 19 V for 5 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

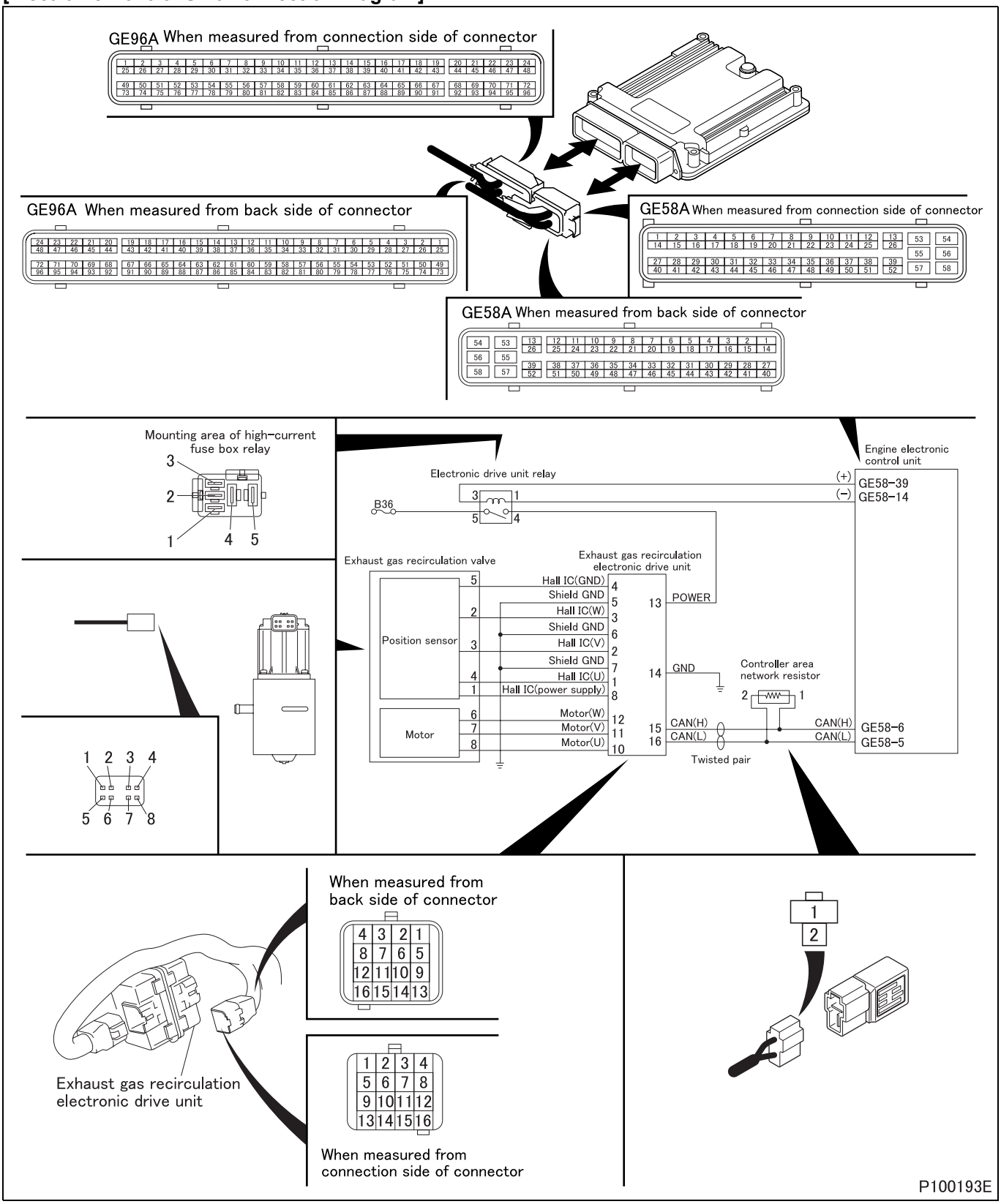
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Related fault check is stopped.

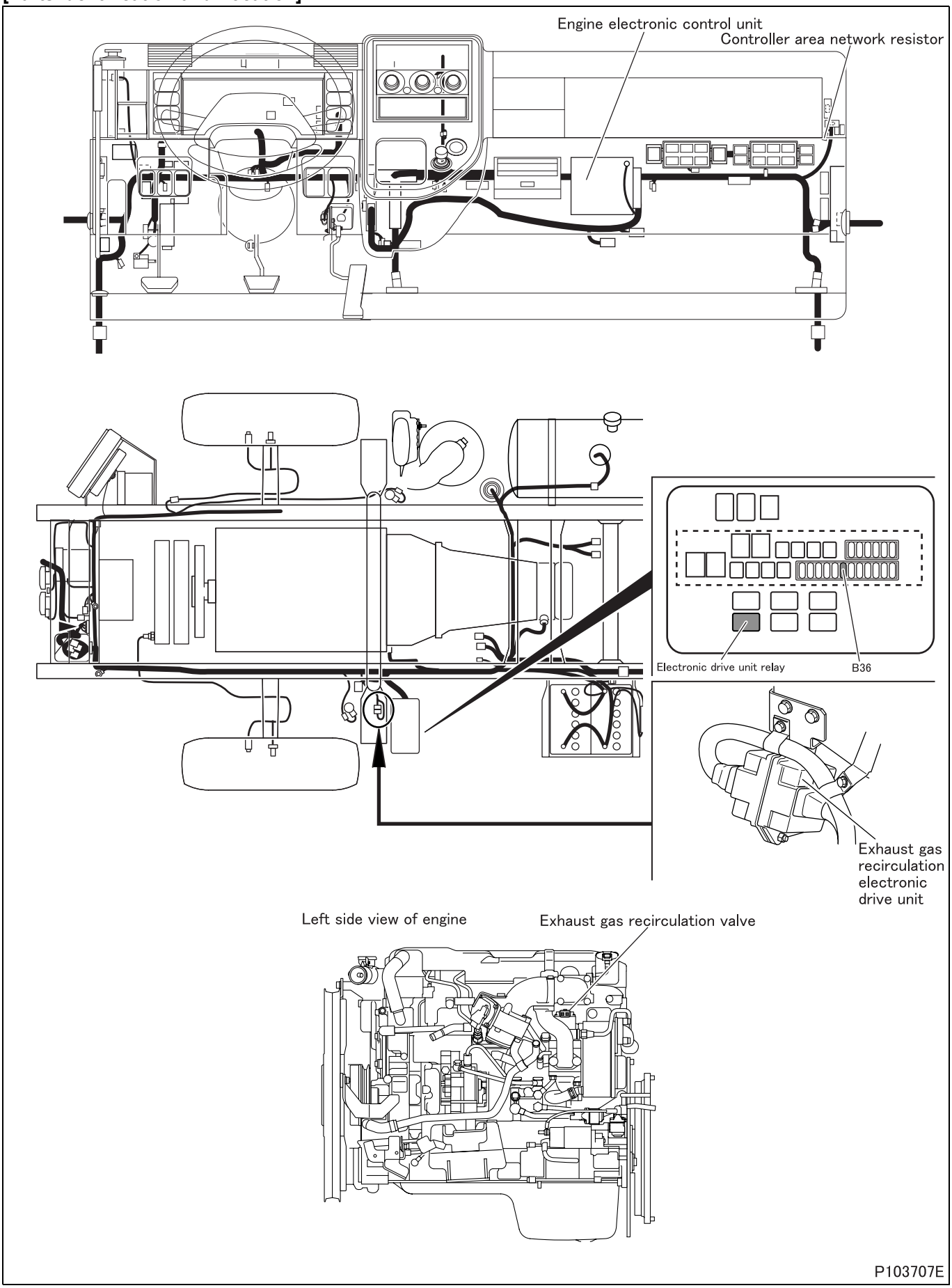
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and battery
- Malfunction of each connector
- Malfunction of battery
- Malfunction of electronic drive unit relay
- Malfunction of electronic drive unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)” • P0688 “EDU Relay (Over Load)”
	Inspection condition		• Starter switch: ON • Engine: stopped
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Remove connector and measure from harness side. • Perform actuator test item No. AF “EDU Relay”
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 4.

Step 4	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B36 and relay connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of electronic drive unit relay, go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between electronic drive unit connector terminal No. 14 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic drive unit
		NO	Modify harness.

[Fault code]
Diagnosis code: P0500/Flash code: 25
[Monitor]
Failure of vehicle speed sensor
[Fault (outline)]
Signal
[Diagnosis check]
- Vehicle speed sensor output signal is monitored. (no pulse)

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Condition (1)>
- Error in vehicle speed processing function in engine electronic control unit occurs and remains for 0.1 second. (Warning lamp (red) is lit and diagnosis code is displayed on third establishment of code generation condition.)

<Condition (2)>
- Vehicle speed remains below 2 km/h {1.24 MPH} as detected for 20 or 60 seconds when engine speed is 1000 rpm and transmission is in neutral.
  (Warning lamp (orange) is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
<Condition (1)>
- Fault diagnosis is performed only once during the driving cycle.

<Condition (2)>
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
Electronic control unit varies in the way of control by the color of warning lamp.
<Warning lamp: Orange>
- Vehicle speed is fixed at backup value.
- Misfire detection is stopped.
- In-use performance counter is stopped.
- Auto cruise control stopped
- Speed limitation device control is stopped.
- Idle up is stopped.
- Related fault check is stopped.

<Warning lamp: Red>
- Vehicle speed is fixed at backup value.
- Auto cruise control stopped
- Speed limitation device control is stopped.
- Traveled distance computation is stopped.
- Related fault check is stopped.

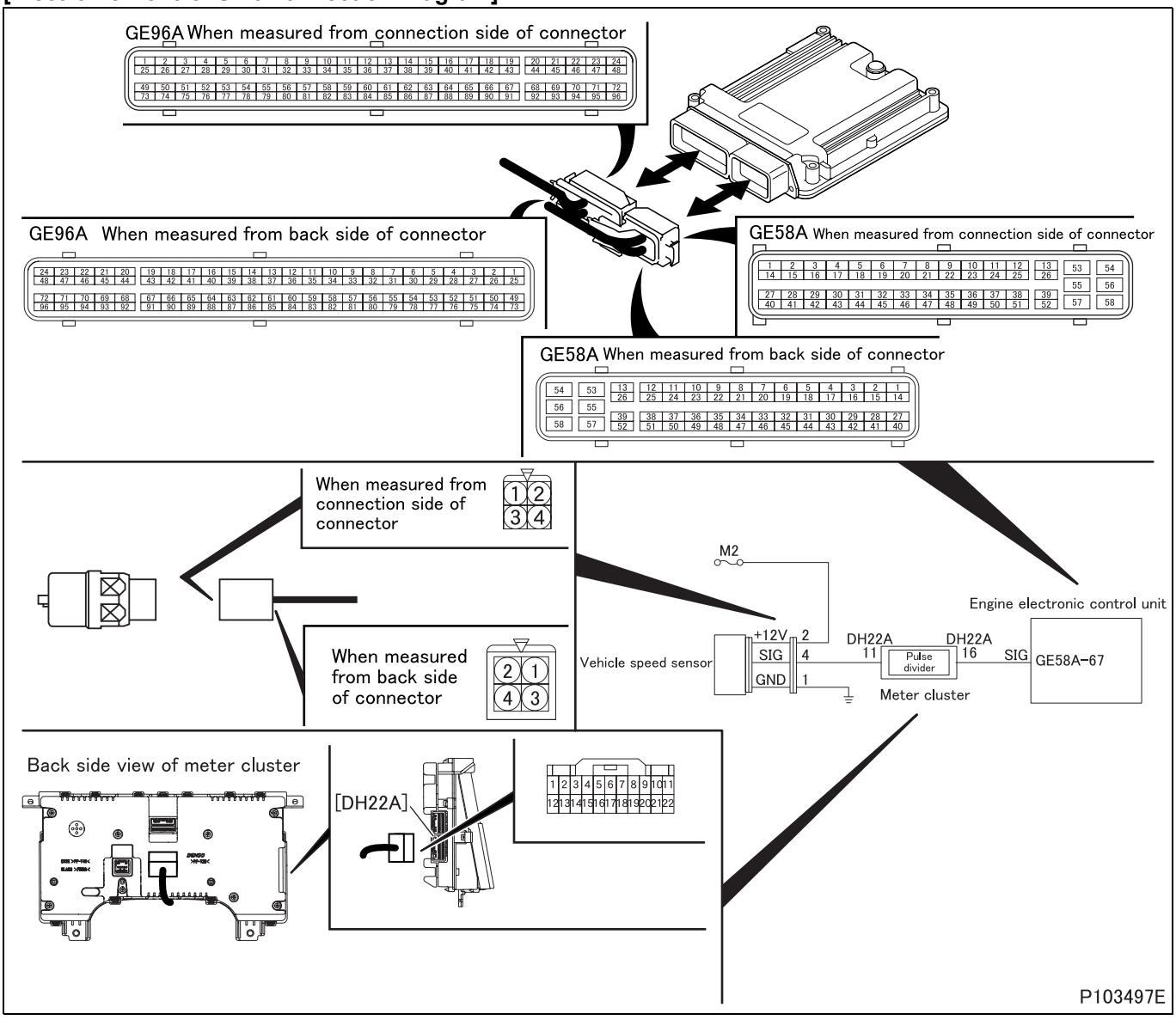
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and pulse divider (built in meter cluster)
- Malfunction of each connector
- Malfunction of pulse divider (built in meter cluster)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

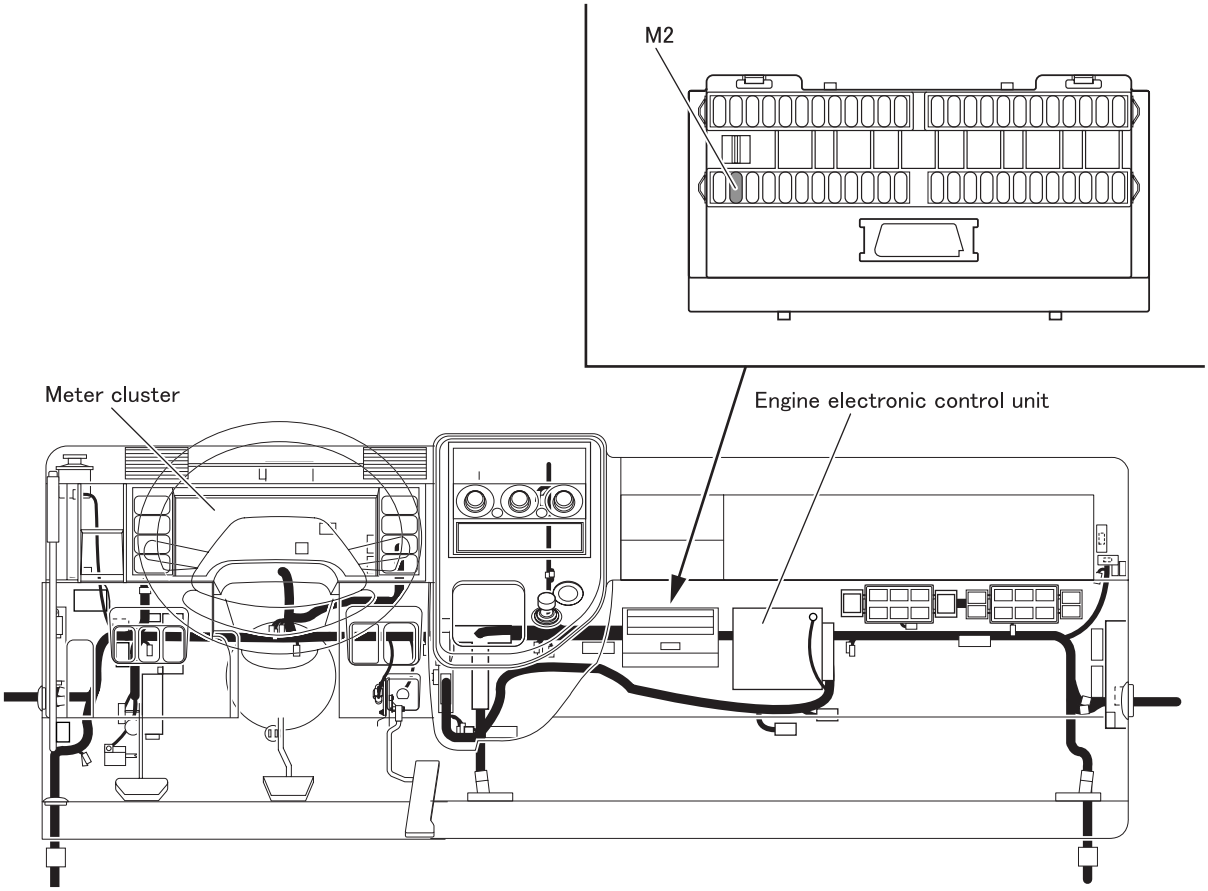
<Condition (1)>
- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

<Condition (2)>
- Lamp is extinguished and code is cleared simultaneously with recovery.

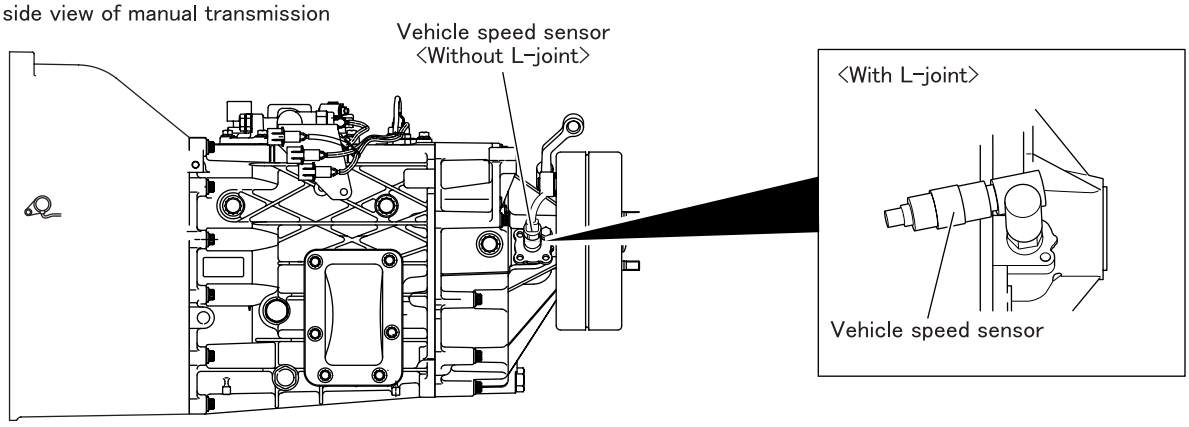
[Electronic Control Unit Connection Diagram]



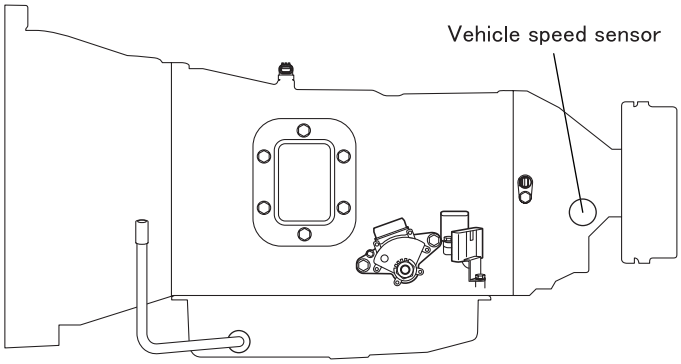
[Parts Identification and Location]



Left side view of manual transmission



Left side view of automatic transmission



P103625E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Vehicle Speed Sensor”. **<Multi-Use Tester used>** • Measure item No. 90 “Vehicle Speed” of Service Data.
	Inspection condition		During vehicle operation
	Requirements		Same indication as speedometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

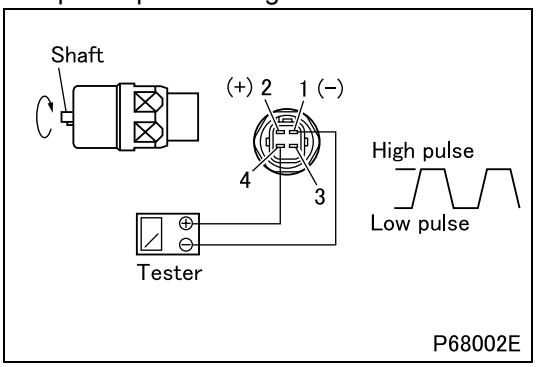
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 67 (+) and chassis ground.
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness. • Remove sensor and slowly turn sensor shaft.
	Requirements		• Low pulse: 0.5 V or less • High pulse: 8 ± 1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and pulse divider
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 67 and meter cluster connector (DH22A) terminal No. 18.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of vehicle speed sensor
	Maintenance item		Measure maximum value A (high pulse voltage) and minimum value B (low pulse voltage) of voltage generated between connector terminals No. 4 (+) and 1 (–).
	Inspection condition		Slowly turn sensor shaft with voltage DC 12 V applied between terminals No. 2 (+) and No. 1 (–).
	Requirements		• Low pulse: 0.5 V or less • High pulse: 8 ± 1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of sensor harness (power supply)
	Maintenance item		Check circuit between connector terminal No. 2 and fuse (M2).
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of sensor harness (ground)
	Maintenance item		Check circuit between connector terminal No. 1 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of sensor harness (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 4 and meter cluster connector (DH22A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by pulse divider connector (meter cluster)
	Maintenance item		Measure value of voltage between connector (DH22A) terminal No. 16 (+) and No. 6 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON • Remove sensor and slowly turn sensor shaft.
	Requirements		• Low pulse: 0.5 V or less • High pulse: 8 ± 1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of pulse divider (meter cluster)

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Vehicle Speed Sensor”. **<Multi-Use Tester used>** • Measure item No. 90 “Vehicle Speed” of Service Data.
	Inspection condition		During vehicle operation
	Requirements		Same indication as speedometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0502/Flash code: 25
[Monitor]
Failure of vehicle speed sensor
[Fault (outline)]
Too low
[Diagnosis check]
- Vehicle speed sensor output signal is monitored. (too low)

[Code generation condition]
- Vehicle speed output from vehicle speed sensor remains less than 1 km/h {0.62 MPH} for 3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

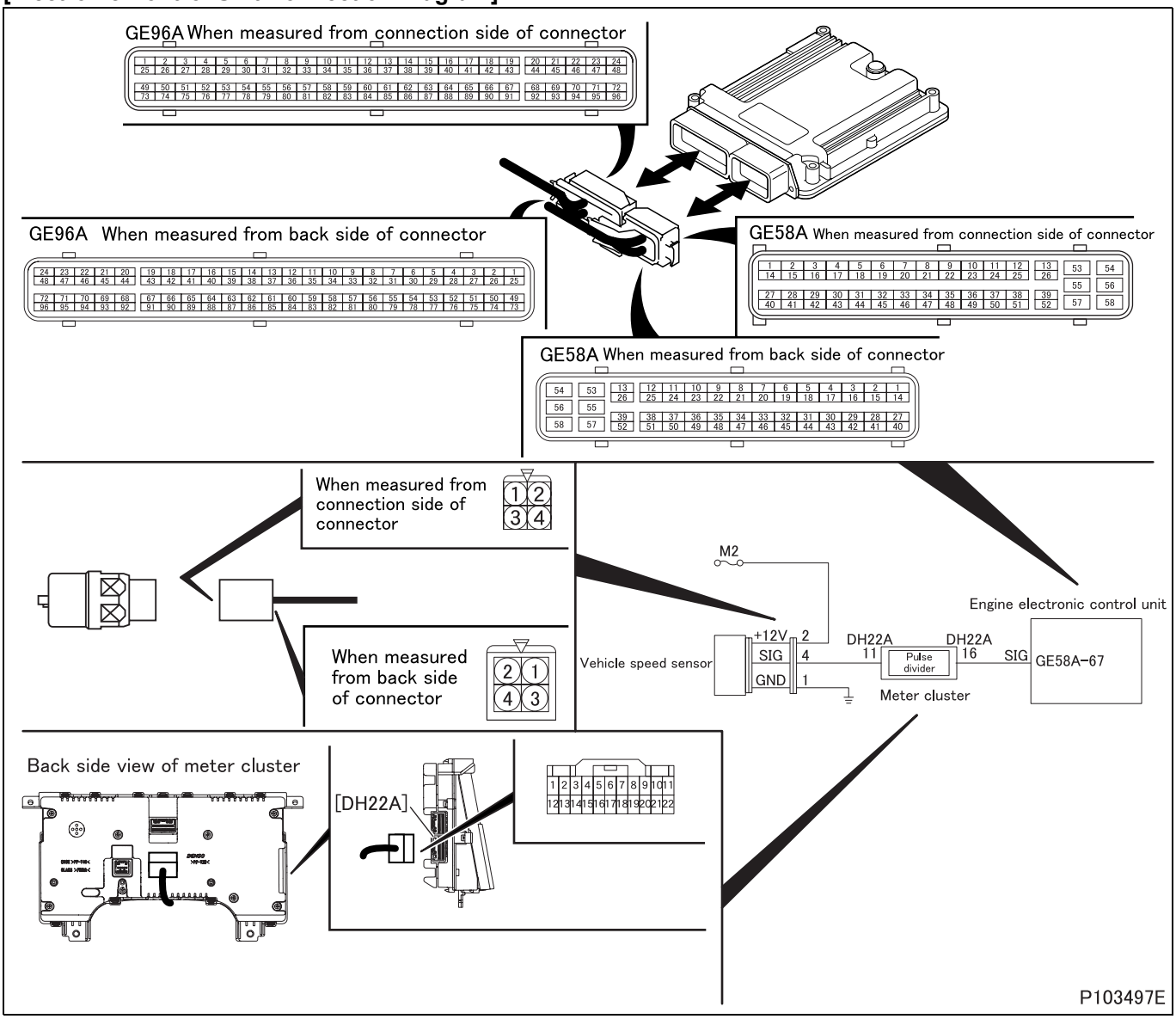
[Diagnostic requirement]
- Engine speed: more than 2000 rpm
- Fuel injection quantity: above 50 mg/cyc
- Time till above conditions were met: more than 2 seconds
- Battery voltage: in order
- MPROP (rail pressure control valve): in order

[Control effected by electronic control unit during fault]
- Vehicle speed is fixed at backup value.
- Misfire detection is stopped.
- In-use performance counter is stopped.
- Auto cruise control stopped
- Speed limitation device control is stopped.
- Idle up is stopped.
- Related fault check is stopped.

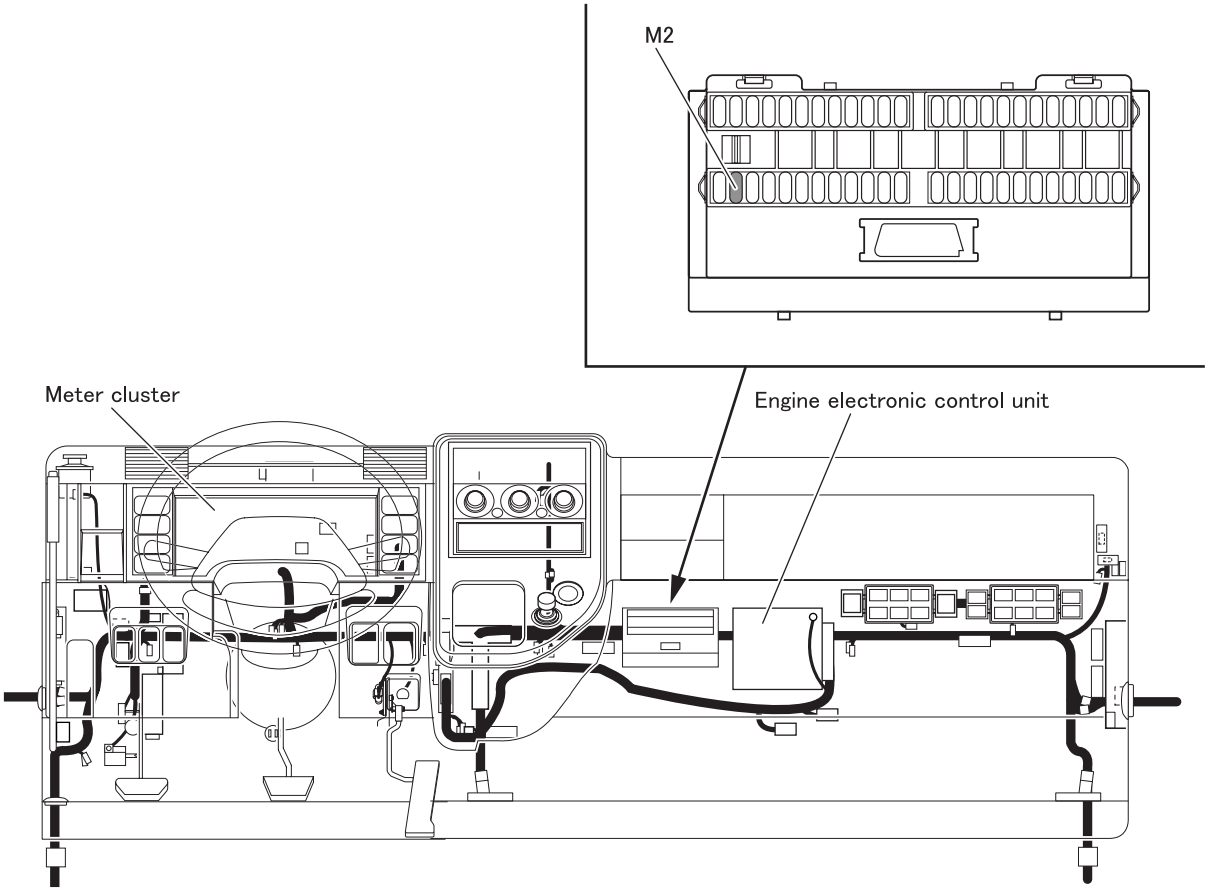
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and pulse divider (built in meter cluster)
- Malfunction of each connector
- Malfunction of pulse divider (built in meter cluster)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

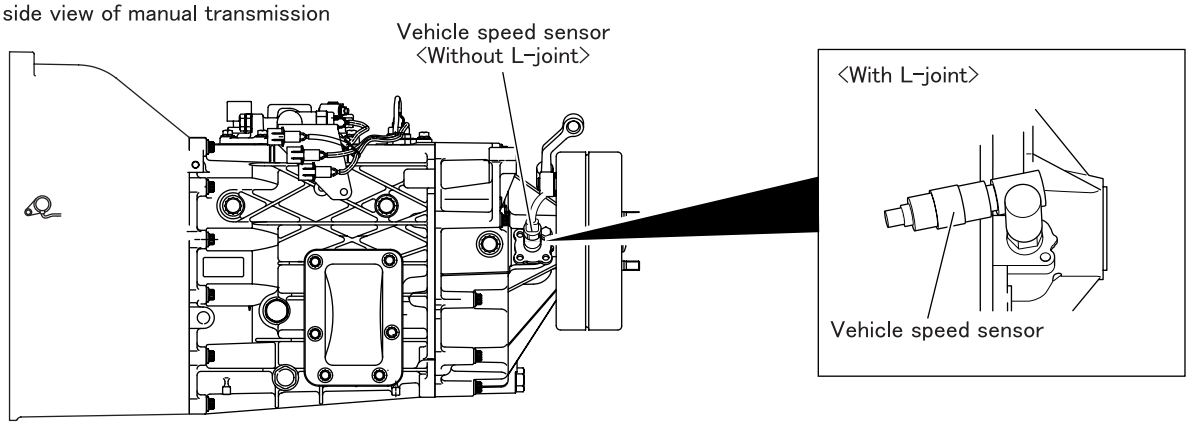
[Electronic Control Unit Connection Diagram]



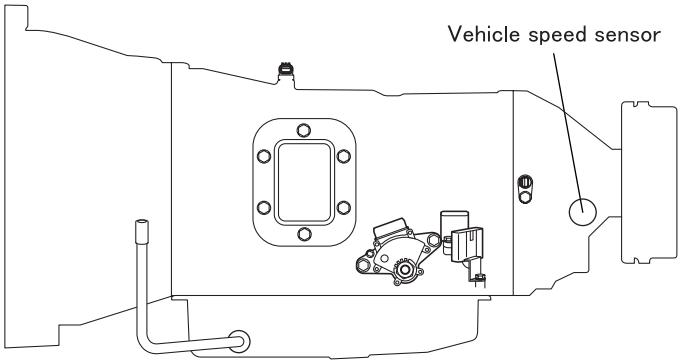
[Parts Identification and Location]



Left side view of manual transmission



Left side view of automatic transmission



P103625E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Vehicle Speed Sensor”. **<Multi-Use Tester used>** • Measure item No. 90 “Vehicle Speed” of Service Data.
	Inspection condition		During vehicle operation
	Requirements		Same indication as speedometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

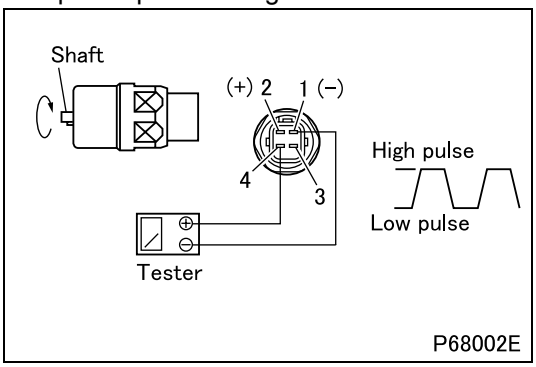
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 67 (+) and chassis ground.
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness. • Remove sensor and slowly turn sensor shaft.
	Requirements		• Low pulse: 0.5 V or less • High pulse: 8 ± 1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and pulse divider
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 67 and meter cluster connector (DH22A) terminal No. 18.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of vehicle speed sensor
	Maintenance item		Measure maximum value A (high pulse voltage) and minimum value B (low pulse voltage) of voltage generated between connector terminals No. 4 (+) and 1 (–).
	Inspection condition		Slowly turn sensor shaft with voltage DC 12 V applied between terminals No. 2 (+) and No. 1 (–).
	Requirements		• Low pulse: 0.5 V or less • High pulse: 8 ± 1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of sensor harness (power supply)
	Maintenance item		Check circuit between connector terminal No. 2 and fuse (M2).
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of sensor harness (ground)
	Maintenance item		Check circuit between connector terminal No. 1 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of sensor harness (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 4 and meter cluster connector (DH22A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by pulse divider connector (meter cluster)
	Maintenance item		Measure value of voltage between connector (DH22A) terminal No. 16 (+) and No. 6 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON • Remove sensor and slowly turn sensor shaft.
	Requirements		• Low pulse: 0.5 V or less • High pulse: 8 ± 1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of pulse divider (meter cluster)

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Vehicle Speed Sensor”. **<Multi-Use Tester used>** • Measure item No. 90 “Vehicle Speed” of Service Data.
	Inspection condition		During vehicle operation
	Requirements		Same indication as speedometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0503/Flash code: 25
[Monitor]
Failure of vehicle speed sensor
[Fault (outline)]
Too high
[Diagnosis check]
- Vehicle speed sensor output signal is monitored. (too high)

[Code generation condition]
- Vehicle speed output from vehicle speed sensor remains more than 70 km/h {43.5 MPH} for 3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

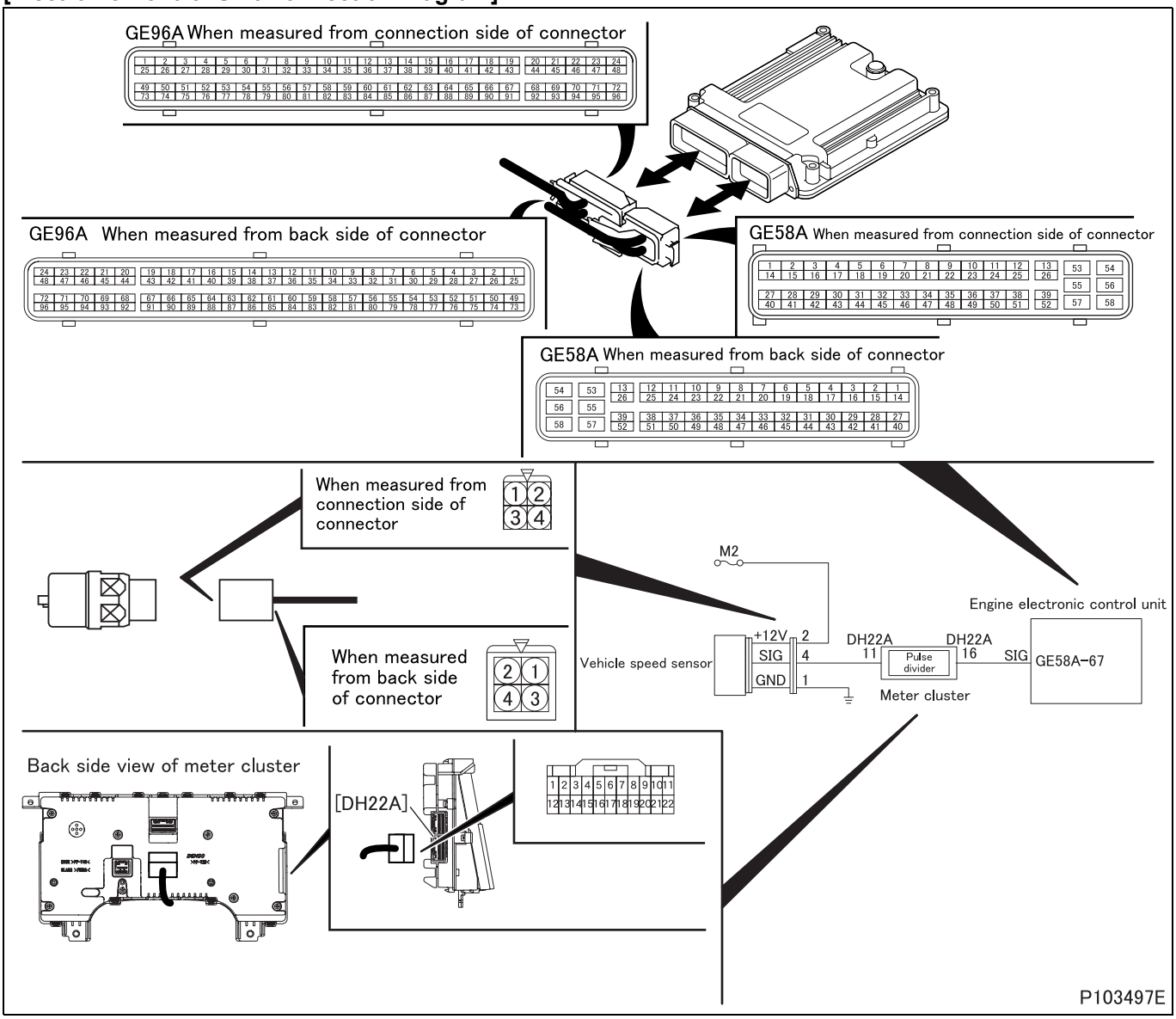
[Diagnostic requirement]
- Engine speed: 600 to 1500 rpm
- Fuel injection quantity: above 35 mg/cyc
- Time till above conditions were met: more than 2 seconds
- Battery voltage: in order
- MPROP (rail pressure control valve): in order

[Control effected by electronic control unit during fault]
- Vehicle speed is fixed at backup value.
- Misfire detection is stopped.
- In-use performance counter is stopped.
- Auto cruise control stopped
- Speed limitation device control is stopped.
- Idle up is stopped.
- Related fault check is stopped.

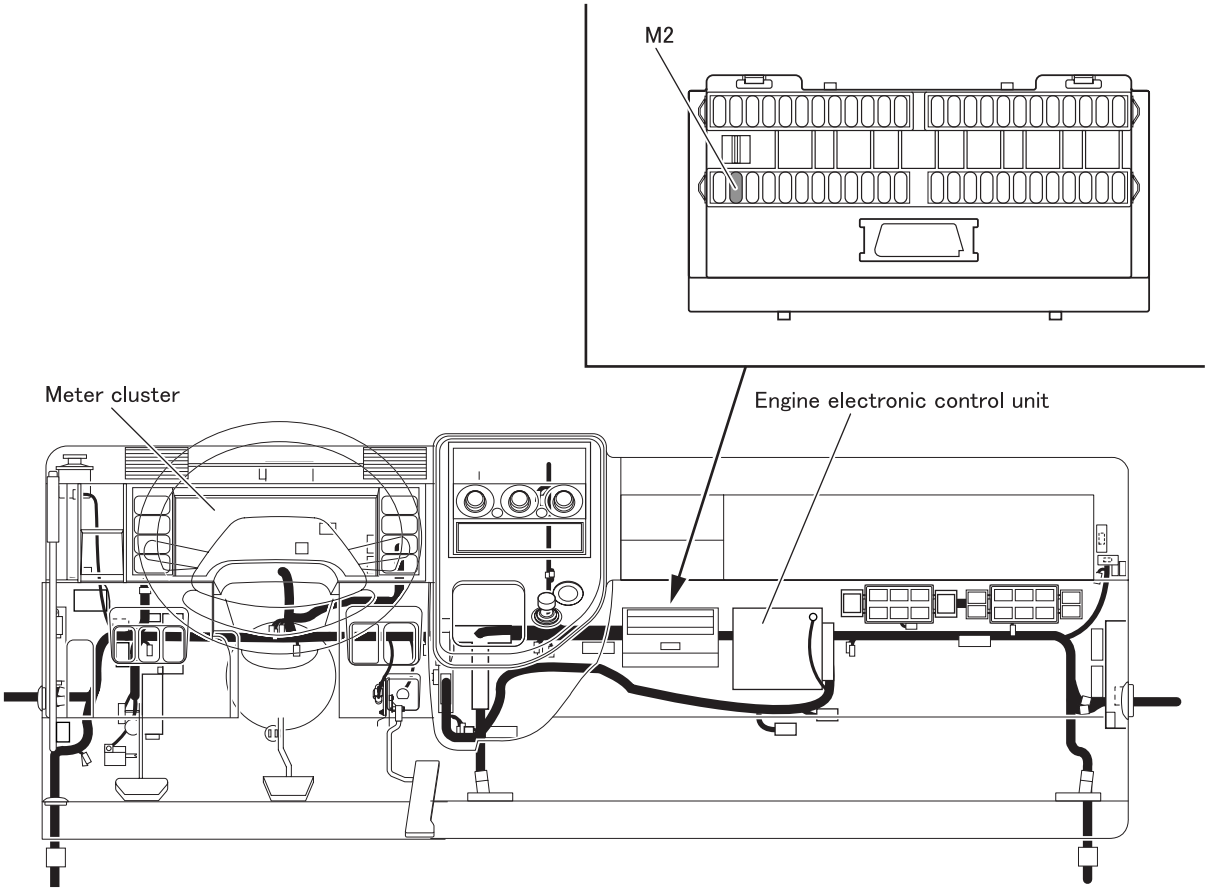
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and pulse divider (built in meter cluster)
- Malfunction of each connector
- Malfunction of pulse divider (built in meter cluster)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

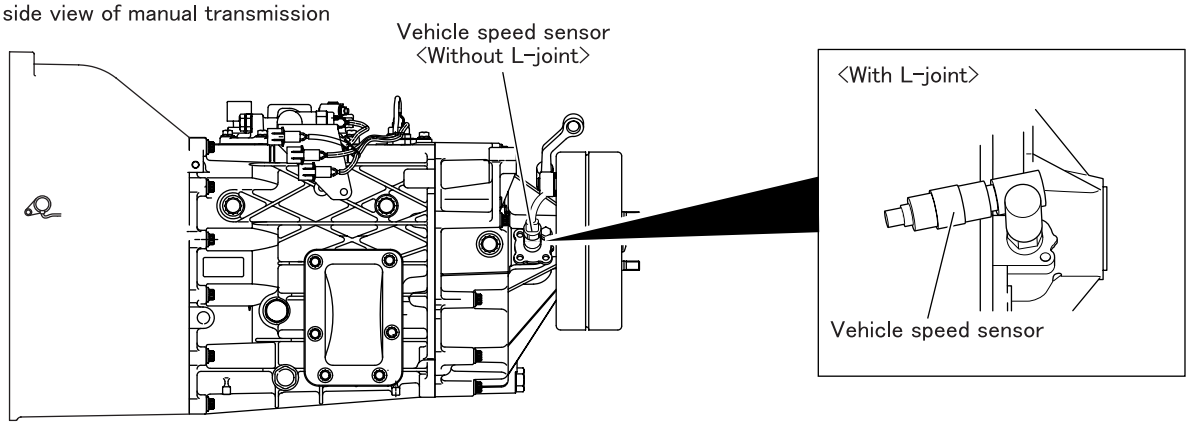
[Electronic Control Unit Connection Diagram]



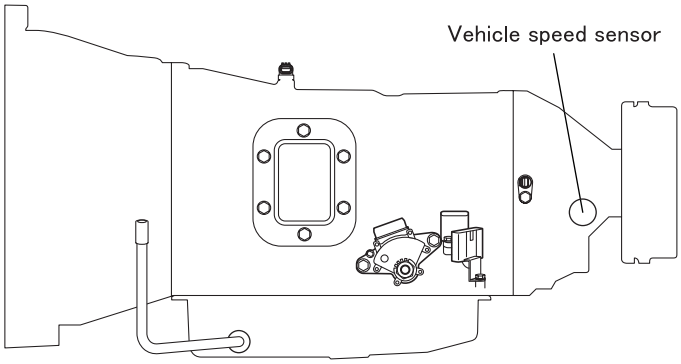
[Parts Identification and Location]



Left side view of manual transmission



Left side view of automatic transmission



P103625E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Vehicle Speed Sensor”. **<Multi-Use Tester used>** • Measure item No. 90 “Vehicle Speed” of Service Data.
	Inspection condition		During vehicle operation
	Requirements		Same indication as speedometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

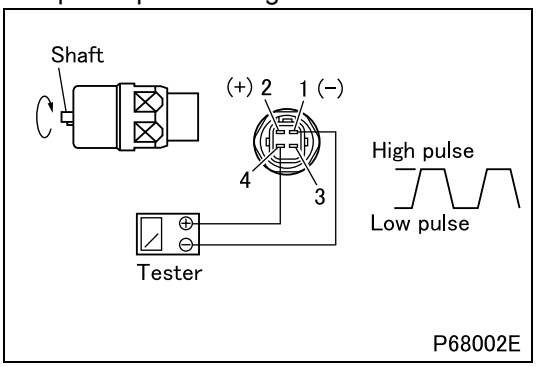
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 67 (+) and chassis ground.
	Inspection condition		• Starter switch: ON • Engine: stopped • Measure from back side of connector of harness with each device connected to harness. • Remove sensor and slowly turn sensor shaft.
	Requirements		• Low pulse: 0.5 V or less • High pulse: 8 ± 1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and pulse divider
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 67 and meter cluster connector (DH22A) terminal No. 18.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of vehicle speed sensor
	Maintenance item		Measure maximum value A (high pulse voltage) and minimum value B (low pulse voltage) of voltage generated between connector terminals No. 4 (+) and 1 (–).
	Inspection condition		Slowly turn sensor shaft with voltage DC 12 V applied between terminals No. 2 (+) and No. 1 (–).
	Requirements		• Low pulse: 0.5 V or less • High pulse: 8 ± 1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of sensor harness (power supply)
	Maintenance item		Check circuit between connector terminal No. 2 and fuse (M2).
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of sensor harness (ground)
	Maintenance item		Check circuit between connector terminal No. 1 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of sensor harness (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 4 and meter cluster connector (DH22A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by pulse divider connector (meter cluster)
	Maintenance item		Measure value of voltage between connector (DH22A) terminal No. 16 (+) and No. 6 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON • Remove sensor and slowly turn sensor shaft.
	Requirements		• Low pulse: 0.5 V or less • High pulse: 8 ± 1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of pulse divider (meter cluster)

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Vehicle Speed Sensor”. **<Multi-Use Tester used>** • Measure item No. 90 “Vehicle Speed” of Service Data.
	Inspection condition		During vehicle operation
	Requirements		Same indication as speedometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0506/Flash code: 52
[Monitor]
Abnormality in idling control (idling speed is too low)
[Fault (outline)]
Idle speed too low
[Diagnosis check]
- Idling speed of vehicle at a stop (in parked condition) is detected by engine speed sensor as actual engine speed and compared with target engine speed for control by engine electronic control unit.

[Code generation condition]
- Actual engine speed remains –100 rpm or less below target engine speed (short of target) for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine status: normal (engine in operation)
- Vehicle speed: less than 2 km/h {1.24 MPH}
- Accelerator pedal position: less than 1%
- Brake is not applied.
- Accelerator pedal position sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Vehicle speed sensor: in order
- Water temperature sensor: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0507/Flash code: 52
[Monitor]
Abnormality in idling control (idling speed is too high)
[Fault (outline)]
Idle speed too high
[Diagnosis check]
- Idling speed of vehicle at a stop (in parked condition) is detected by engine speed sensor as actual engine speed and compared with target engine speed for control by engine electronic control unit.

[Code generation condition]
- Actual engine speed remains 200 rpm or more above target engine speed (over target value at a large margin) for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine status: normal (engine in operation)
- Vehicle speed: less than 2 km/h {1.24 MPH}
- Accelerator pedal position: less than 1%
- Brake is not applied.
- Accelerator pedal position sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Vehicle speed sensor: in order
- Water temperature sensor: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0544/Flash code: 87
[Monitor]
Characteristic abnormality of DPF temperature sensor 1
[Fault (outline)]
Gain and offset drift
[Diagnosis check]
- Difference in voltage output (temperature) between catalytic temperature sensor and DPF temperature sensor 1 is monitored for clogging of front oxidation catalyst.

[Code generation condition]
- Difference in temperature output remains excessively high (over 150°C {302°F}) or low (below –150°C {–238°F}) for 10 seconds <Relative check> and 20 seconds <Separate check>. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- When catalytic temperature sensor and DPF temperature sensor 2 are the same in output.

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of DPF temperature sensor 1

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0545/Flash code: 87
[Monitor]
Failure of DPF temperature sensor 1
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Output voltage of DPF temperature sensor 1 is monitored.

[Code generation condition]
- Output voltage of DPF temperature sensor 1 remains below 0.36 V for 3 seconds. (sensor temperature: 1000°C {1832°F} or more)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

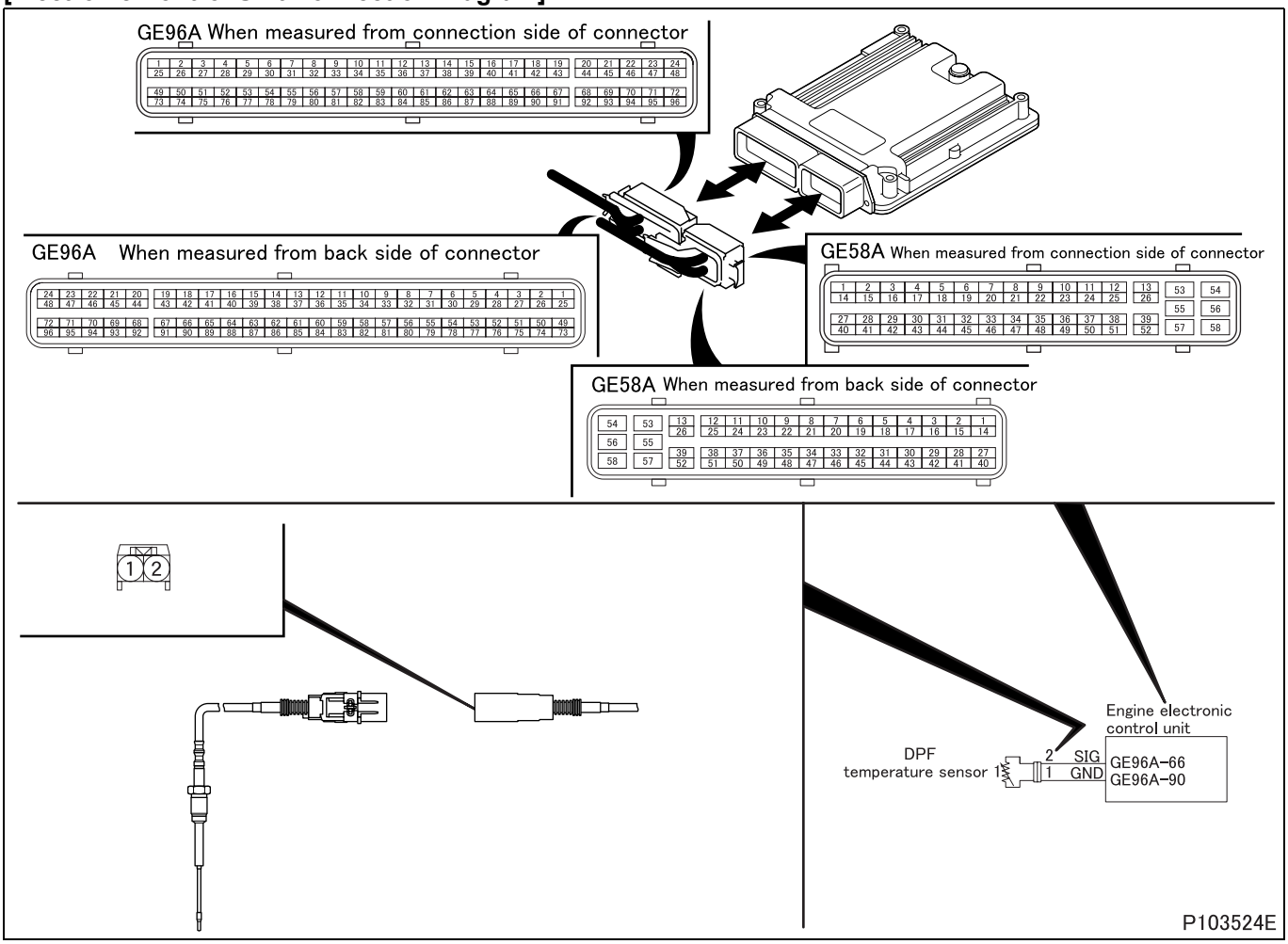
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Pressure before ceramic diesel particulate filter is fixed at backup value.
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

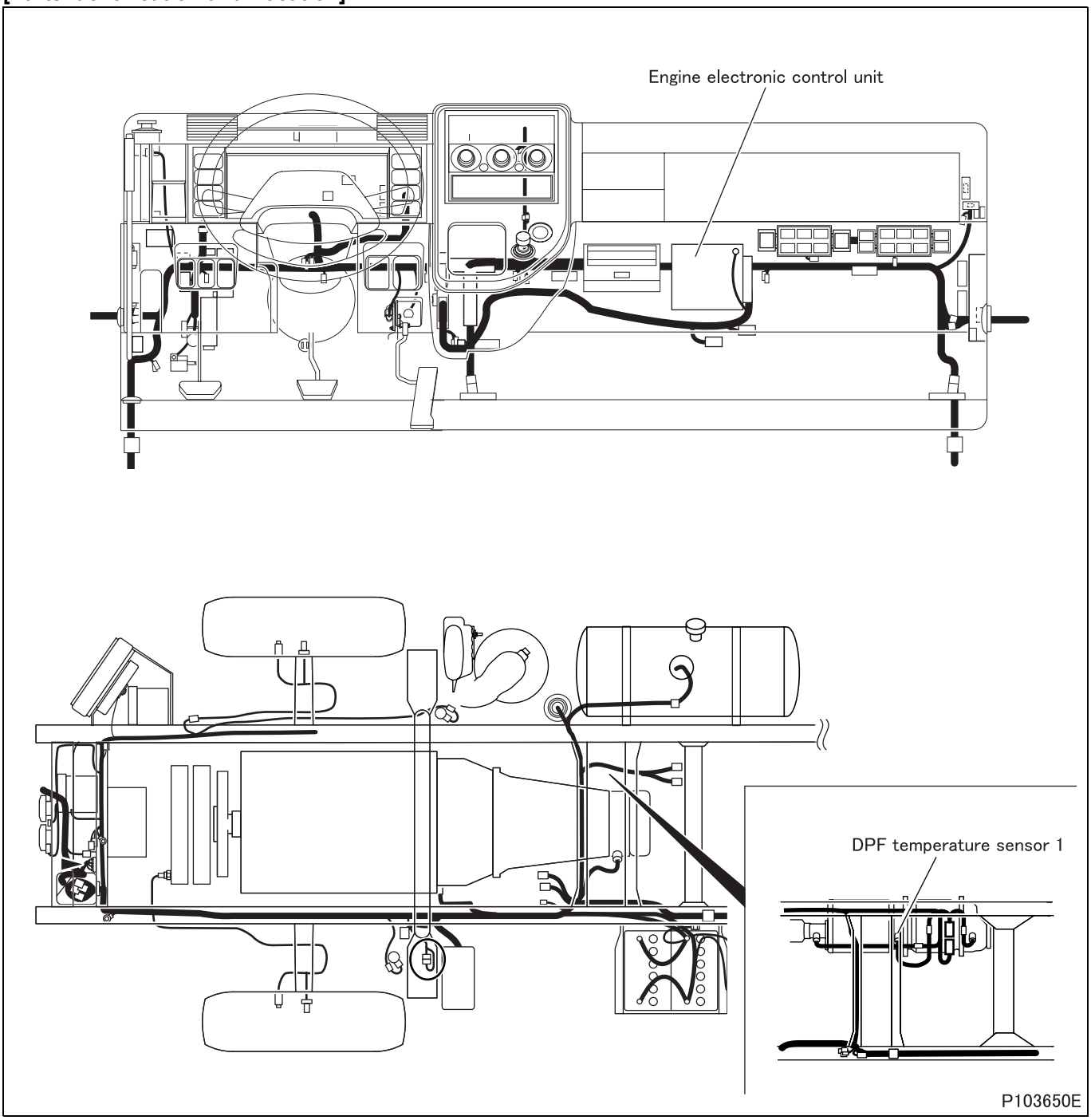
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit
- Malfunction of DPF temperature sensor 1

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 25 “DPF Temperature (UpStream)” of Service Data.
	Inspection condition		While engine is warmed up
	Requirements		Temperature gradually increases.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

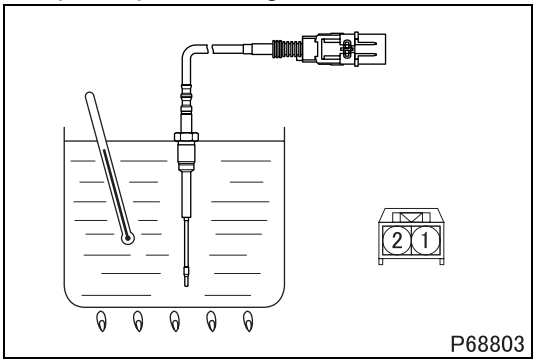
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 66 and 90.
	Inspection condition		• Starter switch: OFF • Disconnect electronic control unit from harness and measure at vehicle-side connector half.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.58 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F}: 241.8 kΩ • 50°C {122°F}: 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F}: 33.58 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F}: 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F}: 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 66 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 90 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 25 “DPF Temperature (UpStream)” of Service Data.
	Inspection condition		While engine is warmed up
	Requirements		Temperature gradually increases.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0546/Flash code: 87
[Monitor]
Failure of DPF temperature sensor 1
[Fault (outline)]
High signal range check
[Diagnosis check]
- Output voltage of DPF temperature sensor 1 is monitored.

[Code generation condition]
- Output voltage of DPF temperature sensor 1 remains over 4.93 V for 30 seconds when engine speed is set at 1200 to 5000 rpm. (sensor temperature: 40°C {118°F} or less)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation conditions.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

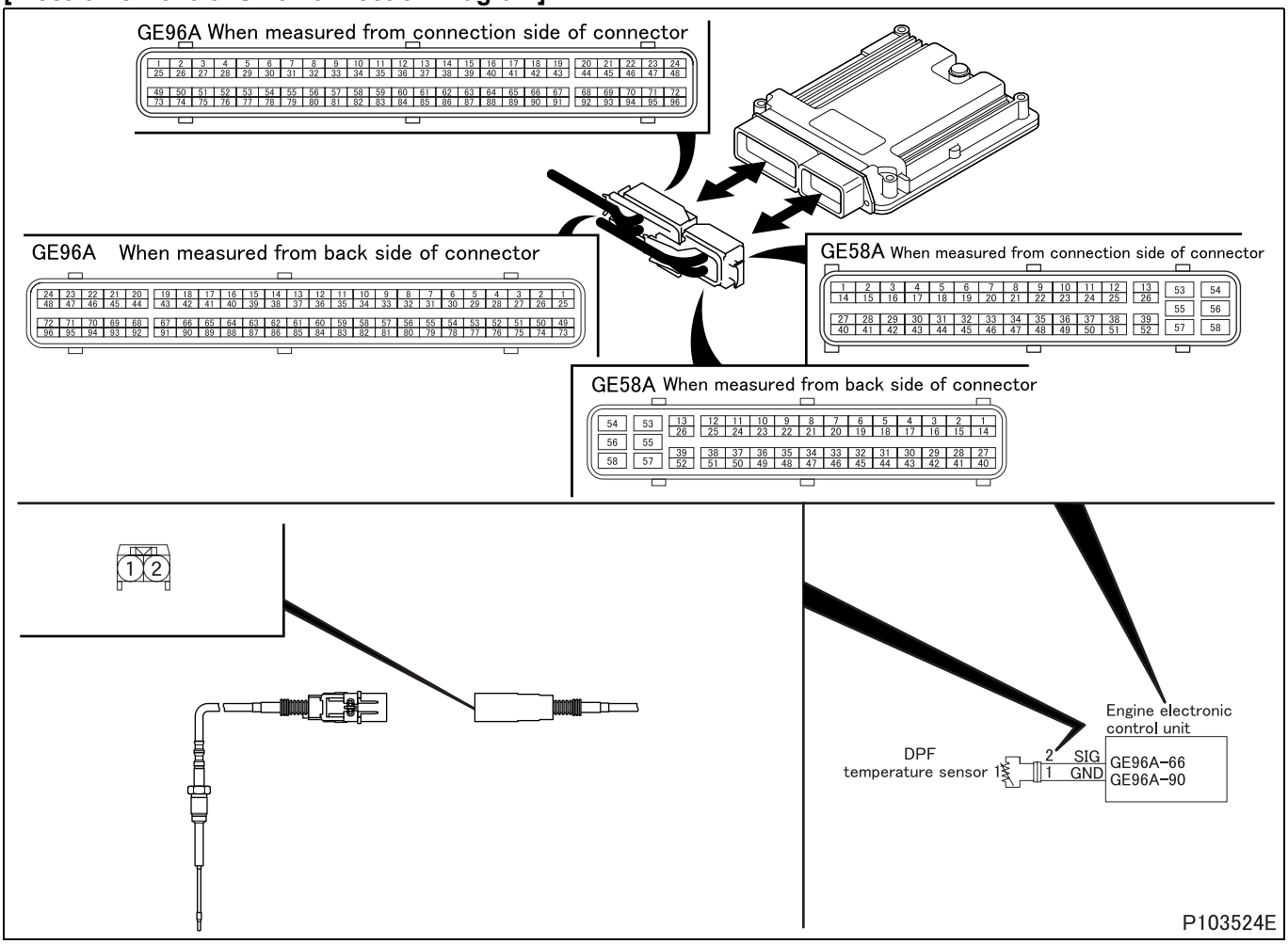
[Diagnostic requirement]
- Engine speed: 1200 to 5000 rpm
- Fuel injection quantity: 32 to 200 mg/cyc
- Water temperature: above –7°C {19°F}

[Control effected by electronic control unit during fault]
- Pressure before ceramic diesel particulate filter is fixed at backup value.
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

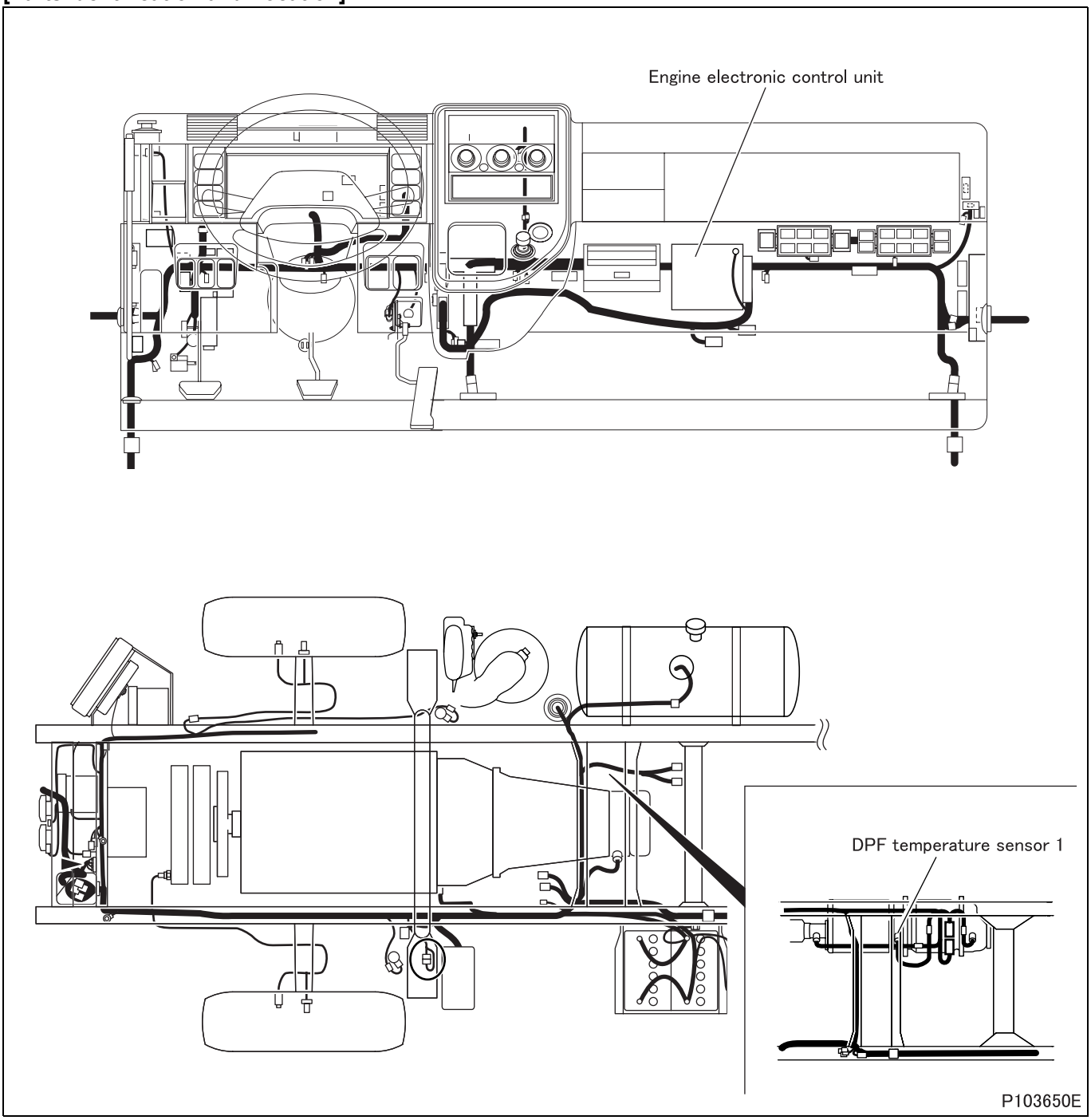
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit
- Malfunction of DPF temperature sensor 1

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 25 “DPF Temperature (UpStream)” of Service Data.
	Inspection condition		While engine is warmed up
	Requirements		Temperature gradually increases.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

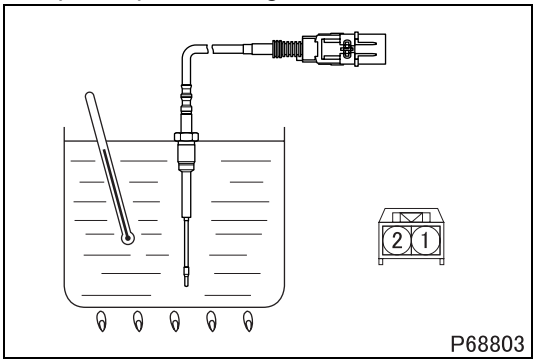
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 66 and 90.
	Inspection condition		• Starter switch: OFF • Disconnect electronic control unit from harness and measure at vehicle-side connector half.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.58 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F}: 241.8 kΩ • 50°C {122°F}: 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F}: 33.58 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F}: 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F}: 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 66 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 90 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 25 “DPF Temperature (UpStream)” of Service Data.
	Inspection condition		While engine is warmed up
	Requirements		Temperature gradually increases.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0562/Flash code: 33
[Monitor]
Failure inside engine electronic control unit
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Power supply voltage in engine electronic control unit at engine stop is monitored.

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Condition (1)>
- Power supply voltage monitoring function in engine electronic control unit remains below 0 V for 3 seconds.
  (Warning lamp (red) is lit and diagnosis code is displayed on third establishment of code generation condition.)

<Condition (2)>
- Error flag (low limit) indicating power voltage in engine electronic control unit remains for 0.1 second.
  (Warning lamp (orange) is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
<Condition (1)>
- Fault diagnosis is continuously performed during the driving cycle.

<Condition (2)>
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine cranking: not controlled

[Control effected by electronic control unit during fault]
Electronic control unit varies in the way of control by the color of warning lamp.
<Warning lamp: Orange>
- Turbocharger initialization is stopped.
- Intake throttle initialization is inhibited.
- Misfire detection is stopped.
- Related fault check is stopped.

<Warning lamp: Red>
- Effects no special control.

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of electronic control unit)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

<Condition (1)>
- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

<Condition (2)>
- Lamp is extinguished and code is cleared simultaneously with recovery.

[Fault code]
Diagnosis code: P0563/Flash code: 33
[Monitor]
Failure inside engine electronic control unit
[Fault (outline)]
High signal range check
[Diagnosis check]
- Power supply voltage in engine electronic control unit at engine stop is monitored.

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Condition (1)>
- Power supply voltage monitoring function in engine electronic control unit remains over 2.3 V for 3 seconds. (Warning lamp (red) is lit and diagnosis code is displayed on third establishment of code generation condition.)

<Condition (2)>
- Error flag (high limit) indicating power voltage in engine electronic control unit remains for 0.1 second (Warning lamp (orange) is lit and diagnosis code is displayed on third establishment of code generation condition).

[Diagnosis check timing]
<Condition (1)>
- Fault diagnosis is continuously performed during the driving cycle.

<Condition (2)>
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine cranking: not controlled

[Control effected by electronic control unit during fault]
Electronic control unit varies in the way of control by the color of warning lamp.
<Warning lamp: Orange>
- Turbocharger initialization is stopped.
- Intake throttle initialization is inhibited.
- Misfire detection is stopped.
- Related fault check is stopped.

<Warning lamp: Red>
- Effects no special control.

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of electronic control unit)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

<Condition (1)>
- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

<Condition (2)>
- Lamp is extinguished and code is cleared simultaneously with recovery.

[Fault code]
Diagnosis code: P0600/Flash code: 64, 76
[Monitor]
Abnormality of speed limitation device system
[Fault (outline)]
- Controller area network
- Message timeout

[Diagnosis check]
- Controller area network communication between engine electronic control unit and multifunction vehicle control unit is monitored for abnormality.

[Code generation condition]
- No controller area network signal is received from multifunction vehicle control unit within specified time after engine start (time out).
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

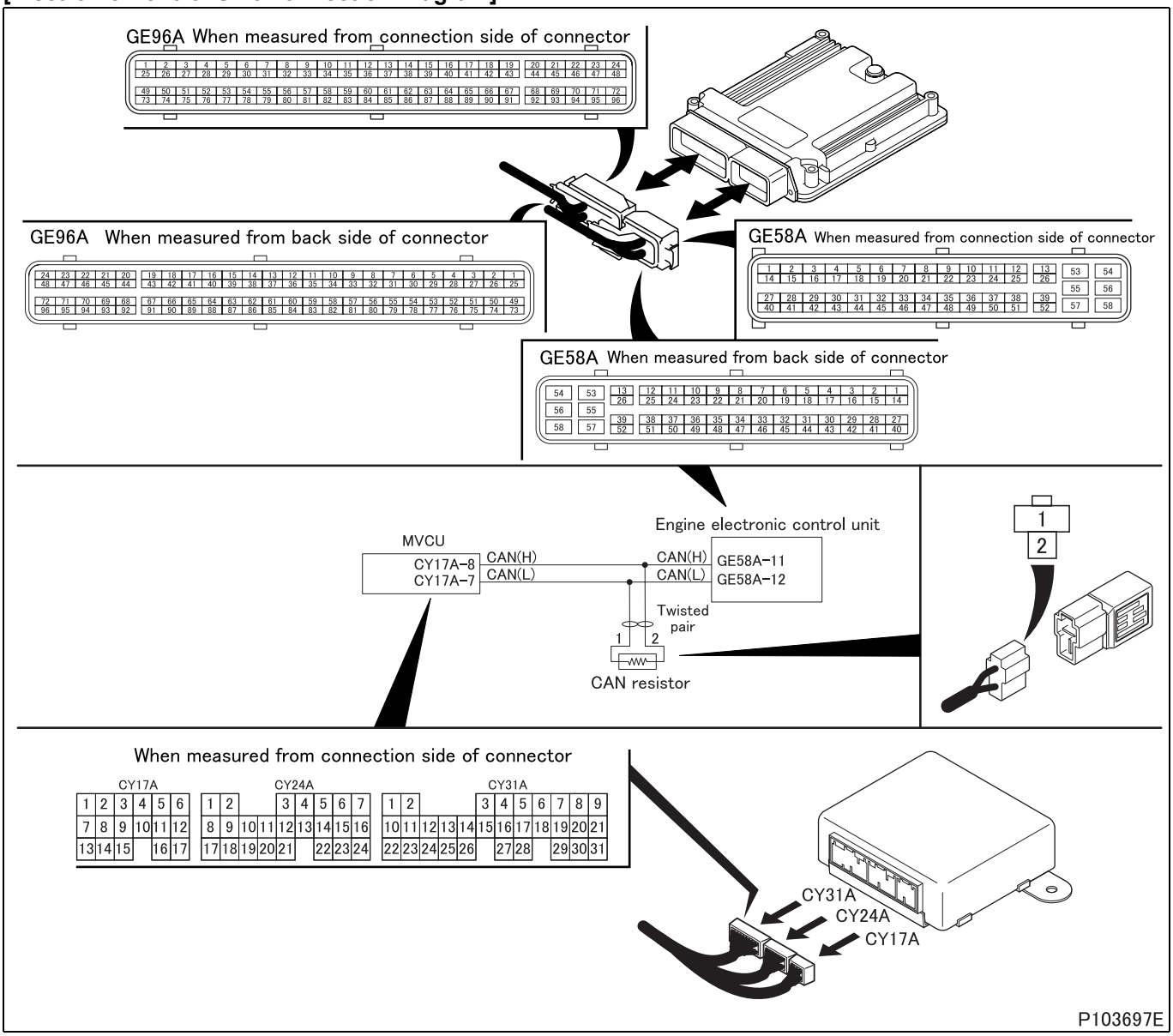
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Speed limitation device control is stopped.

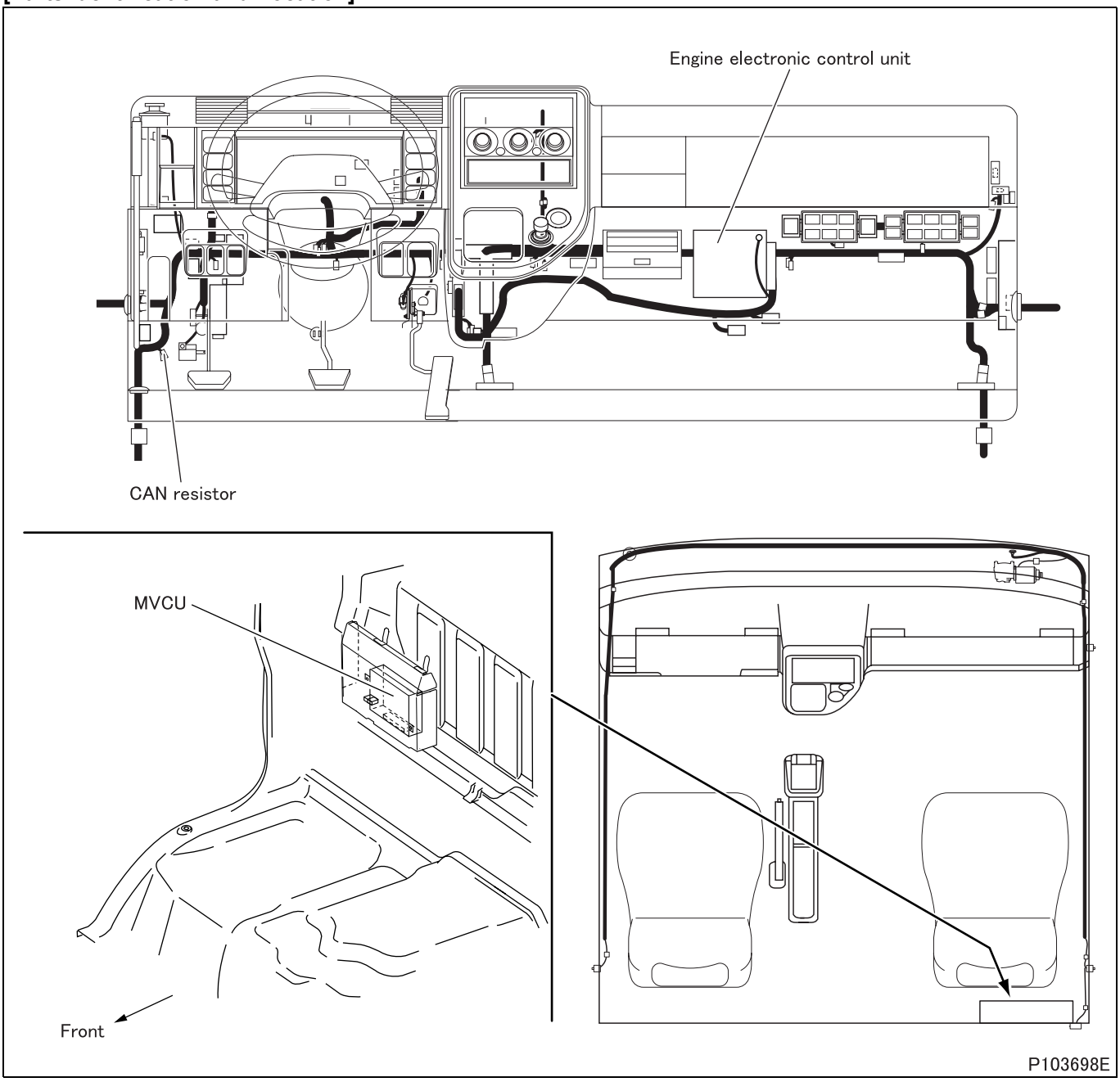
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and multifunction vehicle control unit
- Malfunction of each connector
- Malfunction of electronic control unit
- Malfunction of multifunction vehicle control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

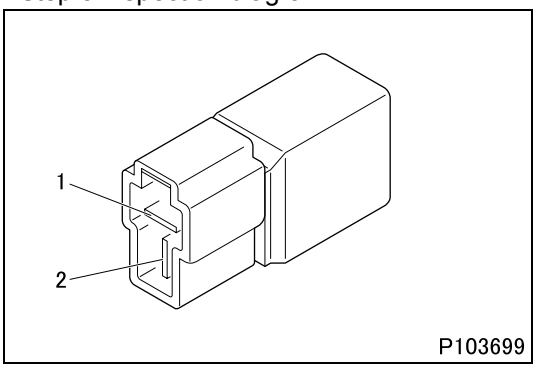
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between engine electronic control unit connector (GE58A) terminal No. 11 and 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		Remove connector and measure resistance.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of controller area network resistor

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and engine electronic control unit connector (GE58A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and engine electronic control unit connector (GE58A) terminal No. 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between multifunction vehicle control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and multifunction vehicle control unit connector (CY17A) terminal No. 8.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between multifunction vehicle control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and multifunction vehicle control unit connector (CY17A) terminal No. 7.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection of multifunction vehicle control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replace the engine electronic control unit as well if this diagnosis code occurs after the replacement of multifunction vehicle control unit.
		NO	Modify connector.

[Fault code]
Diagnosis code: P0605/Flash code: 33
[Monitor]
Failure inside engine electronic control unit
[Fault (outline)]
Electronic control unit
[Diagnosis check]
- Program involving data processing function in engine electronic control unit is monitored for abnormality.

[Code generation condition]
- Abnormality occurred during access to EEPOM (write device in electronic control unit).
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of electronic control unit)

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position, or no recovery is made unless the diagnosis code is erased.
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Fault code]
Diagnosis code: P0607/Flash code: 33
[Monitor]
Failure inside engine electronic control unit
[Fault (outline)]
Injector driver circuit
[Diagnosis check]
- Program involving injector drive circuit in engine electronic control unit is monitored for abnormality.

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
(Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)
- Internal reset
- Initialization error
- Sum check error
- Program flow error
- Signal timeout error

[Diagnosis check timing]
- Fault diagnosis is performed each time when the starter switch is turned from “stop” to “start” position.
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine stopped

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of electronic control unit)

[Recoverability]
- When output signal returns to normal with the starter switch set to ON from OFF (power supply to the electronic control unit resumed), a reset is made.
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

<Condition (1)>
- Code is cleared simultaneously with recovery.

<Condition (2)>
- Lamp is extinguished and code is cleared simultaneously with recovery.

<Condition (3)>
- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

[Fault code]
Diagnosis code: P060B/Flash code: 33
[Monitor]
Failure inside engine electronic control unit
[Fault (outline)]
A/D Converter fault
[Diagnosis check]
- Analog-to-digital signal conversion circuit in engine electronic control unit is monitored for abnormality.

[Code generation condition]
- Circuit remains abnormal as detected for 0.15 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine stopped

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of electronic control unit)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P0611/Flash code: 47
[Monitor]
Injector adjustment data
[Fault (outline)]
Electronic control unit
[Diagnosis check]
- Availability of stored injector adjustment data in engine electronic control unit is monitored.

[Code generation condition]
- Injector adjustment data are found missing.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine stopped

[Probable cause of trouble]
- No injection correction data stored in engine electronic control unit
  (For data alteration/registration and data write operation, contact your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Fault code]
Diagnosis code: P0615/Flash code: 48
[Monitor]
Failure of safety relay
[Fault (outline)]
Overload
[Diagnosis check]
- Engine electronic control unit internal function monitors safety relay circuit for overcurrent.

[Code generation condition]
- Overcurrent remains as detected by engine electronic control unit internal function for 3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

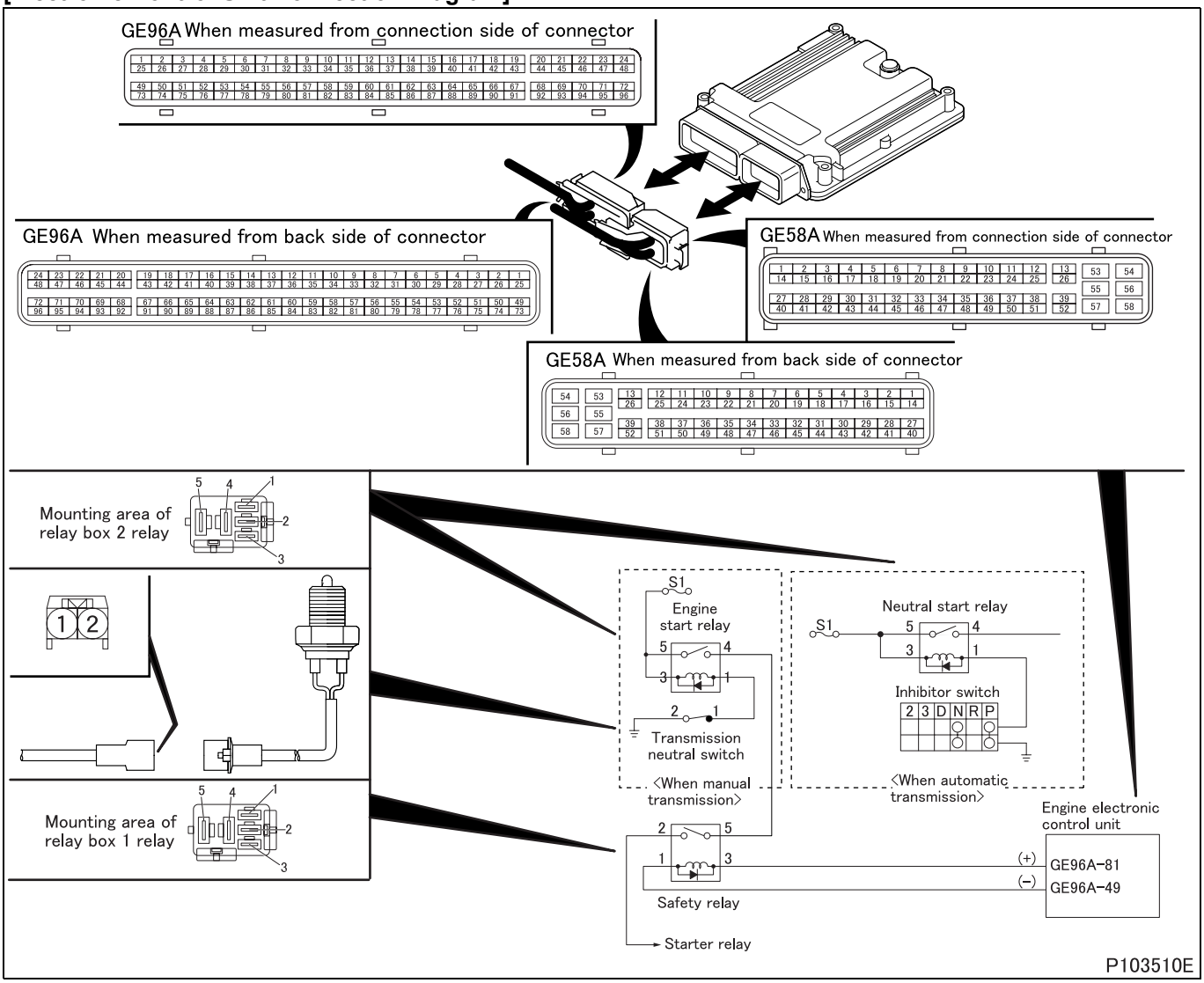
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

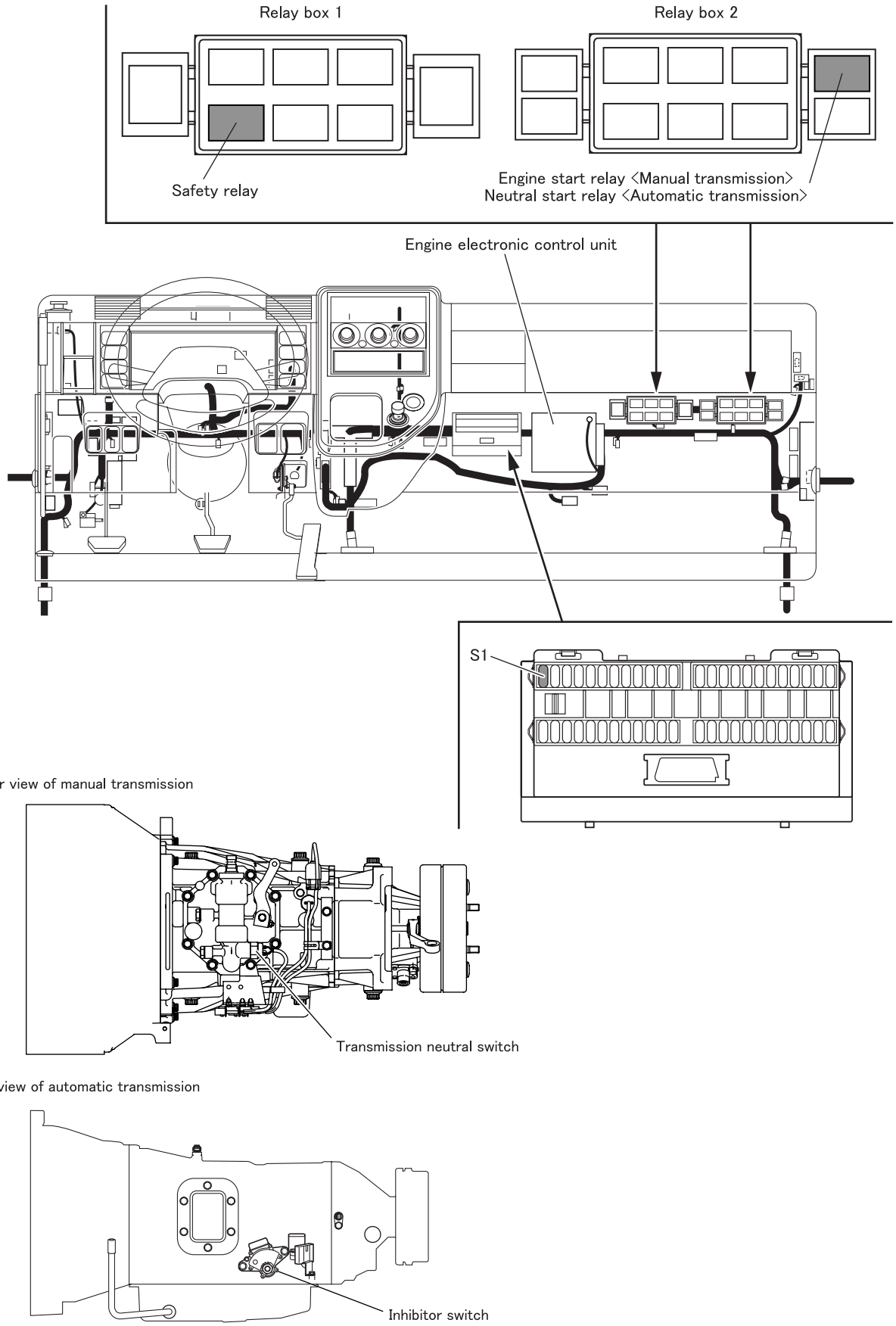
[Probable cause of trouble]
- Short-circuited harness between electronic control unit and safety relay
- Malfunction of each connector
- Malfunction of safety relay
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



P103636E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

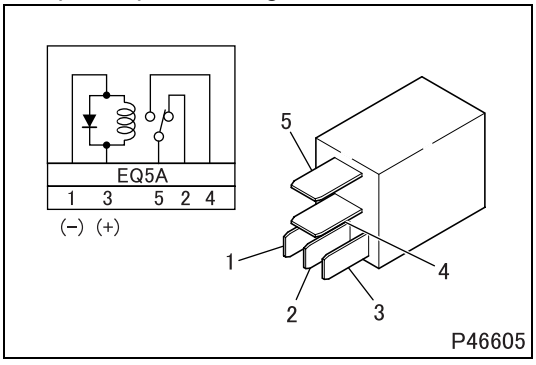
Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Check circuit between connector (GE96A) terminal No. 81 (+) and No. 49 (–).
	Inspection condition		Measure from back side of connector of harness with each device connected to harness.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Go to step 3.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 3	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 2 and 5 when relay operates.
	Inspection condition		Apply battery voltage across connector terminals No. 3 (+) and 1 (–)
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of relay

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between relay and electronic control unit (power supply)
	Maintenance item		Check circuit between relay connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 81.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between relay and electronic control unit (ground)
	Maintenance item		Check circuit between relay connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 49.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AE “Starter Safety Relay”
	Inspection condition		–
	Requirements		This diagnosis code is not displayed again.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0616/Flash code: 48
[Monitor]
Failure of safety relay
[Fault (outline)]
- Short circuit ground
- Open circuit

[Diagnosis check]
- Engine electronic control unit internal function monitors safety relay for short or open circuit to ground.

[Code generation condition]
- Safety relay circuit remains short or open circuited to ground as detected by engine electronic control unit internal function for 3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is halted.

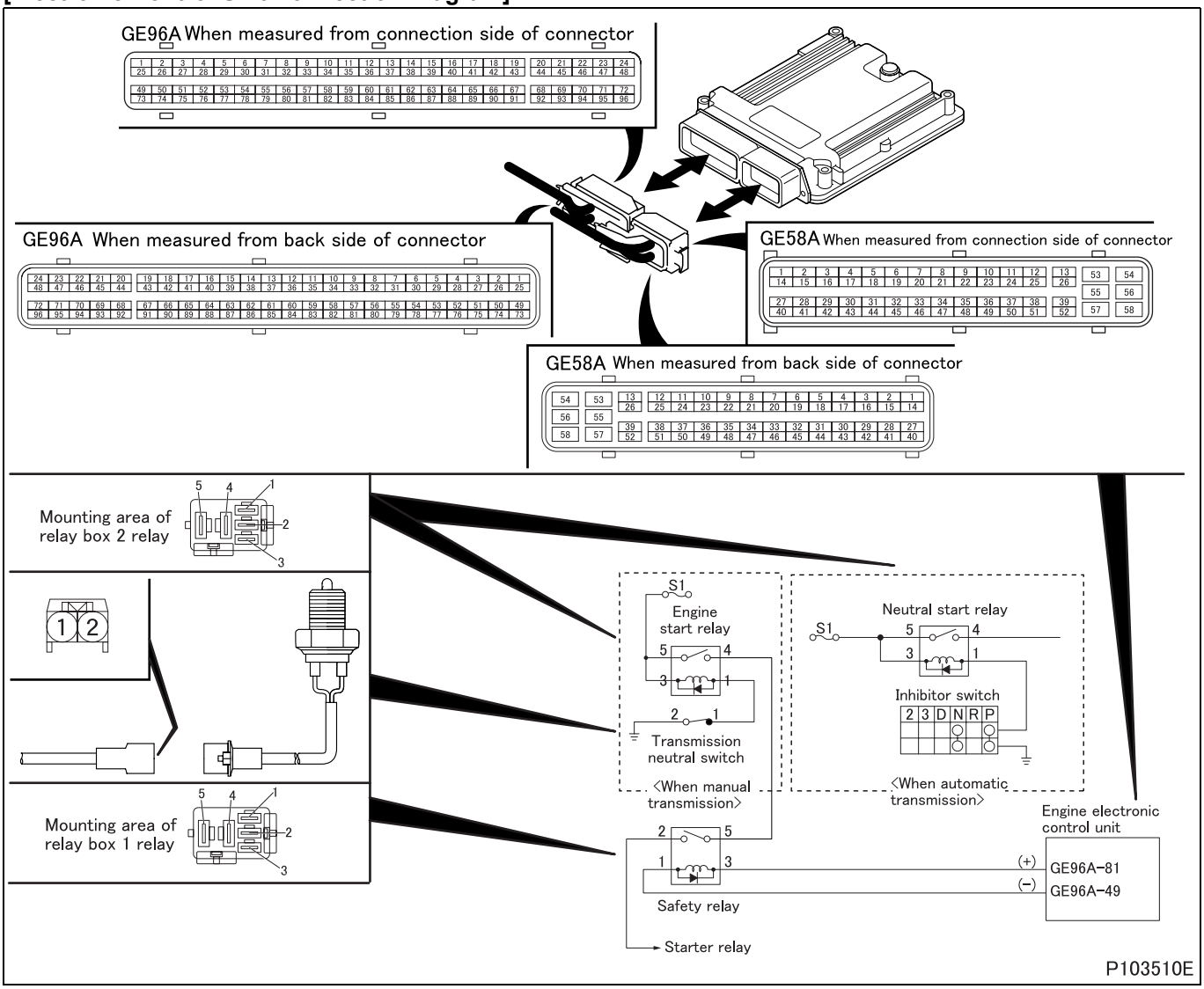
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

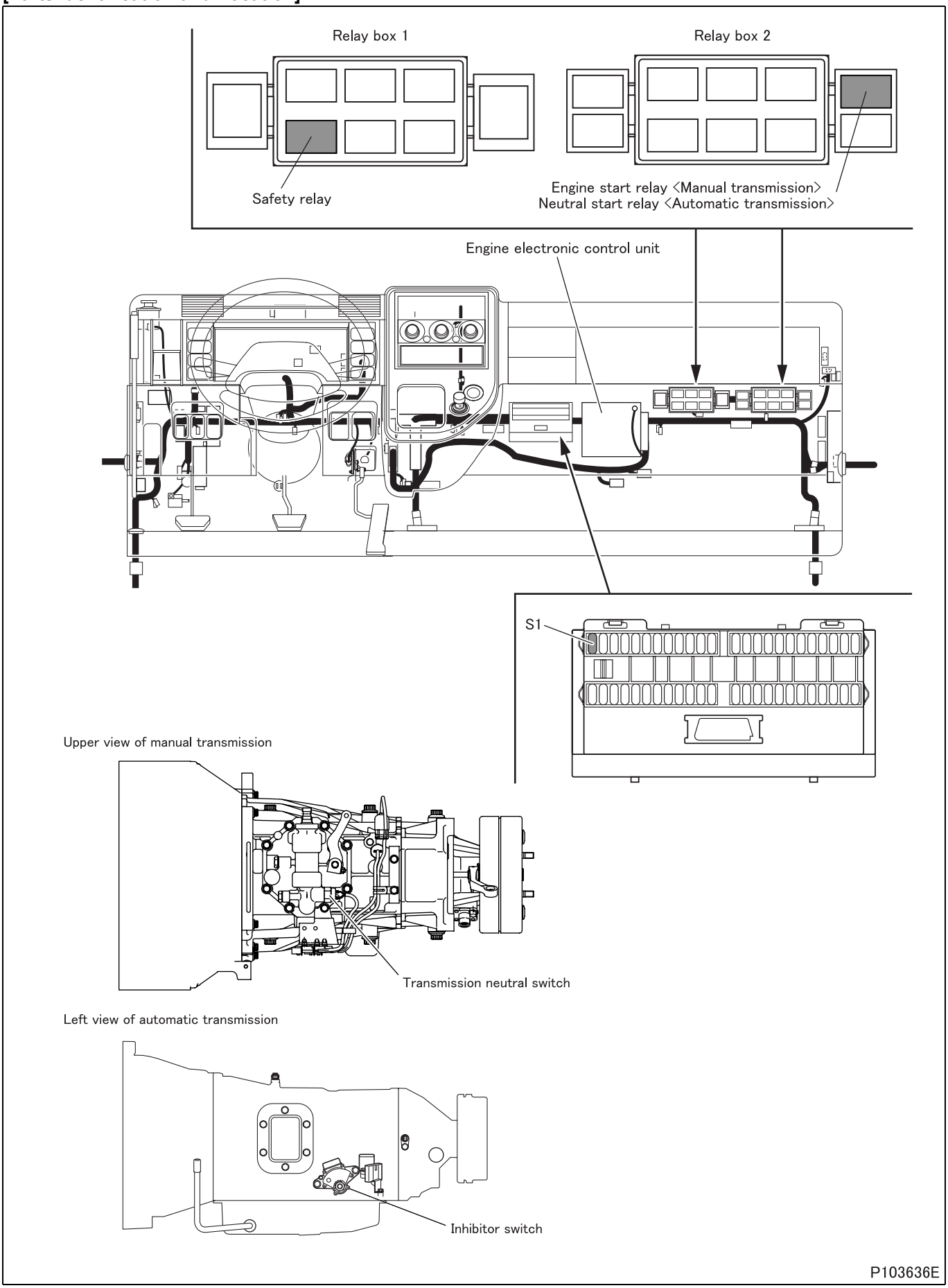
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and safety relay
- Malfunction of each connector
- Malfunction of safety relay
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AE “Starter Safety Relay”
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

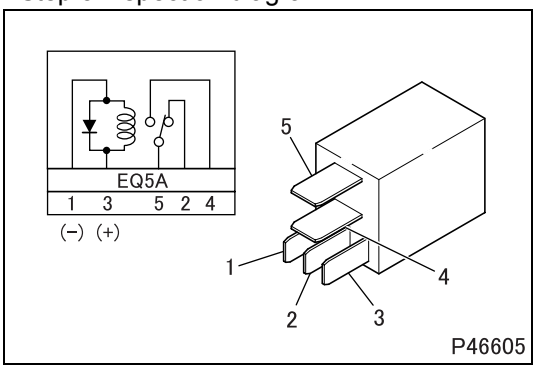
Step 2	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 81 (+) and 49 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Perform actuator test item No. AE “Starter Safety Relay”
	Requirements		Same as battery voltage (automatic reset after six seconds)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 2 and 5 when relay operates.
	Inspection condition		Apply battery voltage across connector terminals No. 3 (+) and 1 (–)
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of relay

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between relay and electronic control unit (power supply)
	Maintenance item		Check circuit between relay connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 81.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between relay and electronic control unit (ground)
	Maintenance item		Check circuit between relay connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 49.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AE “Starter Safety Relay”
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0617/Flash code: 48
[Monitor]
Failure of safety relay
[Fault (outline)]
Short circuit battery
[Diagnosis check]
- Engine electronic control unit internal function monitors safety relay for short circuit to power supply.

[Code generation condition]
- Safety relay circuit remains shorted to power supply as detected by engine electronic control unit internal function for 3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

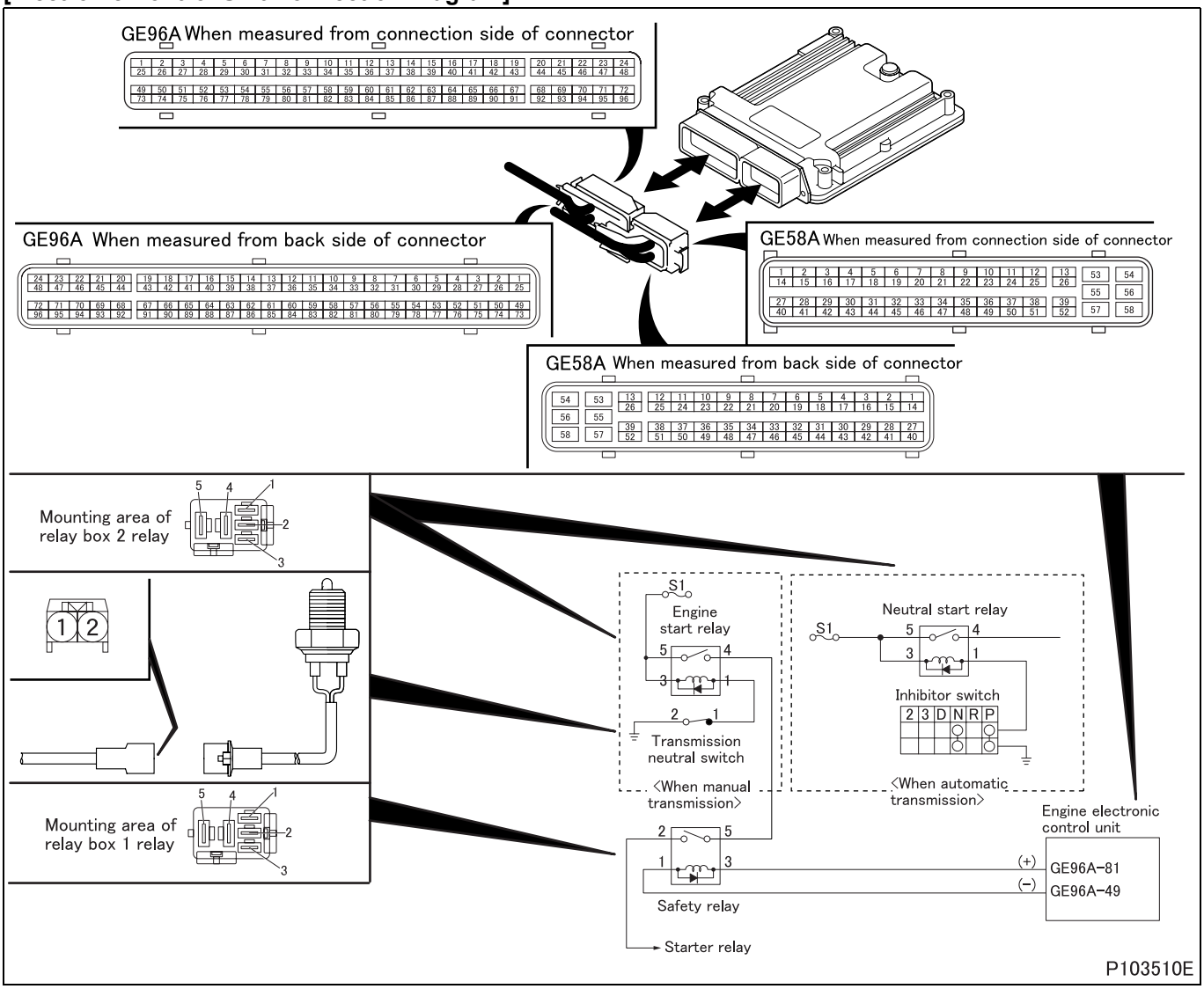
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

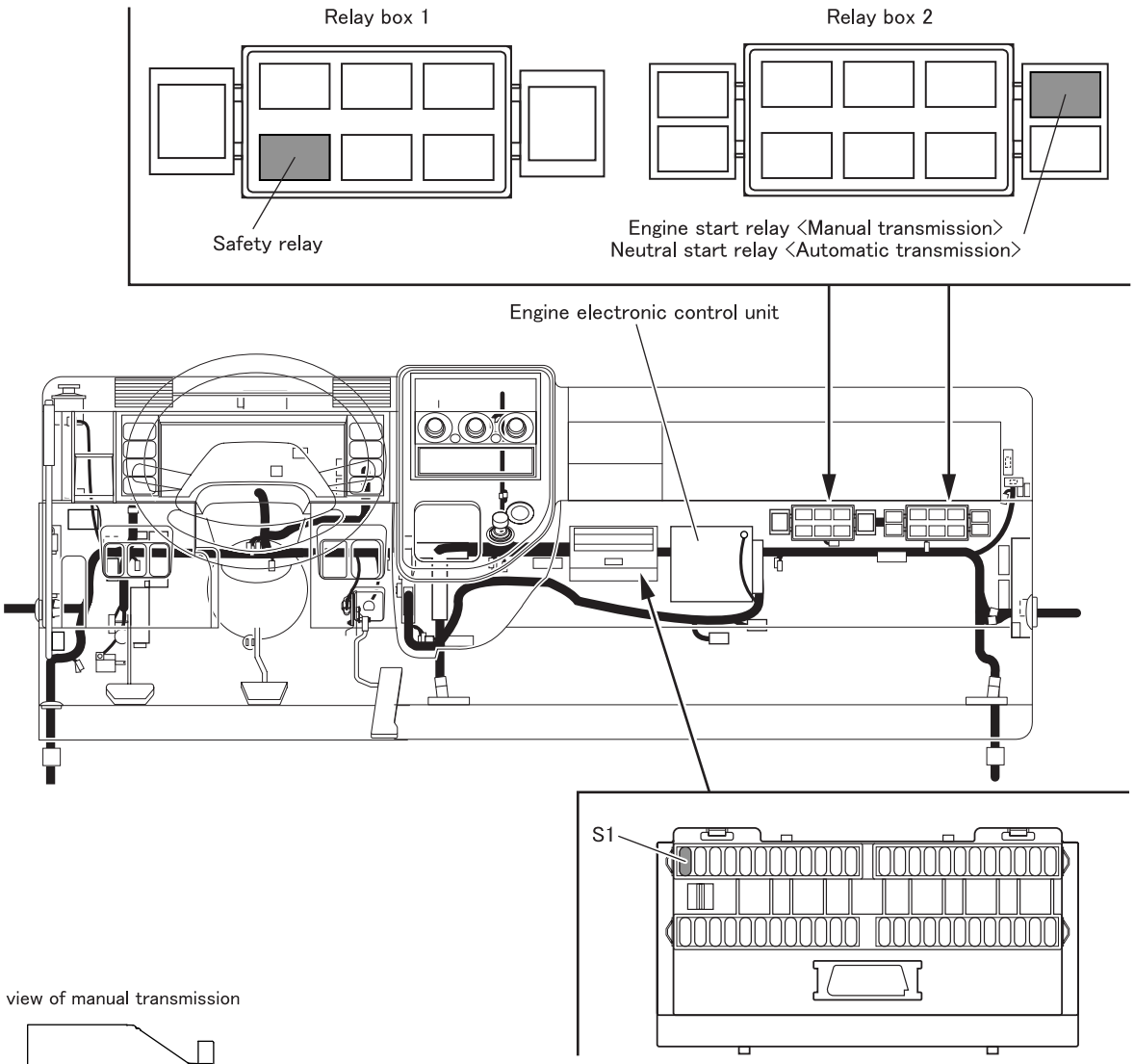
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and relay
- Malfunction of each connector
- Malfunction of safety relay
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

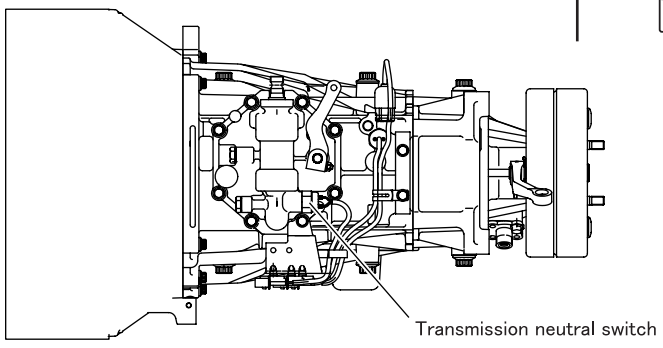
[Electronic Control Unit Connection Diagram]



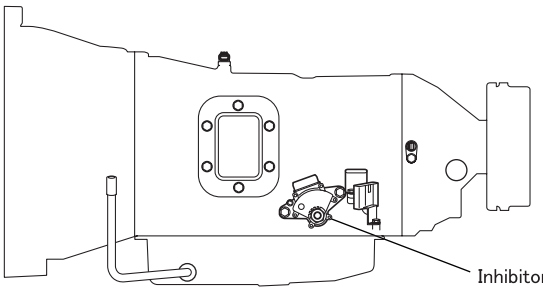
[Parts Identification and Location]



Upper view of manual transmission



Left view of automatic transmission



P103636E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

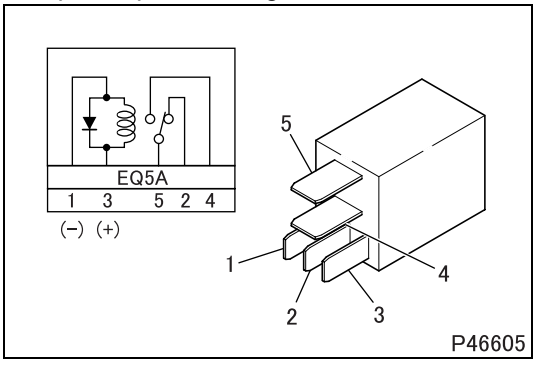
Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 49 and 81.
	Inspection condition		–
	Requirements		343 Ω or more
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 2 and 5 when relay operates.
	Inspection condition		Apply battery voltage across connector terminals No. 3 (+) and 1 (–).
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of relay

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between relay and electronic control unit (power supply)
	Maintenance item		Check circuit between relay connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 81
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between relay and electronic control unit (power supply)
	Maintenance item		Check circuit between relay connector terminal No. 3 and cab ground
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between relay and electronic control unit (ground)
	Maintenance item		Check circuit between relay connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 49
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AE “Starter Safety Relay”
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P061B/Flash code: 33
[Monitor]
Failure inside engine electronic control unit
[Fault (outline)]
Plausibility
[Diagnosis check]
- Injecting quantity computing function in engine electronic control unit is monitored.

[Code generation condition]
- Abnormal condition has occurred in injection quantity arithmetic processing inside engine electronic control unit. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of electronic control unit)

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Fault code]
Diagnosis code: P061C/Flash code: 33
[Monitor]
Failure inside engine electronic control unit
[Fault (outline)]
Plausibility
[Diagnosis check]
- Engine speed computing function in engine electronic control unit is monitored.

[Code generation condition]
- Abnormal condition has occurred in engine speed processing inside engine electronic control unit. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of electronic control unit)

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Fault code]
Diagnosis code: P062D/Flash code: 82
[Monitor]
Failure of injector circuit inside engine electronic control unit
[Fault (outline)]
Injector driver circuit (No. 1 and 3 cylinders)
[Diagnosis check]
- Failure of injector circuit inside engine electronic control unit

[Code generation condition]
- Injector (No. 1, No. 3 cylinder) power supply voltage in engine electronic control unit remains over 61.8 V or below 43.2 V for 3 consecutive cycles (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition).

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

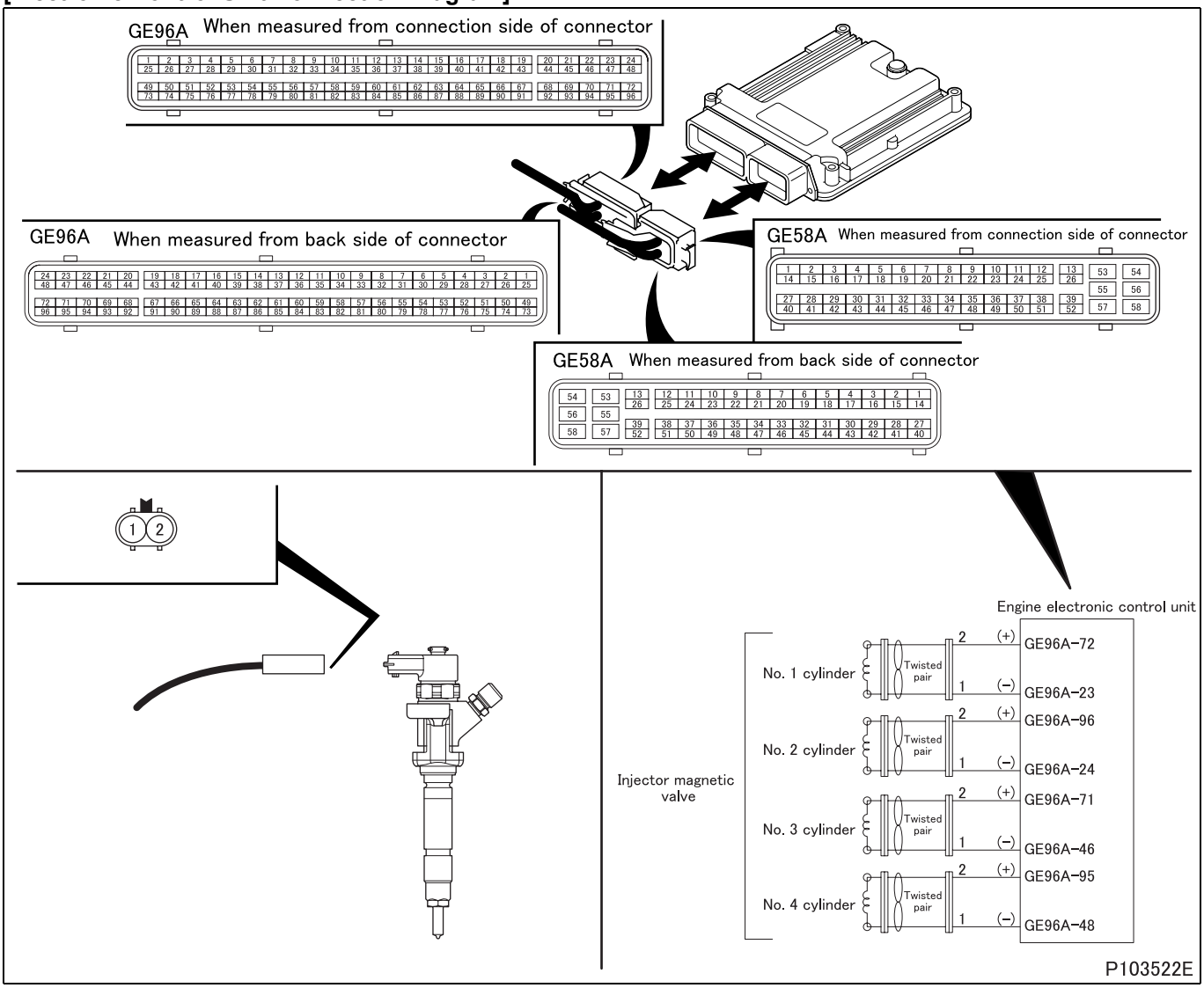
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 1 and No. 4 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Injector actuator test is inhibited.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

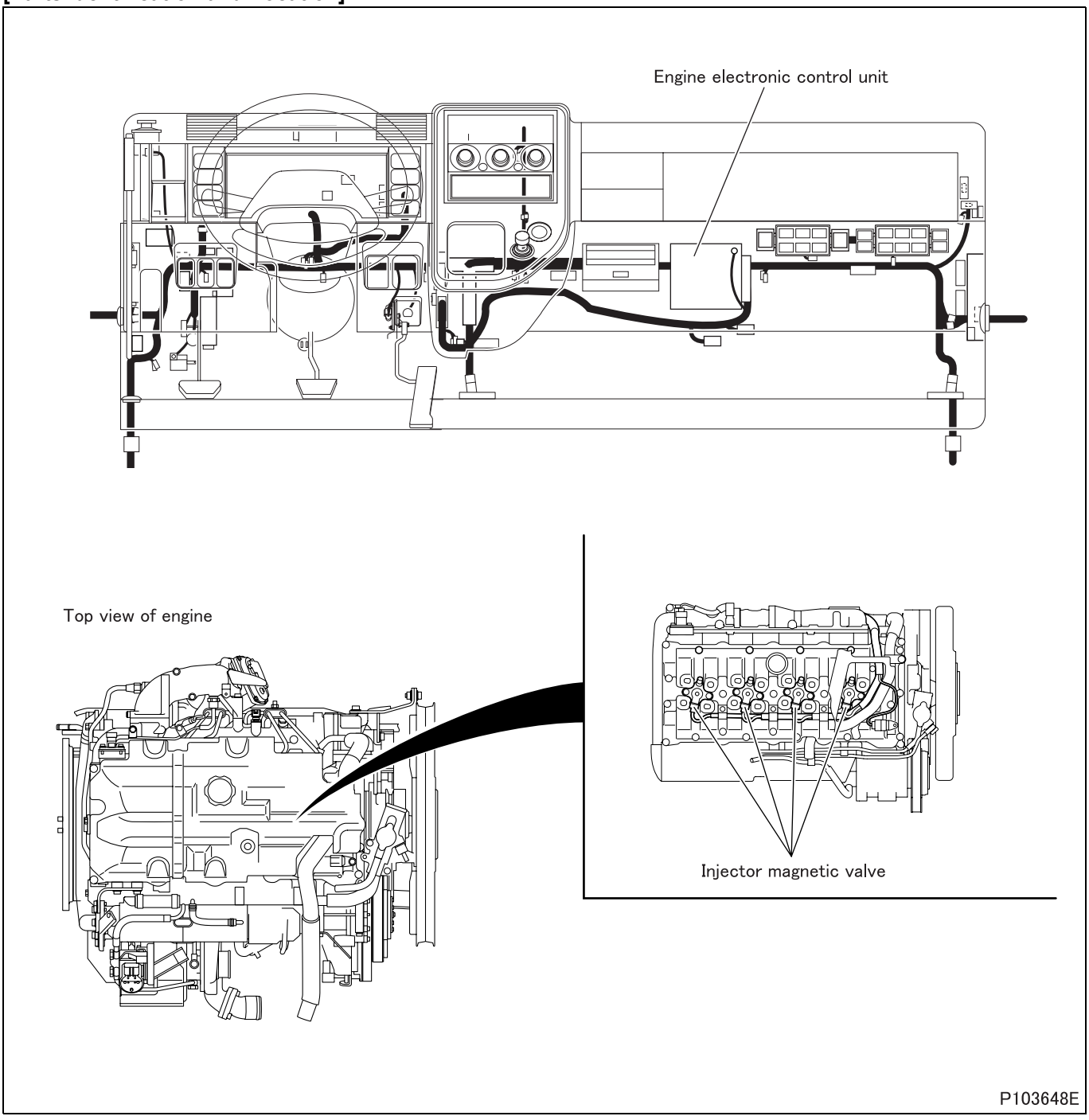
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valves
- Malfunction of each connector
- Malfunction of injector magnetic valves
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform the following actuator tests. • Injector magnetic valve (No. 1 cylinder): Perform item No. BB “Injector Test 1”. • Injector magnetic valve (No. 3 cylinder): Perform item No. BE “Injector Test 4”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) or Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

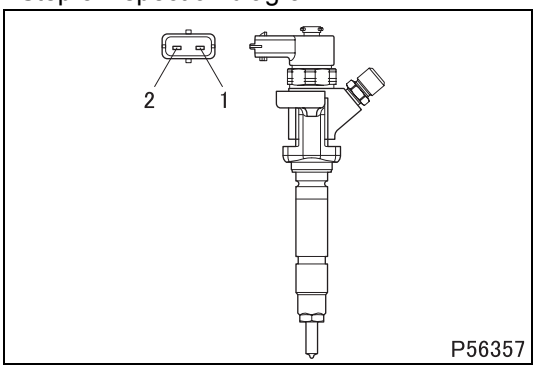
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between following connector (GE96A) terminals. • Injector magnetic valve (No. 1 cylinder): 72 (+) and 23 (–) • Injector magnetic valve (No. 3 cylinder): 71 (+) and 46 (–)
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 1 cylinder): magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 72 • Injector magnetic valve (No. 3 cylinder): magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 71
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 1 cylinder): magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 23 • Injector magnetic valve (No. 3 cylinder): magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 46
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform the following actuator tests. • Injector magnetic valve (No. 1 cylinder): Perform item No. BB “Injector Test 1”. • Injector magnetic valve (No. 3 cylinder): Perform item No. BE “Injector Test 4”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) or Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P062E/Flash code: 82
[Monitor]
Failure of injector circuit inside engine electronic control unit
[Fault (outline)]
Injector driver circuit (No. 2 and 4 cylinders)
[Diagnosis check]
- Injector power supply voltage in engine electronic control unit is monitored.

[Code generation condition]
- Injector (No. 2, No. 4 cylinder) power supply voltage in engine electronic control unit remains over 61.8 V or below 43.2 V for 3 consecutive cycles (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition).

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

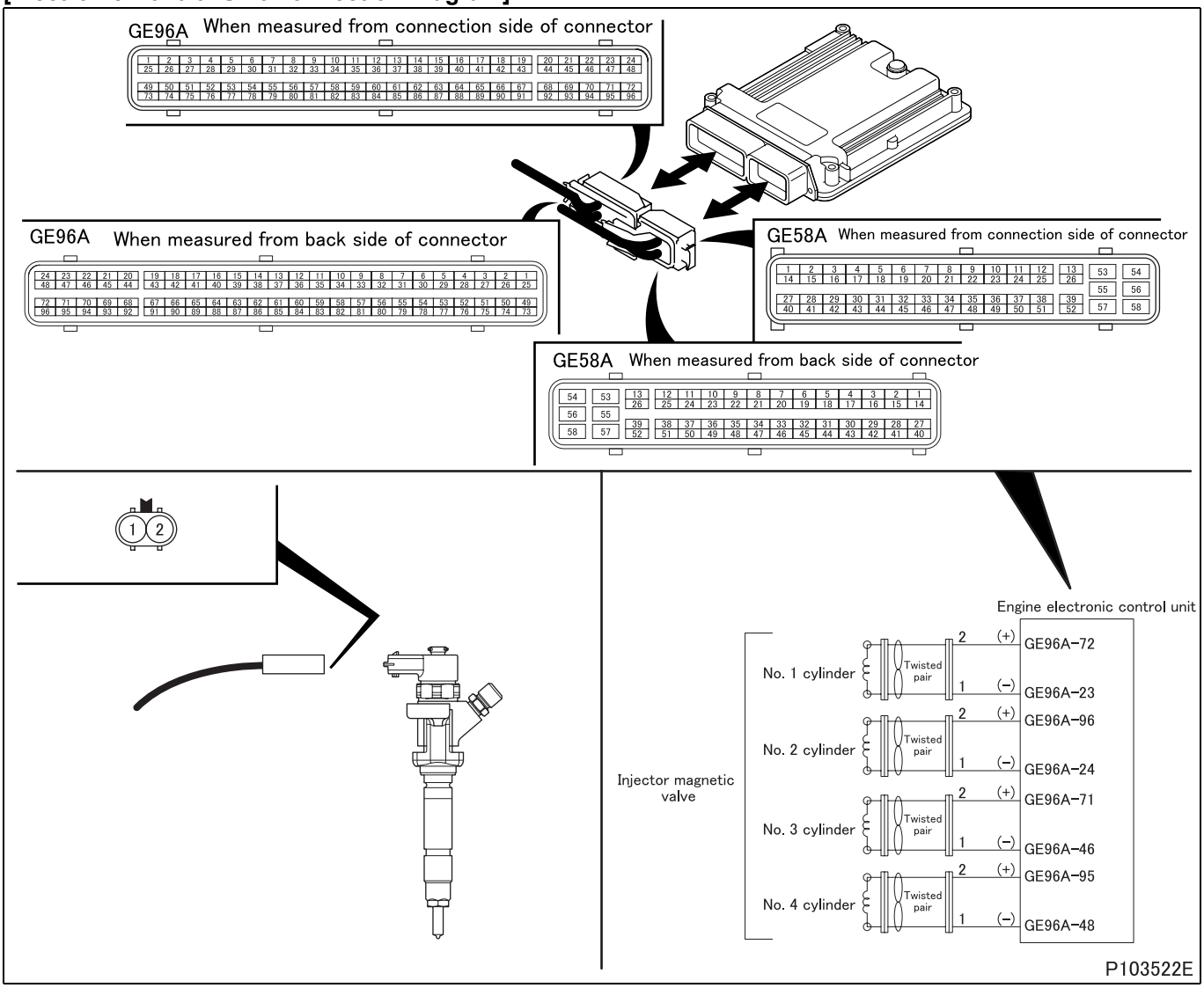
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 2 and No. 3 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Injector actuator test is inhibited.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

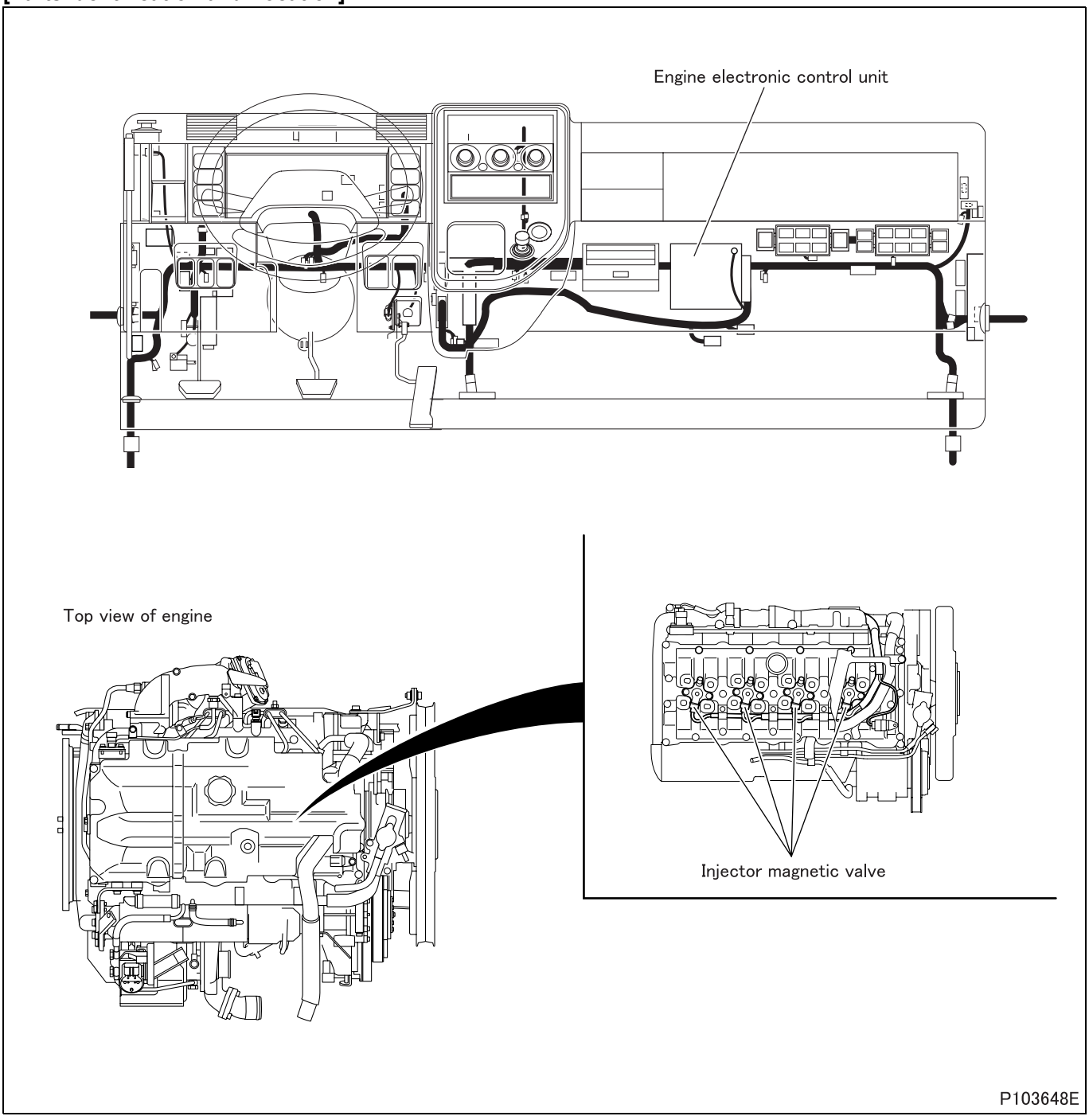
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valves
- Malfunction of each connector
- Malfunction of injector magnetic valves
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform the following actuator tests. • Injector magnetic valve (No. 2 cylinder): Perform item No. BD “Injector Test 3”. • Injector magnetic valve (No. 4 cylinder): Perform item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) or Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

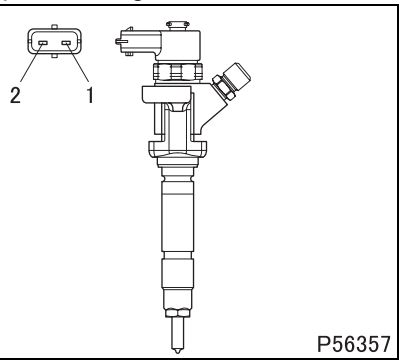
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between following connector (GE96A) terminals. • Injector magnetic valve (No. 2 cylinder): 96 (+) and 24 (–) • Injector magnetic valve (No. 4 cylinder): 95 (+) and 48 (–)
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 2 cylinder): magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 96 • Injector magnetic valve (No. 4 cylinder): magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 95
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 2 cylinder): magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 24 • Injector magnetic valve (No. 4 cylinder): magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 48
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform the following actuator tests. • Injector magnetic valve (No. 2 cylinder): Perform item No. BD “Injector Test 3”. • Injector magnetic valve (No. 4 cylinder): Perform item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) or Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0642/Flash code: 81
[Monitor]
Sensor power supply abnormal
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Sensor supply voltage 1 in engine electronic control unit is monitored.
- Units served by sensor supply voltage 1
- Accelerator pedal position sensor (sensor 1)
- Intake air temperature sensor

[Code generation condition]
- Supply voltage to units remain below 4.7 V for 0.5 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

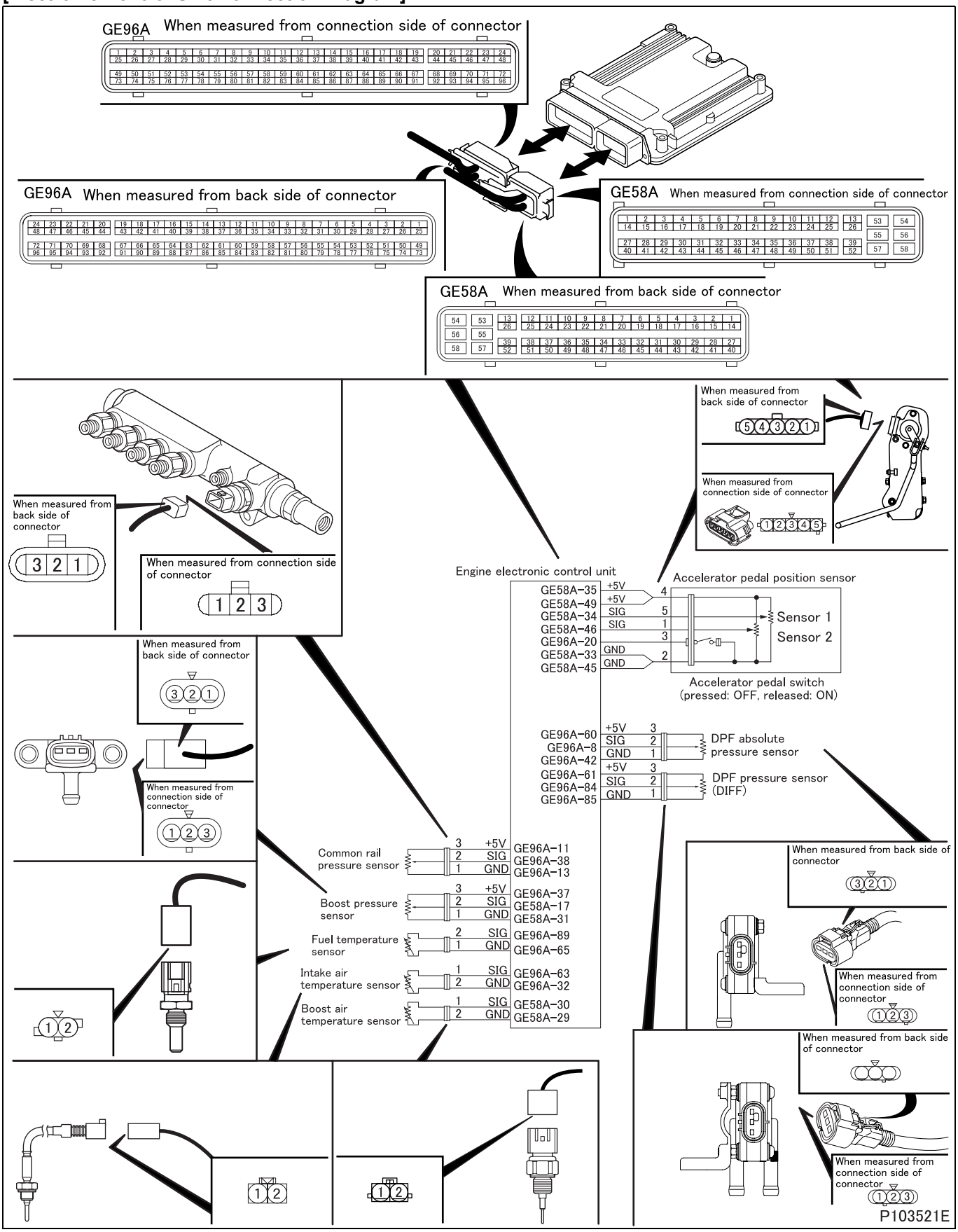
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

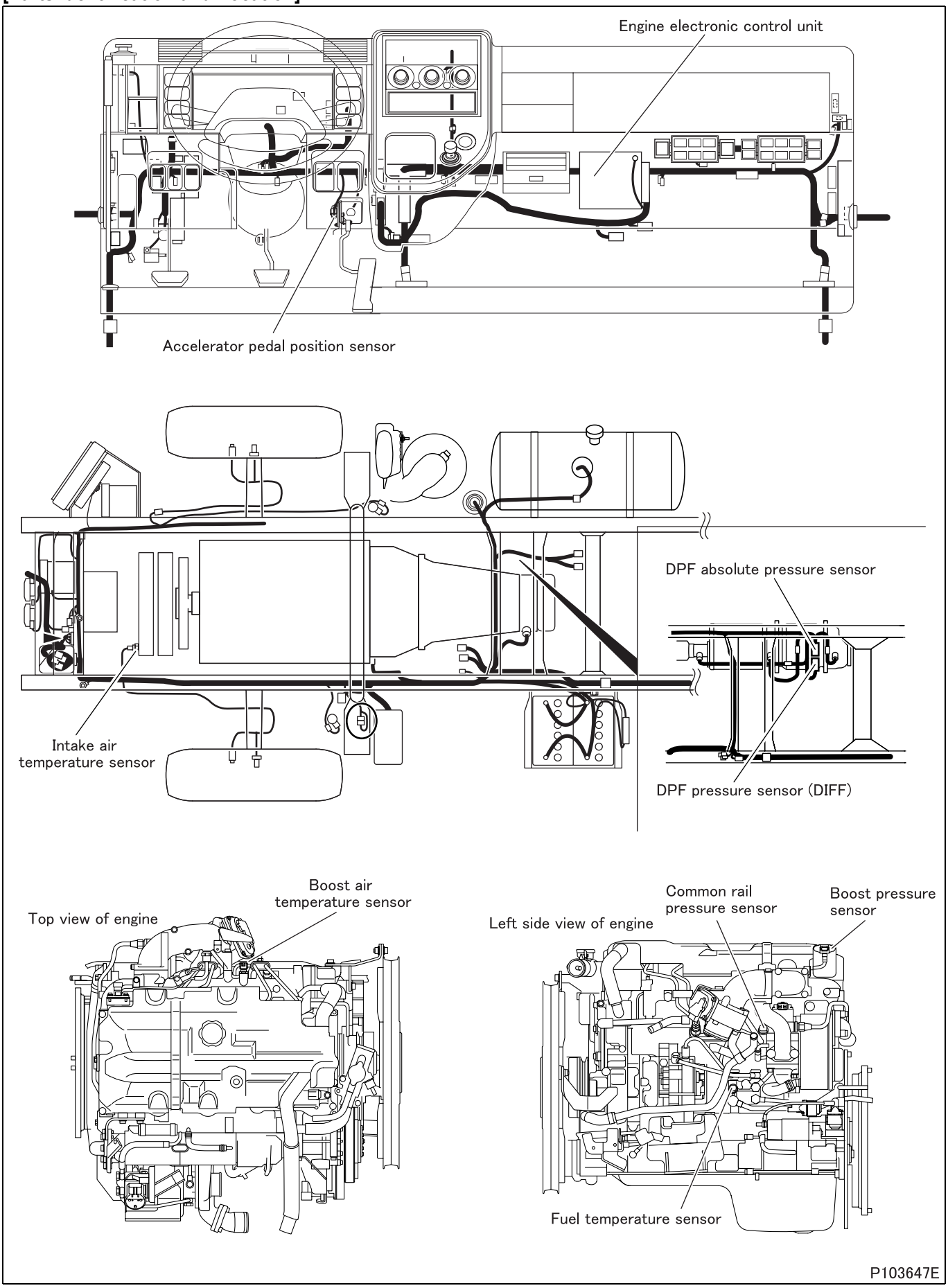
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and each sensor
- Malfunction of each connector
- Malfunction of each sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Modify connector.

Step 2	Inspection items		Inspection by electronic control unit connector (power supply): accelerator pedal position sensor (sensor 1)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 35 (+) and No. 33 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of accelerator pedal position sensor (sensor 1) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and accelerator pedal position sensor (sensor 1) (power supply)
	Maintenance item		Check circuit between accelerator pedal position sensor (sensor 1) connector terminal No. 4 and electronic control unit connector (GE58A) terminal No. 35.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection by electronic control unit connector: intake air temperature sensor
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 63 (+) and No. 32 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 6.

Step 6	Inspection items		Inspection of intake air temperature sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between electronic control unit and intake air temperature sensor (power supply)
	Maintenance item		Check circuit between intake air temperature sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 63
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify harness.

[Fault code]
Diagnosis code: P0643/Flash code: 81
[Monitor]
Sensor power supply abnormal
[Fault (outline)]
High signal range check
[Diagnosis check]
- Sensor supply voltage 1 in engine electronic control unit is monitored.
- Units served by sensor supply voltage 1
- Accelerator pedal position sensor (sensor 1)
- Intake air temperature sensor

[Code generation condition]
- Supply voltage to units remain over 5.3 V for 0.5 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

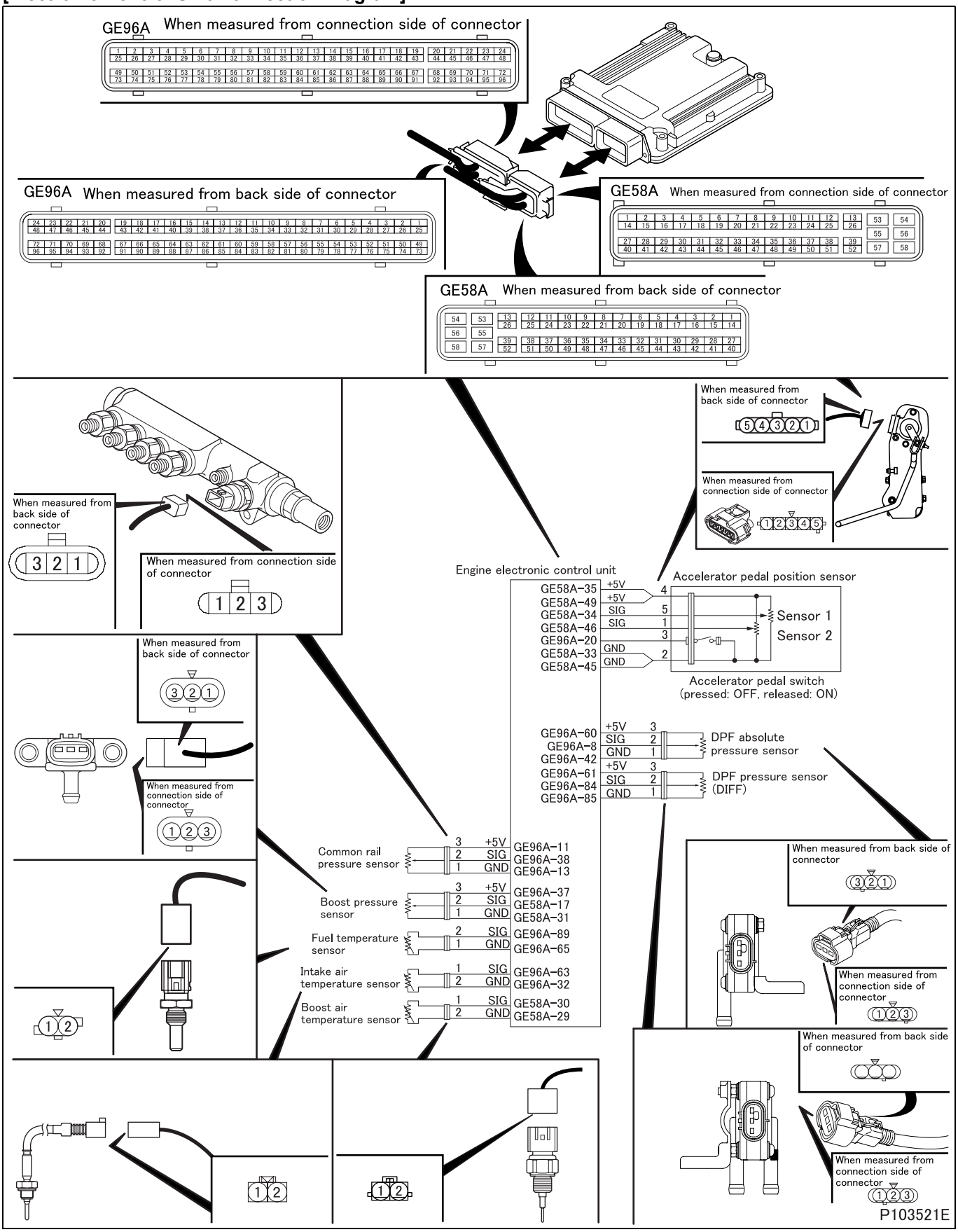
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

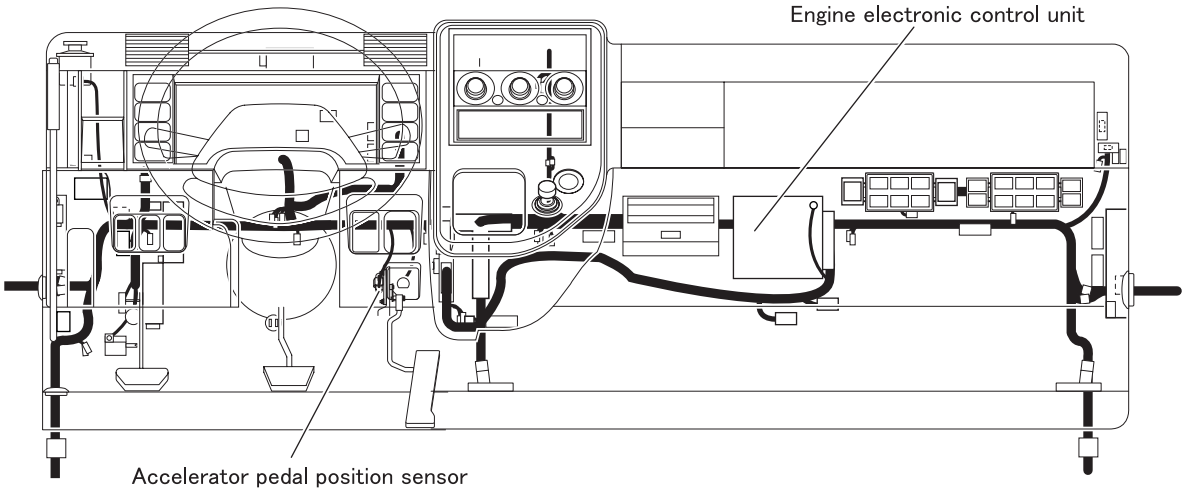
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and each sensor
- Malfunction of each connector
- Malfunction of each sensor
- Malfunction of electronic control unit

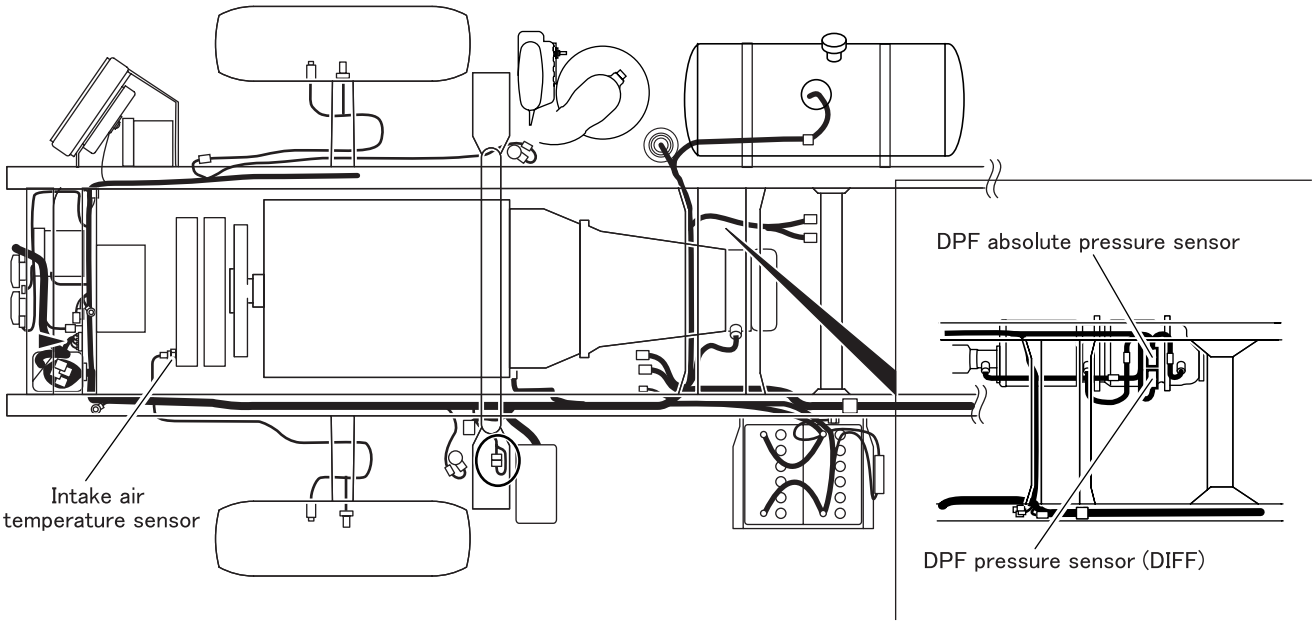
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

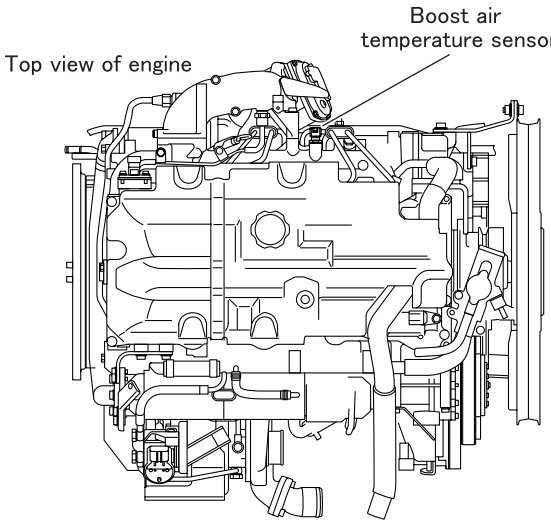
[Electronic Control Unit Connection Diagram]

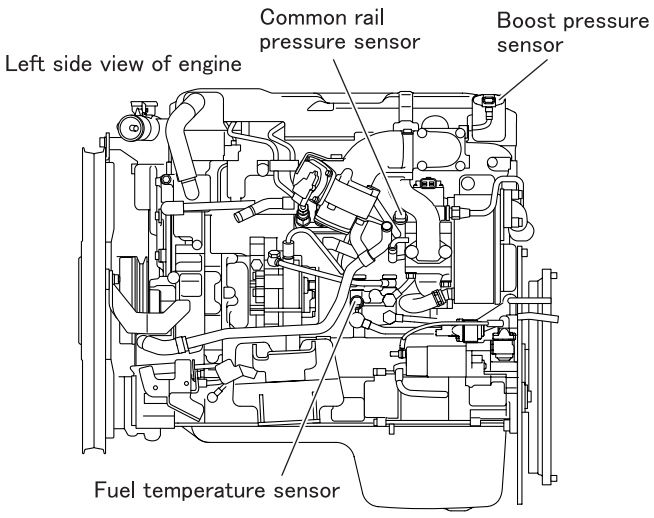


[Parts Identification and Location]









P103647E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Modify connector.

Step 2	Inspection items		Inspection by electronic control unit connector (power supply): accelerator pedal position sensor (sensor 1)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 35 (+) and No. 33 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of accelerator pedal position sensor (sensor 1) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and accelerator pedal position sensor (sensor 1) (power supply)
	Maintenance item		Check circuit between accelerator pedal position sensor (sensor 1) connector terminal No. 4 and electronic control unit connector (GE58A) terminal No. 35.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection by electronic control unit connector: intake air temperature sensor
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 63 (+) and No. 32 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 6.

Step 6	Inspection items		Inspection of intake air temperature sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between electronic control unit and intake air temperature sensor (power supply)
	Maintenance item		Check circuit between intake air temperature sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 63
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify harness.

[Fault code]
Diagnosis code: P0650/Flash code: 3
[Monitor]
Failure of engine warning lamp (orange)
[Fault (outline)]
- Short circuit battery
- Short circuit ground
- Open circuit
- Overload

[Diagnosis check]
- Engine warning lamp (orange) circuit is monitored for fault.

[Code generation condition]
- Engine warning lamp (orange) circuit remains open, shorted or overcurrent as detected for 5 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.
- Fault diagnosis is performed each time when the control is halted.

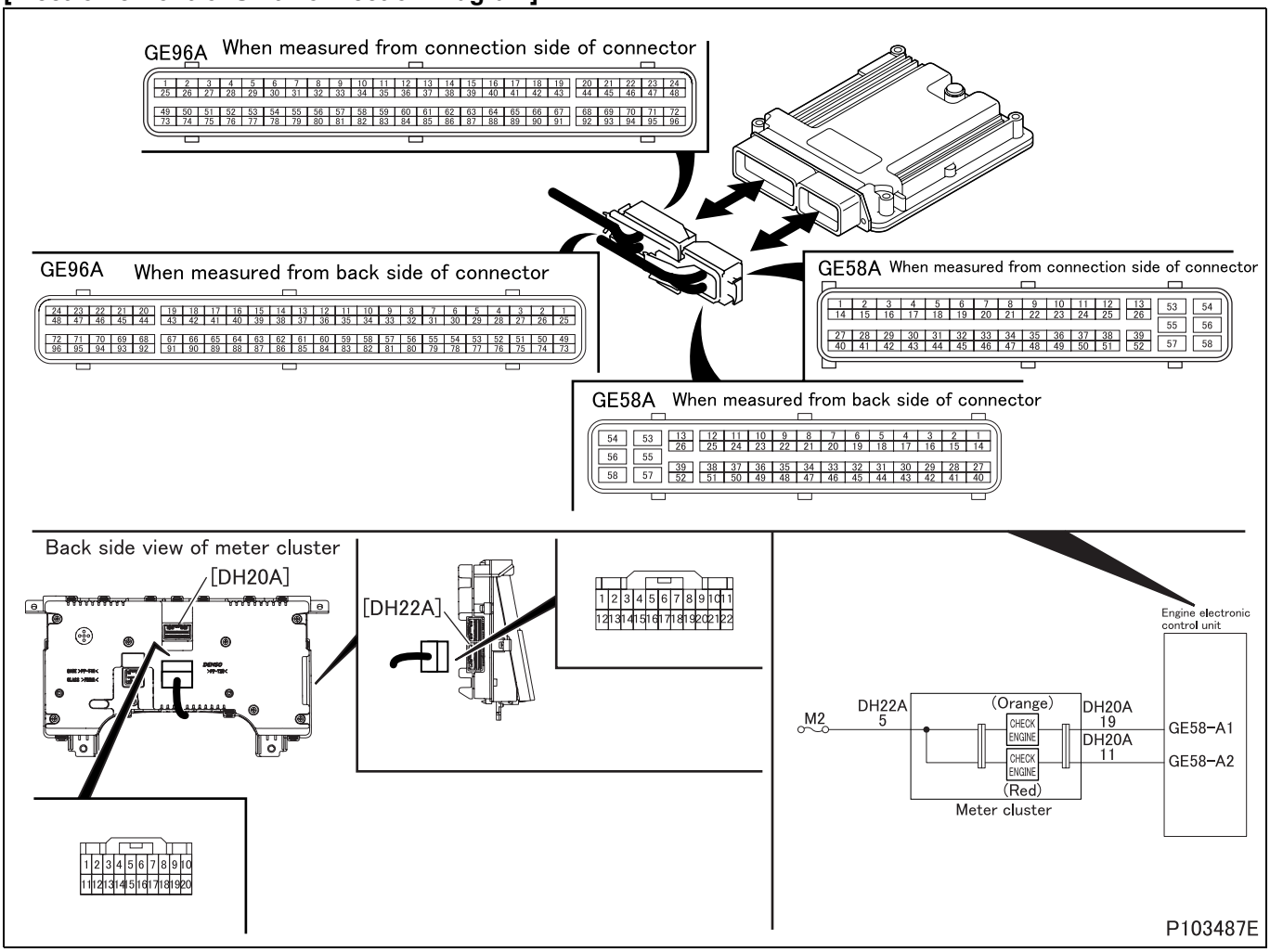
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

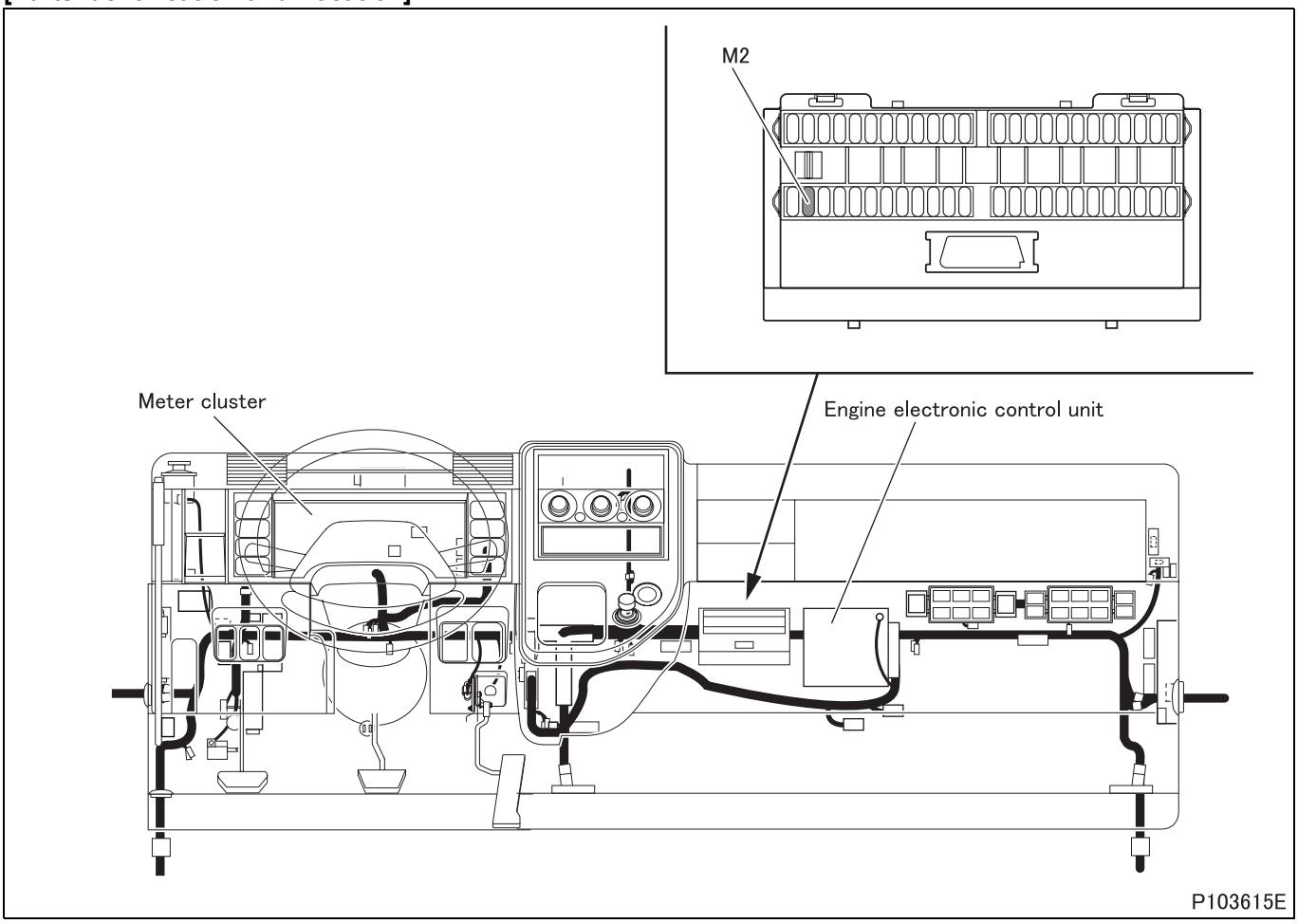
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and meter cluster (engine warning lamp (orange))
- Malfunction of each connector
- Malfunction of meter cluster (engine warning lamp (orange))
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B0 “MIL”.
	Inspection condition		Starter switch: ON
	Requirements		Lamp illuminates for six seconds.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Ground connector (GE58A) terminal No. 1.
	Inspection condition		It wires for the ground harness from the other side of the connector.
	Requirements		Lamp illuminates.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between fuse and meter cluster
	Maintenance item		Check circuit between fuse (M2) and meter cluster connector (DH22A) terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between meter cluster and electronic control unit
	Maintenance item		Check circuit between meter cluster connector (DH20A) terminal No. 19 and electronic control unit connector (GE58A) terminal No. 1
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of meter cluster
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of meter cluster or lamp
		NO	Modify connector.

[Fault code]
Diagnosis code: P0652/Flash code: 81
[Monitor]
Sensor power supply abnormal
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Sensor supply voltage 2 in engine electronic control unit is monitored.
- Units served by sensor supply voltage 2
- Boost pressure sensor
- Accelerator pedal position sensor (sensor 2)
- Fuel temperature sensor

[Code generation condition]
- Supply voltage to units remain below 4.7 V for 0.5 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

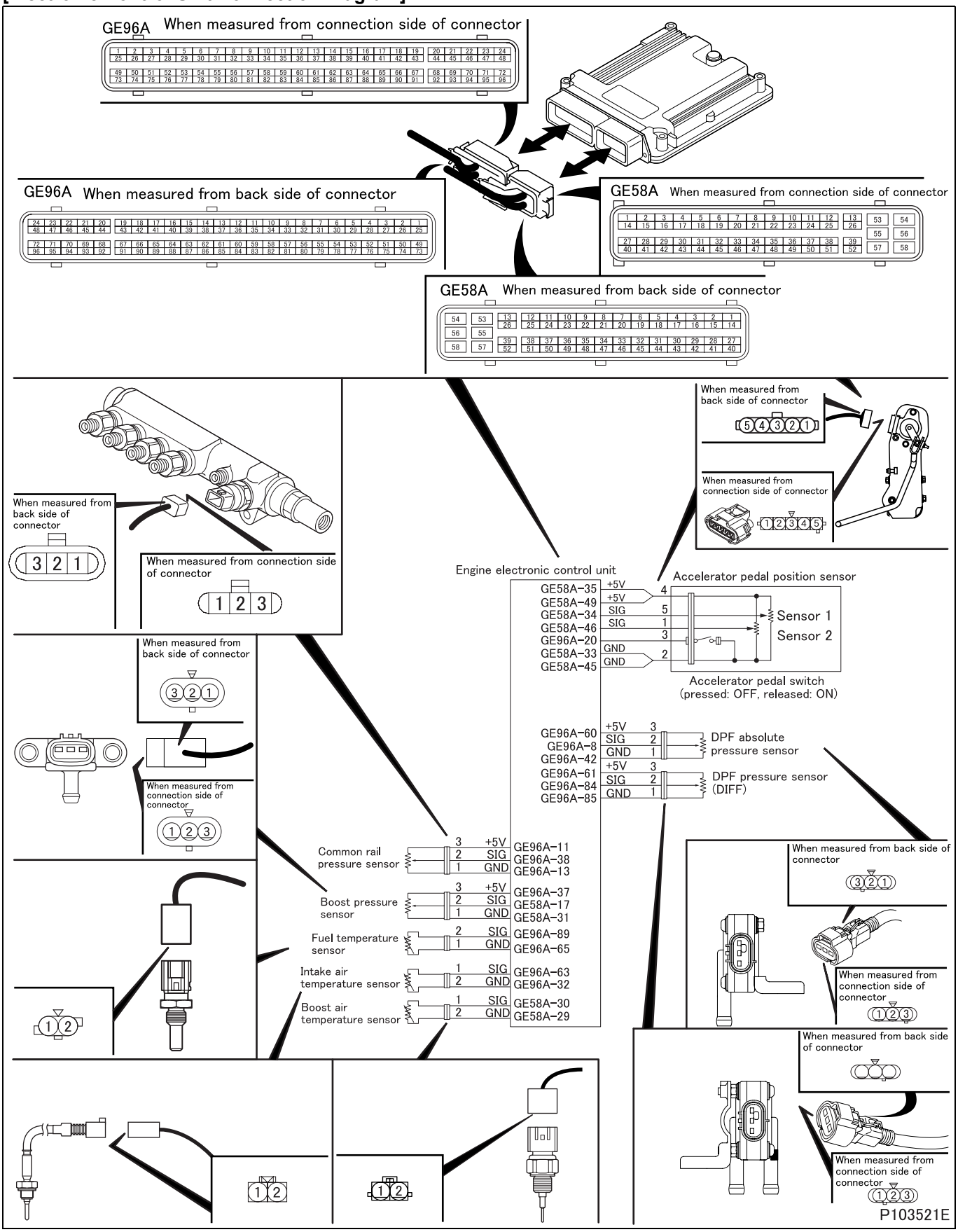
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

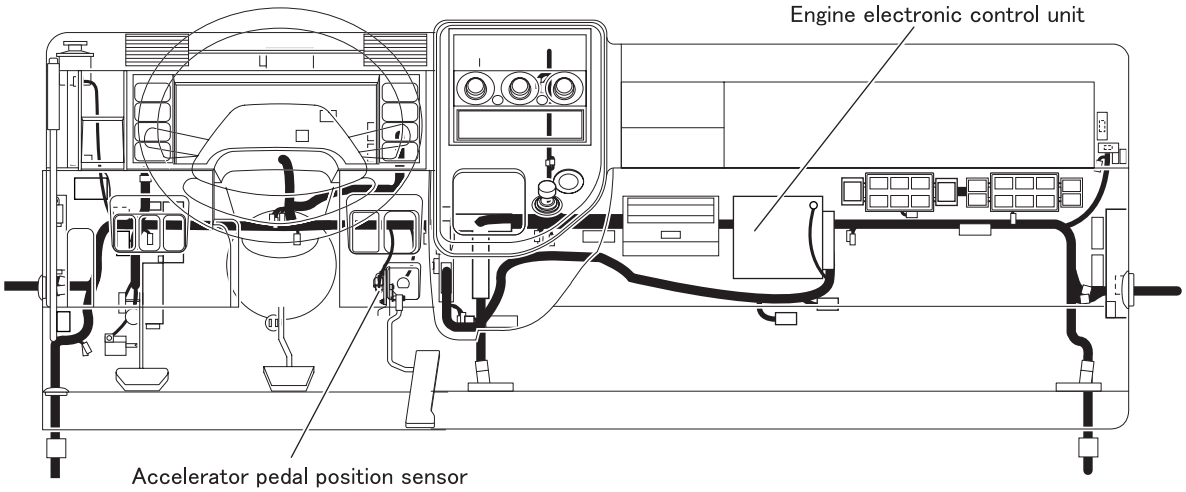
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and each sensor
- Malfunction of each connector
- Malfunction of each sensor
- Malfunction of electronic control unit

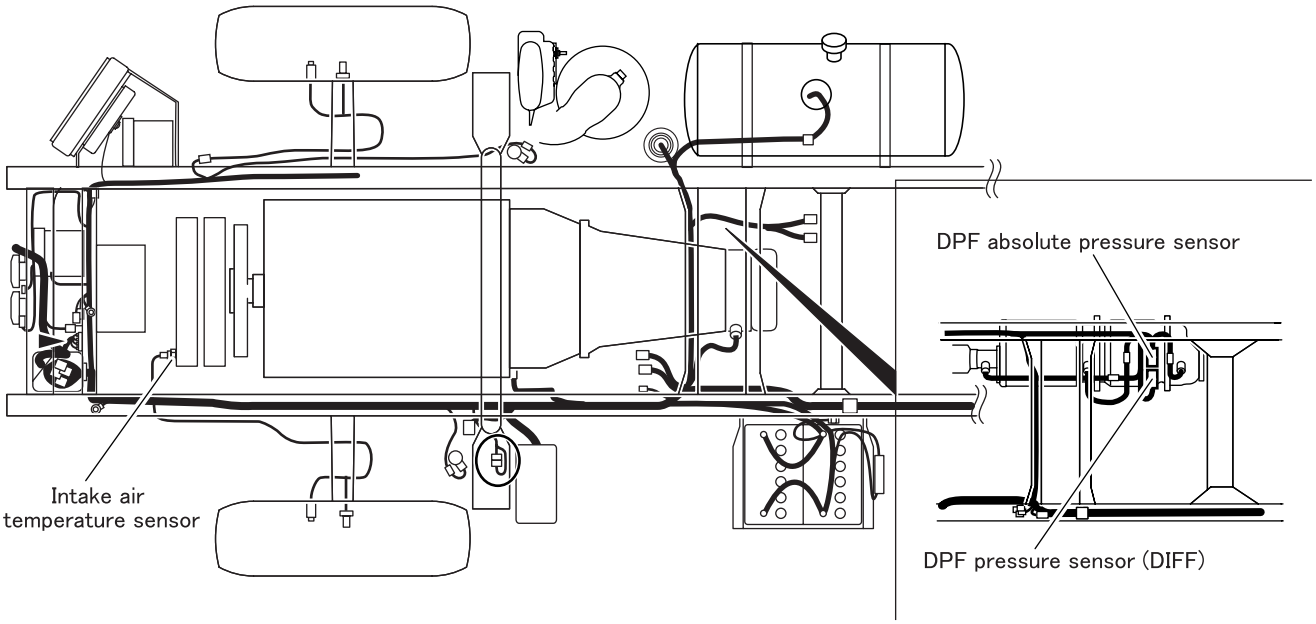
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

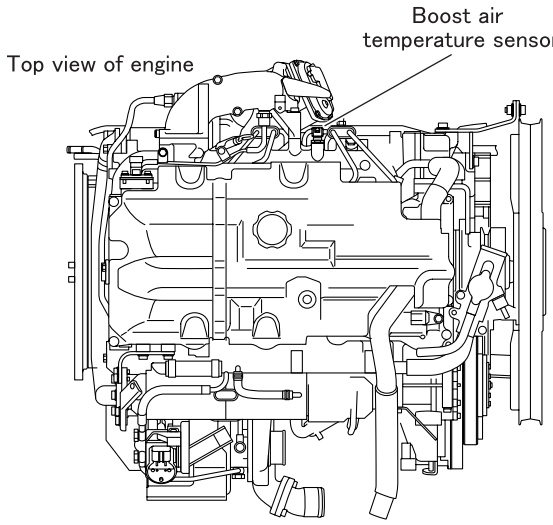
[Electronic Control Unit Connection Diagram]

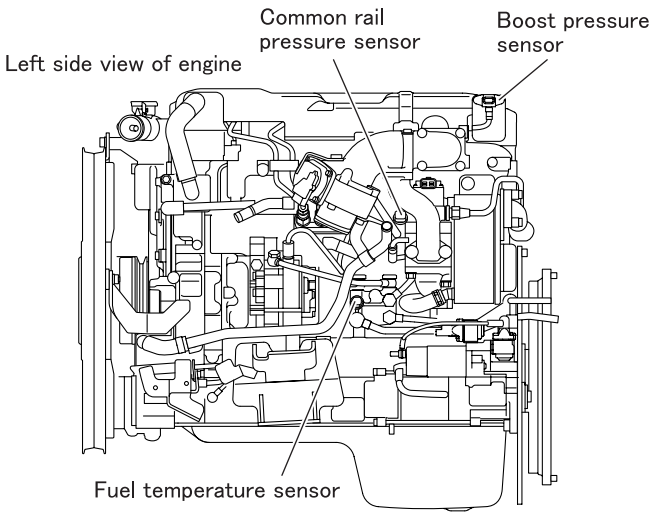


[Parts Identification and Location]









P103647E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Modify connector.

Step 2	Inspection items		Inspection by electronic control unit connector (power supply): boost pressure sensor
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 37 (+) and No. 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of boost pressure sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and boost pressure sensor (power supply)
	Maintenance item		Check circuit between boost pressure sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 37.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection by electronic control unit connector (power supply): accelerator pedal position sensor (sensor 2)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 49 (+) and No. 45 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of accelerator pedal position sensor (sensor 2) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between electronic control unit and accelerator pedal position sensor (sensor 2) (power supply)
	Maintenance item		Check circuit between accelerator pedal position sensor (sensor 2) connector terminal No. 4 and electronic control unit connector (GE58A) terminal No. 49
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by electronic control unit connector: fuel temperature sensor
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 89 (+) and No. 65 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection of fuel temperature sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 10	Inspection items		Inspection of harness between electronic control unit and fuel temperature sensor (power supply)
	Maintenance item		Check circuit between fuel temperature sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 89
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify harness.

[Fault code]
Diagnosis code: P0653/Flash code: 81
[Monitor]
Sensor power supply abnormal
[Fault (outline)]
High signal range check
[Diagnosis check]
- Sensor supply voltage 2 in engine electronic control unit is monitored.
- Units served by sensor supply voltage 2
- Boost pressure sensor
- Accelerator pedal position sensor (sensor 2)
- Fuel temperature sensor

[Code generation condition]
- Supply voltage to units remain over 5.3 V for 0.5 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

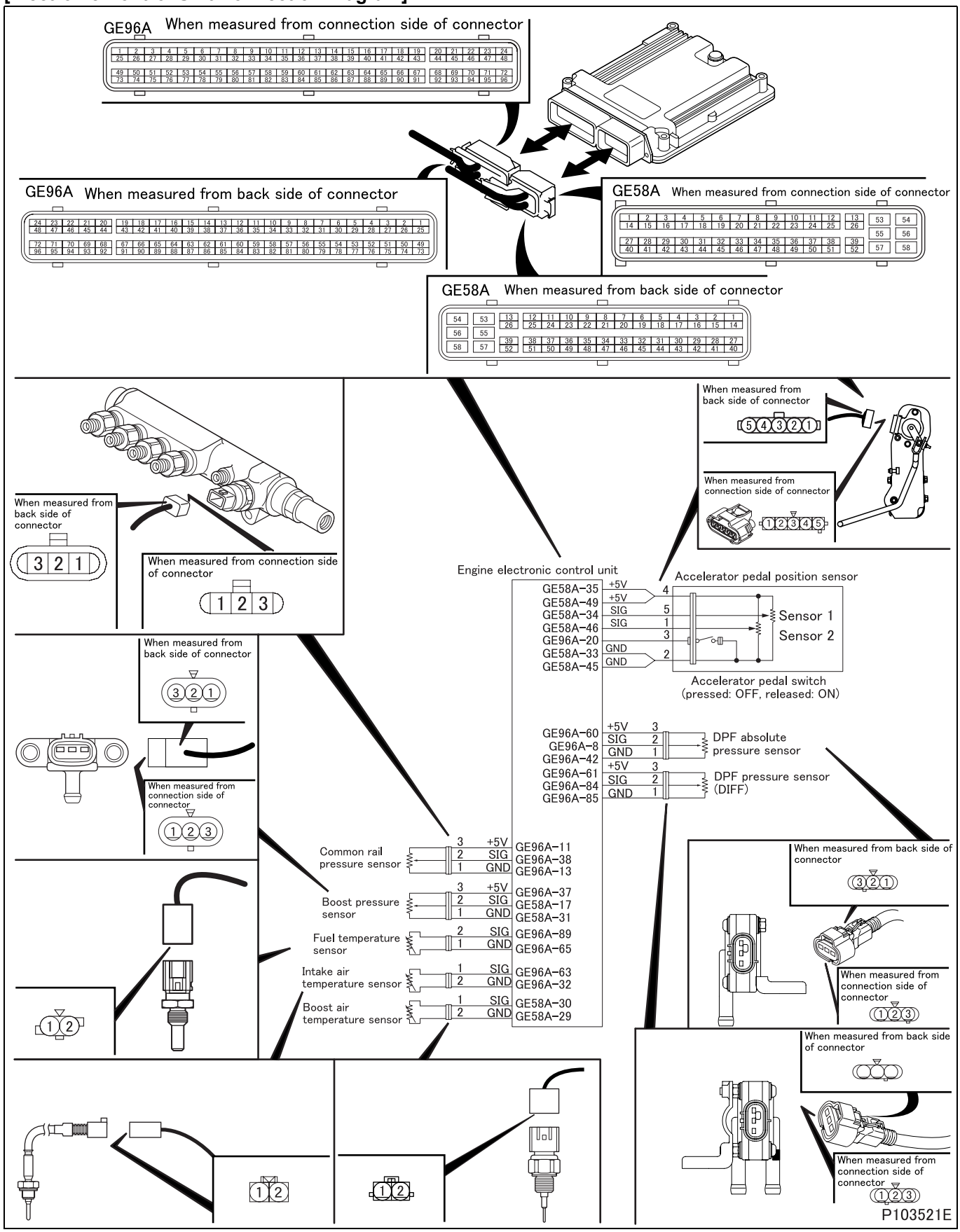
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

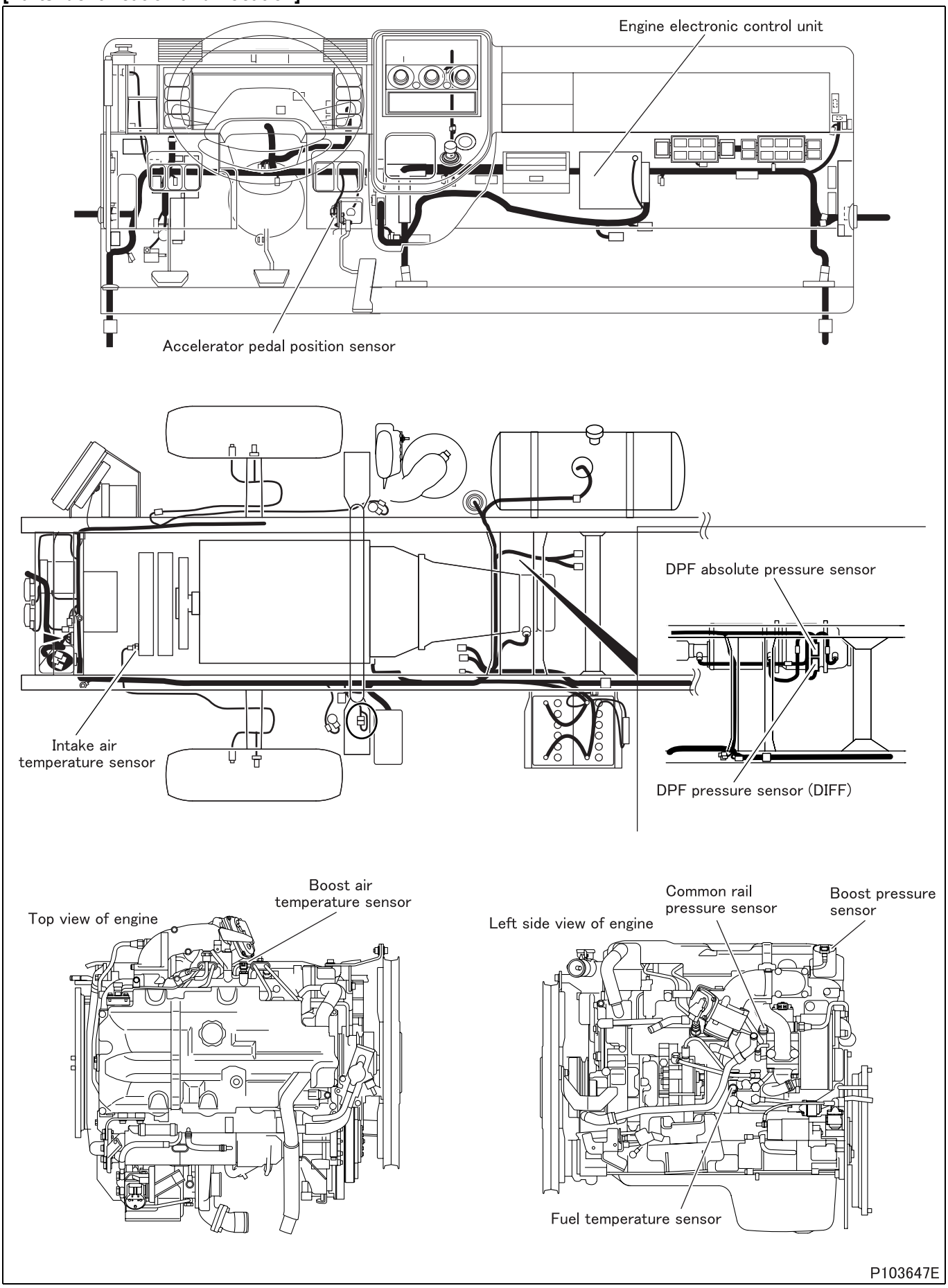
[Probable cause of trouble]
- Open-circuit or short-circuited harness between electronic control unit and each sensor
- Malfunction of each connector
- Malfunction of each sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Modify connector.

Step 2	Inspection items		Inspection by electronic control unit connector (power supply): boost pressure sensor
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 37 (+) and No. 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of boost pressure sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and boost pressure sensor (power supply)
	Maintenance item		Check circuit between boost pressure sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 37.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection by electronic control unit connector (power supply): accelerator pedal position sensor (sensor 2)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 49 (+) and No. 45 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of accelerator pedal position sensor (sensor 2) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between electronic control unit and accelerator pedal position sensor (sensor 2) (power supply)
	Maintenance item		Check circuit between accelerator pedal position sensor (sensor 2) connector terminal No. 4 and electronic control unit connector (GE58A) terminal No. 49
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by electronic control unit connector: fuel temperature sensor
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 89 (+) and No. 65 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection of fuel temperature sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 10	Inspection items		Inspection of harness between electronic control unit and fuel temperature sensor (power supply)
	Maintenance item		Check circuit between fuel temperature sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 89
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify harness.

[Fault code]
Diagnosis code: P0657/Flash code: 79
[Monitor]
Abnormality of magnetic valve power supply
[Fault (outline)]
Short circuit ground
[Diagnosis check]
- Exhaust shutter 3-way magnetic valve circuit is monitored for fault.

[Code generation condition]
- Exhaust shutter 3-way magnetic valve circuit remains shorted to ground as detected for 0.5 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

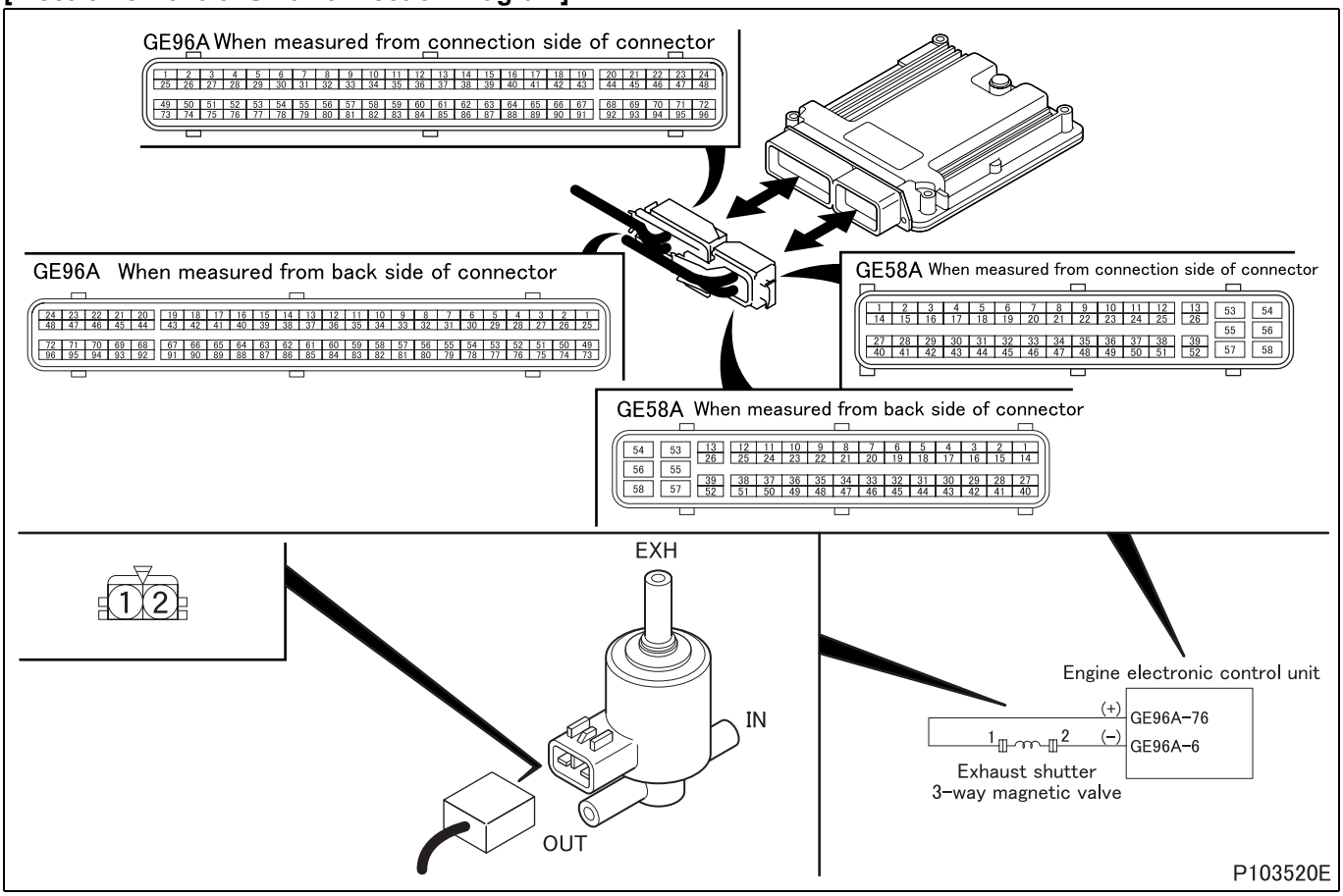
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust shutter 3-way magnetic valve is turned off.

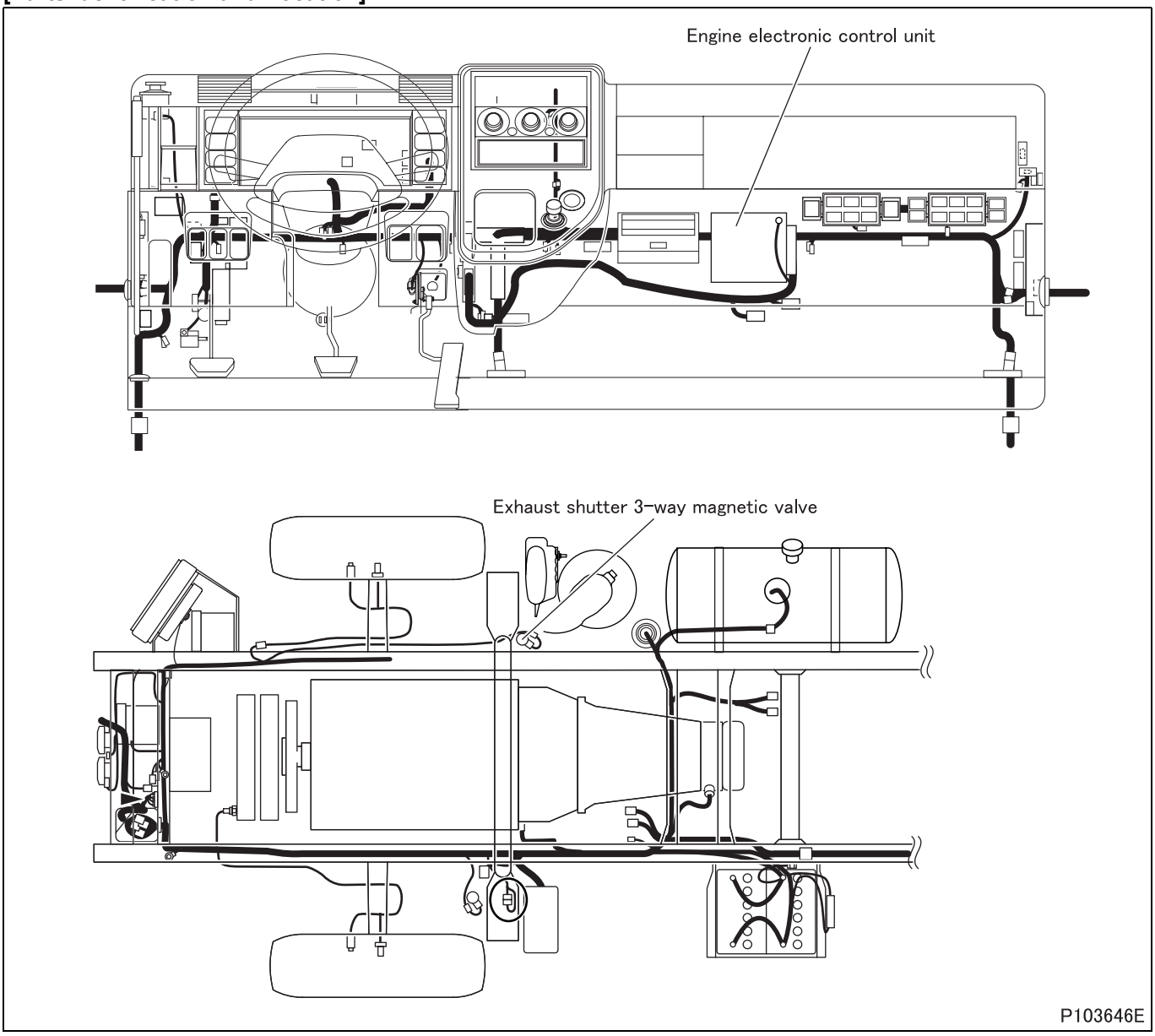
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and exhaust shutter 3-way magnetic valve
- Malfunction of each connector
- Malfunction of exhaust shutter 3-way magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

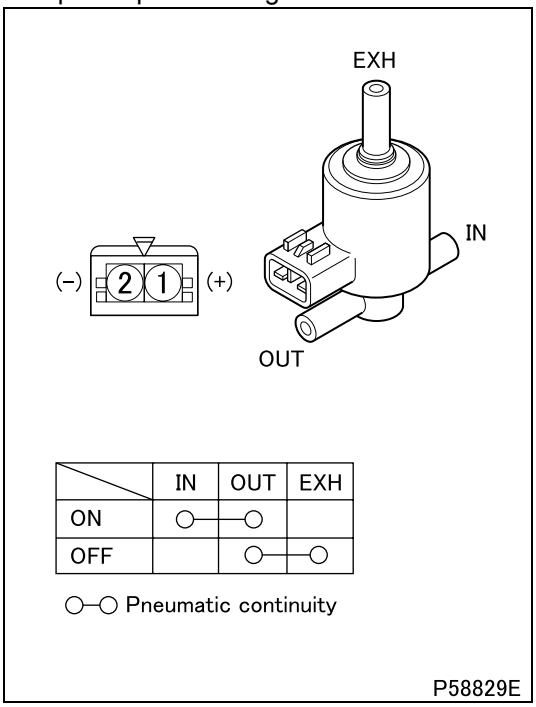
Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 6 and 76.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		48 Ω or more
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of 3-way magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of 3-way magnetic valve unit
	Maintenance item		Measure minimum operating voltage when 3-way magnetic valve operates (judge by operation sound).
	Inspection condition		Gradually increase from zero the voltage applied to terminals No. 1 (+) and 2 (–).
	Requirements		11 V or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of 3-way magnetic valve

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 76.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 1 and chassis ground
	Inspection condition		Disconnect each device from harness and measure from connection side of harness
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AA “Auxiliary Brake M/V 1”.
	Inspection condition		Starter switch: ON
	Requirements		3-way magnetic valve operation sound is noted
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0670/Flash code: 26
[Monitor]
Failure of preheating control system
[Fault (outline)]
- Open circuit
- Overload
- GCU communication error

[Diagnosis check]
- Engine electronic control unit receives fault information from glow electronic control unit.
- Glow electronic control unit monitors condition of electronic control unit.

[Code generation condition]
Diagnosis code is generated under either of the following conditions. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)
- Glow electronic control unit power supply circuit remains open as detected for 0.2 second.
- Power supply temperature in glow electronic control unit remains at 100°C {212°F} for 0.2 second.
- High current fuse (BATT2) directly connected to battery remains blown for 2.3 seconds.
- Glow plug drive terminal voltage remains below 8 V or over 18.5 V for 2.3 seconds when engine requires no warming-up.
- Upper limit temperature remains over 135°C {275°F} for 2.3 seconds.

[Diagnosis check timing]
<Fault diagnosis for PWM (Pulse Width Modulation)>
- Fault diagnosis is performed each time when the control is initiated.
- Fault diagnosis is performed each time when the control is halted.

<Fault diagnosis for other than those above>
- Fault diagnosis is continuously performed.

[Diagnostic requirement]
<Fault diagnosis for PWM (Pulse Width Modulation)>
- Preheating control: stopped
- Preheating control: being effected
- Water temperature: below 65°C {149°F}
- Preheating control: no other error occurs

<Fault diagnosis for other than those above>
- Not applicable.

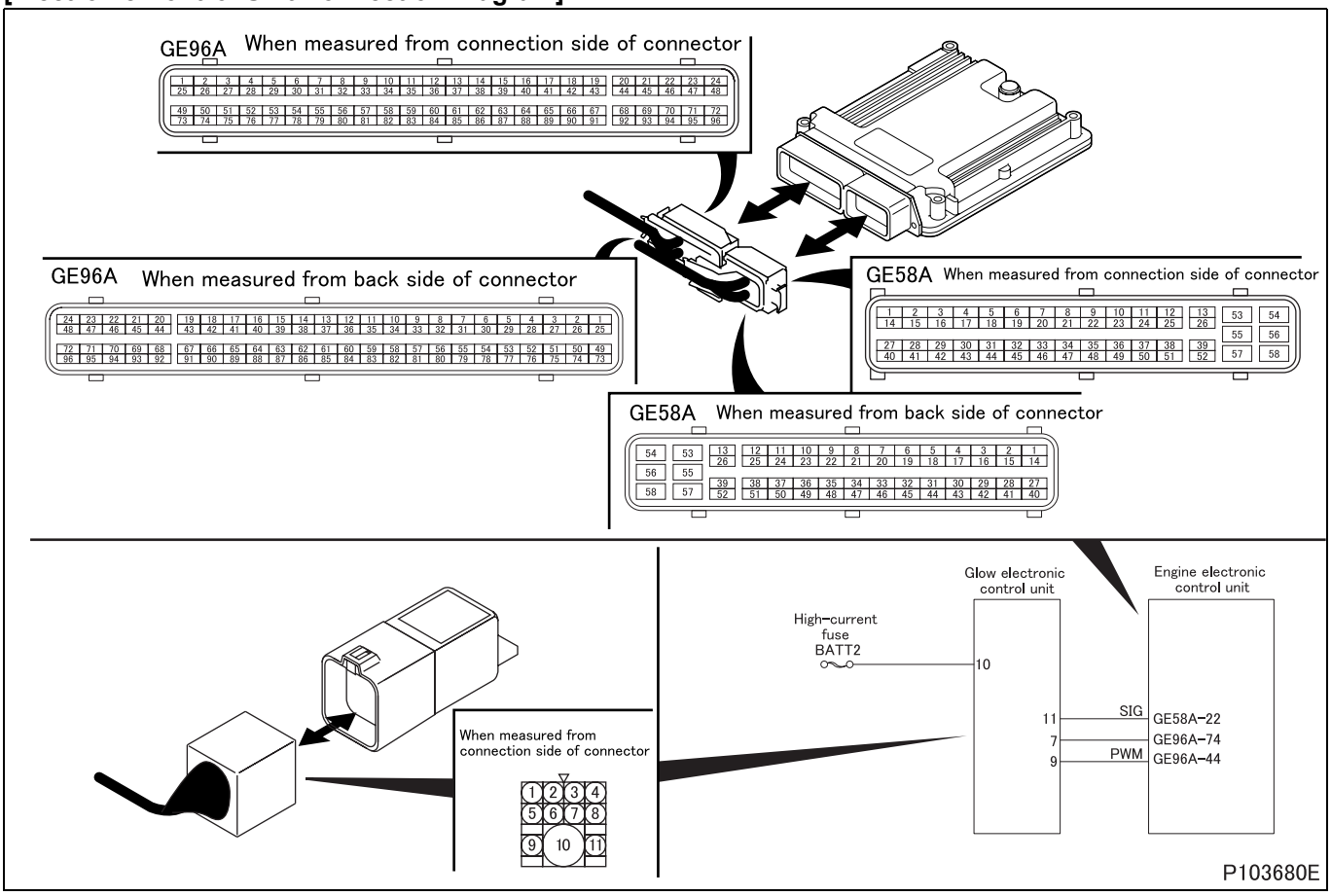
[Control effected by electronic control unit during fault]
Electronic control unit varies in the way of control by the status of warning lamp.
<Warning lamp (orange) lit>
- Effects no special control.

<Warning lamp extinguished (diagnosis code only)>
- Related fault check is stopped.

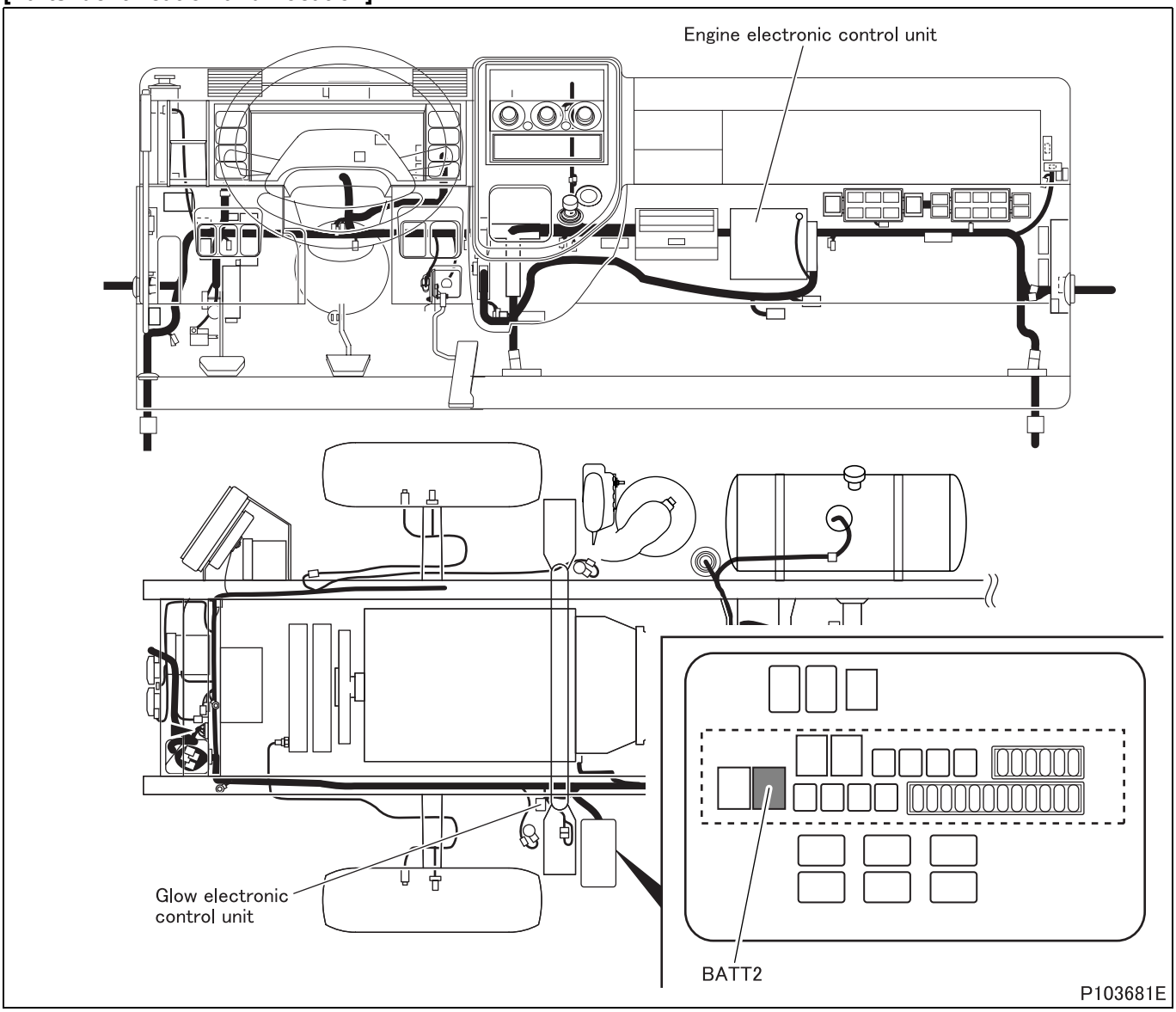
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between glow electronic control unit and high-current fuse (BATT2)
- Blown high-current fuse (BATT2)
- Malfunction of each connector
- Malfunction of glow electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

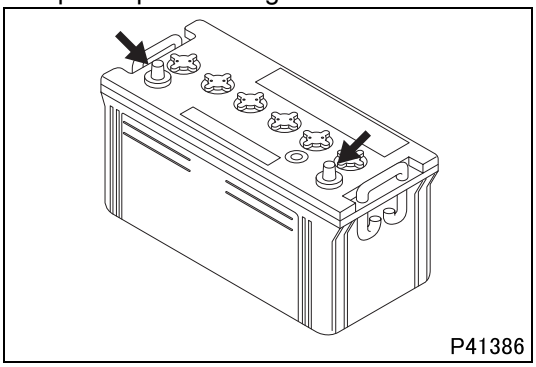
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of high-current fuse (BATT2)
	Maintenance item		Check open circuit of high-current fuse (BATT2)
	Inspection condition		–
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Replacement of fuse

Step 2	Inspection items		Inspection of harness between glow electronic control unit and high-current fuse (BATT2)
	Maintenance item		Check circuit between glow electronic control unit terminal No. 10 and high-current fuse (BATT2) terminal.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify harness.

Step 3	Inspection items		Inspection of battery
	Maintenance item		Measure value of voltage between battery terminal (+) and (–)
	Inspection condition		–
	Requirements		8 to 16 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Inspection of battery (See Gr54.)

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between glow electronic control unit and engine electronic control unit
	Maintenance item		Check circuit between following connector terminals. • Fault information circuit: glow electronic control unit terminal No. 11 - engine electronic control unit (GE58A) terminal No. 22 • Power supply circuit: glow electronic control unit terminal No. 7 - engine electronic control unit (GE96A) terminal No. 74 • Operating signal circuit: glow electronic control unit terminal No. 9 - engine electronic control unit (GE96A) terminal No. 44
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of glow electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of glow electronic control unit, go to step 6
		NO	Modify connector.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of engine electronic control unit
		NO	Modify connector.

[Fault code]
Diagnosis code: P0671/Flash code: 26
[Monitor]
Failure of preheating control system
[Fault (outline)]
No. 1 cylinder fault
[Diagnosis check]
- Engine electronic control unit receives fault information from glow electronic control unit.
- Glow electronic control unit monitors current in No. 1 cylinder glow plug circuit for open or short circuit failure.

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Open-circuit>
- Current remains below 1.9 A for 2.3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

<Short-circuit>
- Current remains over 21 A for 2.3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

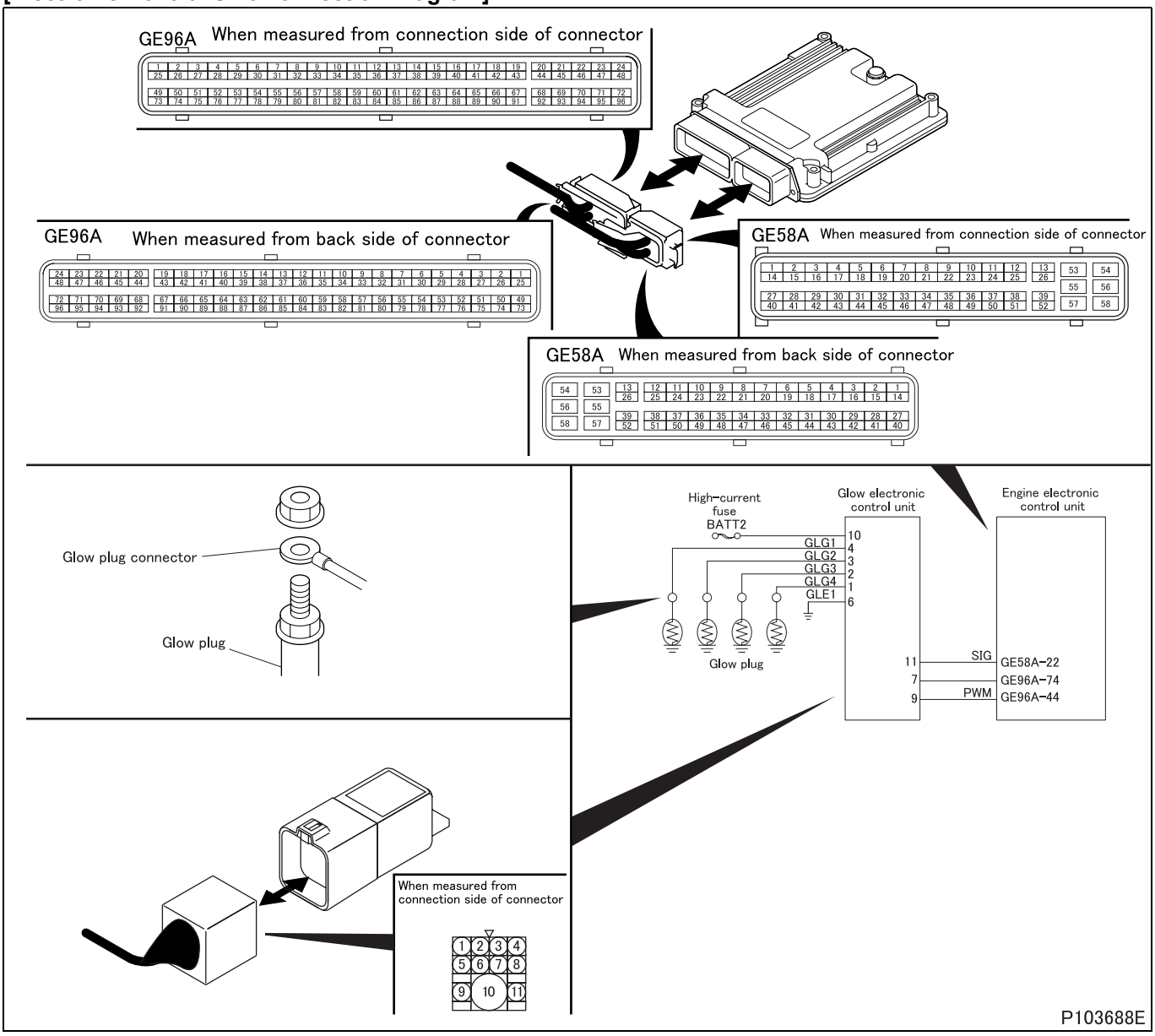
[Diagnostic requirement]
- Glow electronic control unit operating voltage: higher than 8 V

[Control effected by electronic control unit during fault]
- Effects no special control.

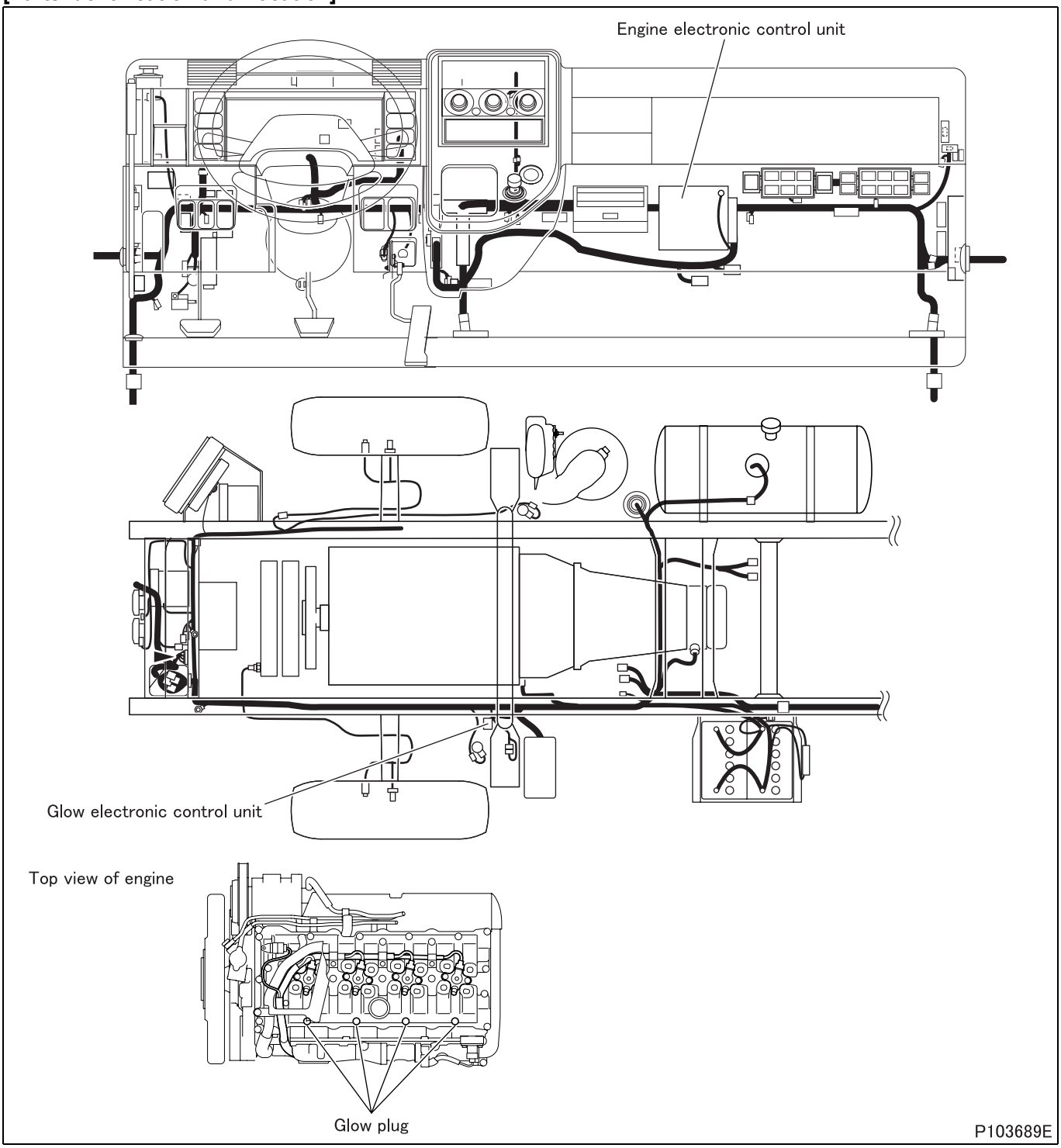
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between glow electronic control unit and glow plug
- Malfunction of each connector
- Malfunction of glow plug
- Malfunction of glow electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

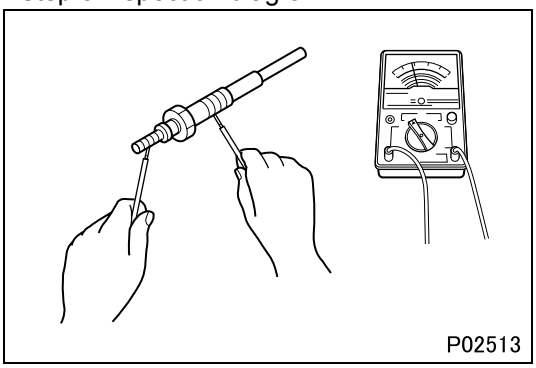
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of harness between glow electronic control unit and chassis ground
	Maintenance item		Check circuit between glow electronic control unit terminal No. 4 and chassis ground
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of harness between glow electronic control unit and glow plug
	Maintenance item		Check circuit between glow electronic control unit terminal No. 4 and glow plug connector (for No. 1 cylinder)
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify harness.

Step 3	Inspection items		Inspection of glow plug unit
	Maintenance item		Measure value of resistance of glow plug as shown in inspection diagram.
	Inspection condition		–
	Requirements		1 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of glow plug

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between glow electronic control unit and engine electronic control unit
	Maintenance item		Check circuit between following connector terminals. • Fault information circuit: glow electronic control unit terminal No. 11 - engine electronic control unit (GE58A) terminal No. 22 • Power supply circuit: glow electronic control unit terminal No. 7 - engine electronic control unit (GE96A) terminal No. 74 • Operating signal circuit: glow electronic control unit terminal No. 9 - engine electronic control unit (GE96A) terminal No. 44
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of glow electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of glow electronic control unit, go to step 6
		NO	Modify connector.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of engine electronic control unit
		NO	Modify connector.

[Fault code]
Diagnosis code: P0672/Flash code: 26
[Monitor]
Failure of preheating control system
[Fault (outline)]
No. 2 cylinder fault
[Diagnosis check]
- Engine electronic control unit receives fault information from glow electronic control unit.
- Glow electronic control unit monitors current in No. 2 cylinder glow plug circuit for open or short circuit failure.

[Code generation condition]
Diagnosis code is generated under either of the following conditions. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)
<Open-circuit>
- Current remains below 1.9 A for 2.3 seconds.

<Short-circuit>
- Current remains over 21 A for 2.3 seconds.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

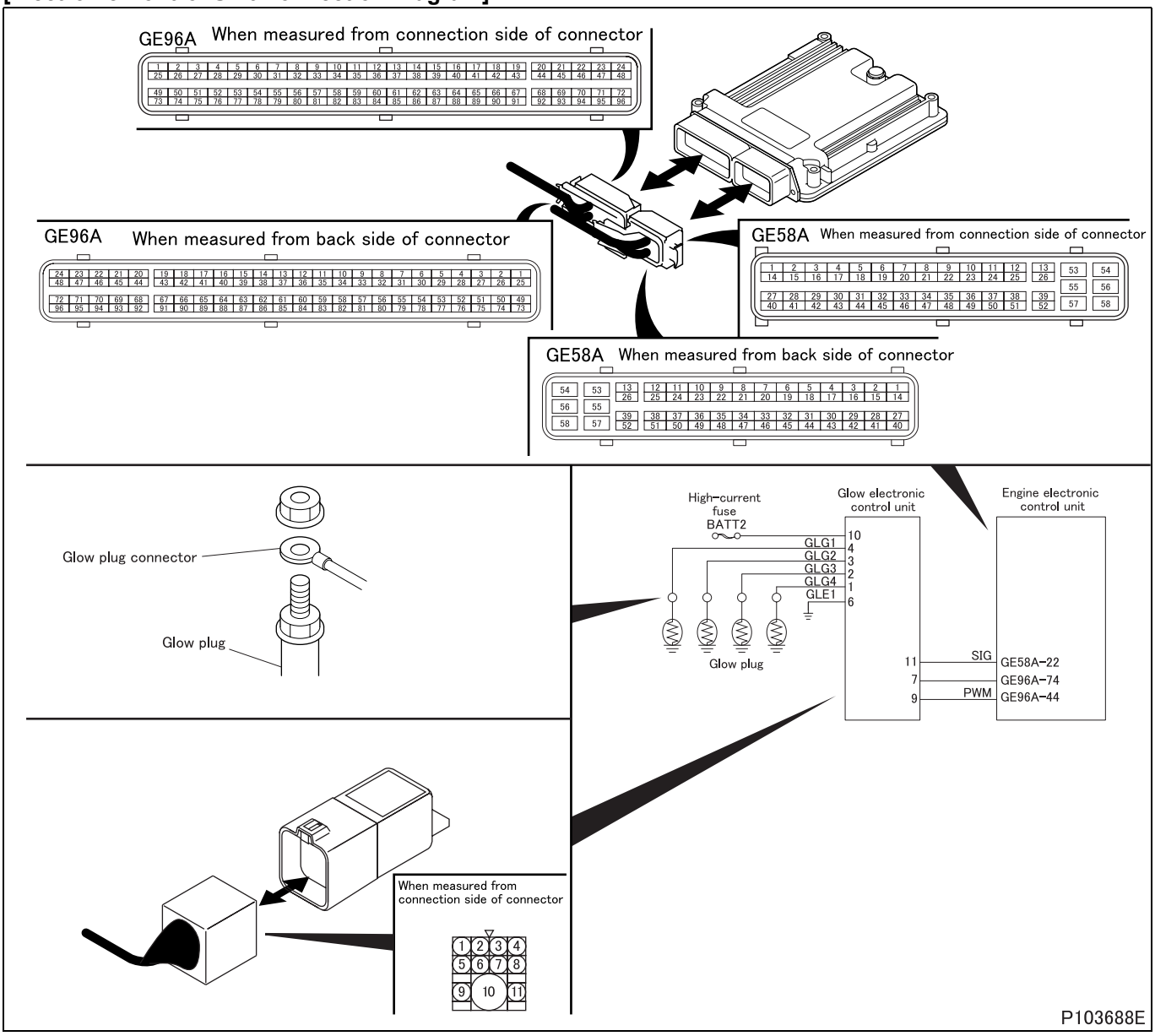
[Diagnostic requirement]
- Glow electronic control unit operating voltage: higher than 8 V

[Control effected by electronic control unit during fault]
- Effects no special control.

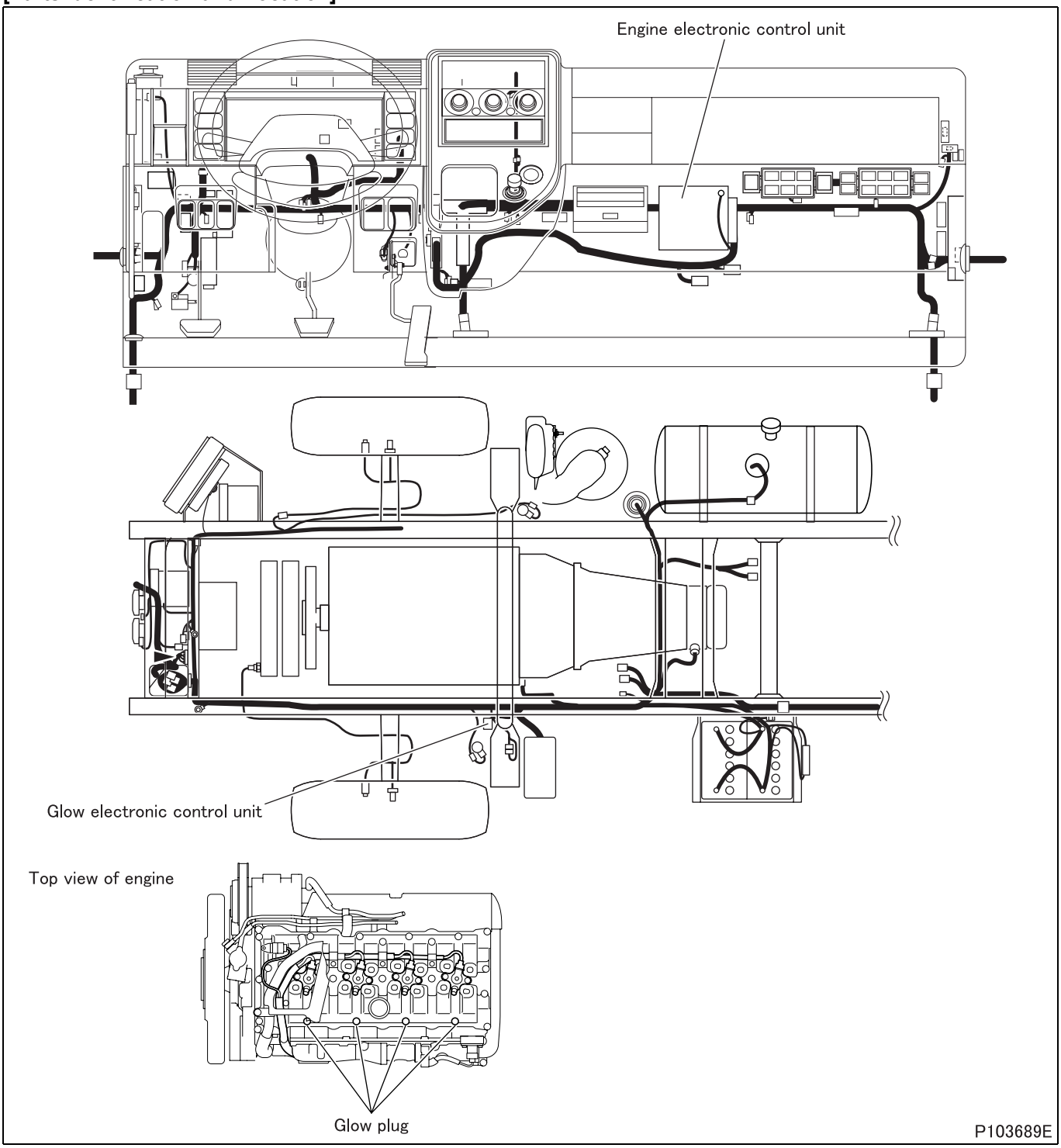
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between glow electronic control unit and glow plug
- Malfunction of each connector
- Malfunction of glow plug
- Malfunction of glow electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

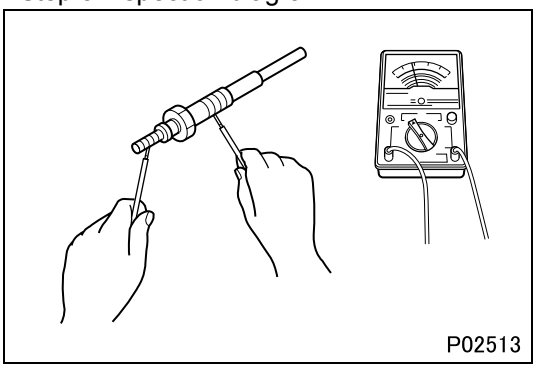
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of harness between glow electronic control unit and chassis ground
	Maintenance item		Check circuit between glow electronic control unit terminal No. 3 and chassis ground
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of harness between glow electronic control unit and glow plug
	Maintenance item		Check circuit between glow electronic control unit terminal No. 3 and glow plug connector (for No. 2 cylinder)
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify harness.

Step 3	Inspection items		Inspection of glow plug unit
	Maintenance item		Measure value of resistance of glow plug as shown in inspection diagram.
	Inspection condition		–
	Requirements		1 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of glow plug

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between glow electronic control unit and engine electronic control unit
	Maintenance item		Check circuit between following connector terminals. • Fault information circuit: glow electronic control unit terminal No. 11 - engine electronic control unit (GE58A) terminal No. 22 • Power supply circuit: glow electronic control unit terminal No. 7 - engine electronic control unit (GE96A) terminal No. 74 • Operating signal circuit: glow electronic control unit terminal No. 9 - engine electronic control unit (GE96A) terminal No. 44
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of glow electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of glow electronic control unit, go to step 6
		NO	Modify connector.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of engine electronic control unit
		NO	Modify connector.

[Fault code]
Diagnosis code: P0673/Flash code: 26
[Monitor]
Failure of preheating control system
[Fault (outline)]
No. 3 cylinder fault
[Diagnosis check]
- Engine electronic control unit receives fault information from glow electronic control unit.
- Glow electronic control unit monitors current in No. 3 cylinder glow plug circuit for open or short circuit failure.

[Code generation condition]
Diagnosis code is generated under either of the following conditions. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)
<Open-circuit>
- Current remains below 1.9 A for 2.3 seconds.

<Short-circuit>
- Current remains over 21 A for 2.3 seconds.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

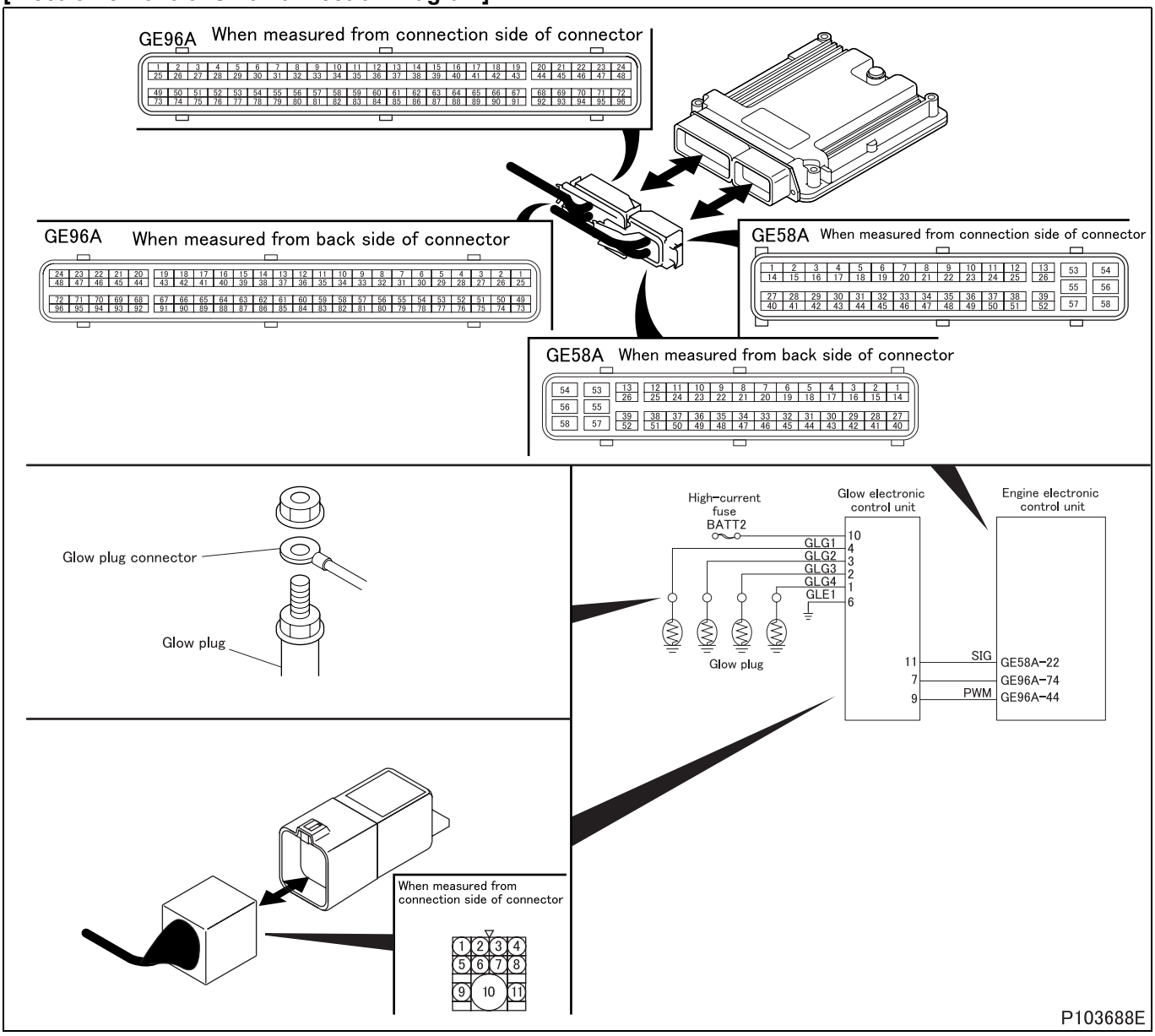
[Diagnostic requirement]
- Glow electronic control unit operating voltage: higher than 8 V

[Control effected by electronic control unit during fault]
- Effects no special control.

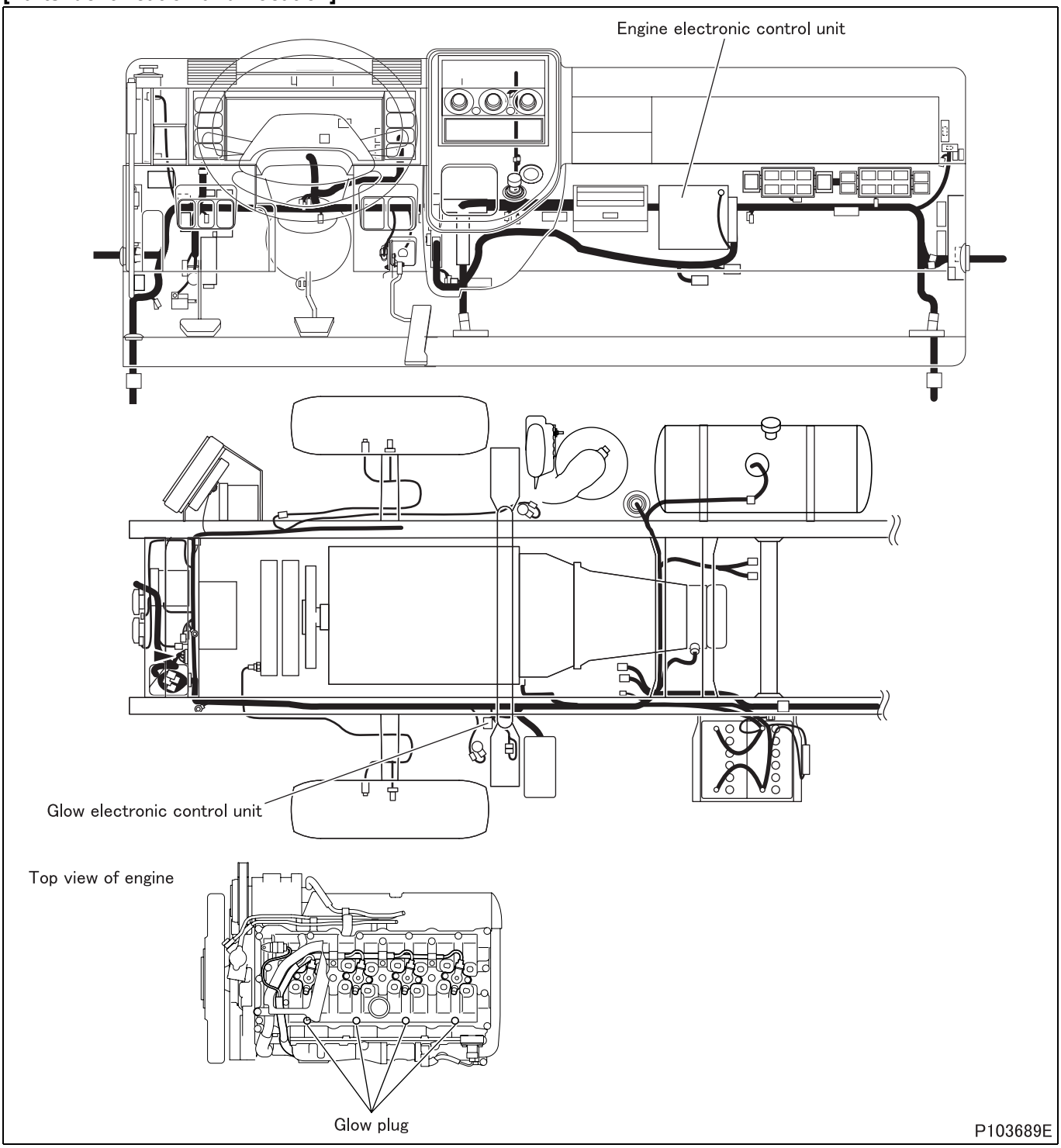
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between glow electronic control unit and glow plug
- Malfunction of each connector
- Malfunction of glow plug
- Malfunction of glow electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

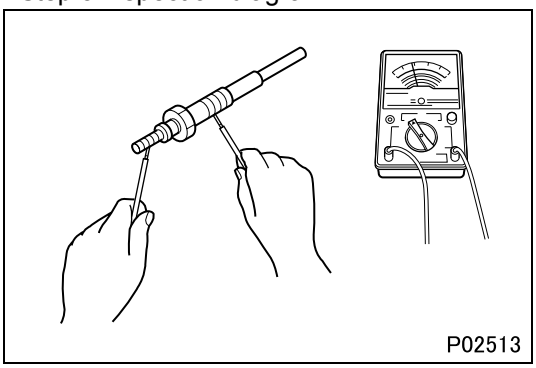
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of harness between glow electronic control unit and chassis ground
	Maintenance item		Check circuit between glow electronic control unit terminal No. 2 and chassis ground
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of harness between glow electronic control unit and glow plug
	Maintenance item		Check circuit between glow electronic control unit terminal No. 2 and glow plug connector (for No. 3 cylinder)
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify harness.

Step 3	Inspection items		Inspection of glow plug unit
	Maintenance item		Measure value of resistance of glow plug as shown in inspection diagram.
	Inspection condition		–
	Requirements		1 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of glow plug

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between glow electronic control unit and engine electronic control unit
	Maintenance item		Check circuit between following connector terminals. • Fault information circuit: glow electronic control unit terminal No. 11 - engine electronic control unit (GE58A) terminal No. 22 • Power supply circuit: glow electronic control unit terminal No. 7 - engine electronic control unit (GE96A) terminal No. 74 • Operating signal circuit: glow electronic control unit terminal No. 9 - engine electronic control unit (GE96A) terminal No. 44
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of glow electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of glow electronic control unit, go to step 6
		NO	Modify connector.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of engine electronic control unit
		NO	Modify connector.

[Fault code]
Diagnosis code: P0674/Flash code: 26
[Monitor]
Failure of preheating control system
[Fault (outline)]
No. 4 cylinder fault
[Diagnosis check]
- Engine electronic control unit receives fault information from glow electronic control unit.
- Glow electronic control unit monitors current in No. 4 cylinder glow plug circuit for open or short circuit failure.

[Code generation condition]
Diagnosis code is generated under either of the following conditions. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)
<Open-circuit>
- Current remains below 1.9 A for 2.3 seconds.

<Short-circuit>
- Current remains over 21 A for 2.3 seconds.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

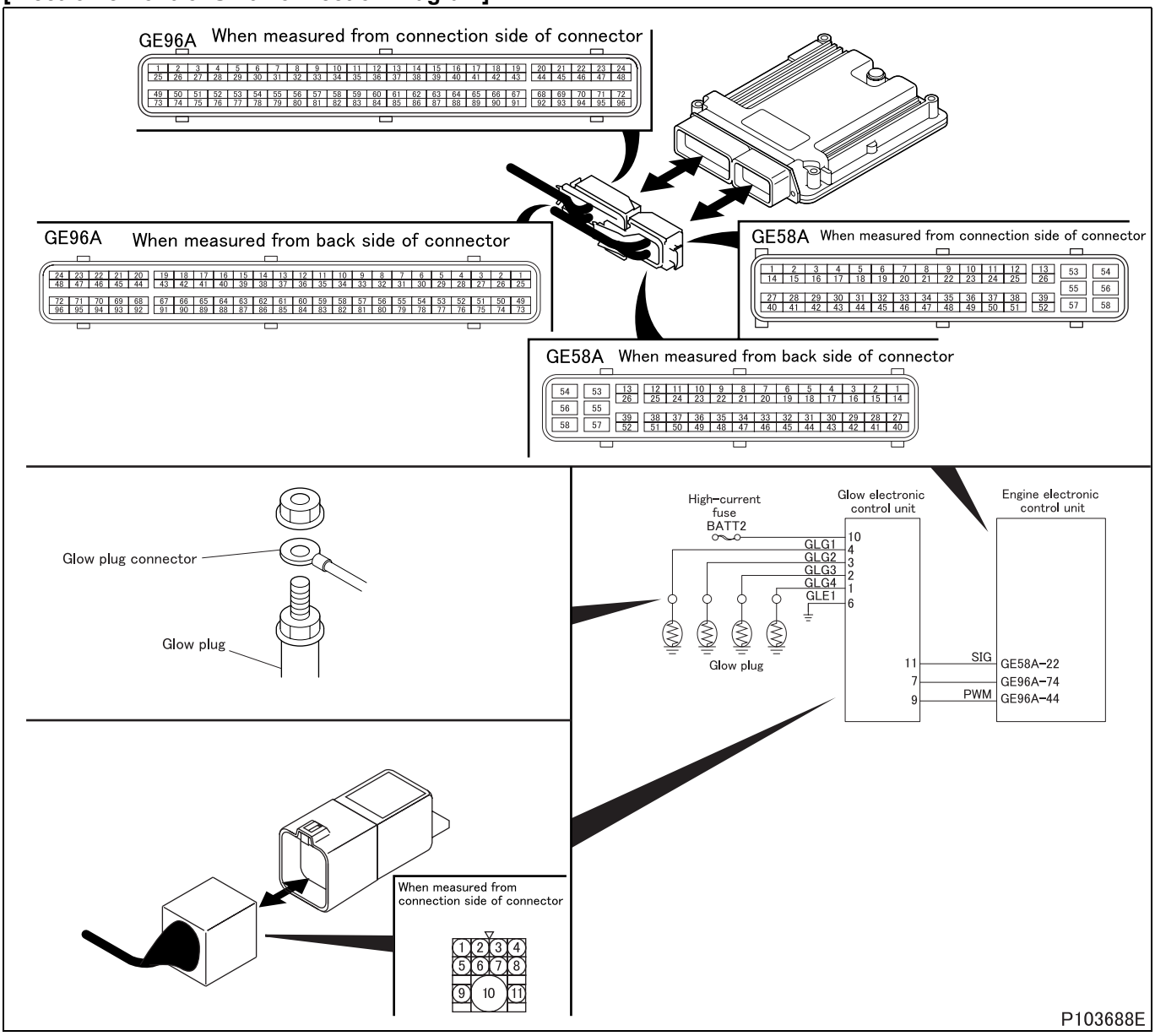
[Diagnostic requirement]
- Glow electronic control unit operating voltage: higher than 8 V

[Control effected by electronic control unit during fault]
- Effects no special control.

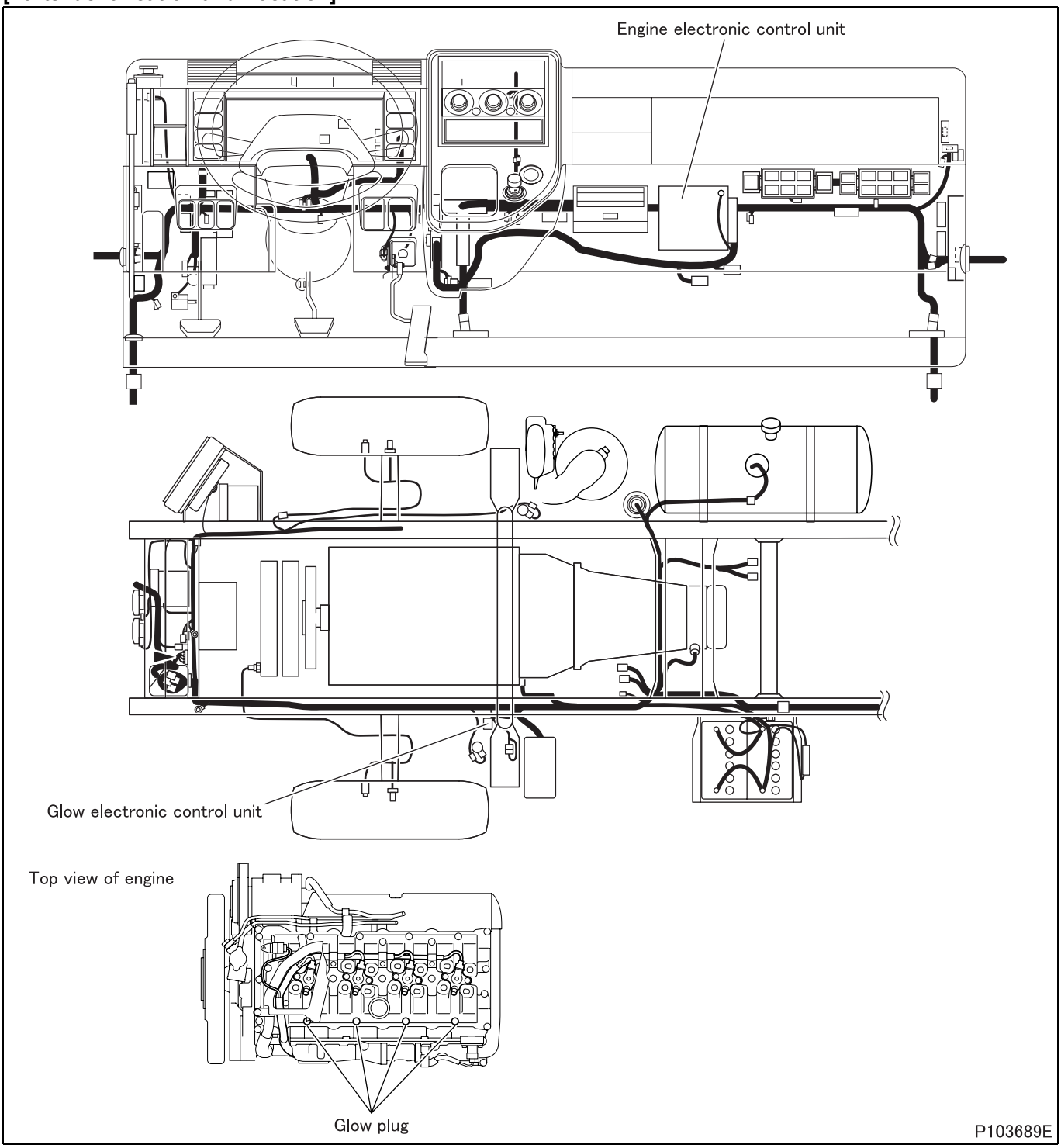
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between glow electronic control unit and glow plug
- Malfunction of each connector
- Malfunction of glow plug
- Malfunction of glow electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

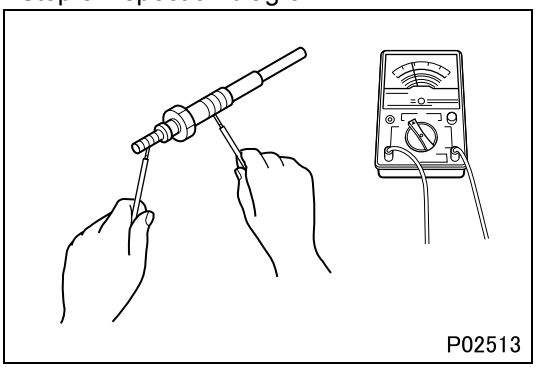
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of harness between glow electronic control unit and chassis ground
	Maintenance item		Check circuit between glow electronic control unit terminal No. 1 and chassis ground
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of harness between glow electronic control unit and glow plug
	Maintenance item		Check circuit between glow electronic control unit terminal No. 1 and glow plug connector (for No. 4 cylinder)
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify harness.

Step 3	Inspection items		Inspection of glow plug unit
	Maintenance item		Measure value of resistance of glow plug as shown in inspection diagram.
	Inspection condition		–
	Requirements		1 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of glow plug

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between glow electronic control unit and engine electronic control unit
	Maintenance item		Check circuit between following connector terminals. • Fault information circuit: glow electronic control unit terminal No. 11 - engine electronic control unit (GE58A) terminal No. 22 • Power supply circuit: glow electronic control unit terminal No. 7 - engine electronic control unit (GE96A) terminal No. 74 • Operating signal circuit: glow electronic control unit terminal No. 9 - engine electronic control unit (GE96A) terminal No. 44
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of glow electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of glow electronic control unit, go to step 6
		NO	Modify connector.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of engine electronic control unit
		NO	Modify connector.

[Fault code]
Diagnosis code: P0684/Flash code: 26
[Monitor]
Failure of preheating control
[Fault (outline)]
Overload
[Diagnosis check]
- Engine electronic control unit monitors data transfer from glow electronic control unit for abnormality (by glow electronic control unit feedback signal).

[Code generation condition]
When either of the following conditions continues for 2, 3 seconds (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.).
- Transmitted signal is too low or too high.
- Transmission time is too long (over).

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

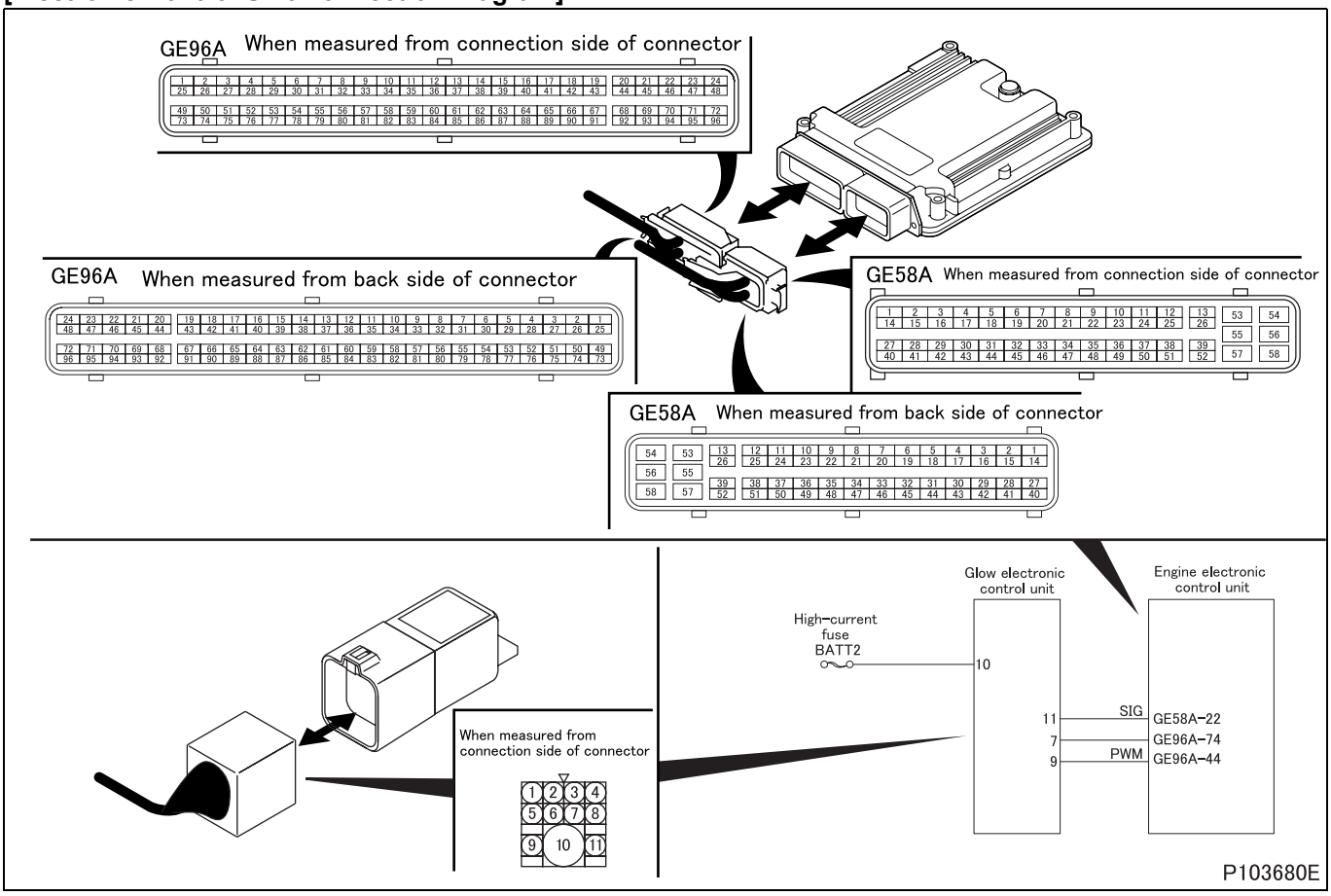
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

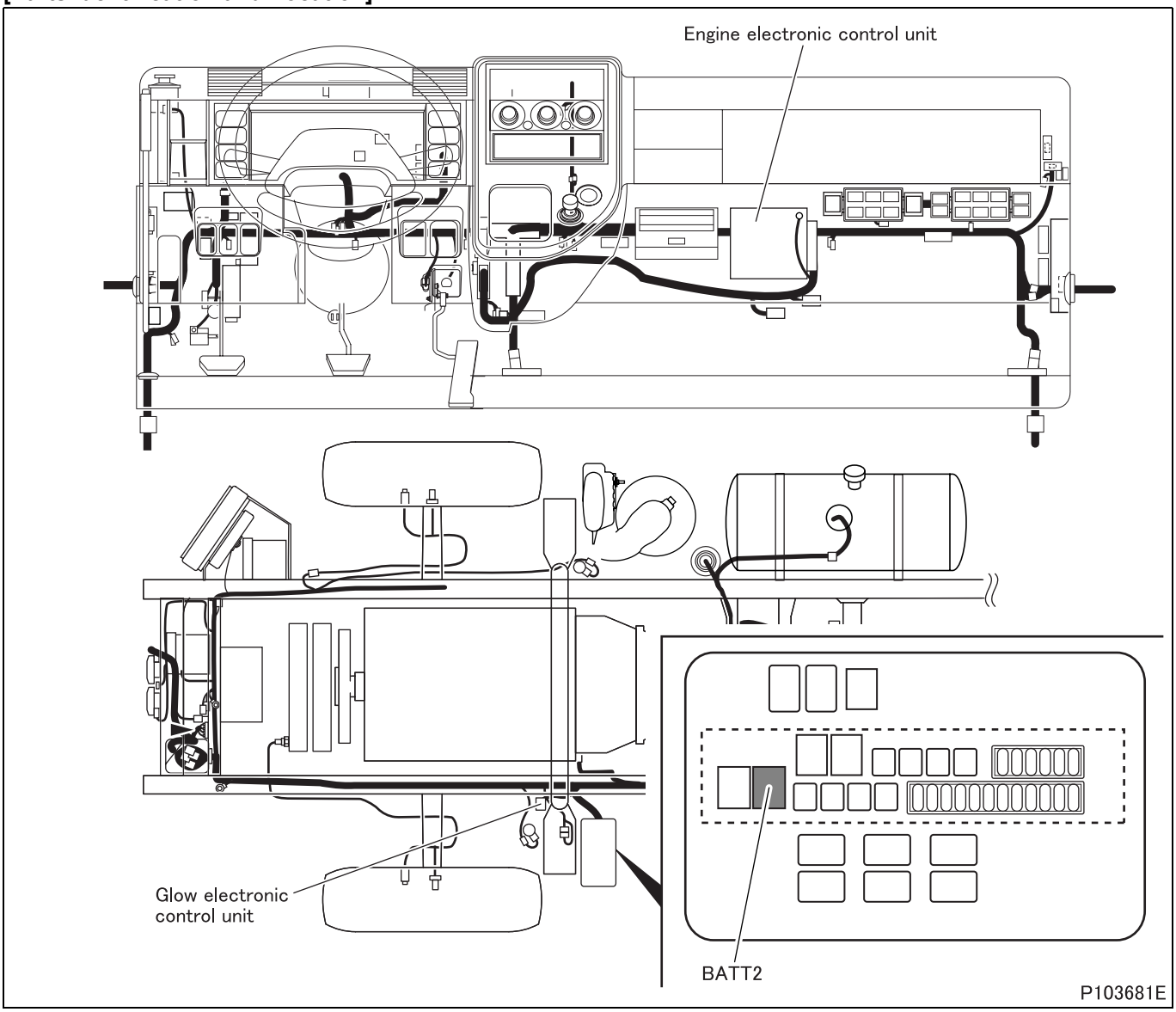
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between glow electronic control unit and engine electronic control unit
- Malfunction of each connector
- Malfunction of glow electronic control unit
- Malfunction of engine electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of harness between glow electronic control unit and engine electronic control unit
	Maintenance item		Check circuit between following connector terminals. • Fault information circuit: glow electronic control unit terminal No. 11 - engine electronic control unit (GE58A) terminal No. 22 • Power supply circuit: glow electronic control unit terminal No. 7 - engine electronic control unit (GE96A) terminal No. 74 • Operating signal circuit: glow electronic control unit terminal No. 9 - engine electronic control unit (GE96A) terminal No. 44
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Modify harness.

Step 2	Inspection items		Inspection of glow electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of glow electronic control unit, go to step 3
		NO	Modify connector.

Step 3	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of engine electronic control unit
		NO	Modify connector.

[Fault code]
Diagnosis code: P0685/Flash code: 84
[Monitor]
Failure of electronic drive unit relay
[Fault (outline)]
Open circuit
[Diagnosis check]
- Electronic drive unit relay circuit is monitored for fault.

[Code generation condition]
- Electronic drive unit relay circuit remains open as detected for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is halted.

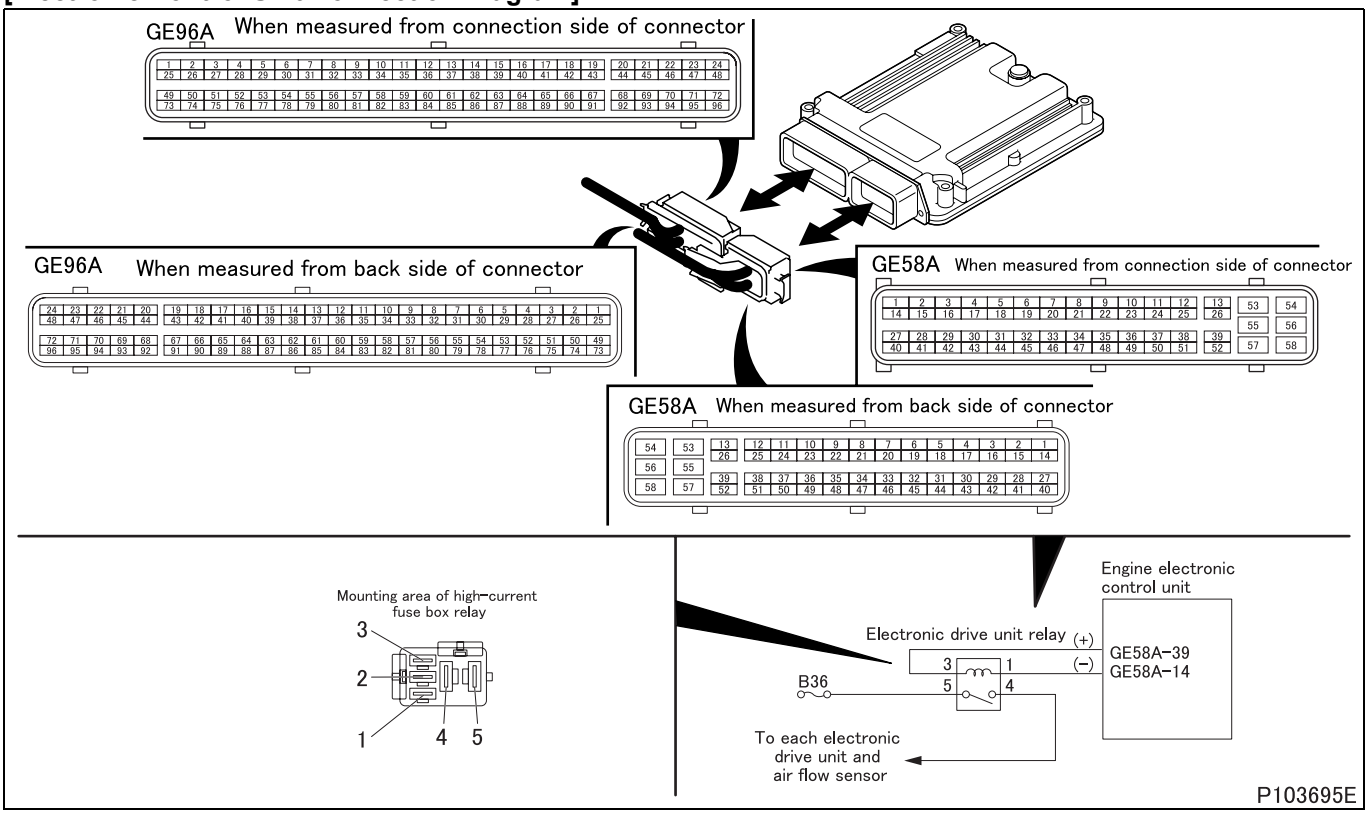
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Post injection is inhibited.
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

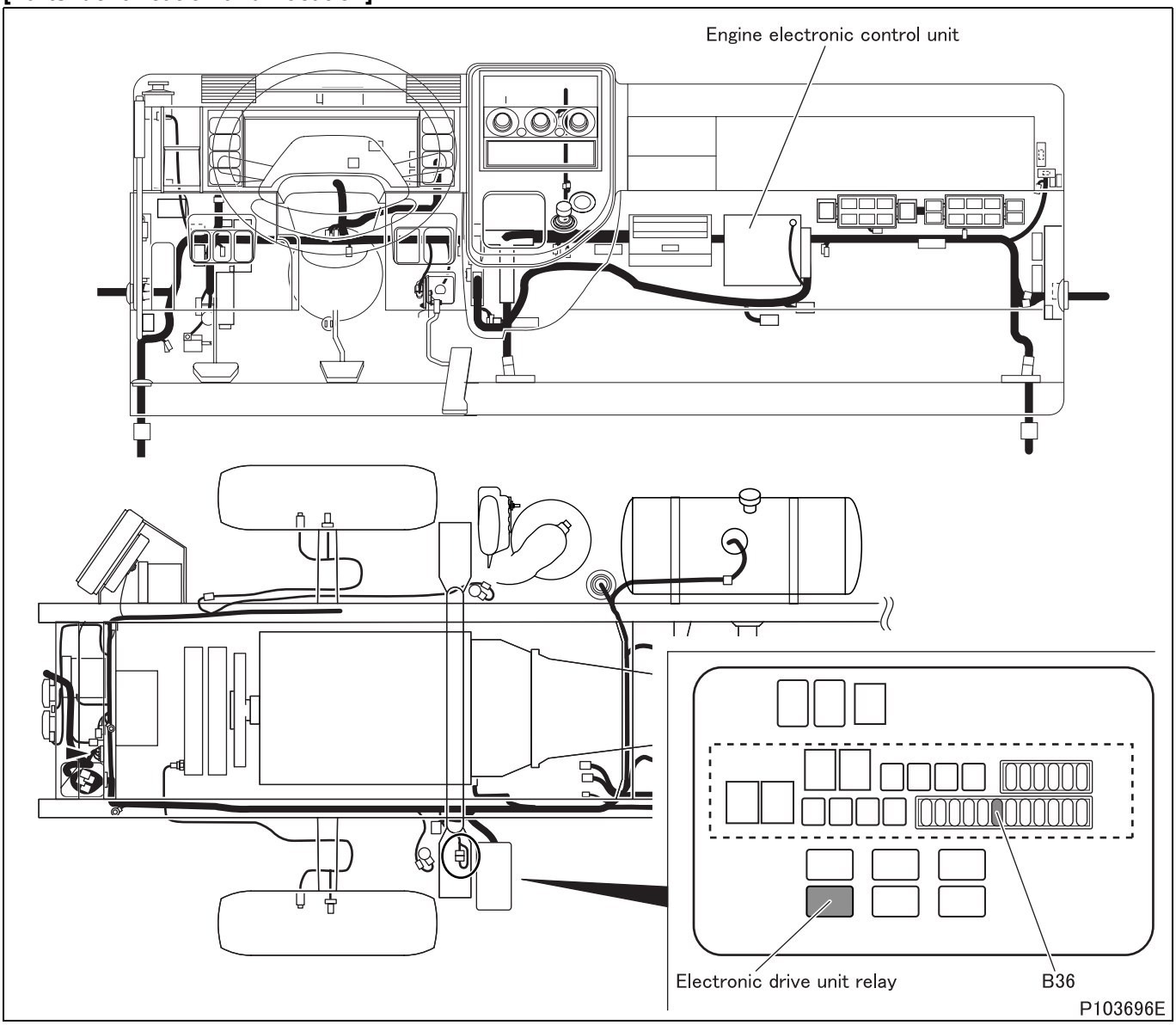
[Probable cause of trouble]
- Open-circuit of harness between electronic control unit and electronic drive unit relay
- Malfunction of each connector
- Malfunction of electronic drive unit relay
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AF “EDU Relay”.
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

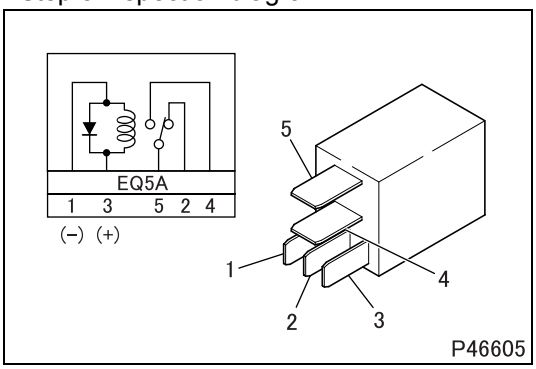
Step 2	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 39 (+) and No. 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage (automatic reset after six seconds)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 4 and 5 when relay operates.
	Inspection condition		Apply battery voltage across connector terminals No. 3 (+) and 1 (–).
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of relay

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between relay and electronic control unit (power supply)
	Maintenance item		Check circuit between relay connector terminal No. 3 and electronic drive unit connector (GE58A) terminal No. 39
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between relay and electronic control unit (ground)
	Maintenance item		Check circuit between relay connector terminal No. 1 and electronic drive unit connector (GE58A) terminal No. 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AF “EDU Relay”.
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0686/Flash code: 84
[Monitor]
Failure of electronic drive unit relay
[Fault (outline)]
Short circuit ground
[Diagnosis check]
- Electronic drive unit relay circuit is monitored for fault.

[Code generation condition]
- Electronic drive unit relay circuit remains shorted to ground as detected for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is halted.

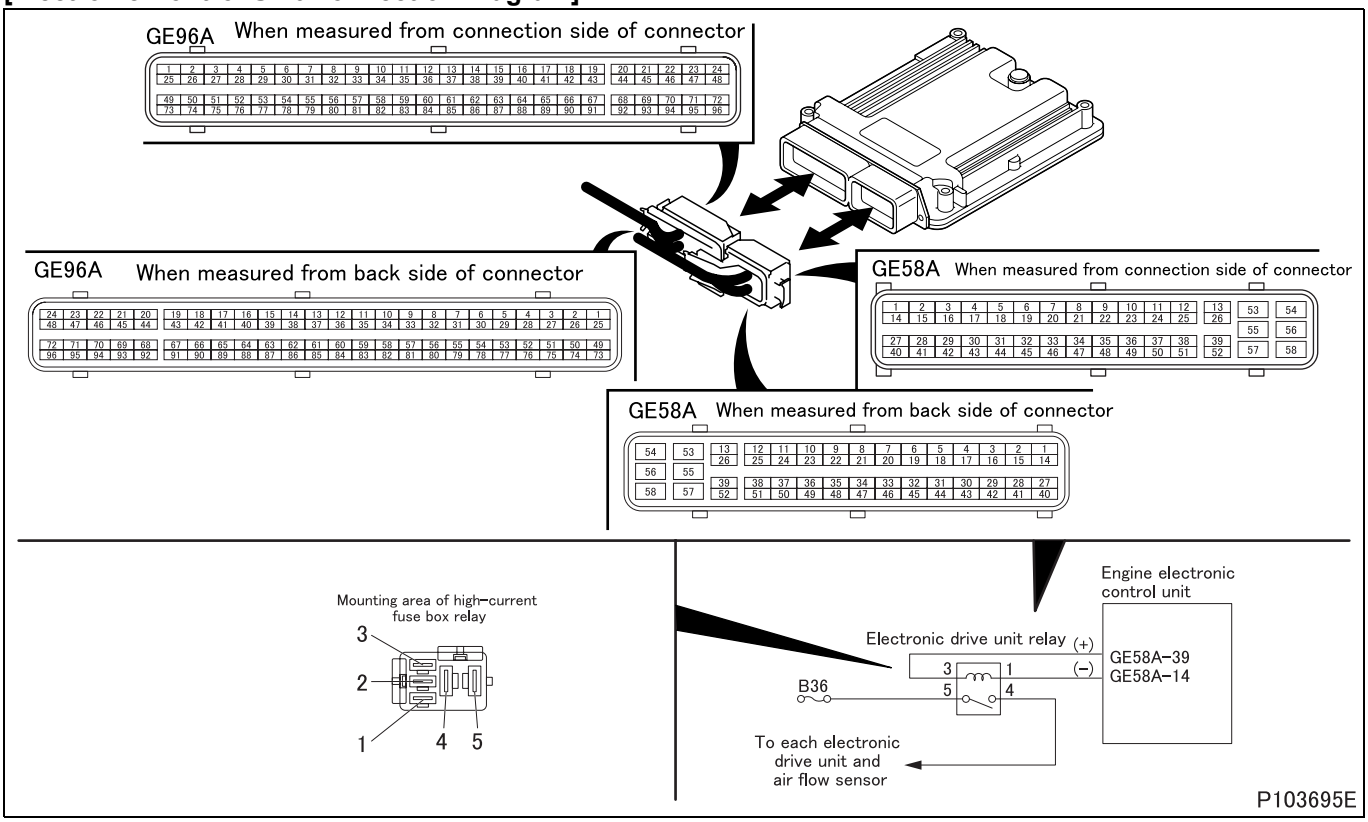
[Diagnostic requirement]
- After-run executed
- Electronic drive unit relay request signal: OFF

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Post injection is inhibited.
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

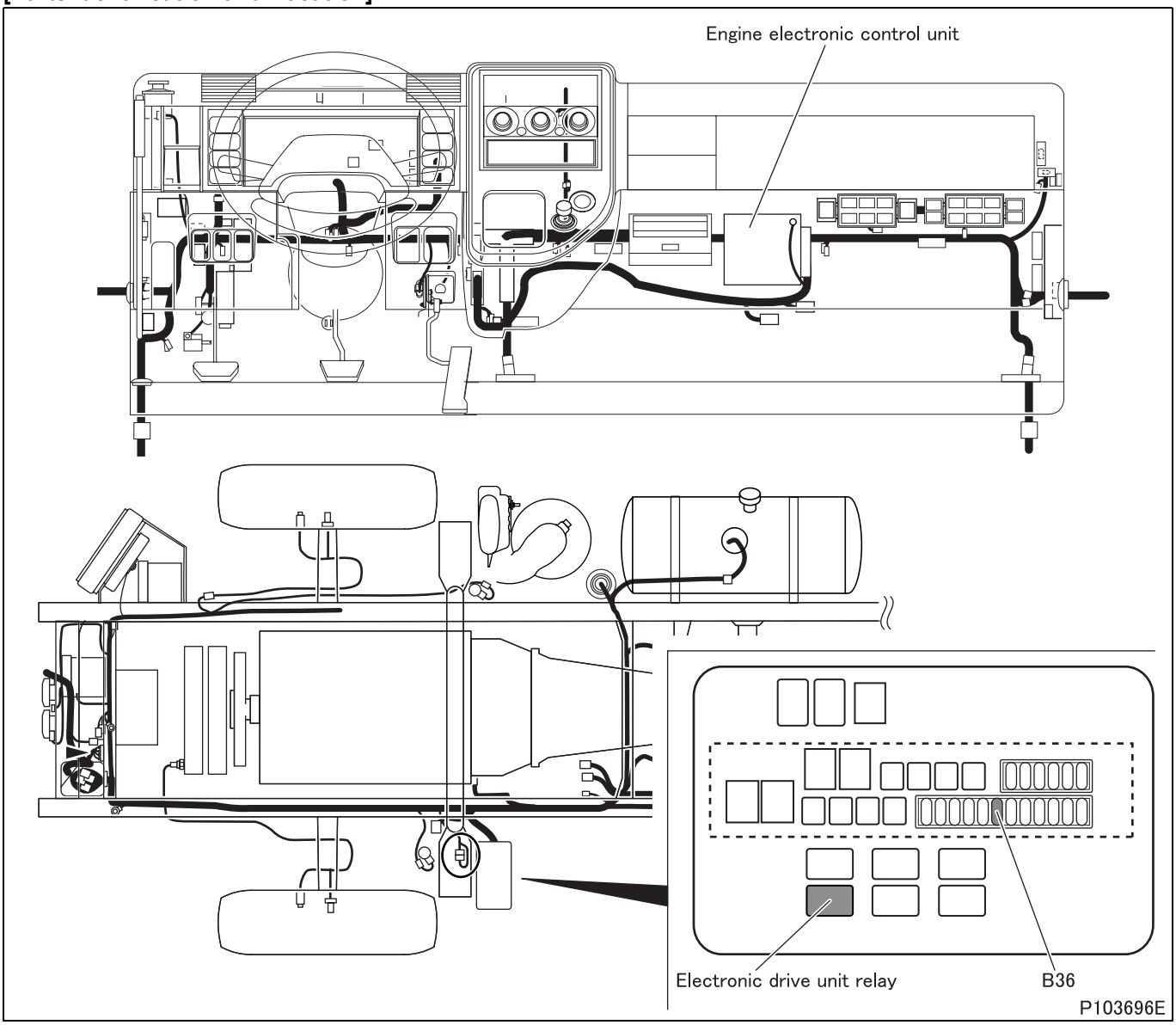
[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and electronic drive unit relay
- Malfunction of each connector
- Malfunction of electronic drive unit relay
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AF “EDU Relay”.
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

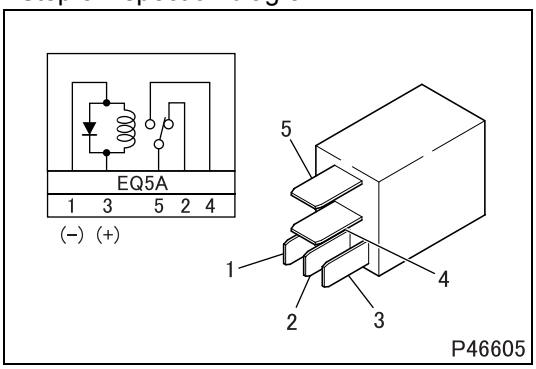
Step 2	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 39 (+) and No. 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage (automatic reset after six seconds)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 4 and 5 when relay operates.
	Inspection condition		Apply battery voltage across connector terminals No. 3 (+) and 1 (–).
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of relay

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between relay and electronic control unit (power supply)
	Maintenance item		Check circuit between relay connector terminal No. 3 and electronic drive unit connector (GE58A) terminal No. 39
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between relay and electronic control unit (ground)
	Maintenance item		Check circuit between relay connector terminal No. 1 and electronic drive unit connector (GE58A) terminal No. 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AF “EDU Relay”.
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0687/Flash code: 84
[Monitor]
Failure of electronic drive unit relay
[Fault (outline)]
Short circuit battery
[Diagnosis check]
- Electronic drive unit relay circuit is monitored for fault.

[Code generation condition]
- Electronic drive unit relay circuit remains shorted to power supply as detected for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

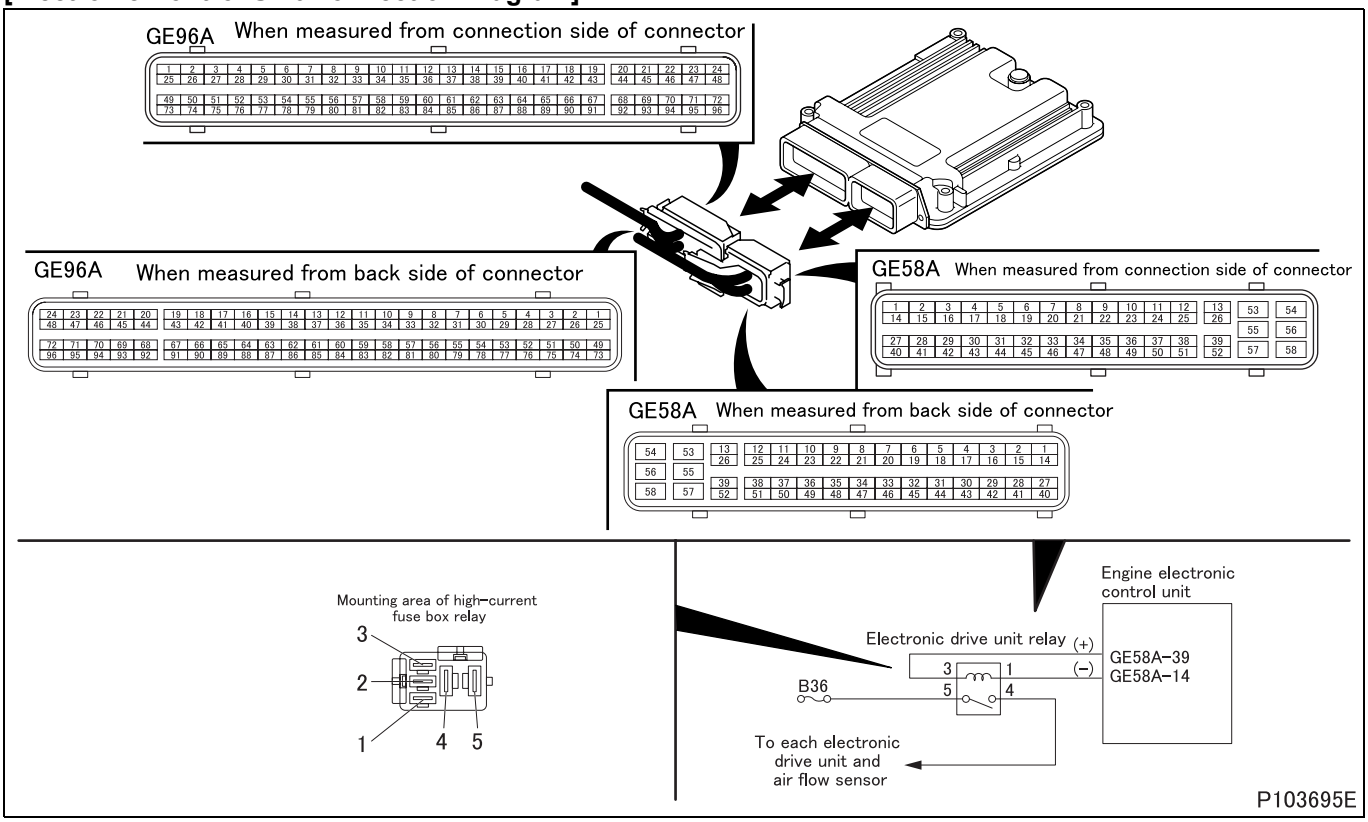
[Diagnostic requirement]
- Electronic drive unit relay is on.
- Electronic drive unit relay request signal: ON

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Post injection is inhibited.
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

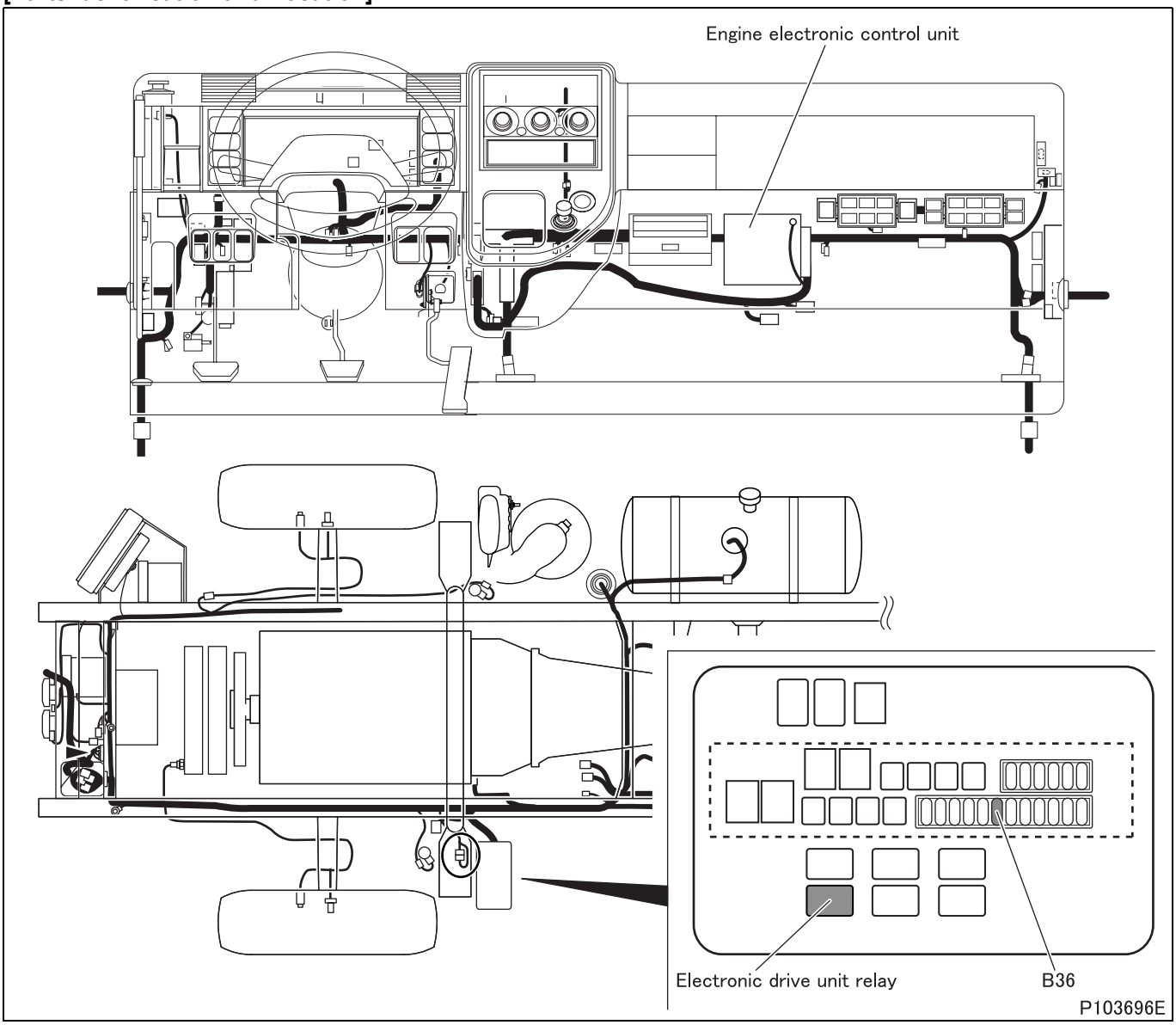
[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and electronic drive unit relay
- Malfunction of each connector
- Malfunction of electronic drive unit relay
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AF “EDU Relay”.
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

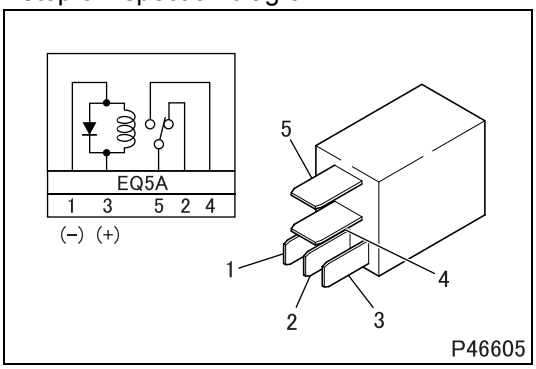
Step 2	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 39 (+) and No. 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage (automatic reset after six seconds)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 4 and 5 when relay operates.
	Inspection condition		Apply battery voltage across connector terminals No. 3 (+) and 1 (–).
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of relay

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between relay and electronic control unit (power supply)
	Maintenance item		Check circuit between relay connector terminal No. 3 and electronic drive unit connector (GE58A) terminal No. 39
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between relay and electronic control unit (ground)
	Maintenance item		Check circuit between relay connector terminal No. 1 and electronic drive unit connector (GE58A) terminal No. 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AF “EDU Relay”.
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0688/Flash code: 84
[Monitor]
Failure of electronic drive unit relay
[Fault (outline)]
Overload
[Diagnosis check]
- Electronic drive unit relay circuit is monitored for fault.

[Code generation condition]
- Power supply temperature in electronic drive unit relay circuit remains at 100°C {212°F} for 1 second (overcurrent).
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

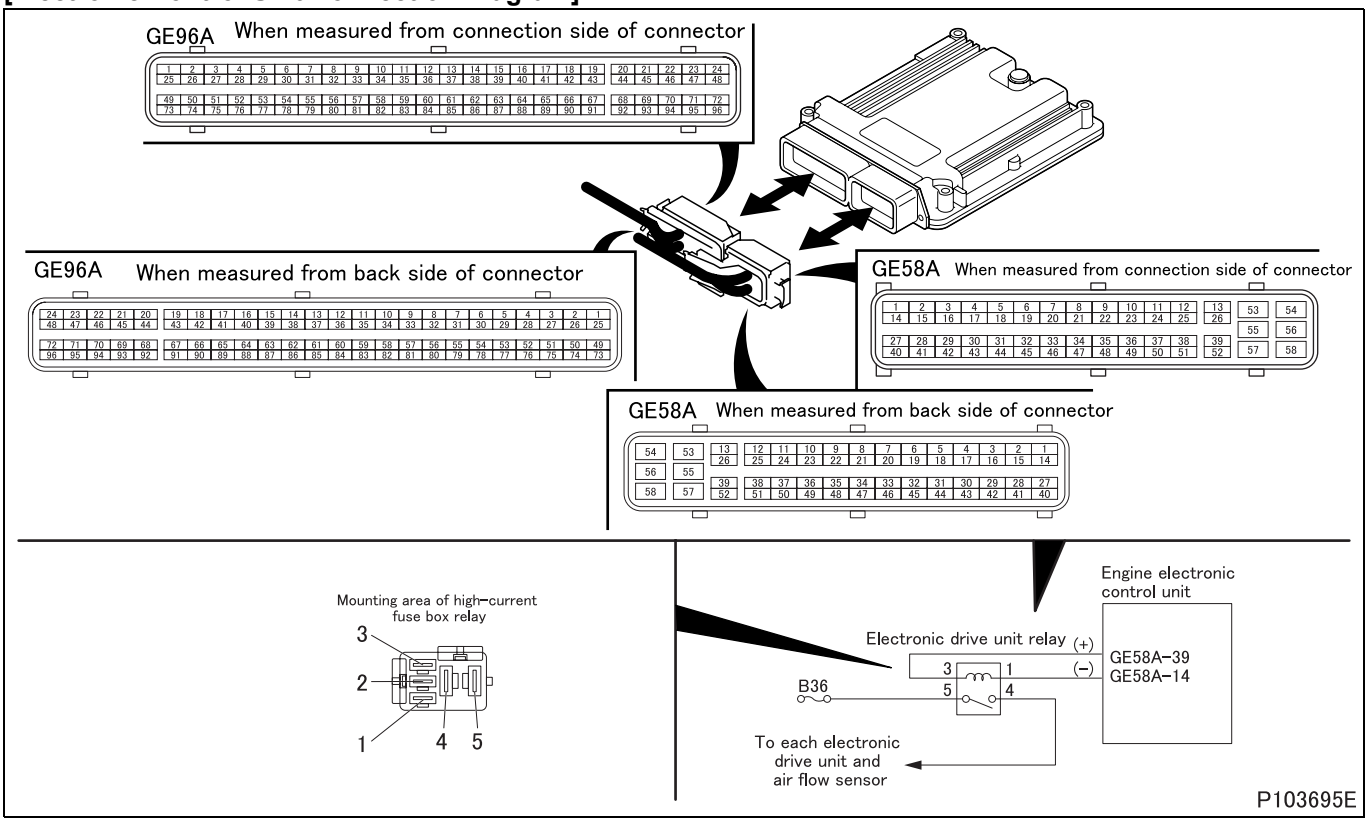
[Diagnostic requirement]
- Electronic drive unit relay is on.
- Electronic drive unit relay request signal: ON

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Post injection is inhibited.
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

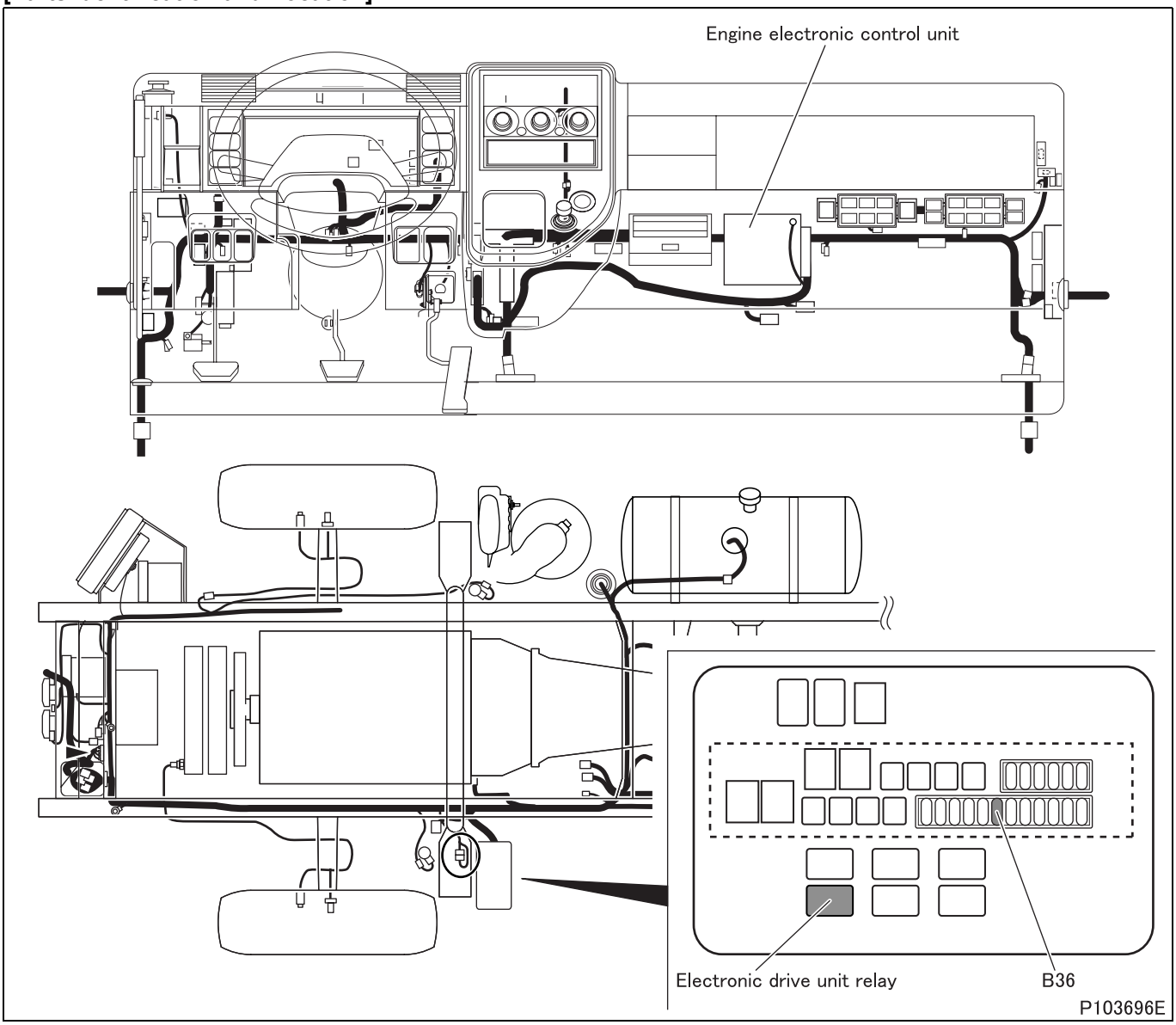
[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and electronic drive unit
- Malfunction of each connector
- Malfunction of electronic drive unit relay
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AF “EDU Relay”.
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

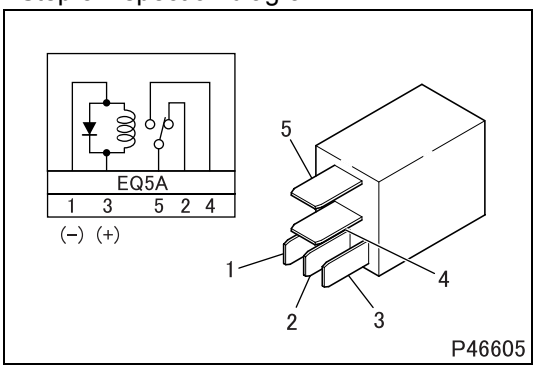
Step 2	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 39 (+) and No. 14 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage (automatic reset after six seconds)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 4 and 5 when relay operates.
	Inspection condition		Apply battery voltage across connector terminals No. 3 (+) and 1 (–).
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of relay

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between relay and electronic control unit (power supply)
	Maintenance item		Check circuit between relay connector terminal No. 3 and electronic drive unit connector (GE58A) terminal No. 39
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between relay and electronic control unit (ground)
	Maintenance item		Check circuit between relay connector terminal No. 1 and electronic drive unit connector (GE58A) terminal No. 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AF “EDU Relay”.
	Inspection condition		–
	Requirements		Relay operation sound is noted (automatic reset after six seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0698/Flash code: 81
[Monitor]
Sensor power supply abnormal
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Sensor supply voltage 3 in engine electronic control unit is monitored.
- Units served by sensor supply voltage 3
- Common rail pressure sensor
- DPF pressure sensor (DIFF)
- Boost air temperature sensor

[Code generation condition]
- Supply voltage to units remain below 4.7 V for 0.5 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

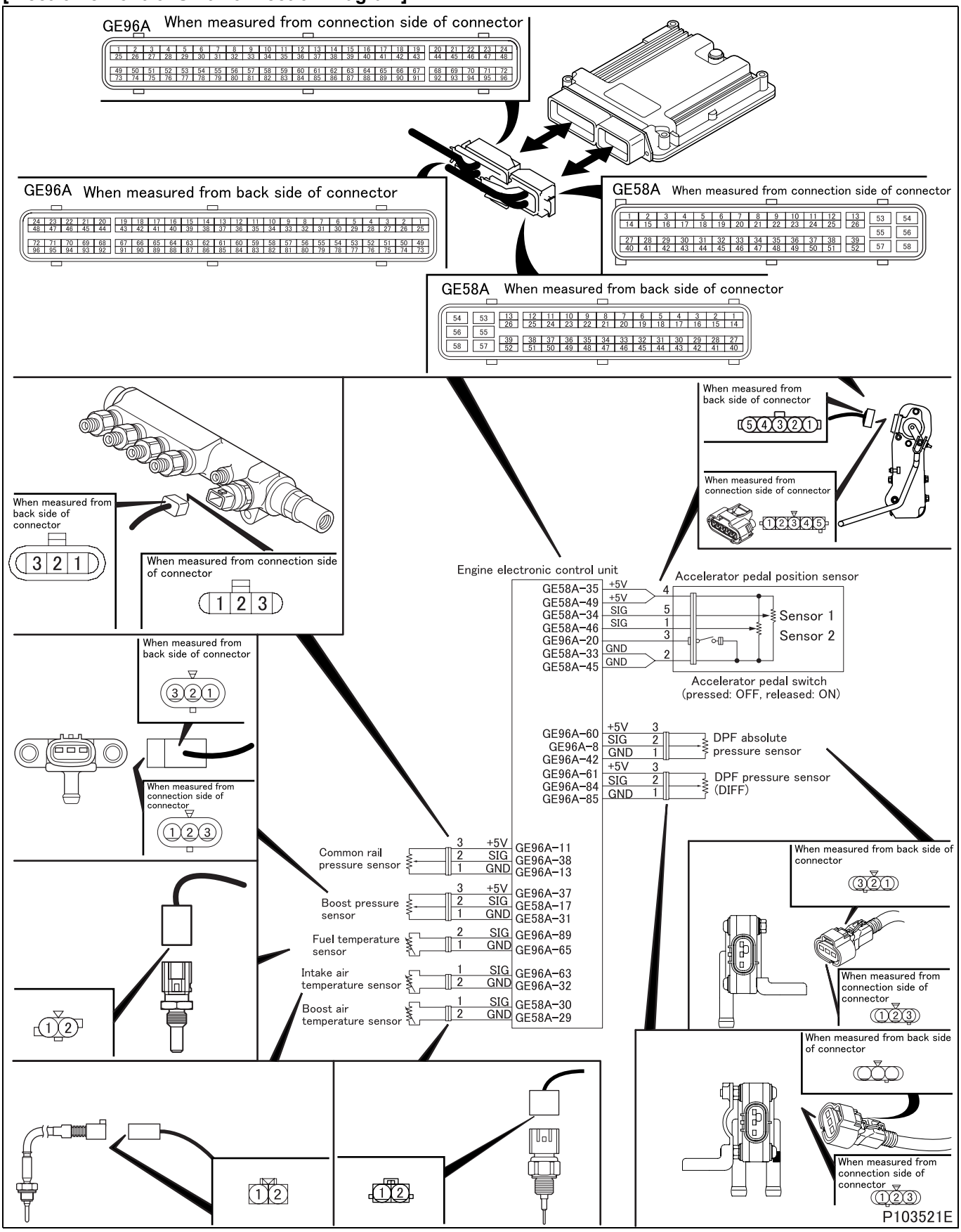
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

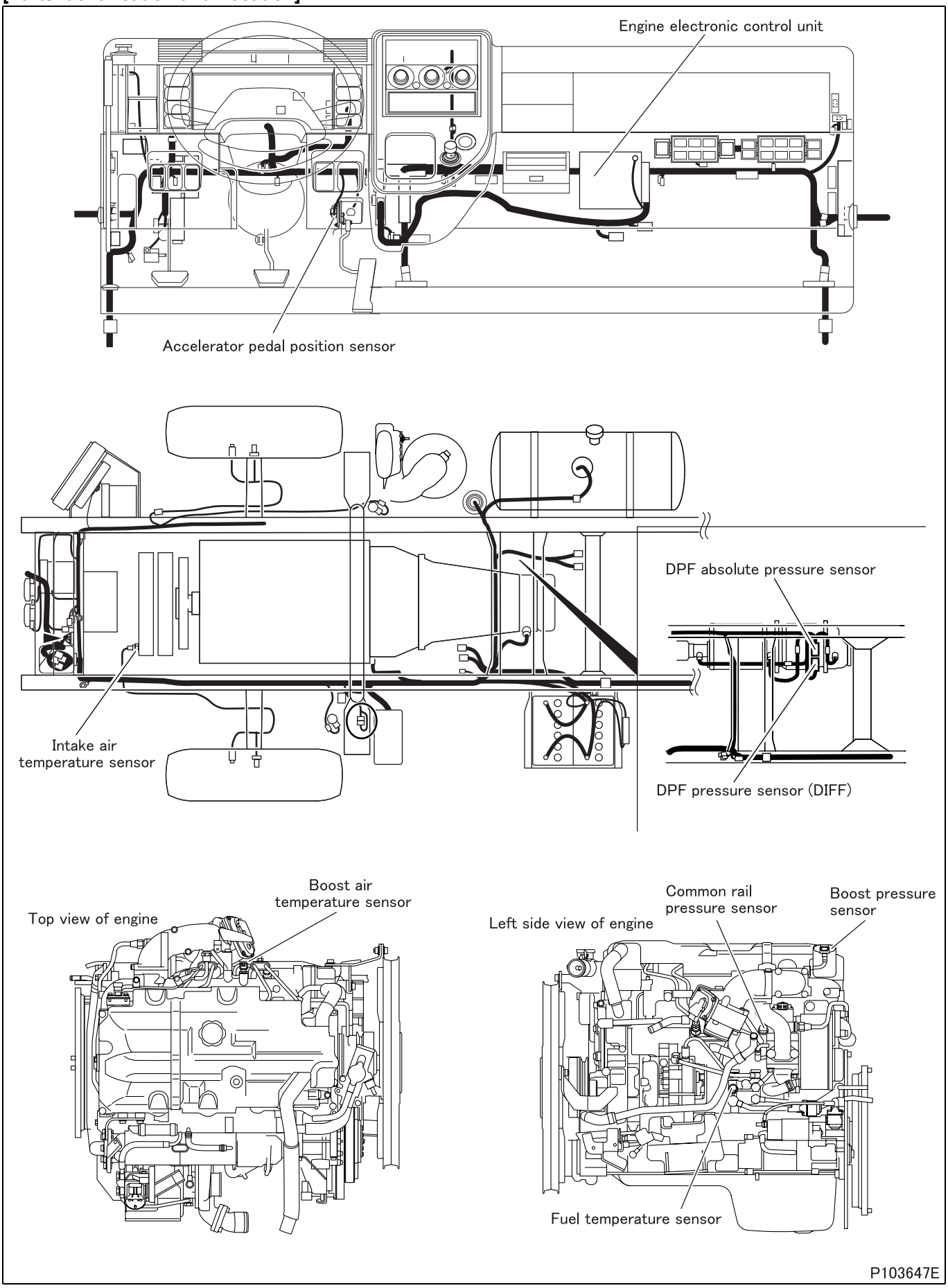
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and each sensor
- Malfunction of each connector
- Malfunction of each sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Modify connector.

Step 2	Inspection items		Inspection by electronic control unit connector (power supply): common rail pressure sensor
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 11 (+) and No. 13 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of common rail pressure sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and common rail pressure sensor (power supply)
	Maintenance item		Check circuit between common rail pressure sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection by electronic control unit connector (power supply): DPF pressure sensor (DIFF)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 61 (+) and No. 85 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of DPF pressure sensor (DIFF) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between electronic control unit and DPF pressure sensor (DIFF) (power supply)
	Maintenance item		Check circuit between DPF pressure sensor (DIFF) connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 61.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by electronic control unit connector: boost air temperature sensor
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 30 (+) and No. 29 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection of boost air temperature sensor
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 10	Inspection items		Inspection of harness between electronic control unit and boost air temperature sensor (power supply)
	Maintenance item		Check circuit between boost air temperature sensor connector terminal No. 1 and electronic control unit connector (GE58A) terminal No. 30
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify harness.

[Fault code]
Diagnosis code: P0699/Flash code: 81
[Monitor]
Sensor power supply abnormal
[Fault (outline)]
High signal range check
[Diagnosis check]
- Sensor supply voltage 3 in engine electronic control unit is monitored.
- Units served by sensor supply voltage 3
- Common rail pressure sensor
- DPF pressure sensor (DIFF)
- Boost air temperature sensor

[Code generation condition]
- Supply voltage to units remain over 5.3 V for 0.5 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

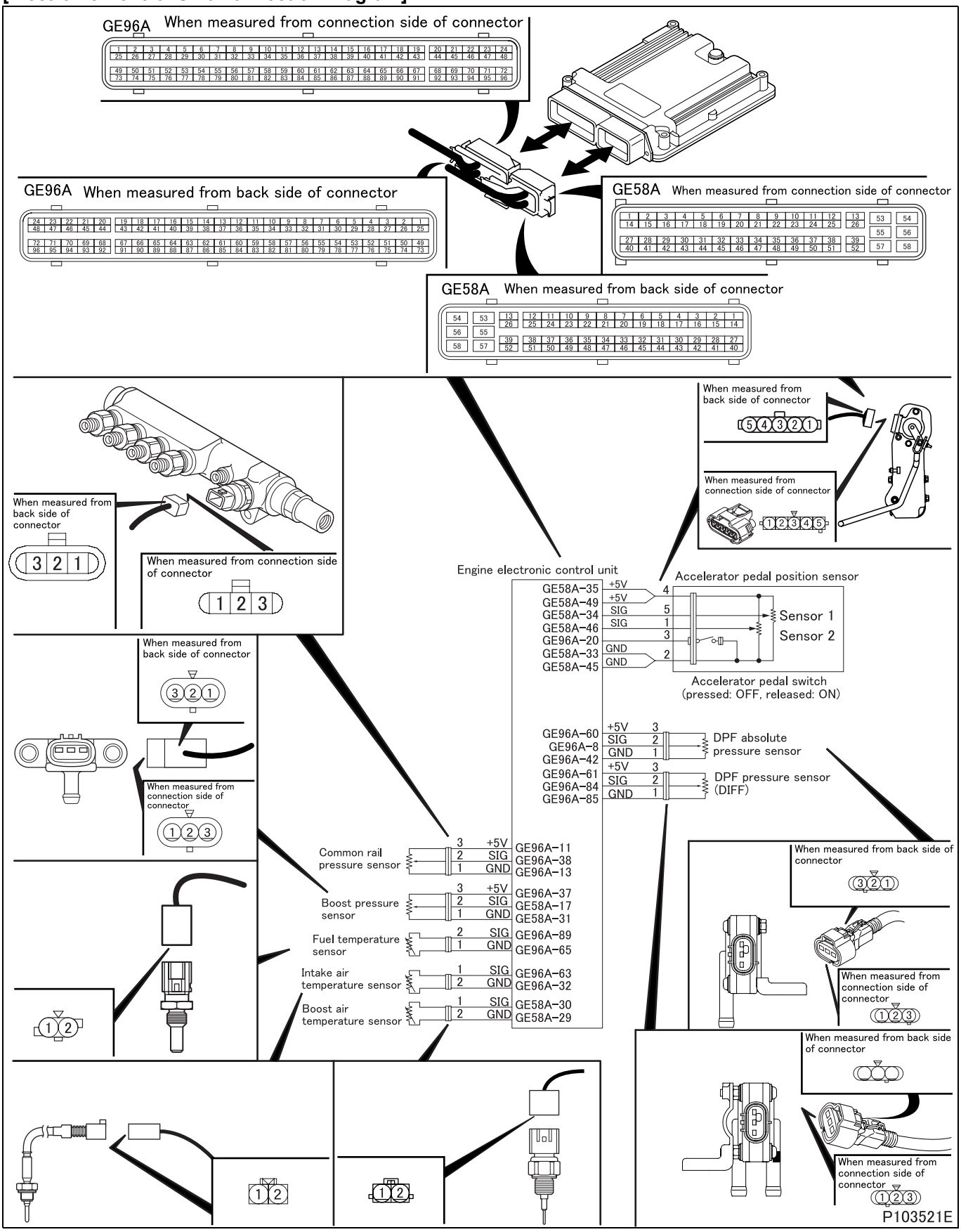
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

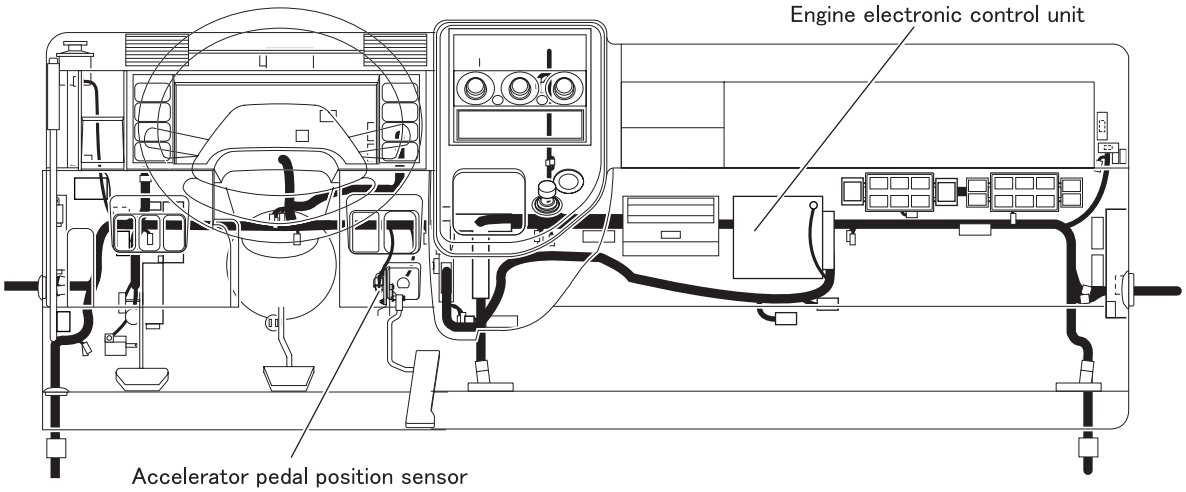
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and each sensor
- Malfunction of each connector
- Malfunction of each sensor
- Malfunction of electronic control unit

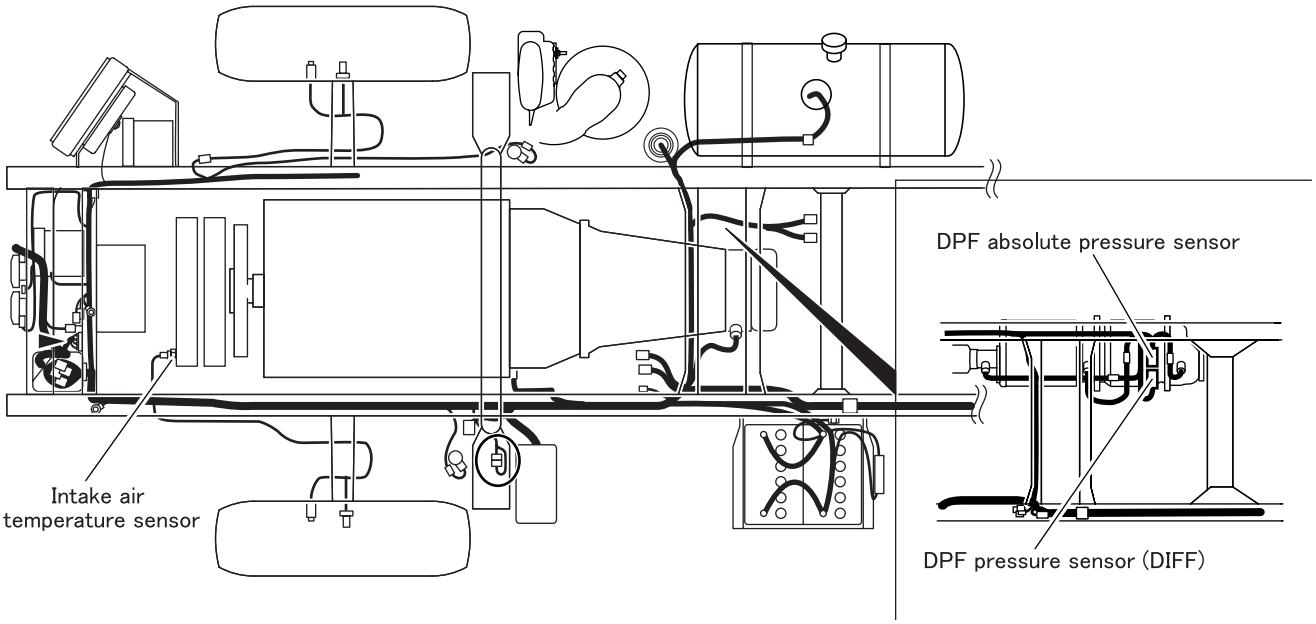
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

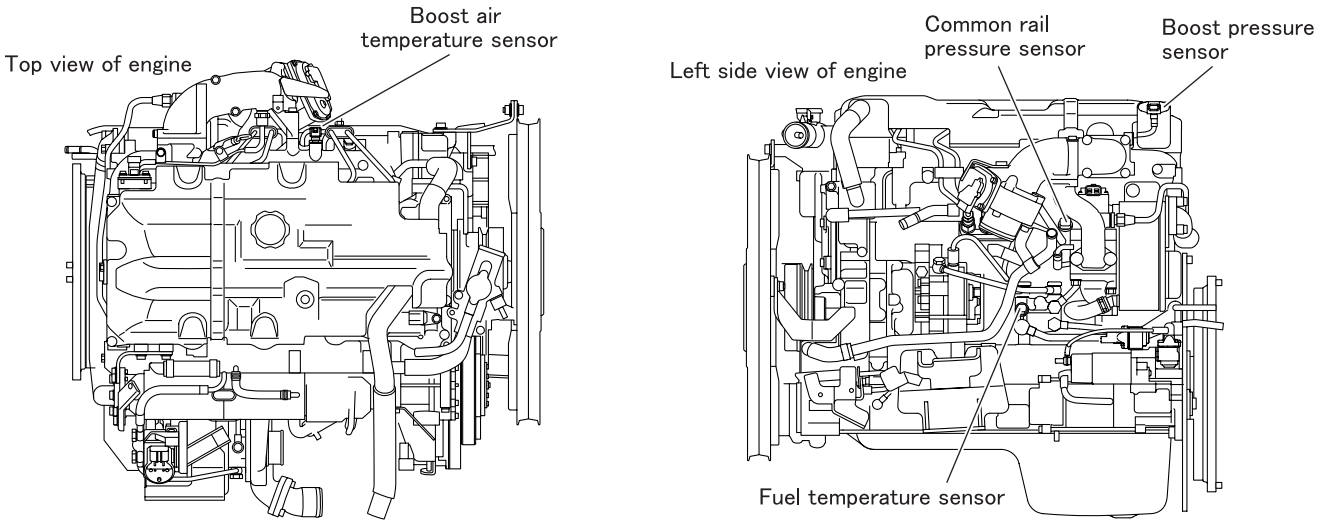
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]







P103647E

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Modify connector.

Step 2	Inspection items		Inspection by electronic control unit connector (power supply): common rail pressure sensor
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 11 (+) and No. 13 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection of common rail pressure sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and common rail pressure sensor (power supply)
	Maintenance item		Check circuit between common rail pressure sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection by electronic control unit connector (power supply): DPF pressure sensor (DIFF)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 61 (+) and No. 85 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of DPF pressure sensor (DIFF) connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between electronic control unit and DPF pressure sensor (DIFF) (power supply)
	Maintenance item		Check circuit between DPF pressure sensor (DIFF) connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 61.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by electronic control unit connector: boost air temperature sensor
	Maintenance item		Measure value of voltage between connector (GE58A) terminal No. 30 (+) and No. 29 (–).
	Inspection condition		• Measure from back side of connector of harness with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection of boost air temperature sensor
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 10	Inspection items		Inspection of harness between electronic control unit and boost air temperature sensor (power supply)
	Maintenance item		Check circuit between boost air temperature sensor connector terminal No. 1 and electronic control unit connector (GE58A) terminal No. 30
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify harness.

[Fault code]
Diagnosis code: P0700/Flash code: 71
[Monitor]
Failure of automatic transmission control
[Fault (outline)]
Fault present in TCM
(TCM: Transmission Control Module)
[Diagnosis check]
- Transfer of fault status information from automatic transmission electronic control unit is monitored.

[Code generation condition]
- Fault information from automatic transmission electronic control unit has been received for more than 2 seconds. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

[Probable cause of trouble]
- Failure of automatic transmission system (See Gr23.)

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P1169/Flash code: 56
[Monitor]
Characteristic value in air flow sensor
[Fault (outline)]
Electronic control unit
[Diagnosis check]
- Availability of stored air flow sensor data in engine electronic control unit is checked.

[Code generation condition]
- Air flow sensor data are found missing.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

[Probable cause of trouble]
- No air flow sensor data stored in engine electronic control unit
  (For data alteration/registration and data write operation, contact your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Fault code]
Diagnosis code: P1170/Flash code: 34
[Monitor]
Injection quantity adjustment data
[Fault (outline)]
Electronic control unit
[Diagnosis check]
- Availability of stored injection quantity adjustment data in engine electronic control unit is checked.

[Code generation condition]
- Injection quantity adjustment data are found missing.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injection quantity adjustment data is fixed at backup value.

[Probable cause of trouble]
- No injection quantity adjustment data stored in engine electronic control unit
  (For data alteration/registration and data write operation, contact your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Fault code]
Diagnosis code: P1410/Flash code: 92
[Monitor]
Excessive exhaust pressure
[Fault (outline)]
- Low signal range check
- High signal range check

[Diagnosis check]
- Pressure before ceramic filter is monitored by DPF absolute pressure sensor for clogging of ceramic filter.

[Code generation condition]
- Pressure before ceramic filter remains over specified value for 3 seconds.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

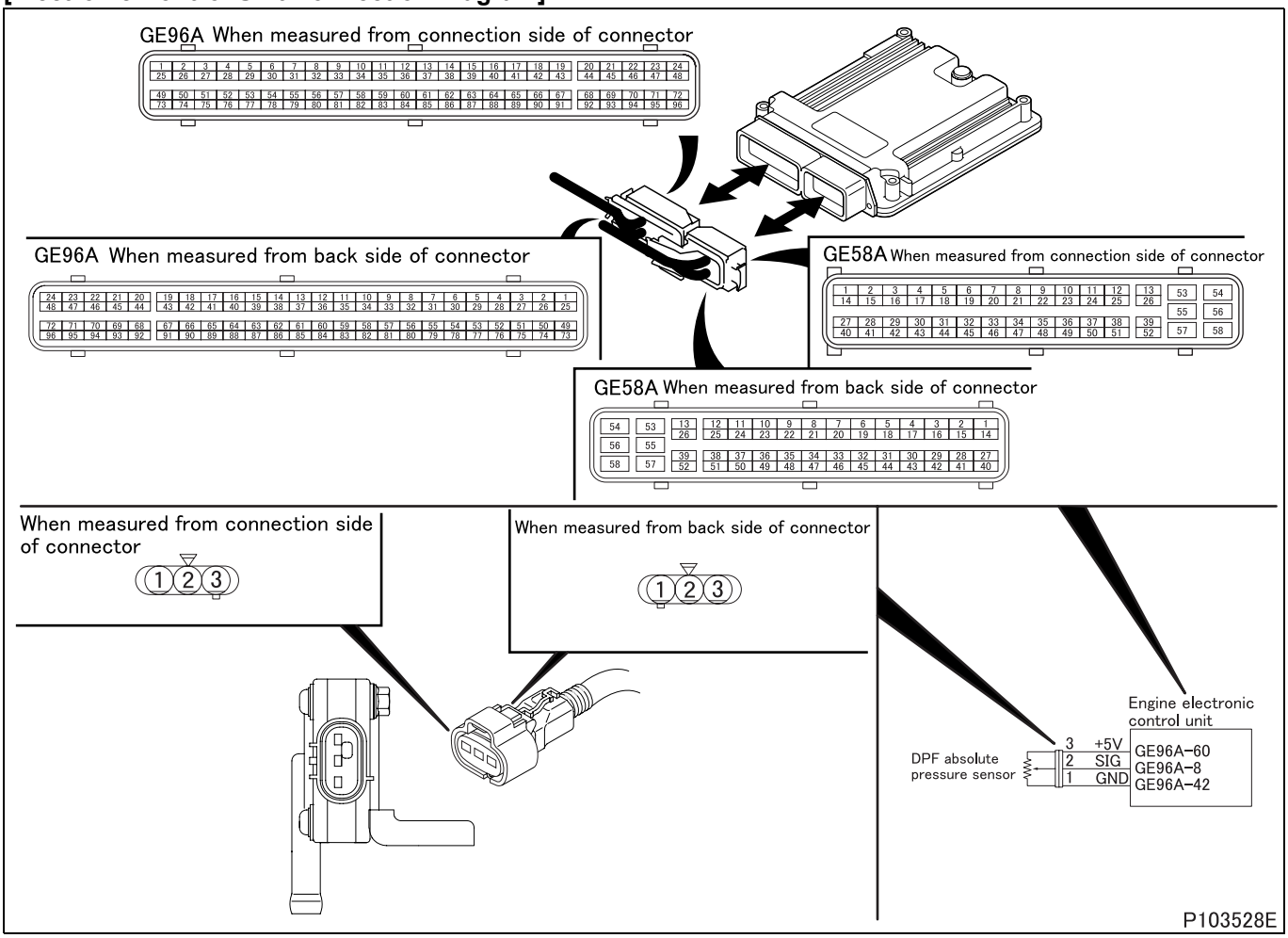
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- Exhaust gas recirculation control is stopeed.
- Throttle control disabled.
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.

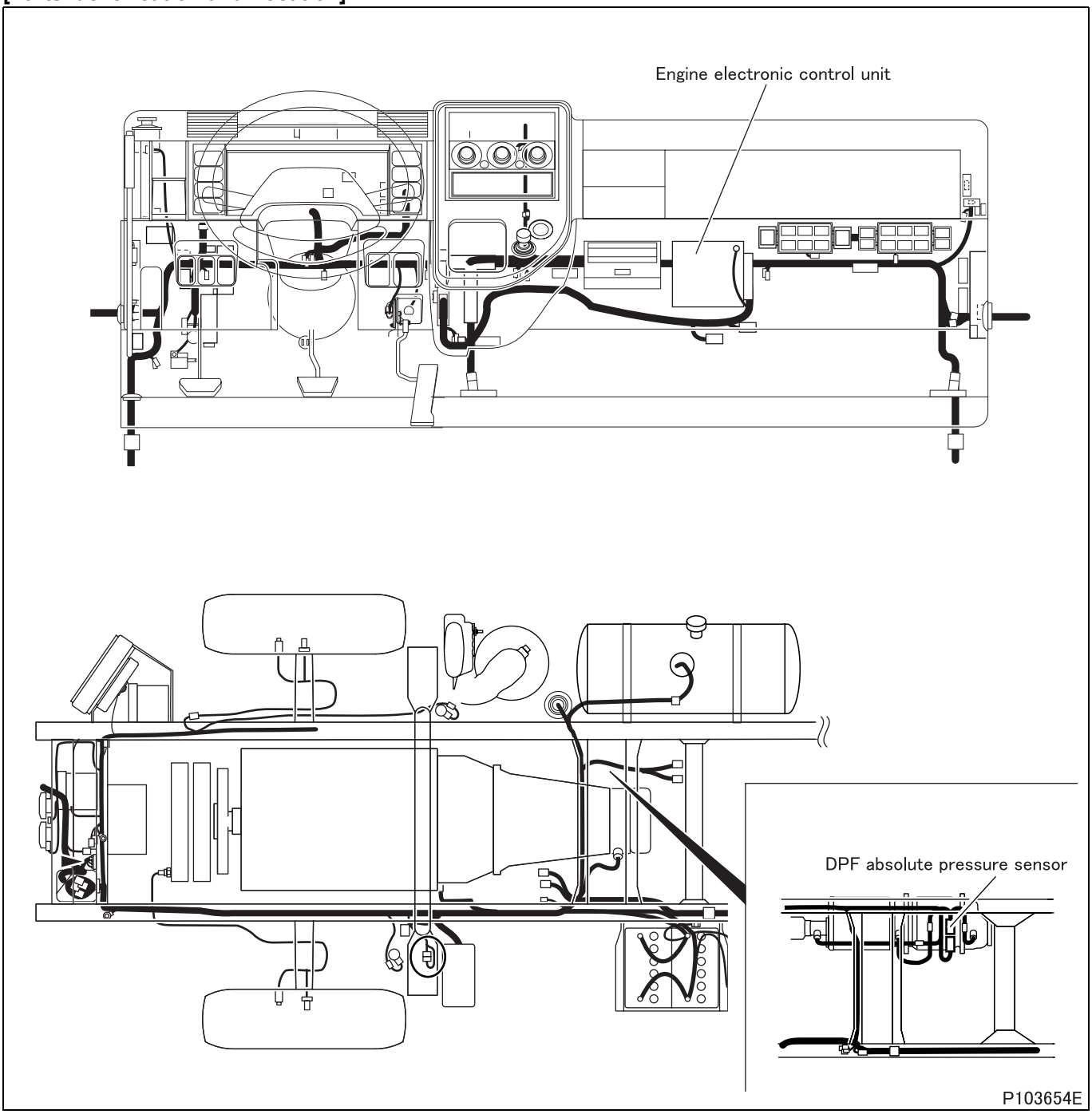
[Probable cause of trouble]
- Excessive smoke emission (due to malfunction of engine proper, common rail or exhaust gas recirculation system)
- Malfunction of diesel particulate filter regeneration control
- Excessive particuler matter (PM) deposit
- Malfunction of DPF absolute pressure sensor.
- Malfunction of engine electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



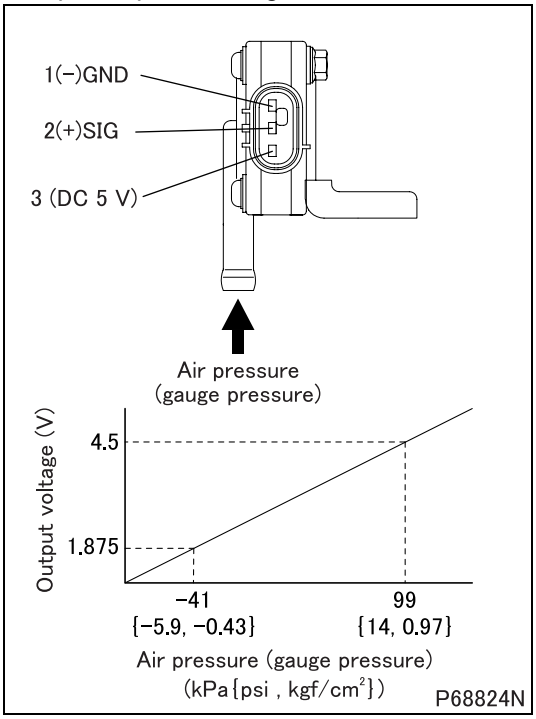
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow sensor (Low)” • P0103 “Airflow sensor (High)” • P0426 ”EXH Gas Temp SNSR1 (Plausibility)” • P0427 ”EXH Gas Temp SNSR1 (Low)” • P0428 ”EXH Gas Temp SNSR1 (High)” • P0545 ”DPF Temp SNSR (upstream) Low” • P0546 ”DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (HIgh) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	After inspection of diagnosis cord that is occuring, go to step 2.
		NO	Go to step 2.

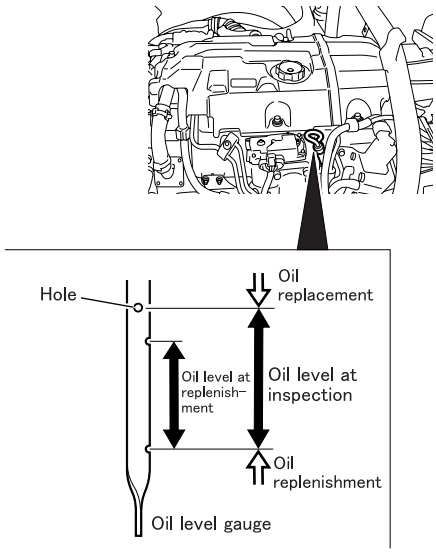
Step 2	Inspection items		Inspection of DPF absolute pressure sensor unit
	Maintenance item		Measure value of voltage between terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across connector terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 41 ± 3.2 kPa {5.9 ± 0.5 psi, 0.43 ± 0.03 kgf/cm^2}: 1.875 V • 99 ± 3.2 kPa {14 ± 0.5 psi, 1.0 ± 0.03 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Replacement of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine is stopped.
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4.

<Step 3 inspection diagram>

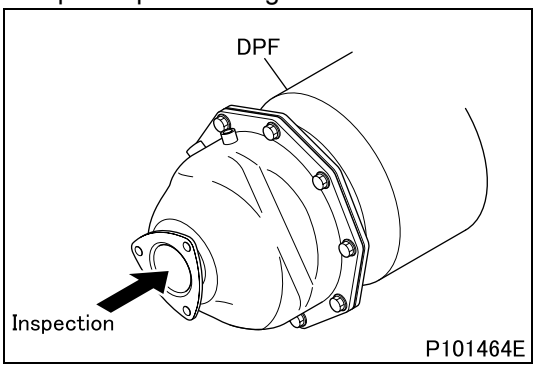


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	After correction and replacement of hose, go to step 5.

Step 5	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information and go to step 7.

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of diesel particulate filter unit for clogging and cleaning of the diesel particulate filter unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”.
	Inspection condition		Perform the following preparatory works. • Place the transmission in neutral. (place the automatic transmission in P range) • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related Information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F}. (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”)
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P1411/Flash code: 88
[Monitor]
Diesel particulate filter is overheated.
[Fault (outline)]
- Low signal range check
- High signal range check
- Plausibility

[Diagnosis check]
- Temperature after ceramic diesel particulate filter is monitored and manual filter regeneration is stopped if filter temperature excessively rises.

[Code generation condition]
- Temperature output from DPF temperature sensor 2 remains over 700°C {1292°F} for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
<Fault diagnosis for signals>
- Fault diagnosis is continuously performed during the driving cycle.

<Fault diagnosis by comparison with other information>
- Fault diagnosis is performed only once during the driving cycle.

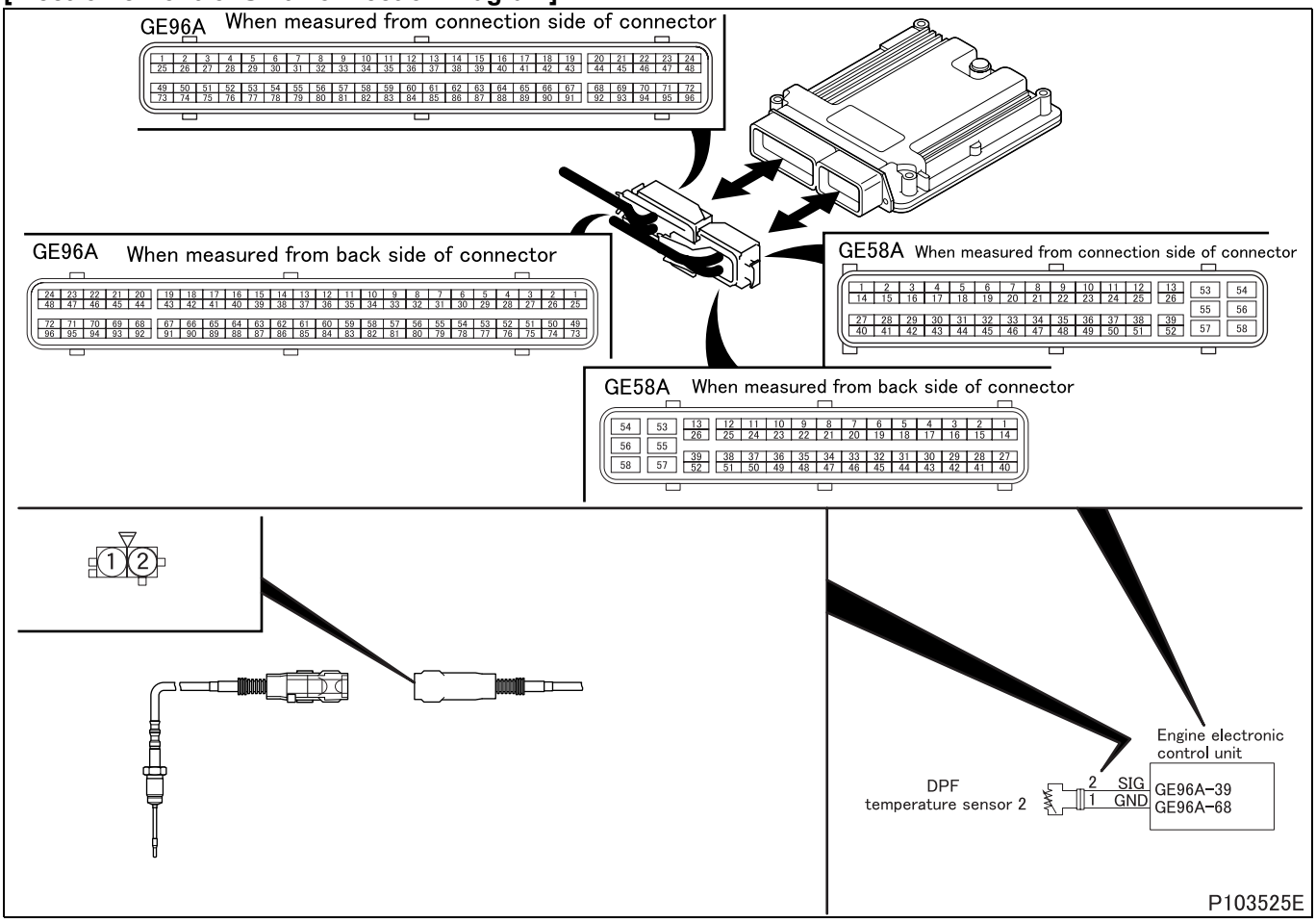
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.

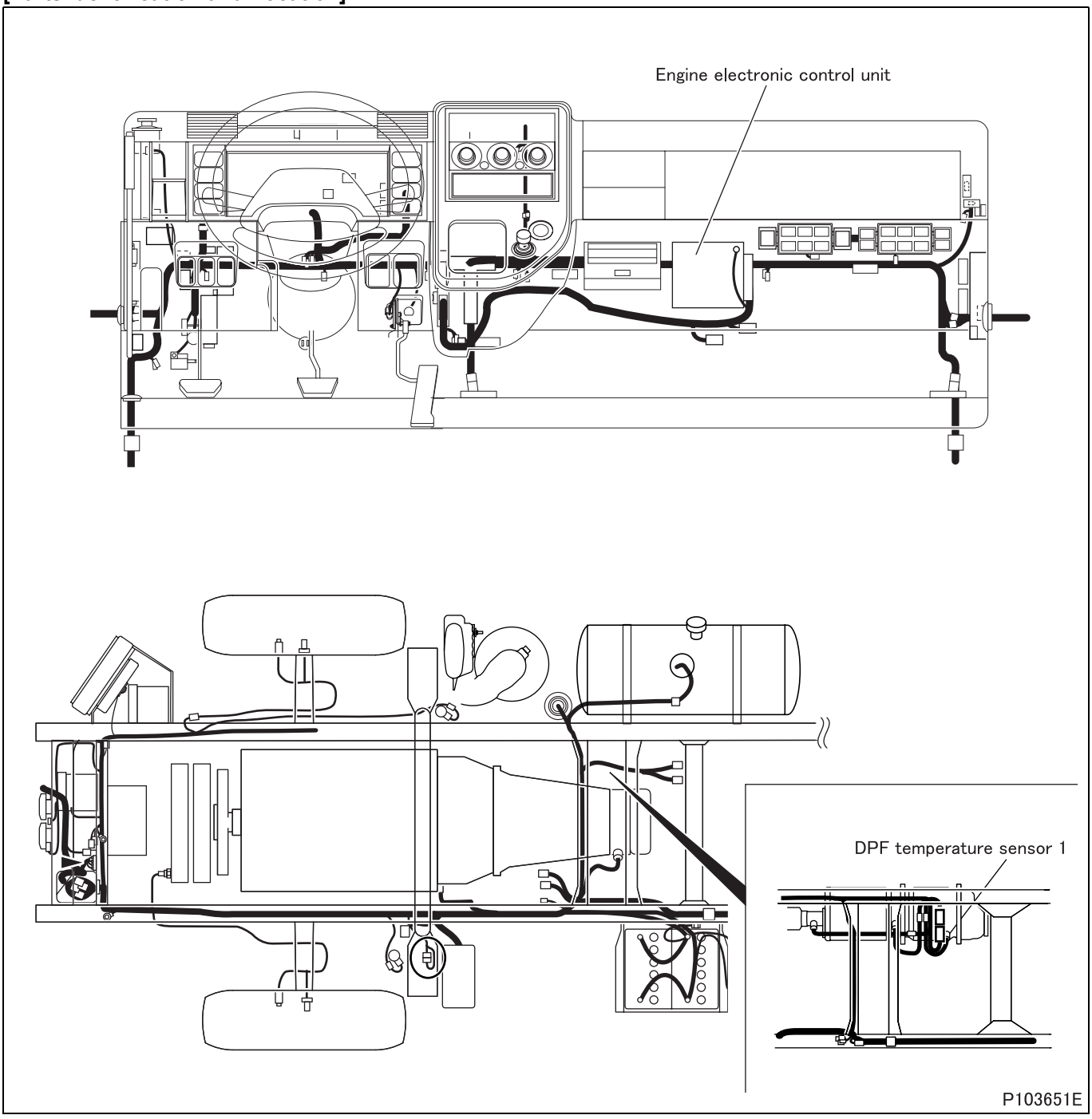
[Probable cause of trouble]
- Excessive smoke emission (due to malfunction of engine proper, common rail or exhaust gas recirculation system)
- Malfunction of diesel particulate filter regeneration control
- Excessive particulate matter (PM) deposit
- Malfunction of engine electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



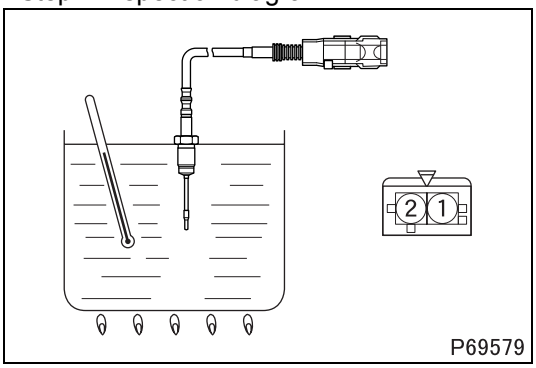
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow Sensor (Low)” • P0103 “Airflow Sensor (High)” • P0426 “EXH Gas Temp SNSR1 (Plausibility)” • P0427 “EXH Gas Temp SNSR1 (Low)” • P0428 “EXH Gas Temp SNSR1 (High)” • P0545 “DPF Temp SNSR (upstream) Low” • P0546 “DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	After inspection of diagnosis code that is occurring, go to step 2.
		NO	Go to step 2.

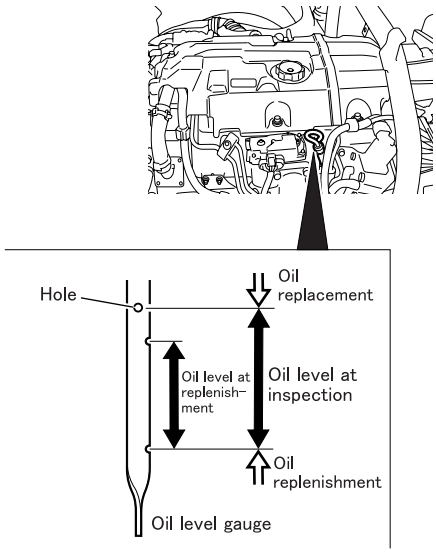
Step 2	Inspection items		Inspection of DPF temperature sensor 2 unit
	Maintenance item		Measure value of resistance between terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 2 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Cleaning of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine is stopped.
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4.

<Step 3 inspection diagram>

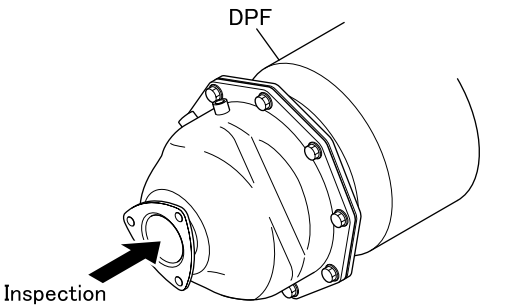


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	After correction and replacement of hose, go to step 5.

Step 5	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information and go to step 7.

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of diesel particulate filter unit for clogging and cleaning of the diesel particulate filter unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”.
	Inspection condition		Perform following preparatory works. • Place the transmission in neutral. (place the automatic transmission in P range) • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F}. (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”)
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P1412/Flash code: 92
[Monitor]
Temperature increase is insufficient for automatic diesel particulate filter regeneration control
[Fault (outline)]
Plausibility
[Diagnosis check]
- Temperature in diesel particulate filter during automatic filter regeneration is monitored through DPF temperature sensor 1.

[Code generation condition]
- Abnormality is determined if the remaining of temperature below 250°C {482°F} during 5 km {3.11 miles} of running after start of automatic diesel particulate filter regeneration is repeated three times.

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

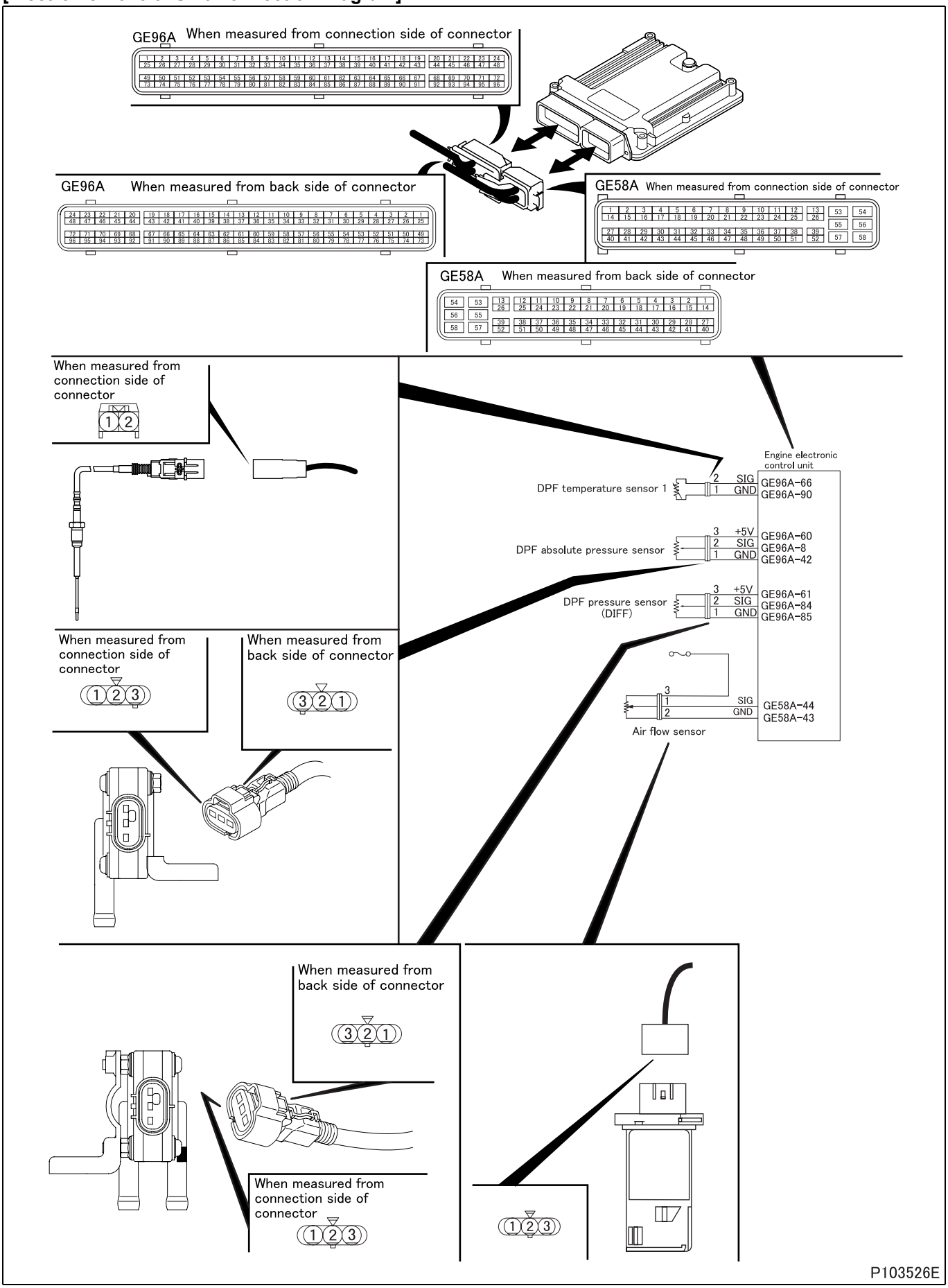
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible)

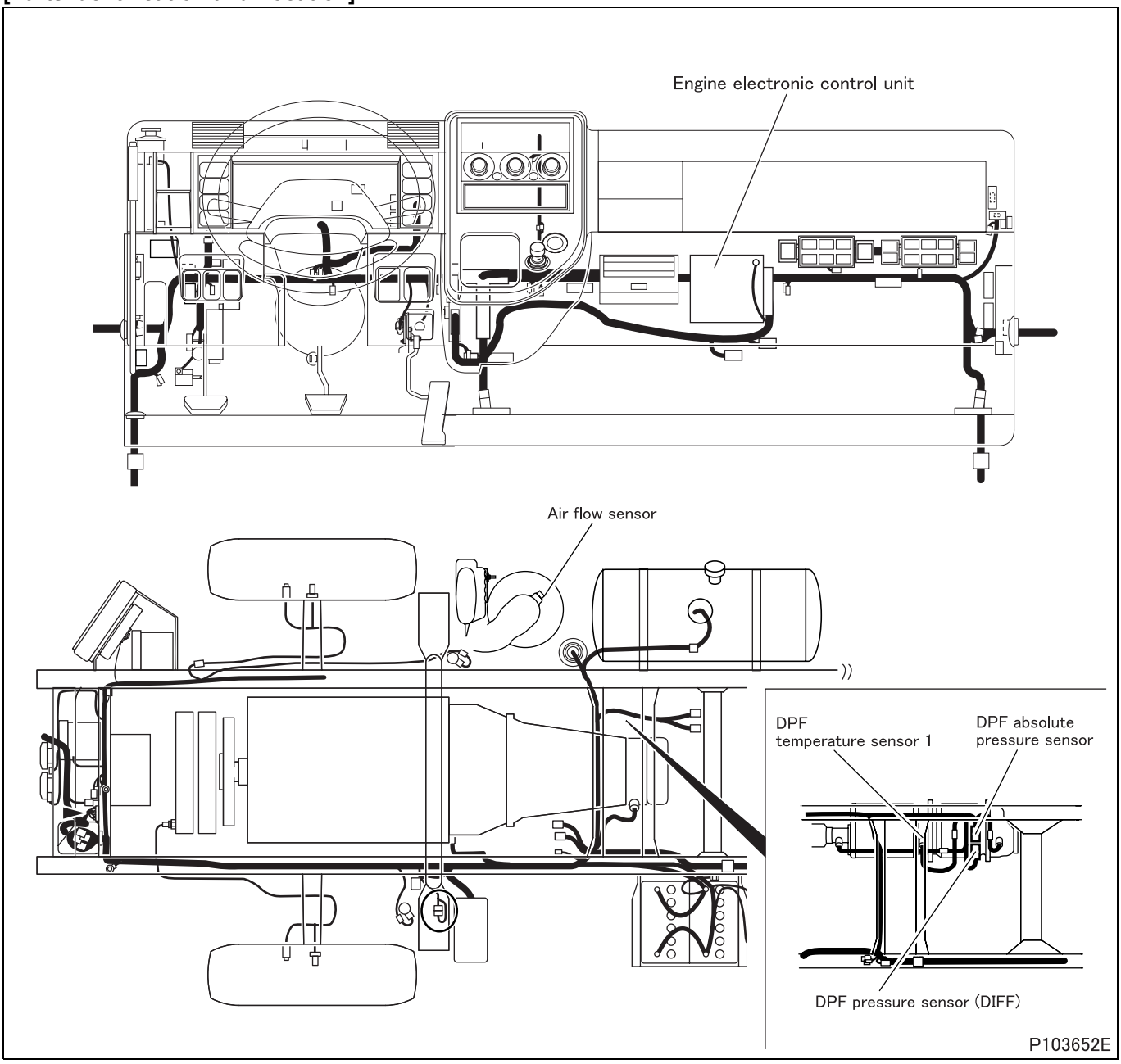
[Probable cause of trouble]
- Malfunction of diesel particulate filter regeneration control
- Malfunction of DPF temperature sensor 1
- Malfunction of engine electronic control unit
- Malfunction of common rail
- Malfunction of diesel particulate filter (front oxidation catalyst)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



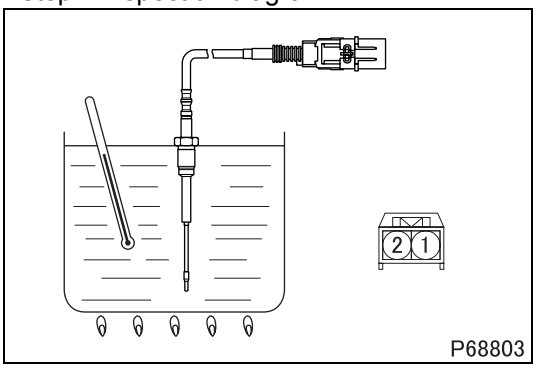
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow Sensor (Low)” • P0103 “Airflow Sensor (High)” • P0426 “EXH Gas Temp SNSR1 (Plausibility)” • P0427 “EXH Gas Temp SNSR1 (Low)” • P0428 “EXH Gas Temp SNSR1 (High)” • P0545 “DPF Temp SNSR (upstream) Low” • P0546 “DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	After inspection of diagnosis code that is occurring, go to step 2.
		NO	Go to step 2.

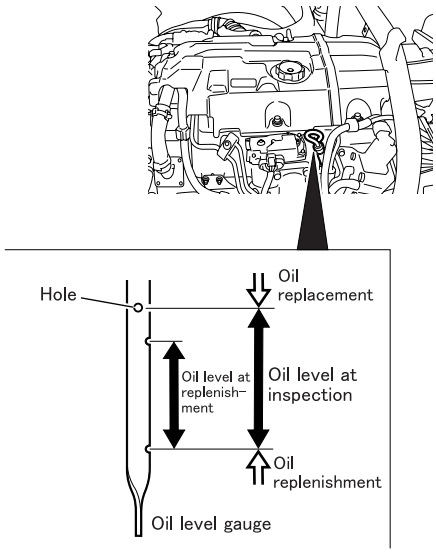
Step 2	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Cleaning of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine is stopped.
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4.

<Step 3 inspection diagram>

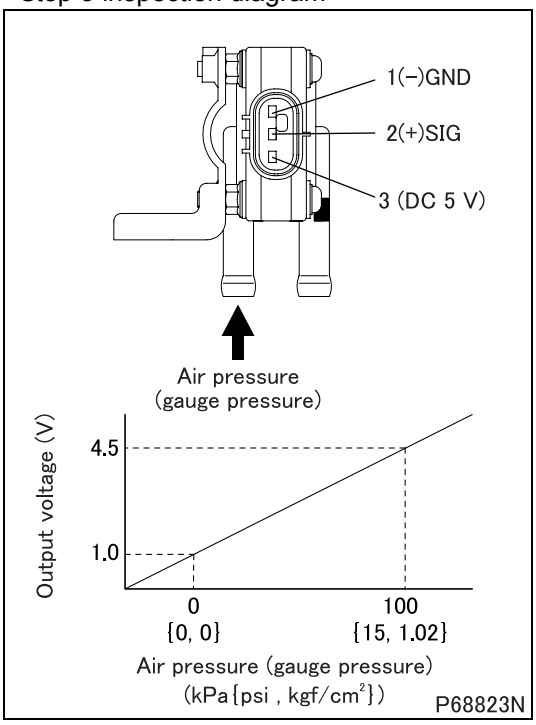


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Correction and replacement of hose

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of sensor

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of diesel particulate filter
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1413/Flash code: 92
[Monitor]
Temperature increase is insufficient for automatic diesel particulate filter regeneration control
[Fault (outline)]
Plausibility
[Diagnosis check]
- Temperature in diesel particulate filter during automatic filter regeneration is monitored through DPF temperature sensor 1.

[Code generation condition]
- Abnormality is determined if the remaining of temperature below 500°C {932°F} for 30 minutes after start of automatic diesel particulate filter regeneration is repeated three times.

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

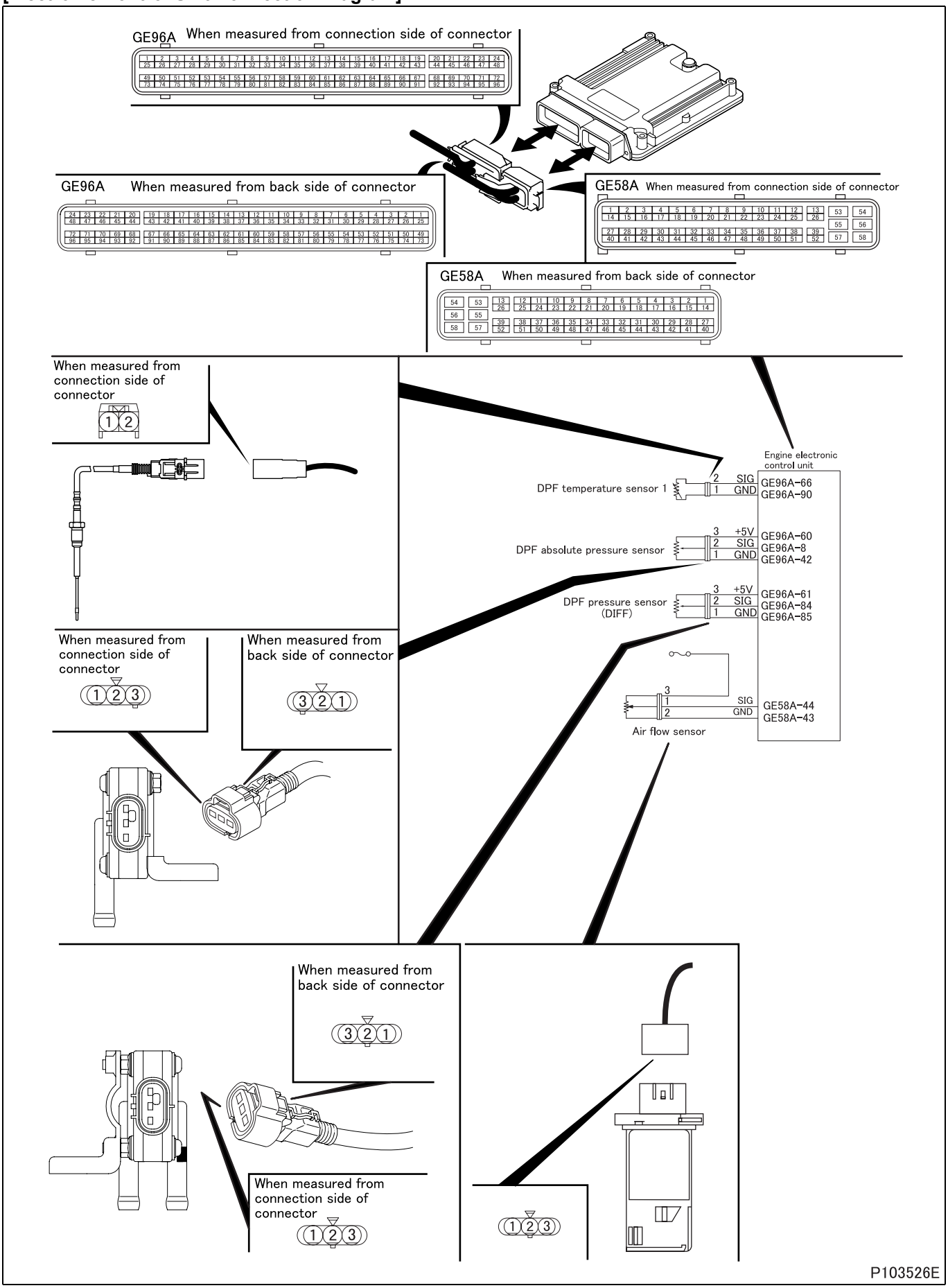
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).

[Probable cause of trouble]
- Malfunction of diesel particulate filter regeneration control
- Malfunction of DPF temperature sensor 1
- Malfunction of engine electronic control unit
- Malfunction of common rail
- Malfunction of diesel particulate filter (front oxidation catalyst)

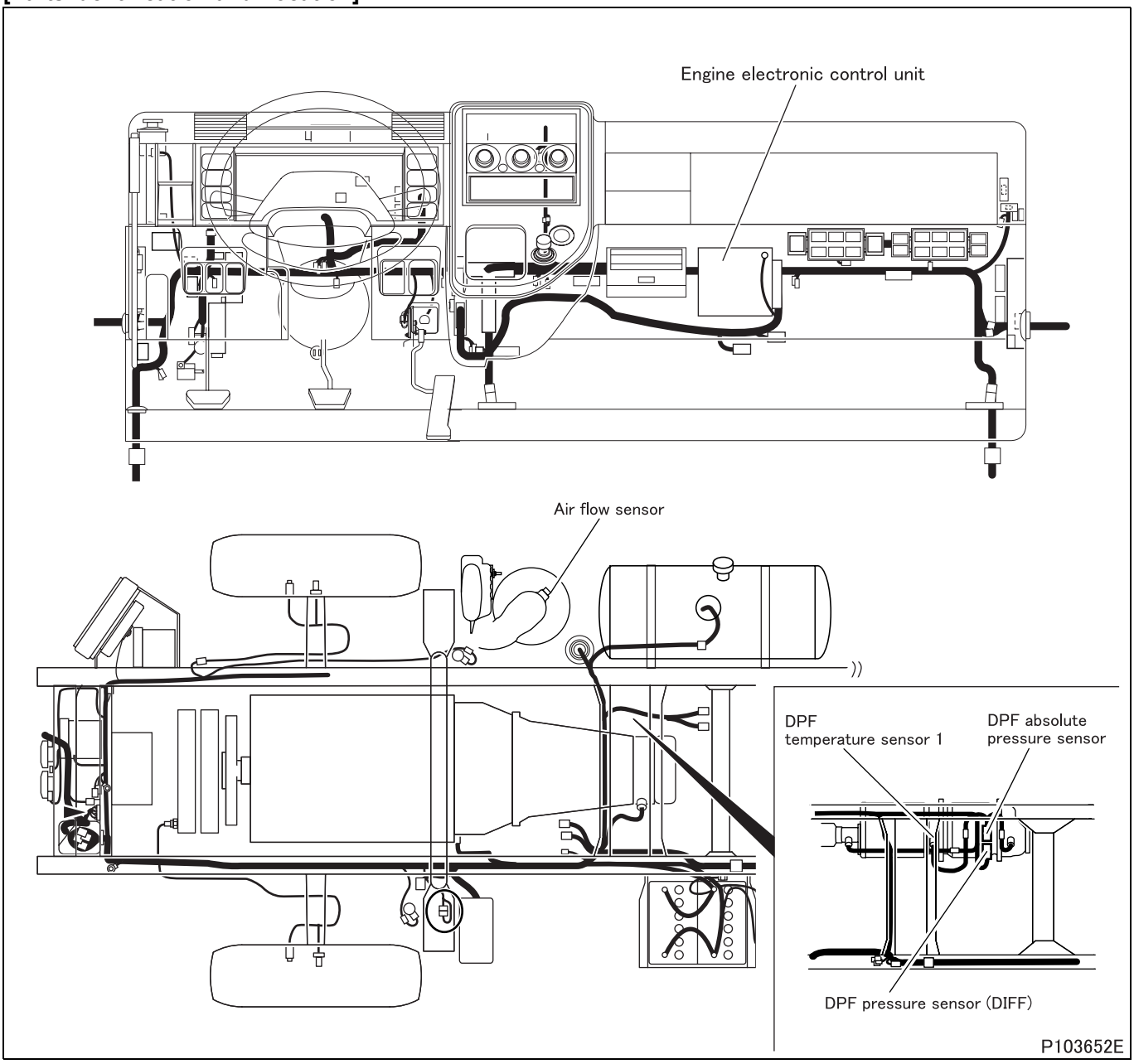
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



P103526E

[Parts Identification and Location]



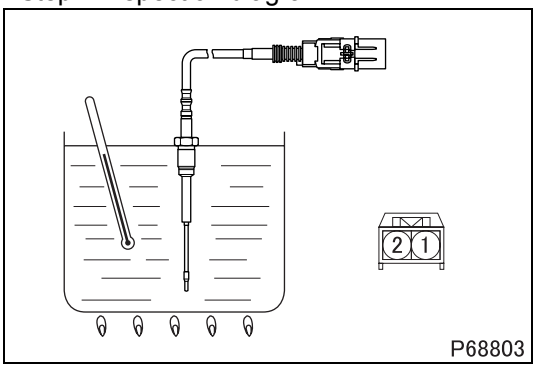
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow Sensor (Low)” • P0103 “Airflow Sensor (High)” • P0426 “EXH Gas Temp SNSR1 (Plausibility)” • P0427 “EXH Gas Temp SNSR1 (Low)” • P0428 “EXH Gas Temp SNSR1 (High)” • P0545 “DPF Temp SNSR (upstream) Low” • P0546 “DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	After inspection of diagnosis code that is occurring, go to step 2.
		NO	Go to step 2.

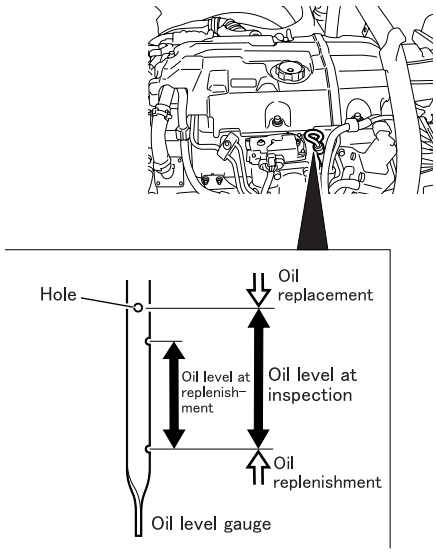
Step 2	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Cleaning of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine is stopped.
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4.

<Step 3 inspection diagram>

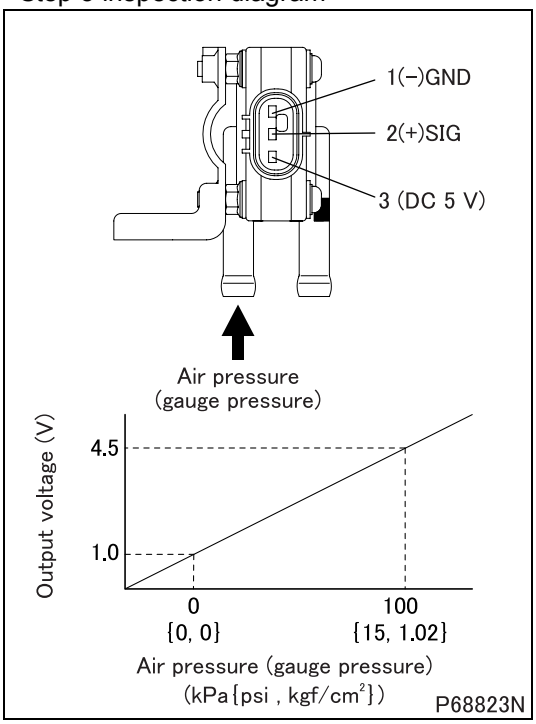


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Correction and replacement of hose

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of sensor

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of diesel particulate filter
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1414/Flash code: 92
[Monitor]
Temperature increase is insufficient for automatic diesel particulate filter regeneration control
[Fault (outline)]
Plausibility
[Diagnosis check]
- Temperature in diesel particulate filter during automatic filter regeneration is monitored through DPF temperature sensor 1.

[Code generation condition]
- Abnormality is determined if the remaining of temperature over 620°C {1148°F} for 10 minutes after start of automatic diesel particulate filter regeneration is repeated three times.

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

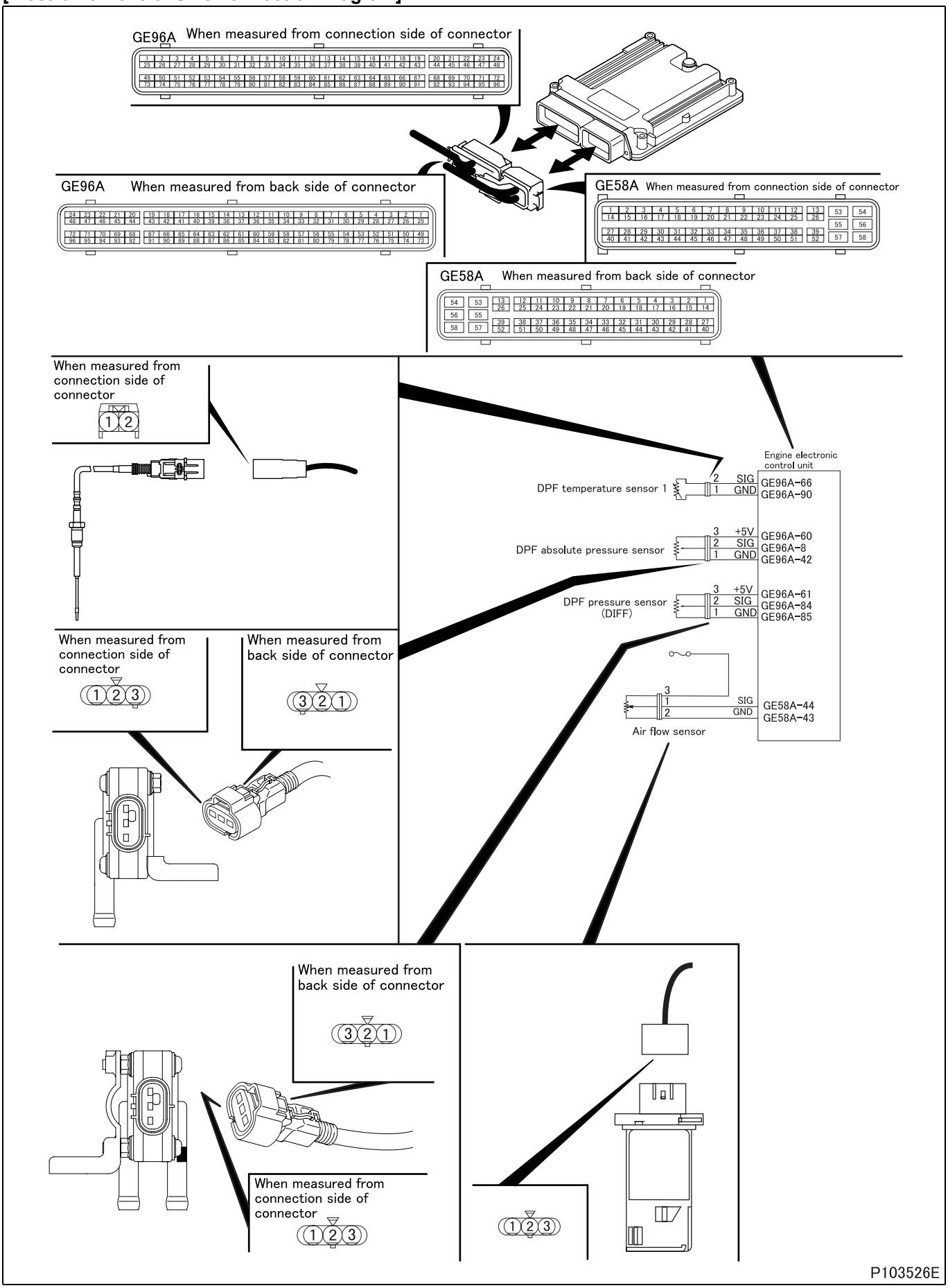
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).

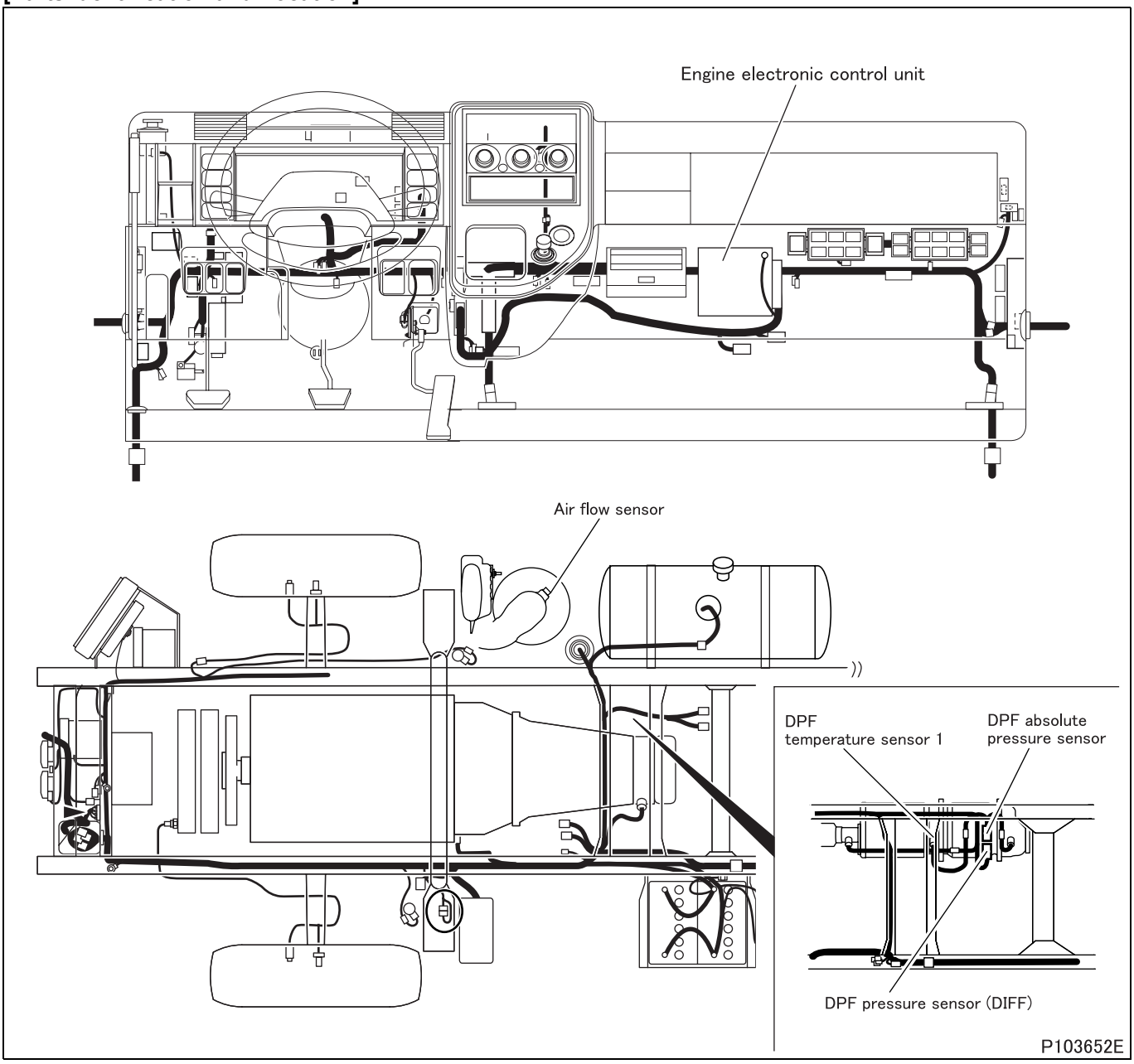
[Probable cause of trouble]
- Malfunction of diesel particulate filter regeneration control
- Malfunction of DPF temperature sensor 1
- Malfunction of engine electronic control unit
- Malfunction of common rail
- Malfunction of diesel particulate filter (front oxidation catalyst)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



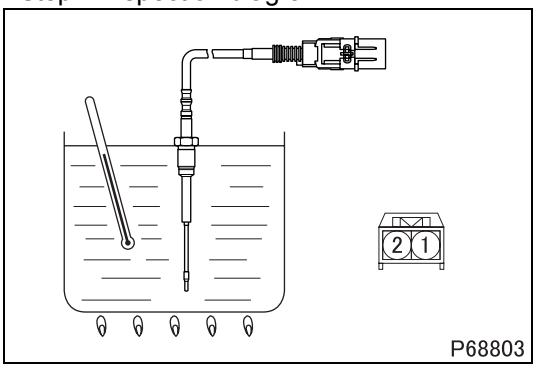
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow Sensor (Low)” • P0103 “Airflow Sensor (High)” • P0426 “EXH Gas Temp SNSR1 (Plausibility)” • P0427 “EXH Gas Temp SNSR1 (Low)” • P0428 “EXH Gas Temp SNSR1 (High)” • P0545 “DPF Temp SNSR (upstream) Low” • P0546 “DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	After inspection of diagnosis code that is occurring, go to step 2.
		NO	Go to step 2.

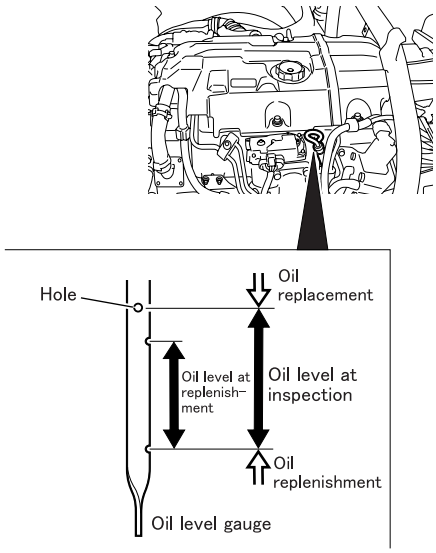
Step 2	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Cleaning of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine is stopped.
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4.

<Step 3 inspection diagram>

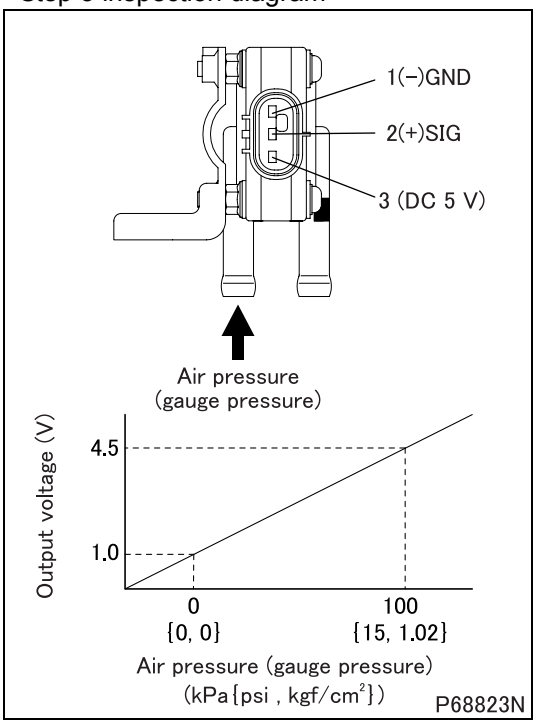


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Correction and replacement of hose

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of sensor

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of diesel particulate filter
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1415/Flash code: 92
[Monitor]
Failure of automatic diesel particulate filter regeneration control
[Fault (outline)]
Plausibility
[Diagnosis check]
- Duration of automatic diesel particulate filter regeneration is monitored.

[Code generation condition]
- Regeneration exceeds specified time. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

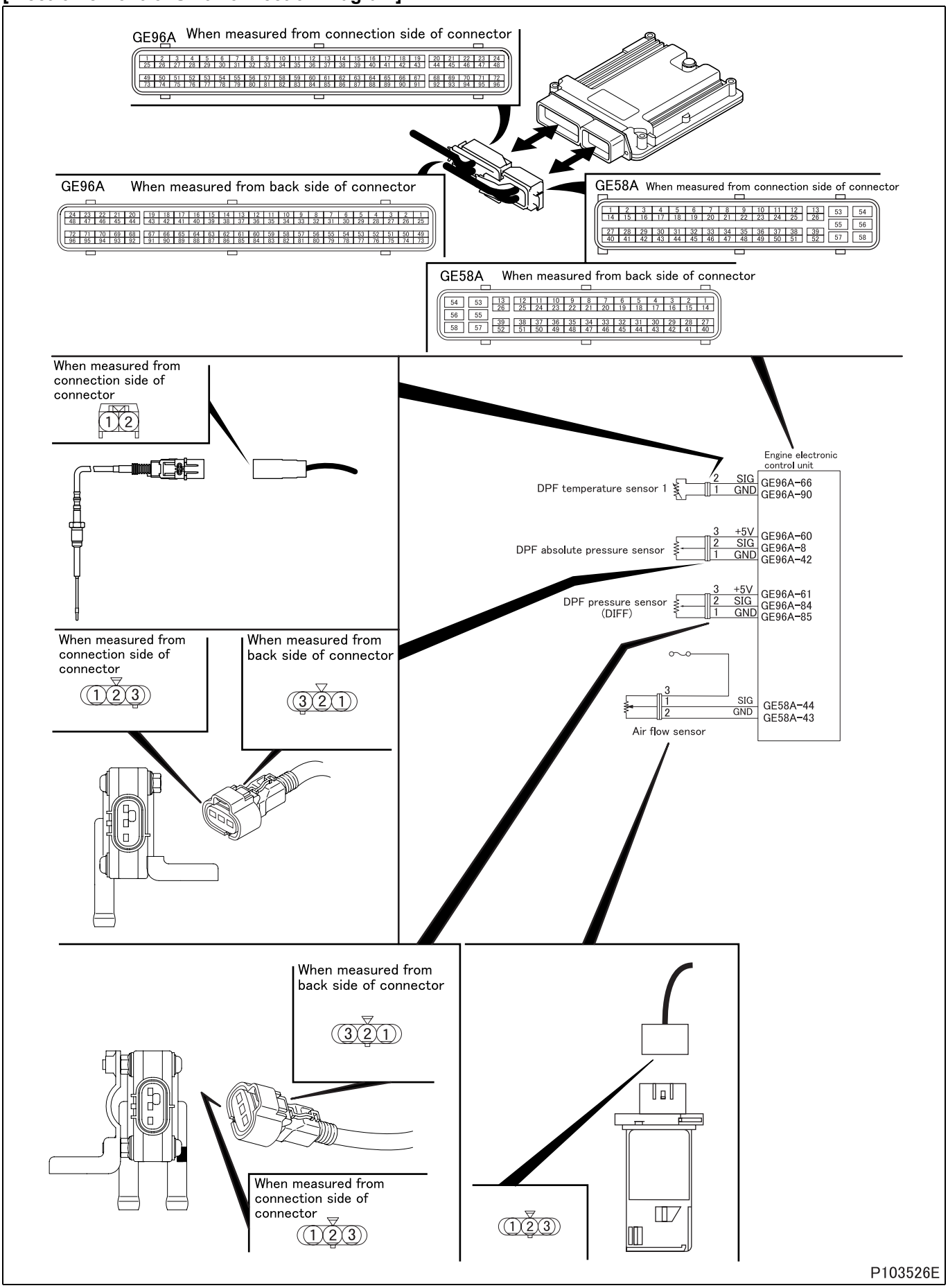
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).

[Probable cause of trouble]
- Malfunction of diesel particulate filter regeneration control
- Malfunction of DPF temperature sensor 1
- Malfunction of engine electronic control unit
- Malfunction of common rail
- Malfunction of diesel particulate filter (front oxidation catalyst)

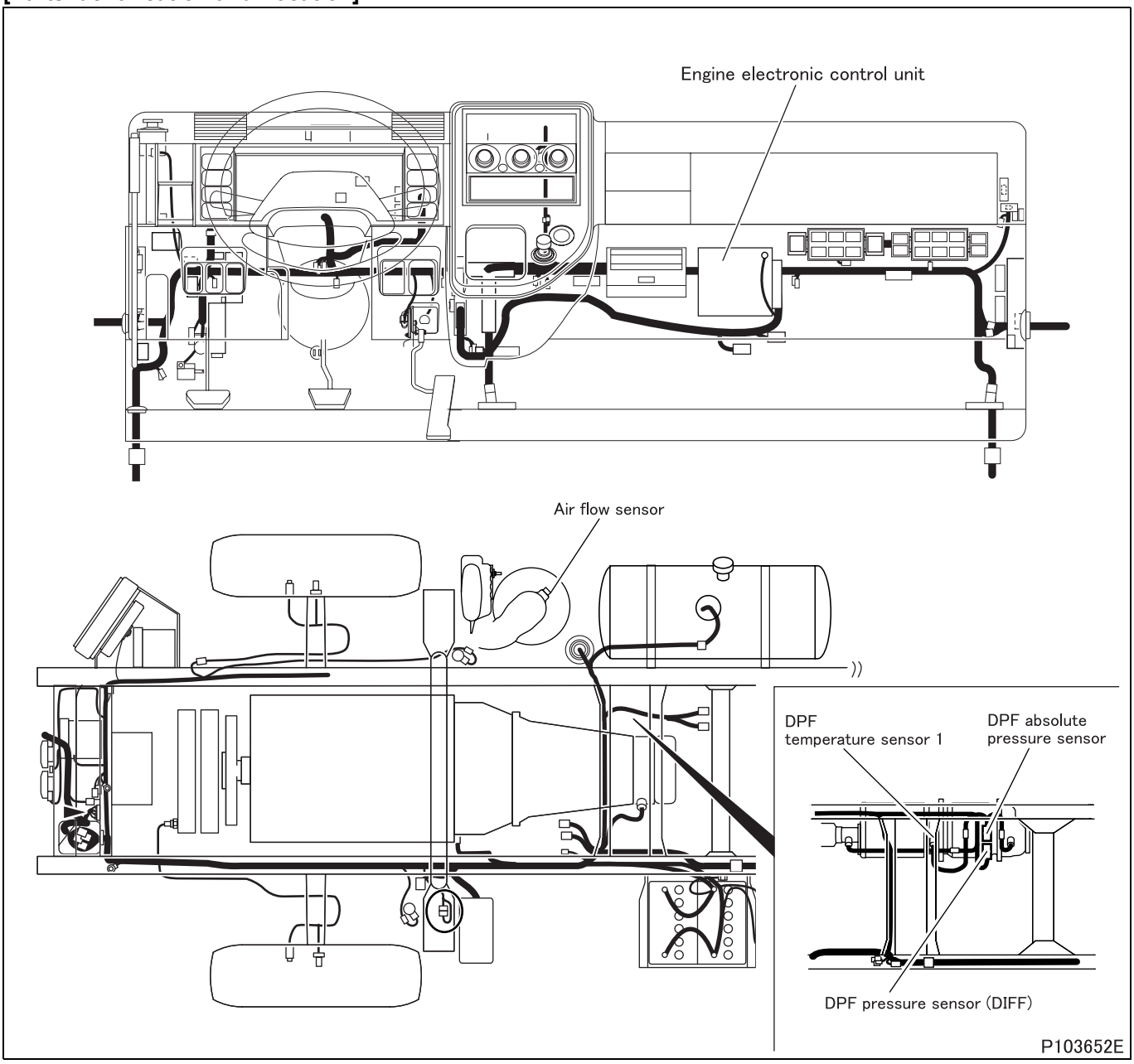
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



P103526E

[Parts Identification and Location]



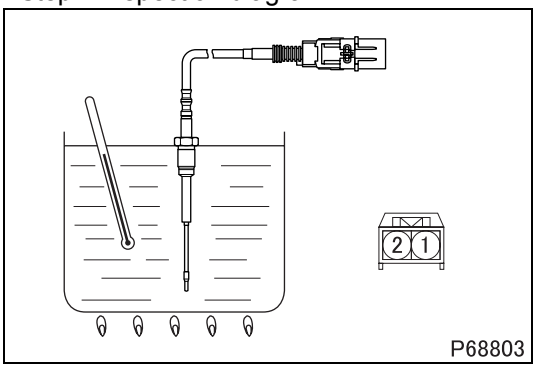
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow Sensor (Low)” • P0103 “Airflow Sensor (High)” • P0426 “EXH Gas Temp SNSR1 (Plausibility)” • P0427 “EXH Gas Temp SNSR1 (Low)” • P0428 “EXH Gas Temp SNSR1 (High)” • P0545 “DPF Temp SNSR (upstream) Low” • P0546 “DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	After inspection of diagnosis code that is occurring, go to step 2.
		NO	Go to step 2.

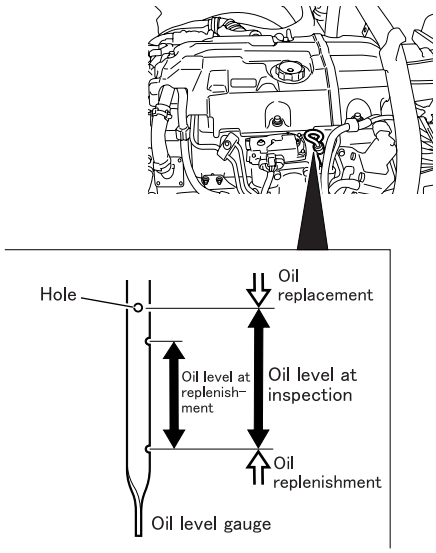
Step 2	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Cleaning of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine stopped
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4

<Step 3 inspection diagram>

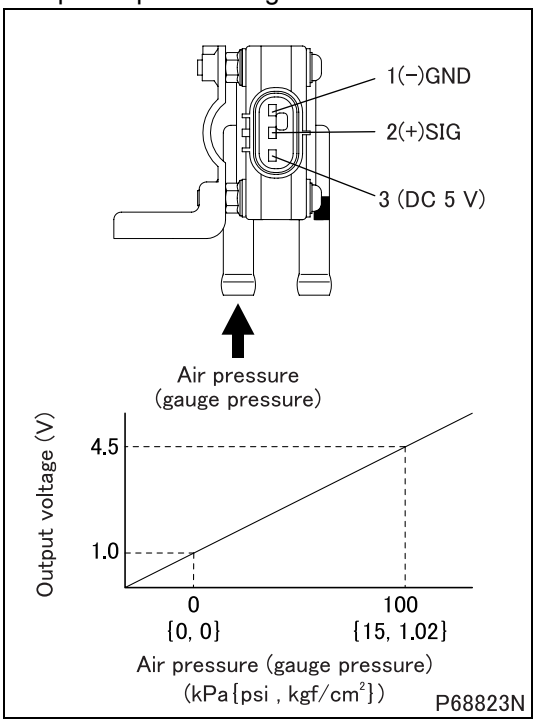


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Correction and replacement of hose

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of sensor

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of diesel particulate filter
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1416/Flash code: 92
[Monitor]
Temperature increase is insufficient for manual diesel particulate filter regeneration control
[Fault (outline)]
Plausibility
[Diagnosis check]
- Temperature in diesel particulate filter during manual diesel particular filter regeneration is monitored through DPF temperature sensor 1.

[Code generation condition]
- If temperature does not exceed 250°C {482°F} in 5 minutes after start of manual diesel particulate filter regeneration.

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

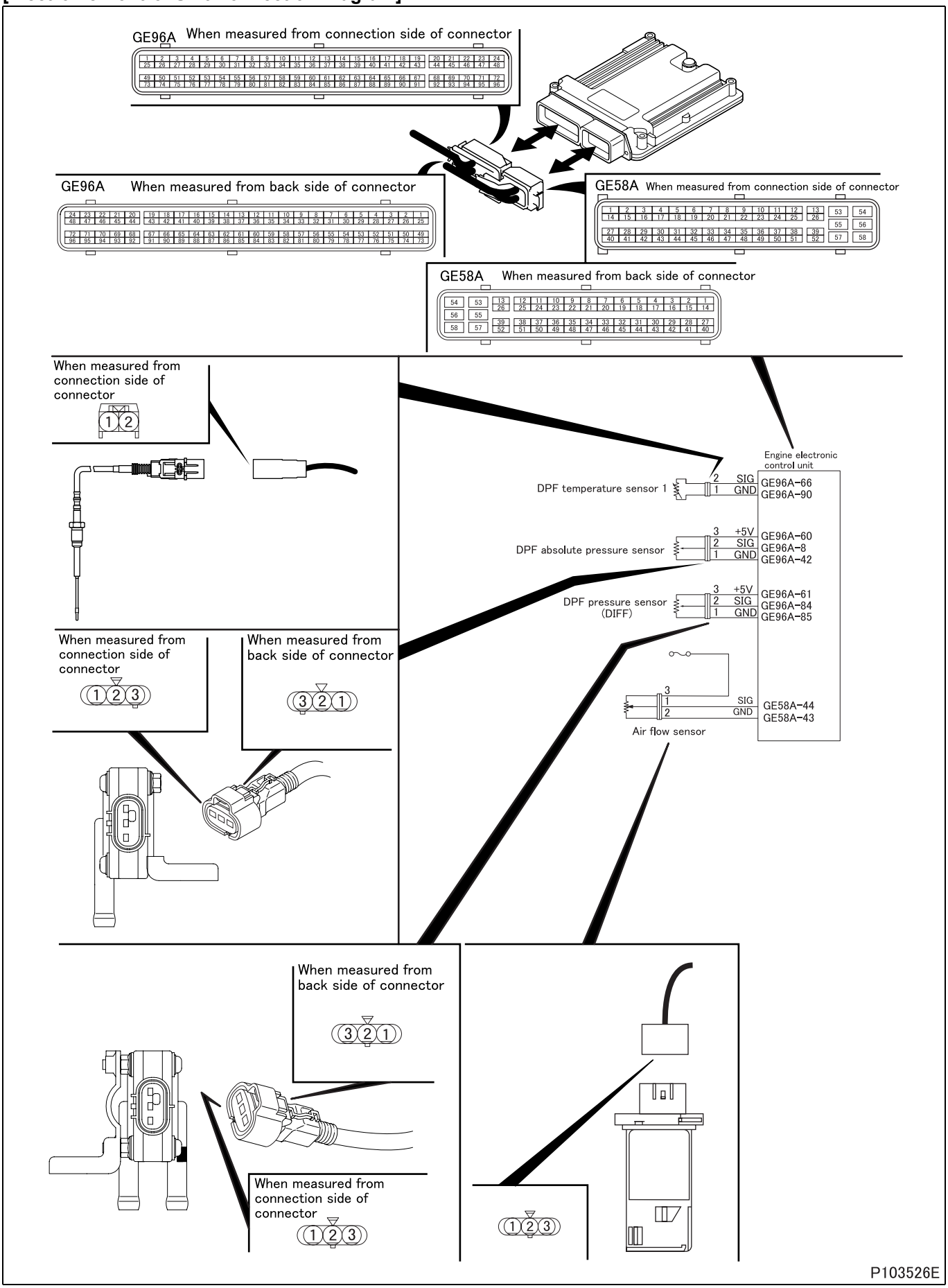
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped.

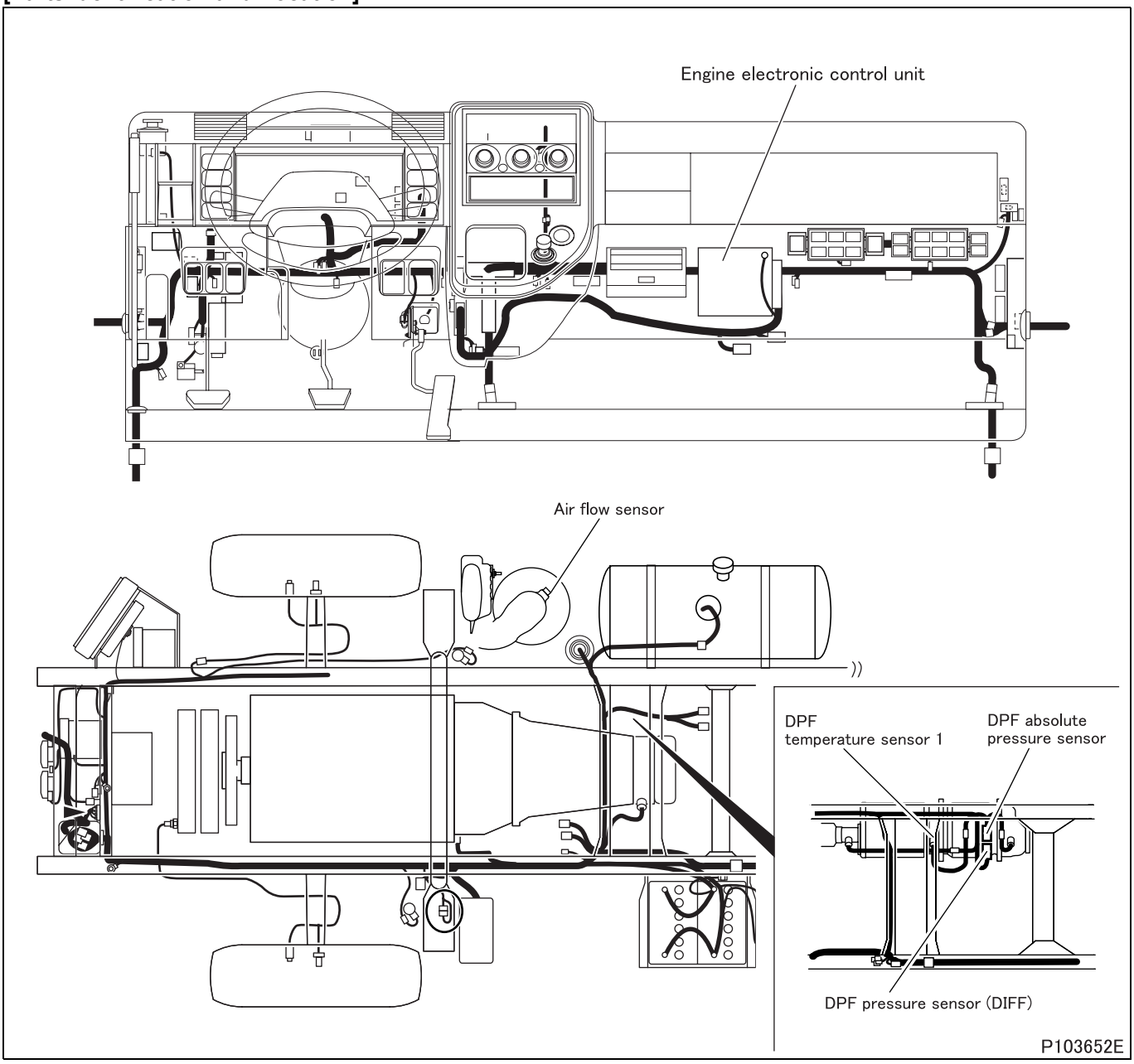
[Probable cause of trouble]
- Malfunction of diesel particulate filter regeneration control
- Malfunction of DPF temperature sensor 1
- Malfunction of engine electronic control unit
- Malfunction of common rail
- Malfunction of diesel particulate filter (front oxidation catalyst)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



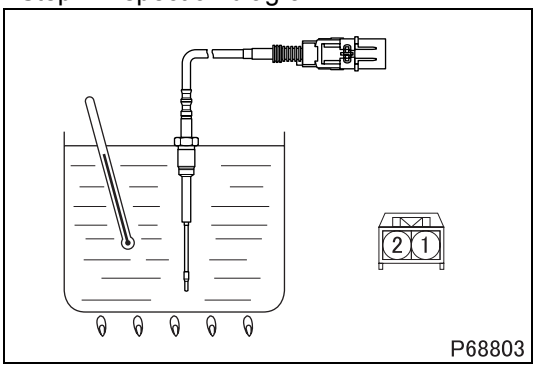
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow Sensor (Low)” • P0103 “Airflow Sensor (High)” • P0426 “EXH Gas Temp SNSR1 (Plausibility)” • P0427 “EXH Gas Temp SNSR1 (Low)” • P0428 “EXH Gas Temp SNSR1 (High)” • P0545 “DPF Temp SNSR (upstream) Low” • P0546 “DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring and go to step 2.
		NO	Go to step 2.

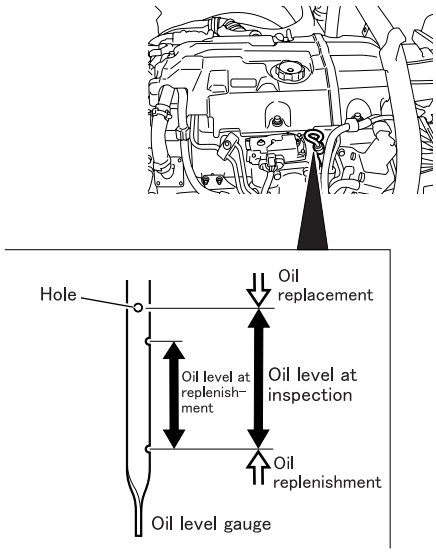
Step 2	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No.1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Cleaning of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine stopped
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4

<Step 3 inspection diagram>

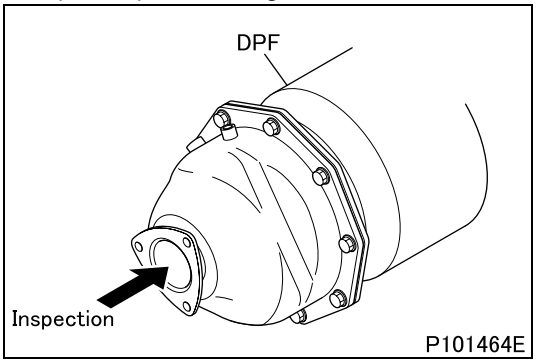


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	After correction and replacement of hose, go to step 5.

Step 5	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information.

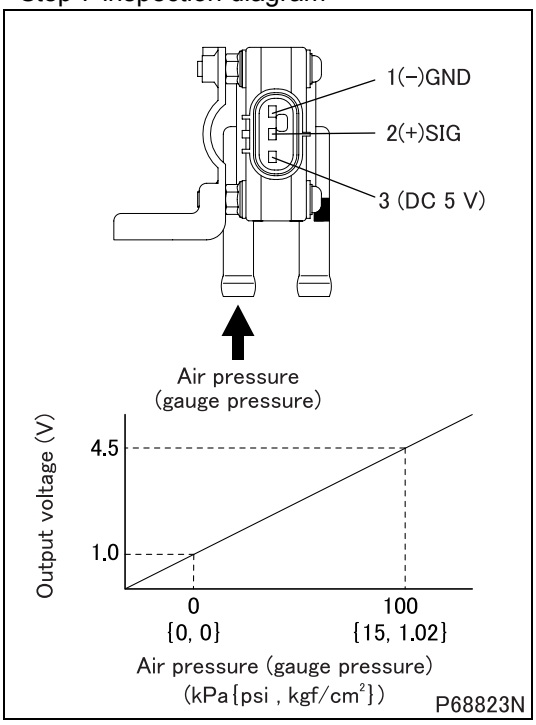
<Step 5 inspection diagram>



Step 6	Inspection items		Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”
	Inspection condition		Perform the following preparatory works. • Place the transmission in neutral (place the automatic transmission in P range). • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related Information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F} (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”).
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of electronic control unit

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of sensor

Step 9	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of diesel particulate filter
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1417/Flash code: 92
[Monitor]
Temperature increase is insufficient for manual diesel particulate filter regeneration control
[Fault (outline)]
Plausibility
[Diagnosis check]
- Temperature in diesel particulate filter during manual diesel particular filter regeneration is monitored through DPF temperature sensor 1.

[Code generation condition]
- If temperature remains below 500°C {932°F} for 30 minutes after start of manual diesel particulate filter regeneration.

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

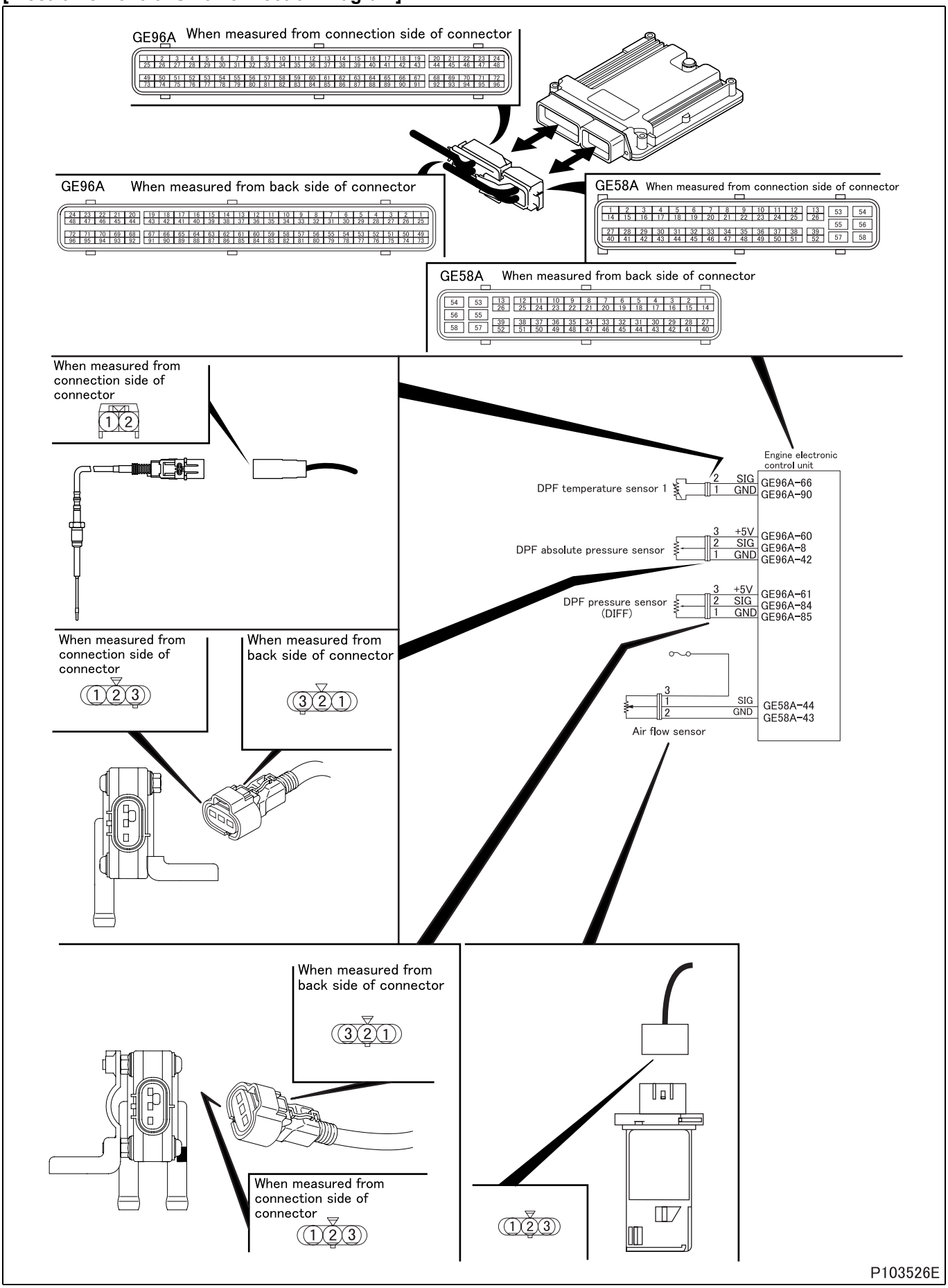
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped.

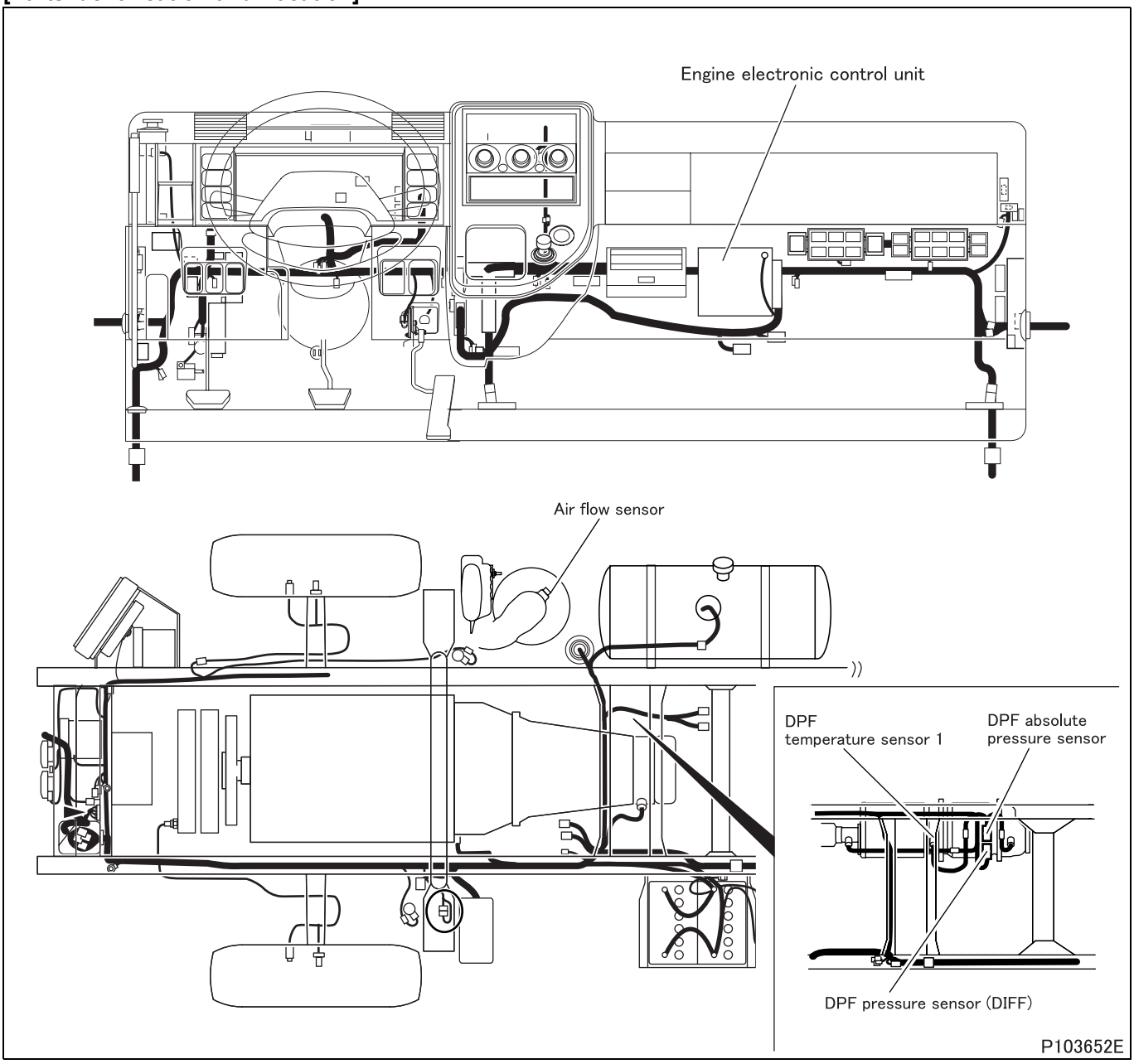
[Probable cause of trouble]
- Malfunction of diesel particulate filter regeneration control
- Malfunction of DPF temperature sensor 1
- Malfunction of engine electronic control unit
- Malfunction of common rail
- Malfunction of diesel particulate filter (front oxidation catalyst)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



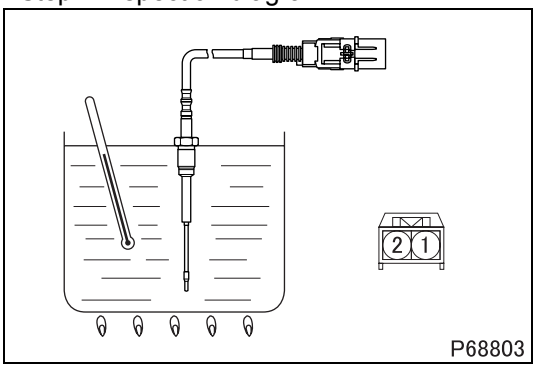
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow Sensor (Low)” • P0103 “Airflow Sensor (High)” • P0426 “EXH Gas Temp SNSR1 (Plausibility)” • P0427 “EXH Gas Temp SNSR1 (Low)” • P0428 “EXH Gas Temp SNSR1 (High)” • P0545 “DPF Temp SNSR (upstream) Low” • P0546 “DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring and go to step 2.
		NO	Go to step 2.

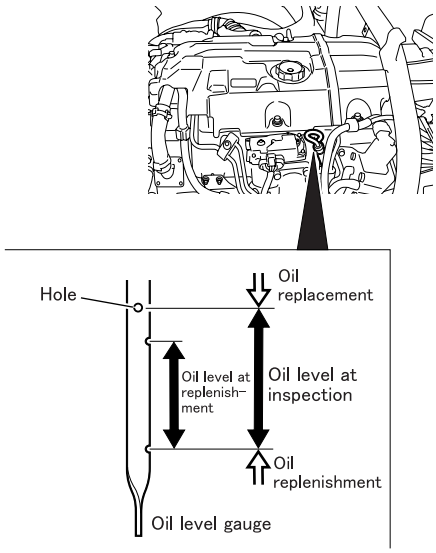
Step 2	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Cleaning of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine stopped
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4

<Step 3 inspection diagram>

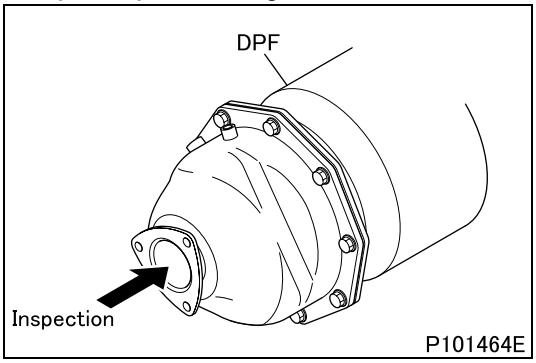


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	After correction and replacement of hose, go to step 5.

Step 5	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information.

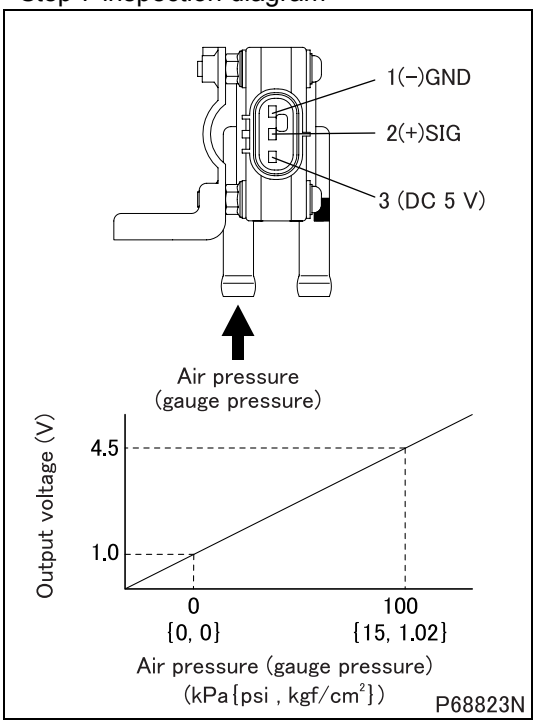
<Step 5 inspection diagram>



Step 6	Inspection items		Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”
	Inspection condition		Perform the following preparatory works. • Place the transmission in neutral (place the automatic transmission in P range). • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related Information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F} (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”).
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of electronic control unit

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of sensor

Step 9	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of diesel particulate filter
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1418/Flash code: 92
[Monitor]
Temperature increase is insufficient for manual diesel particulate filter regeneration control
[Fault (outline)]
Plausibility
[Diagnosis check]
- Temperature in diesel particulate filter during manual diesel particular filter regeneration is monitored through DPF temperature sensor 1.

[Code generation condition]
- If temperature remains over 620°C {1148°F} for 10 minutes after start of manual diesel particulate filter regeneration.

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

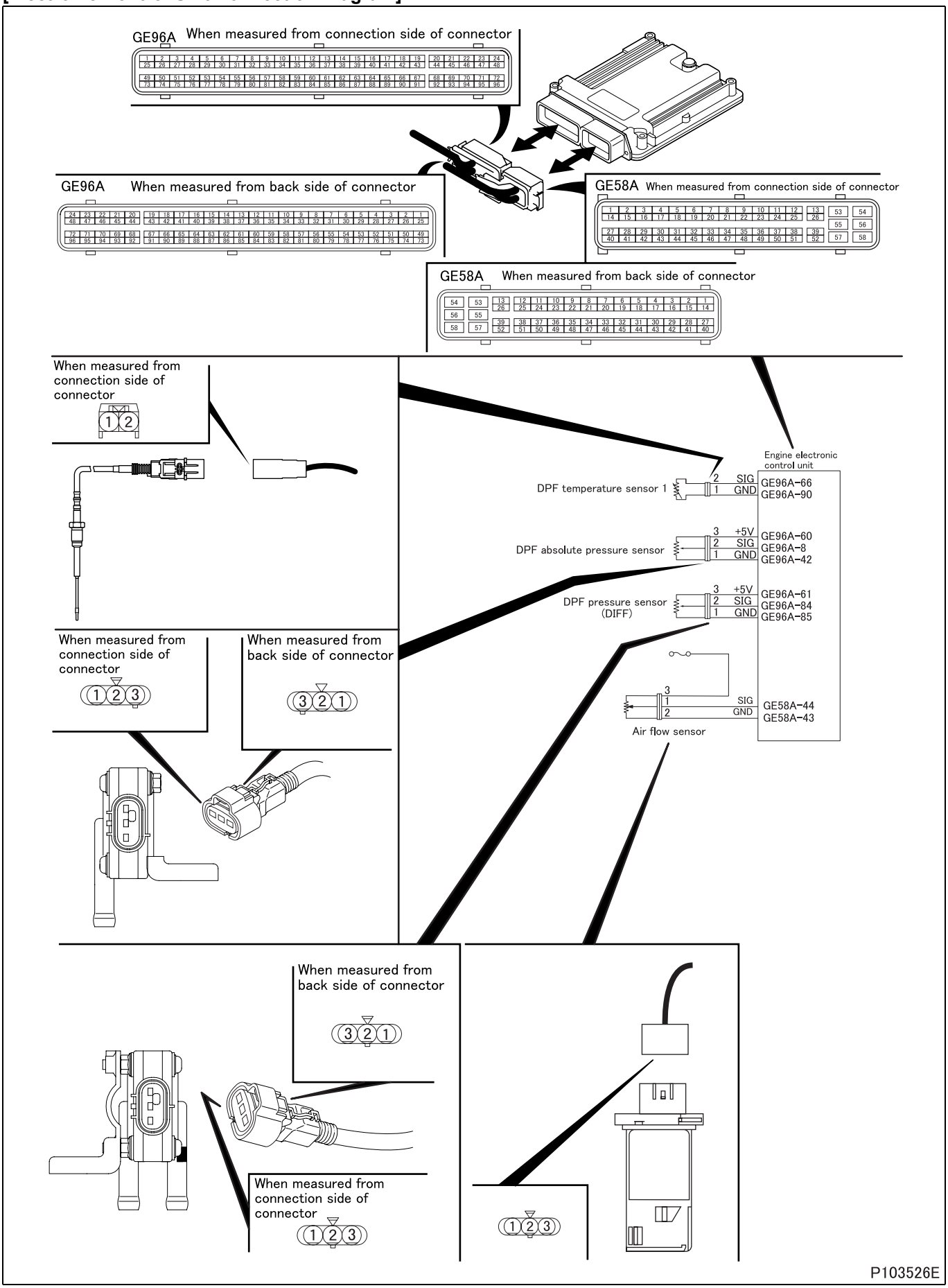
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped.

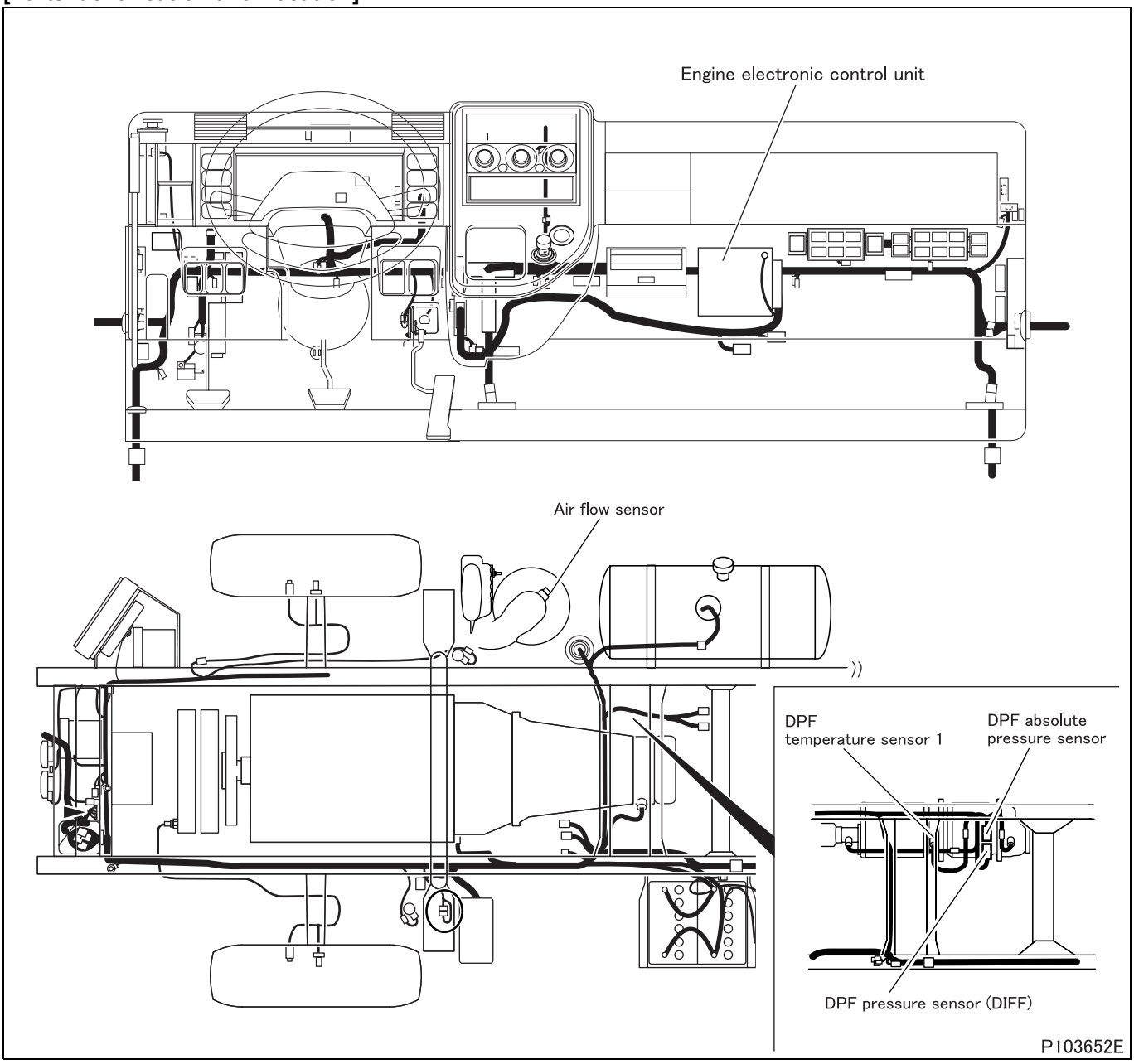
[Probable cause of trouble]
- Malfunction of diesel particulate filter regeneration control
- Malfunction of DPF temperature sensor 1
- Malfunction of engine electronic control unit
- Malfunction of common rail
- Malfunction of diesel particulate filter (front oxidation catalyst)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



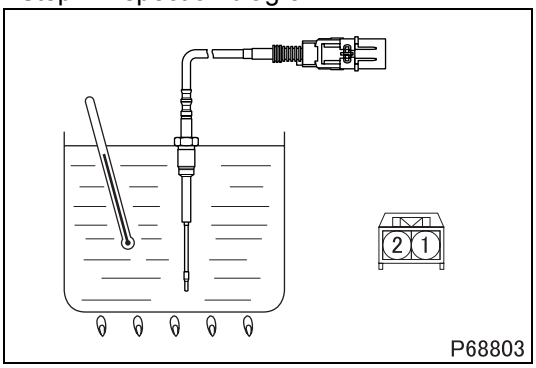
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow Sensor (Low)” • P0103 “Airflow Sensor (High)” • P0426 “EXH Gas Temp SNSR1 (Plausibility)” • P0427 “EXH Gas Temp SNSR1 (Low)” • P0428 “EXH Gas Temp SNSR1 (High)” • P0545 “DPF Temp SNSR (upstream) Low” • P0546 “DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring and go to step 2.
		NO	Go to step 2.

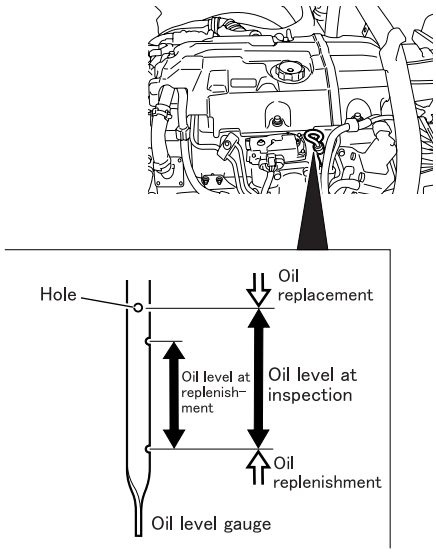
Step 2	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Cleaning of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine stopped
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4

<Step 3 inspection diagram>

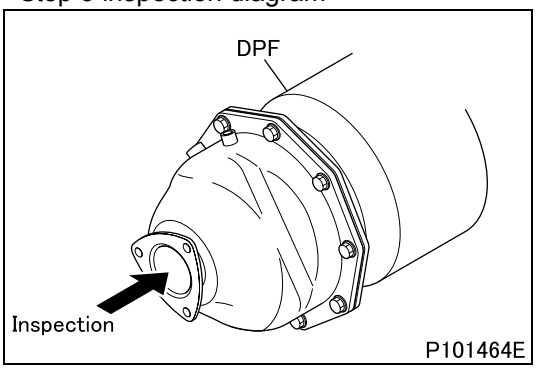


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	After correction and replacement of hose, go to step 5.

Step 5	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information.

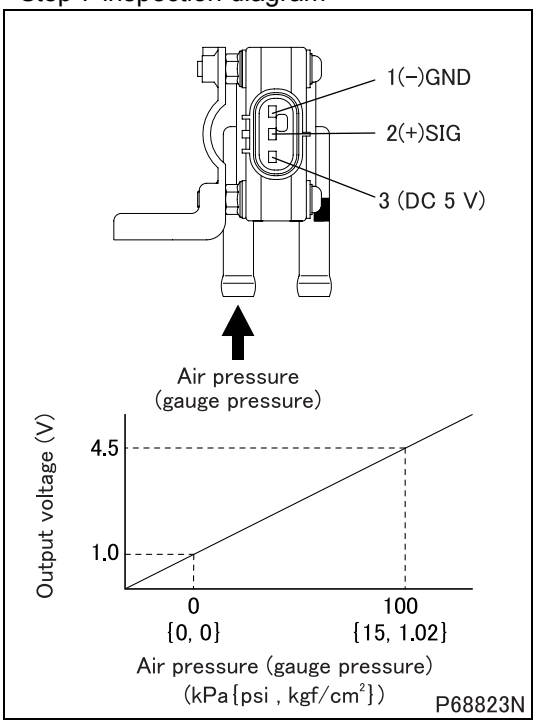
<Step 5 inspection diagram>



Step 6	Inspection items		Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”
	Inspection condition		Perform the following preparatory works. • Place the transmission in neutral (place the automatic transmission in P range). • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related Information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F} (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”).
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of electronic control unit

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of sensor

Step 9	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of diesel particulate filter
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1419/Flash code: 92
[Monitor]
Failure of manual diesel particulate filter regeneration control
[Fault (outline)]
Plausibility
[Diagnosis check]
- Duration of manual diesel particulate filter regeneration is monitored.

[Code generation condition]
- Regeneration exceeds specified time. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

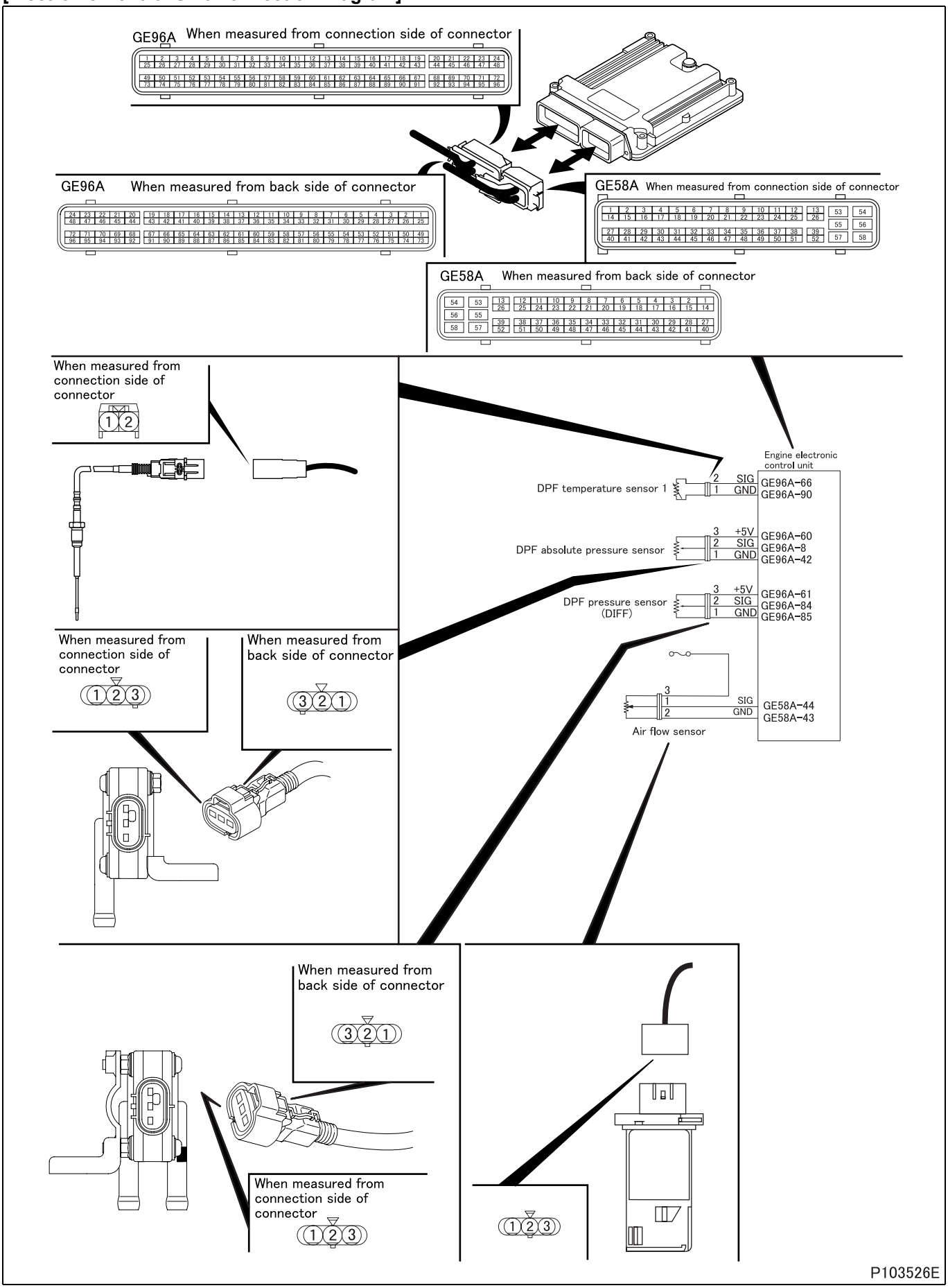
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped.

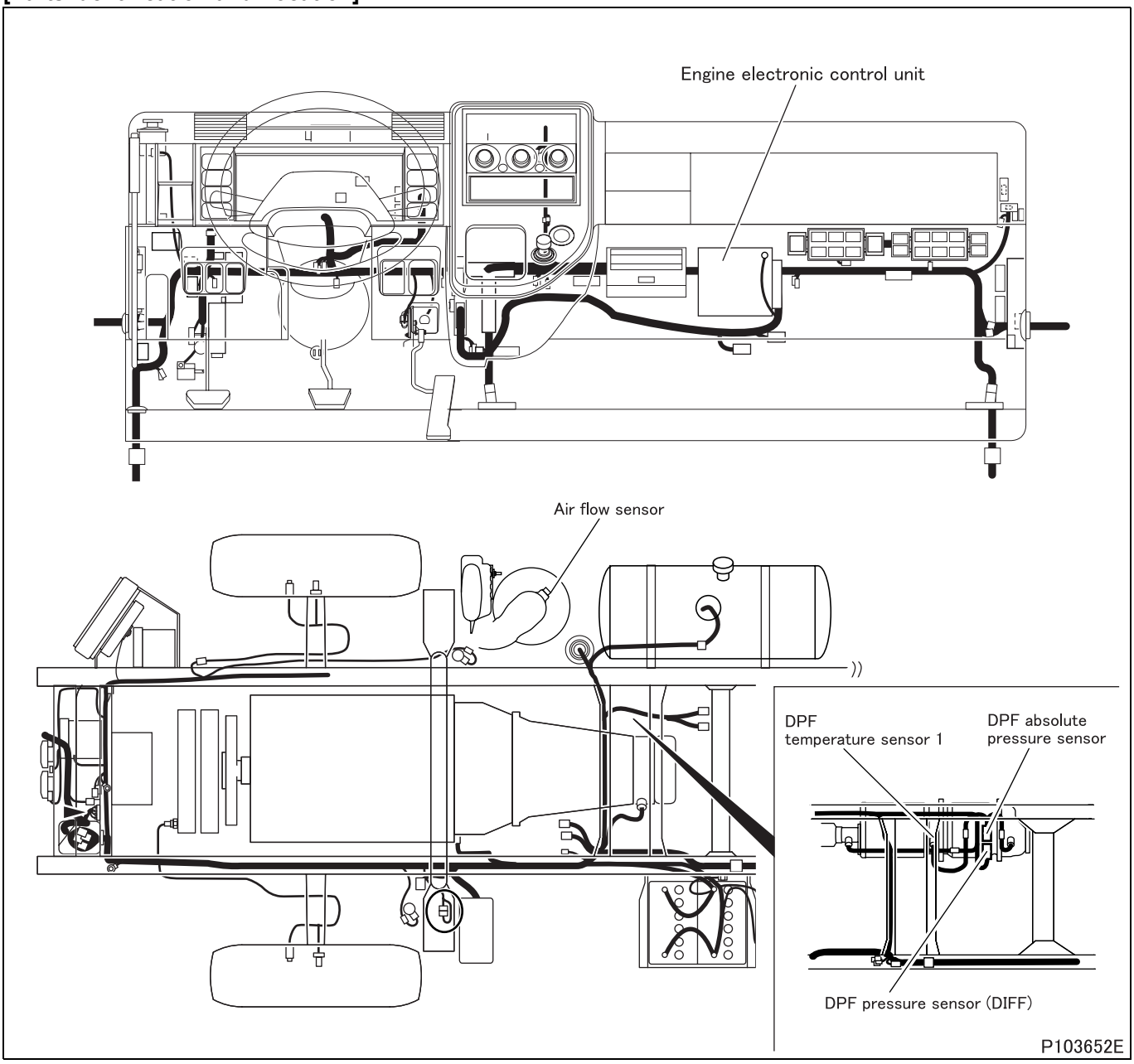
[Probable cause of trouble]
- Malfunction of diesel particulate filter regeneration control
- Malfunction of DPF temperature sensor 1
- Malfunction of engine electronic control unit
- Malfunction of common rail
- Malfunction of diesel particulate filter (front oxidation catalyst)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



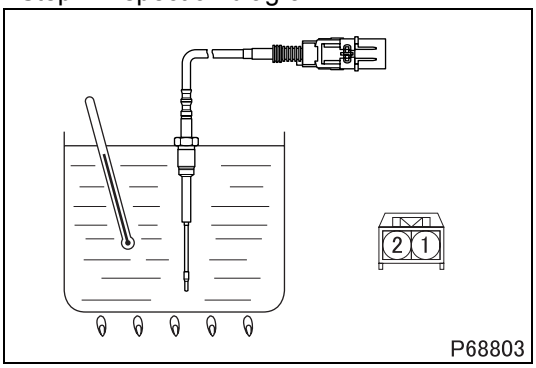
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow Sensor (Low)” • P0103 “Airflow Sensor (High)” • P0426 “EXH Gas Temp SNSR1 (Plausibility)” • P0427 “EXH Gas Temp SNSR1 (Low)” • P0428 “EXH Gas Temp SNSR1 (High)” • P0545 “DPF Temp SNSR (upstream) Low” • P0546 “DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring and go to step 2.
		NO	Go to step 2.

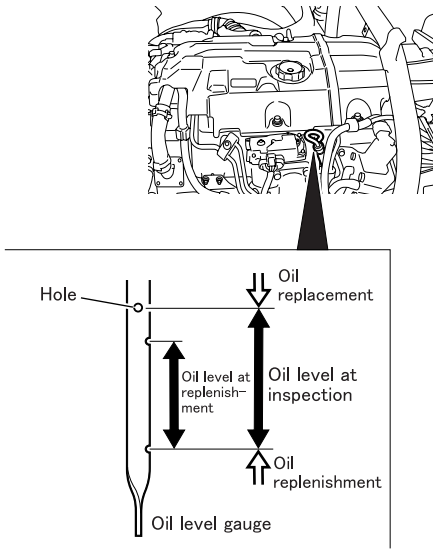
Step 2	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Cleaning of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine stopped
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4

<Step 3 inspection diagram>

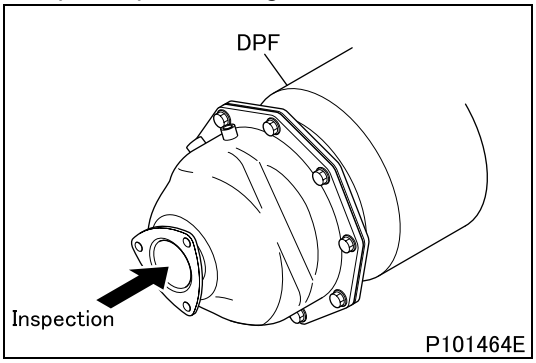


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	After correction and replacement of hose, go to step 5.

Step 5	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information.

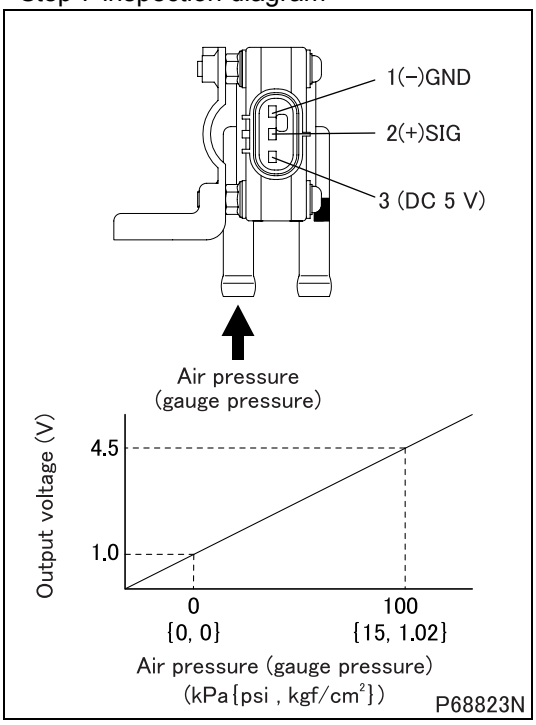
<Step 5 inspection diagram>



Step 6	Inspection items		Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”
	Inspection condition		Perform the following preparatory works. • Place the transmission in neutral (place the automatic transmission in P range). • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related Information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F} (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”).
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of electronic control unit

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of sensor

Step 9	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of diesel particulate filter
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1421/Flash code: 92
[Monitor]
Diesel particulate filter clogged
[Fault (outline)]
Plausibility
[Diagnosis check]
- Particulate matter (PM) deposit estimated by engine electronic control unit exceeded specified value.

[Code generation condition]
- Particulate matter (PM) deposit is more than specified value (clogging level: low).
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

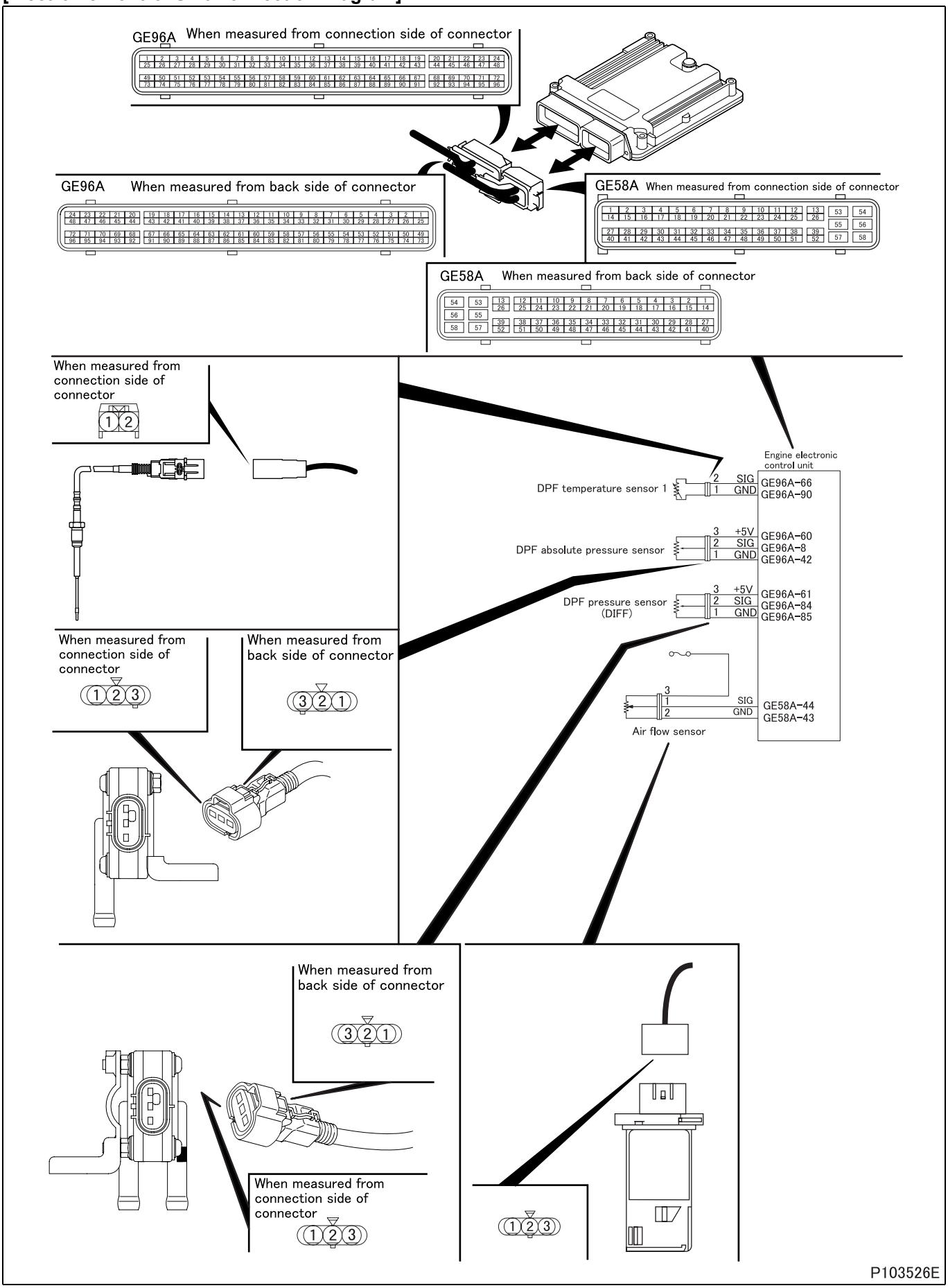
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>

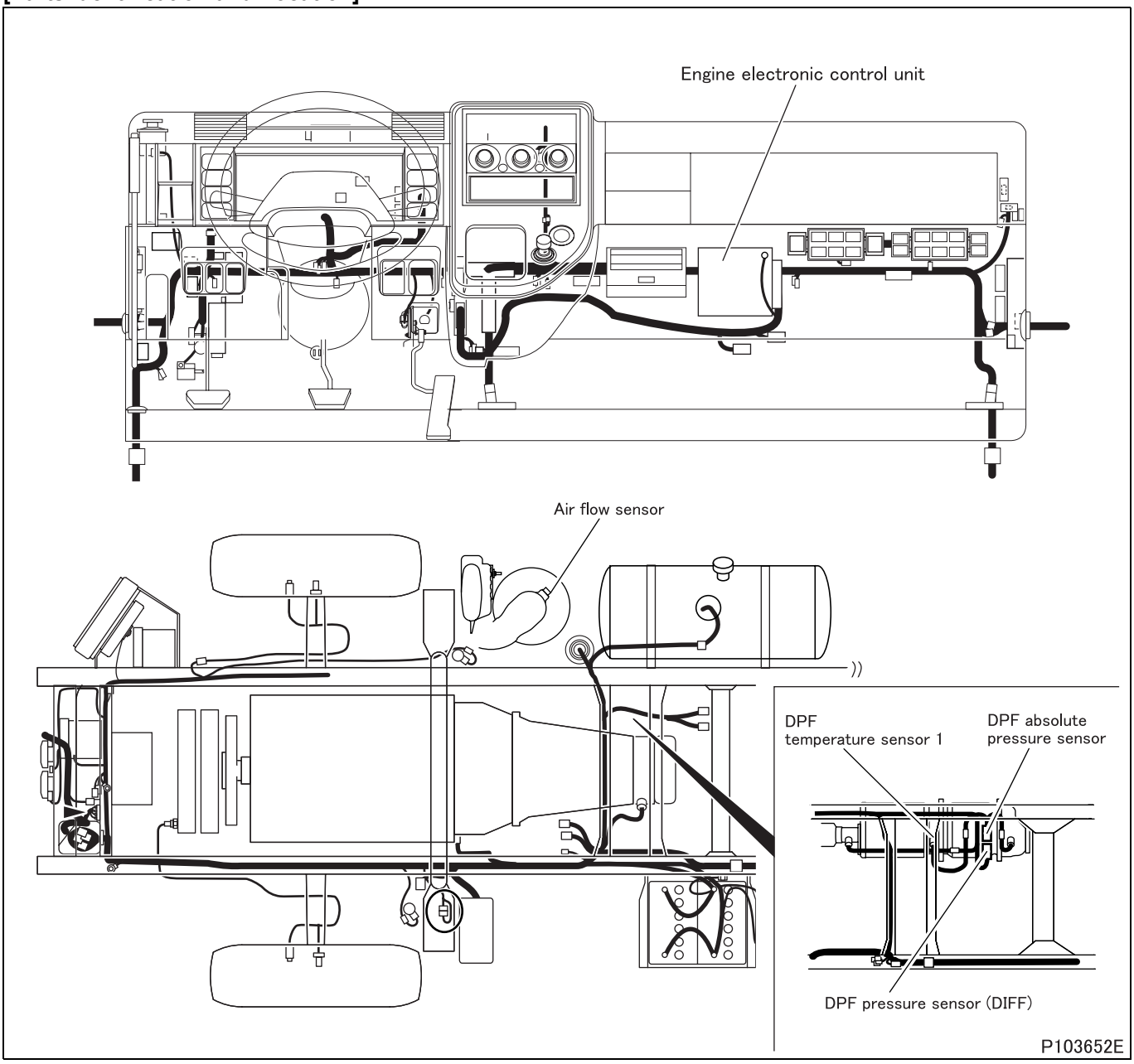
[Probable cause of trouble]
- Failure of diesel particulate filter indicator lamp
- Failure of diesel particulate filter cleaning switch
- Manual diesel particulate filter regeneration is not performed.
- Excessive smoke emission (due to malfunction of engine proper, common rail or exhaust gas recirculation system)
- Malfunction of air flow sensor
- Malfunction of DPF absolute pressure sensor or DPF pressure sensor (DIFF)
- Malfunction of diesel particulate filter

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]

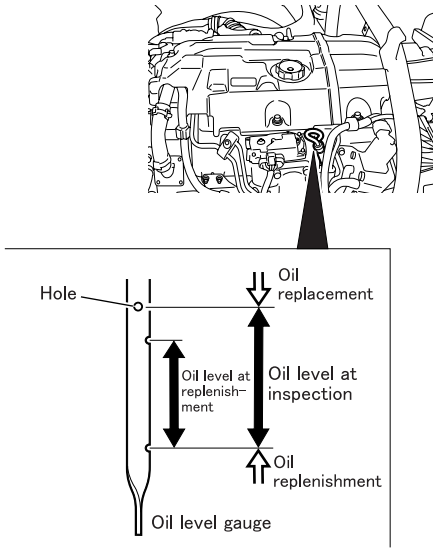


[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine stopped
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	After replacement of oil, go to step 2

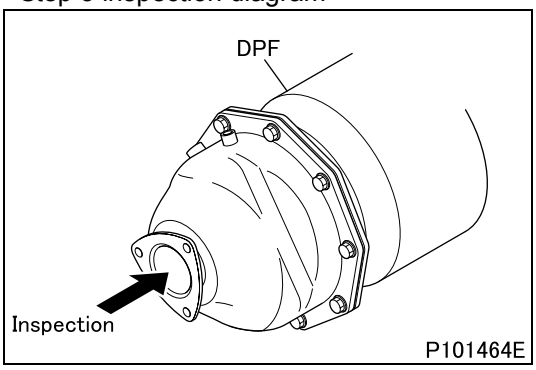
<Step 1 inspection diagram>



Step 2	Inspection items		Inspection by manual diesel particulate filter regeneration
	Maintenance item		Perform Multi-Use Tester actuator test item No. A5 “DPF Regeneration (Manual)”, and clean ceramic diesel particulate filter.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Engine: idling • Place the transmission in neutral. (place the automatic transmission in P range) • Parking brake: vehicle parked (parking brake switch: ON) • After engine warm-up
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection
		NO	Go to step 3.

Step 3	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information.

<Step 3 inspection diagram>



Step 4	Inspection items		Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”
	Inspection condition		Perform the following preparatory works. • Place the transmission in neutral. (place the automatic transmission in P range) • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F}. (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”)
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection
		NO	Go to step 5.

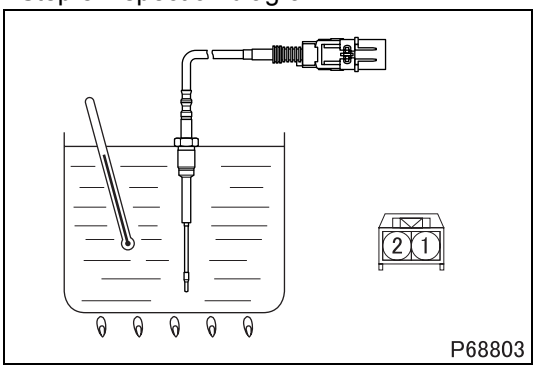
Step 5	Inspection items		Inspection by control data
	Maintenance item		Measure item No. B8 “DPF Indicator Lamp” of Service Data.
	Inspection condition		Perform Multi-Use Tester actuator test item No. A6 “DPF Lamp”.
	Requirements		Diesel particulate filter indicator lamp illuminates (automatic reset after 15 seconds)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of engine electronic control unit

Step 6	Inspection items		Inspection by control data
	Maintenance item		Measure item No. A4 “DPF SW” of Service Data.
	Inspection condition		–
	Requirements		Press diesel particulate filter cleaning switch and check that “DPF SW” display switches from OFF to ON.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of diesel particulate filter cleaning switch or engine electronic control unit

Step 7	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	After correction and replacement of hose, go to step 8.

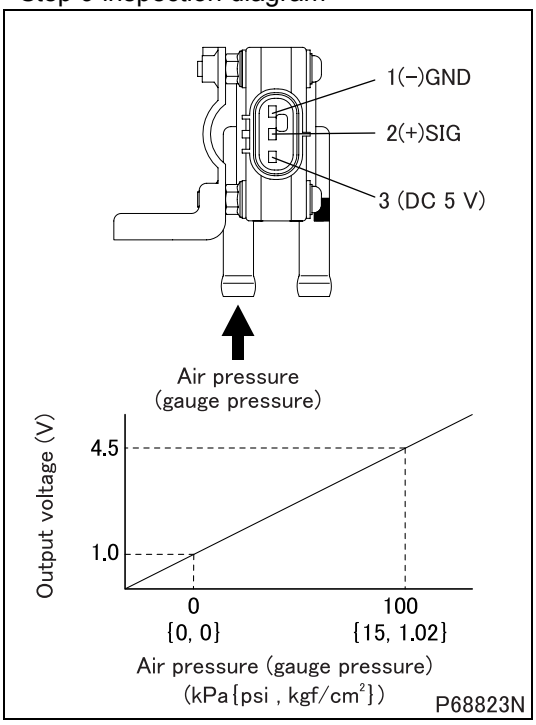
Step 8	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Cleaning of sensor

<Step 8 inspection diagram>



Step 9	Inspection items		Inspection of DPF pressure sensor (DIFF)
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of DPF pressure sensor (DIFF)

<Step 9 inspection diagram>



Step 10	Inspection items		Inspection of air flow sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Replacement of air flow sensor

Step 11	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	• Inspection of exhaust gas recirculation system (exhaust gas recirculation pipe, exhaust gas recirculation cooler, exhaust gas recirculation valve) • Inspection of engine
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1422/Flash code: 92
[Monitor]
Diesel particulate filter clogged
[Fault (outline)]
Plausibility
[Diagnosis check]
- Particulate matter (PM) deposit estimated by engine electronic control unit exceeded specified value.

[Code generation condition]
- Particulate matter (PM) deposit is more than specified value (clogging level: medium to high).
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

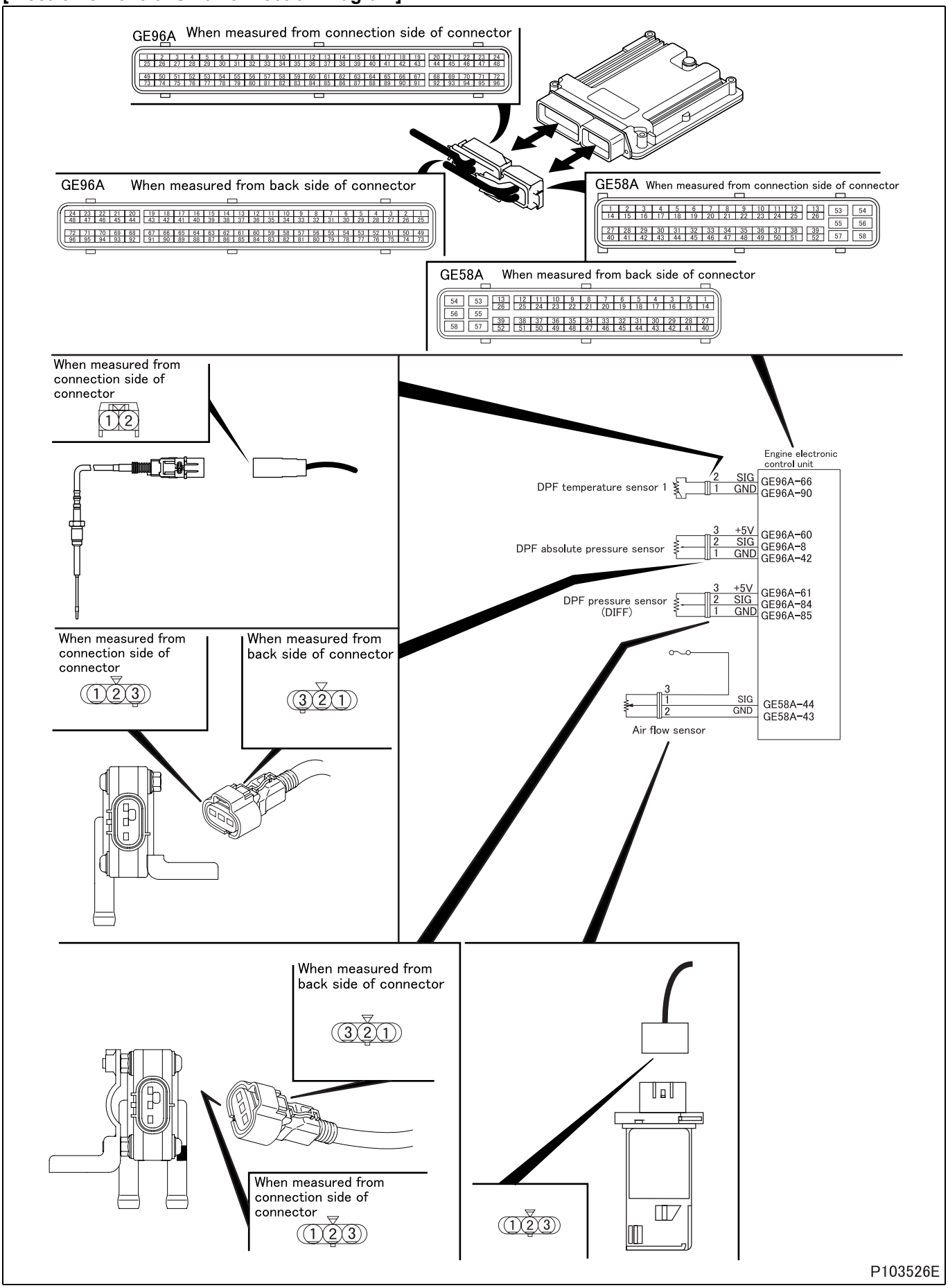
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- Auto cruise control stopped
- Traction control is stopped <Automatic transmission>
- Diesel particulate filter regeneration is stopped.

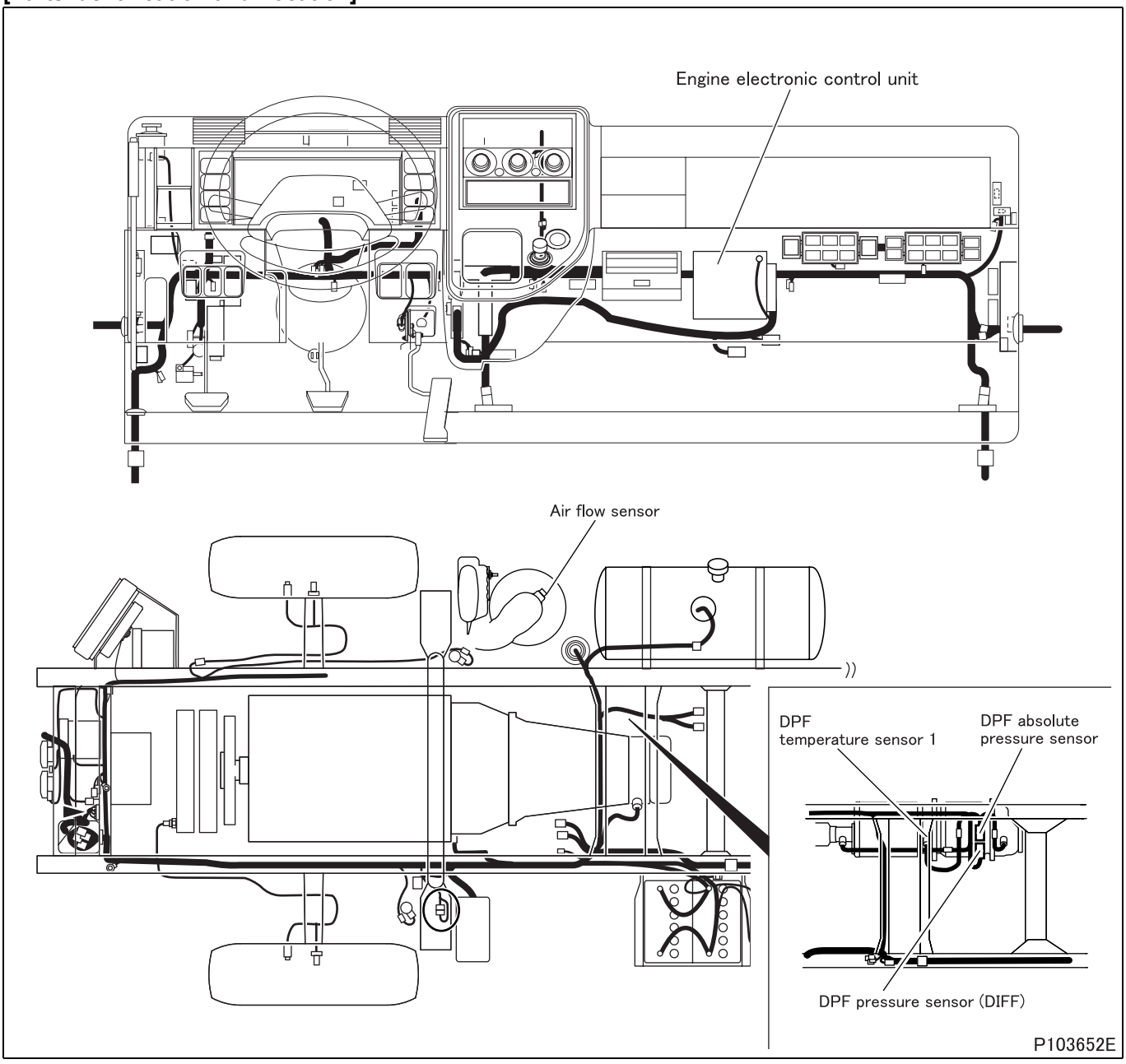
[Probable cause of trouble]
- Failure of diesel particulate filter indicator lamp
- Failure of diesel particulate filter cleaning switch
- Manual diesel particulate filter regeneration is not performed.
- Excessive smoke emission (due to malfunction of engine proper, common rail or exhaust gas recirculation system)
- Malfunction of air flow sensor
- Malfunction of DPF absolute pressure sensor or DPF pressure sensor (DIFF)
- Malfunction of diesel particulate filter

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]

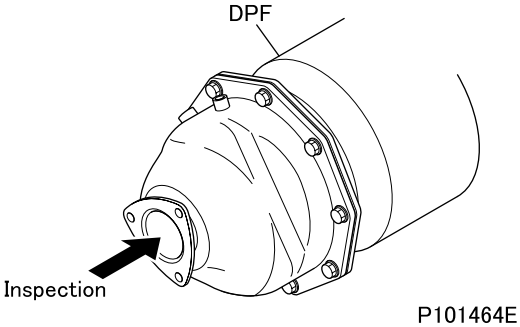


[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information.

<Step 1 inspection diagram>



Step 2	Inspection items		Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”
	Inspection condition		Perform the following preparatory works. • Place the transmission in neutral. (place the automatic transmission in P range) • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F}. (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”)
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection
		NO	Go to step 3.

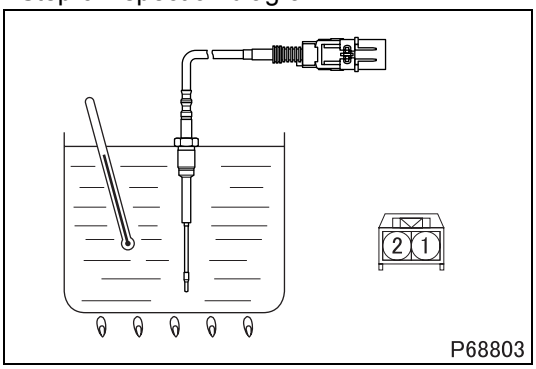
Step 3	Inspection items		Inspection by control data
	Maintenance item		Measure item No. B8 “DPF Indicator Lamp” of Service Data.
	Inspection condition		Perform Multi-Use Tester actuator test item No. A6 “DPF Lamp”.
	Requirements		Diesel particulate filter indicator lamp illuminates (automatic reset after 15 seconds)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of engine electronic control unit

Step 4	Inspection items		Inspection by control data
	Maintenance item		Measure item No. A4 “DPF SW” of Service Data.
	Inspection condition		–
	Requirements		Press diesel particulate filter cleaning switch and check that “DPF SW” display switches from OFF to ON.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of diesel particulate filter cleaning switch or engine electronic control unit

Step 5	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	After correction and replacement of hose, go to step 6.

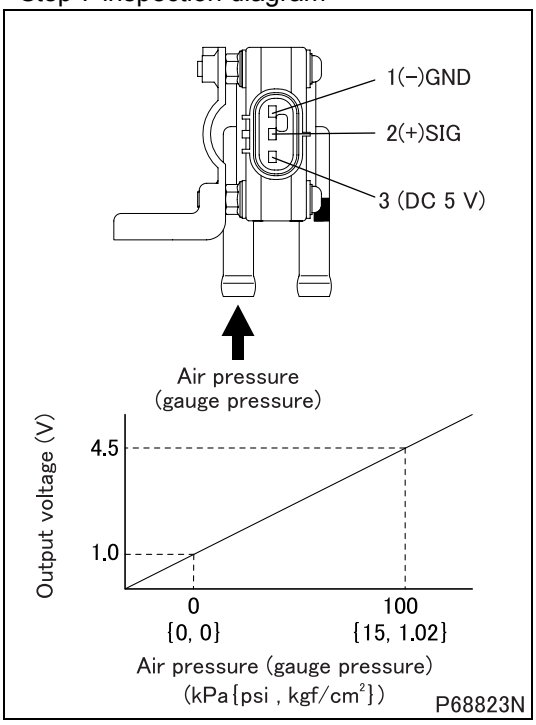
Step 6	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Cleaning of sensor

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of DPF pressure sensor (DIFF)
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of DPF pressure sensor (DIFF)

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of air flow sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of air flow sensor

Step 9	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	• Inspection of exhaust gas recirculation system (exhaust gas recirculation pipe, exhaust gas recirculation cooler, exhaust gas recirculation valve) • Inspection of engine
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1430/Flash code: 78
[Monitor]
Failure of diesel particulate filter cleaning switch
[Fault (outline)]
Plausibility
[Diagnosis check]
- Working condition of diesel particulate filter cleaning switch during manual diesel particulate filter regeneration is monitored.

[Code generation condition]
- Output signal remains ON for 60 seconds after diesel particulate filter cleaning switch turned ON for manual filter regeneration is turned OFF.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

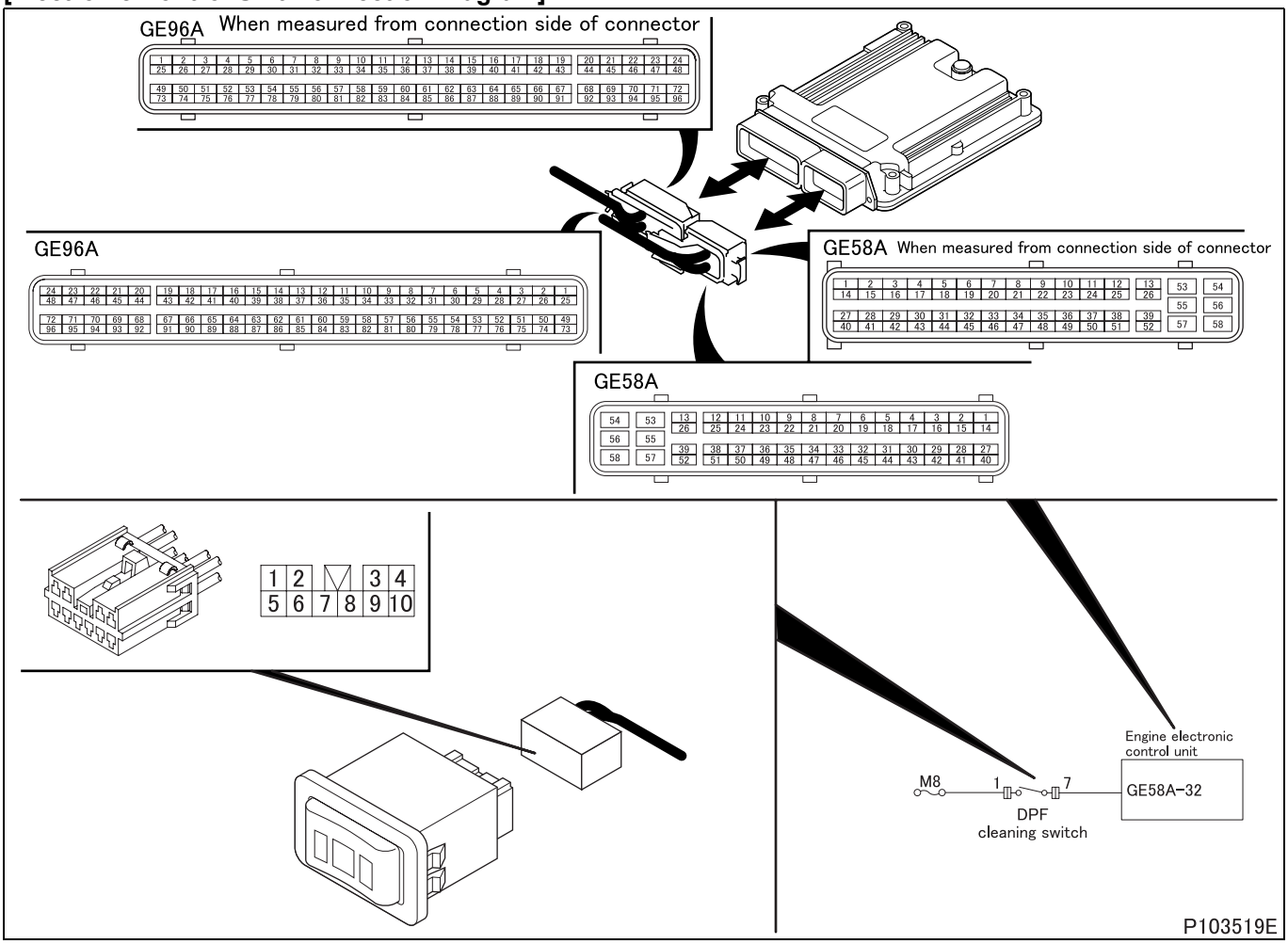
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

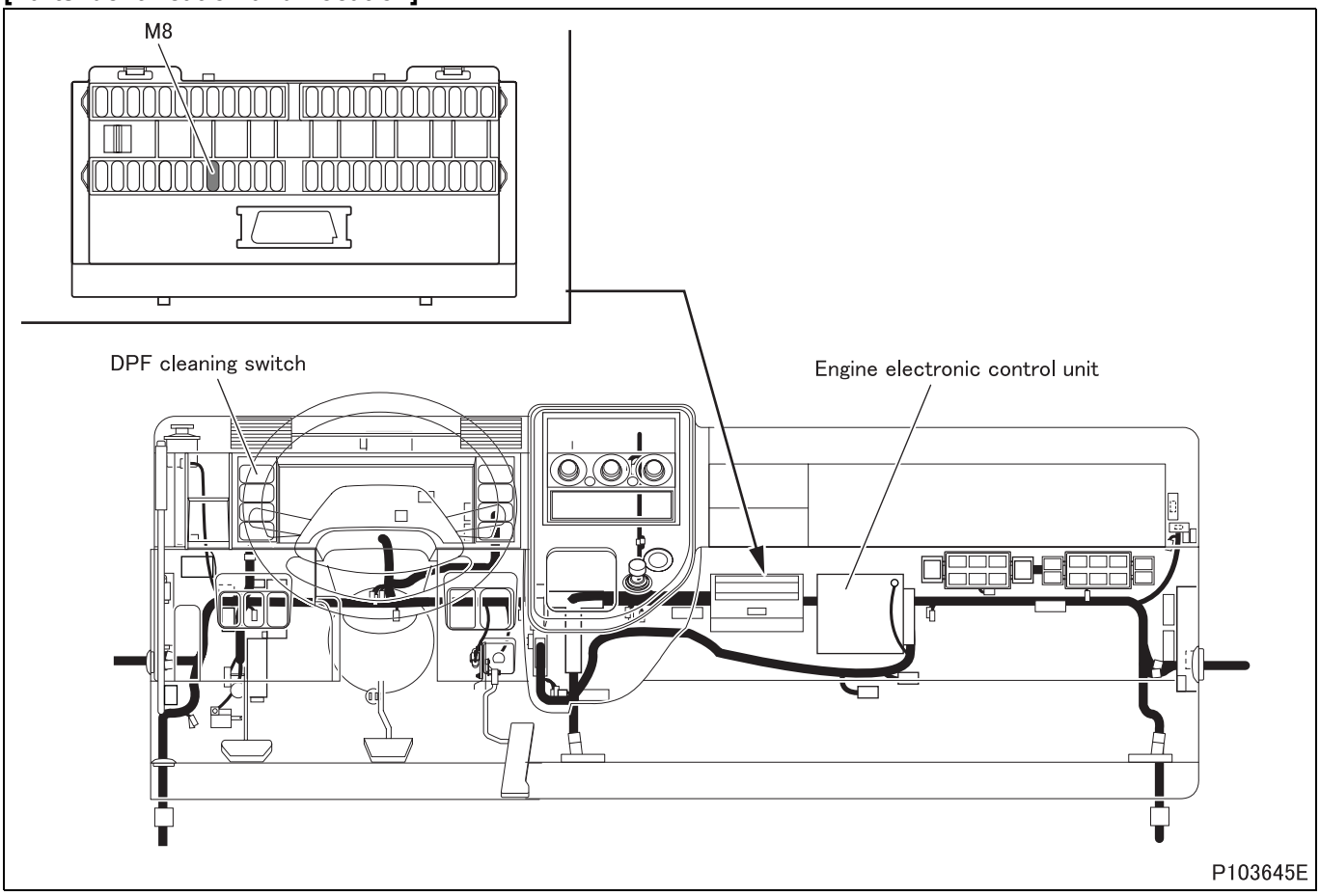
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and switch
- Malfunction of each connector
- Malfunction of switch
- Malfunction of engine electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

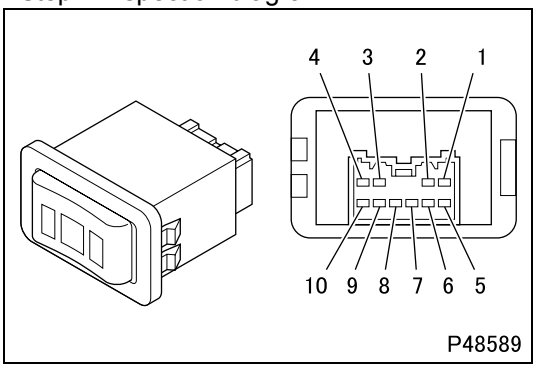
Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. A4 “DPF SW” of Service Data.
	Inspection condition		–
	Requirements		Press diesel particulate filter cleaning switch and check that “DPF SW” display switches from OFF to ON.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of diesel particulate filter cleaning switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of diesel particulate filter cleaning switch unit
	Maintenance item		• Switch: Check continuity between connector terminal No. 1 and 8. • Switch ON: Check continuity between connector terminal No. 1 and 7.
	Inspection condition		Disconnect connector and measure switch side.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of switch

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between electronic control unit and diesel particulate filter cleaning switch
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 32 and diesel particulate filter cleaning switch connector terminal No. 7.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between fuse and diesel particulate filter cleaning switch
	Maintenance item		Check circuit between fuse M8 and diesel particulate filter cleaning switch connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		Measure item No. A4 “DPF SW” of Service Data.
	Inspection condition		–
	Requirements		Press diesel particulate filter cleaning switch and check that “DPF SW” display switches from OFF to ON.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P1435/Flash code: 92
[Monitor]
Diesel particulate filter broken
[Fault (outline)]
Efficiency below threshold (blocked diesel particulate filter)
[Diagnosis check]
- Ceramic filter is monitored for clogging through DPF pressure sensor (DIFF) during operation of diesel particulate filter regeneration function.

[Code generation condition]
- Difference between actual diesel particulate filter pressure and maximum pressure calculated by electronic control unit remains out of control map for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine operating mode: normal (engine in operation)
- Pressure adjustment in DPF pressure sensor (DIFF):
  Has been carried out this drive cycle ; for drift correction, the following conditions exist for >5s :
  - Engine speed: less than 875 rpm
  - Fuel injection quantity: below 25 mg/cyc
  - Exhaust flow rate: less than 90 m^3/h
  - Exhaust gas recirculation valve position: more than 8 mm {0.3 in.}
- Exhaust volume-flow rate: 500 to 900 m^3/h
- Diesel particulate filter inlet temperature: 200 to 400°C {392 to 752°F}
- Water temperature: 65 to 110°C {149 to 230°F}
- Atmospheric pressure: more than 750 mbar {10.87 psi}
- Approximate environment atmospheric temperature: –7 to 50°C {19 to 122°F}
- Frequency of diesel particulate filter regeneration control: less than 3 times (discontinued after start of diesel particulate filter regeneration control)
- Soot deposit: 15 to 30 g {0.53 to 1.06 oz}
- Diesel particulate filter regeneration control: not effected
- Controller area network communication of exhaust gas recirculation electronic drive unit: in order
- DPF pressure sensor (DIFF): in order
- Air flow sensor: in order
- Atmospheric pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Catalytic temperature sensor: in order
- DPF temperature sensor 1: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order

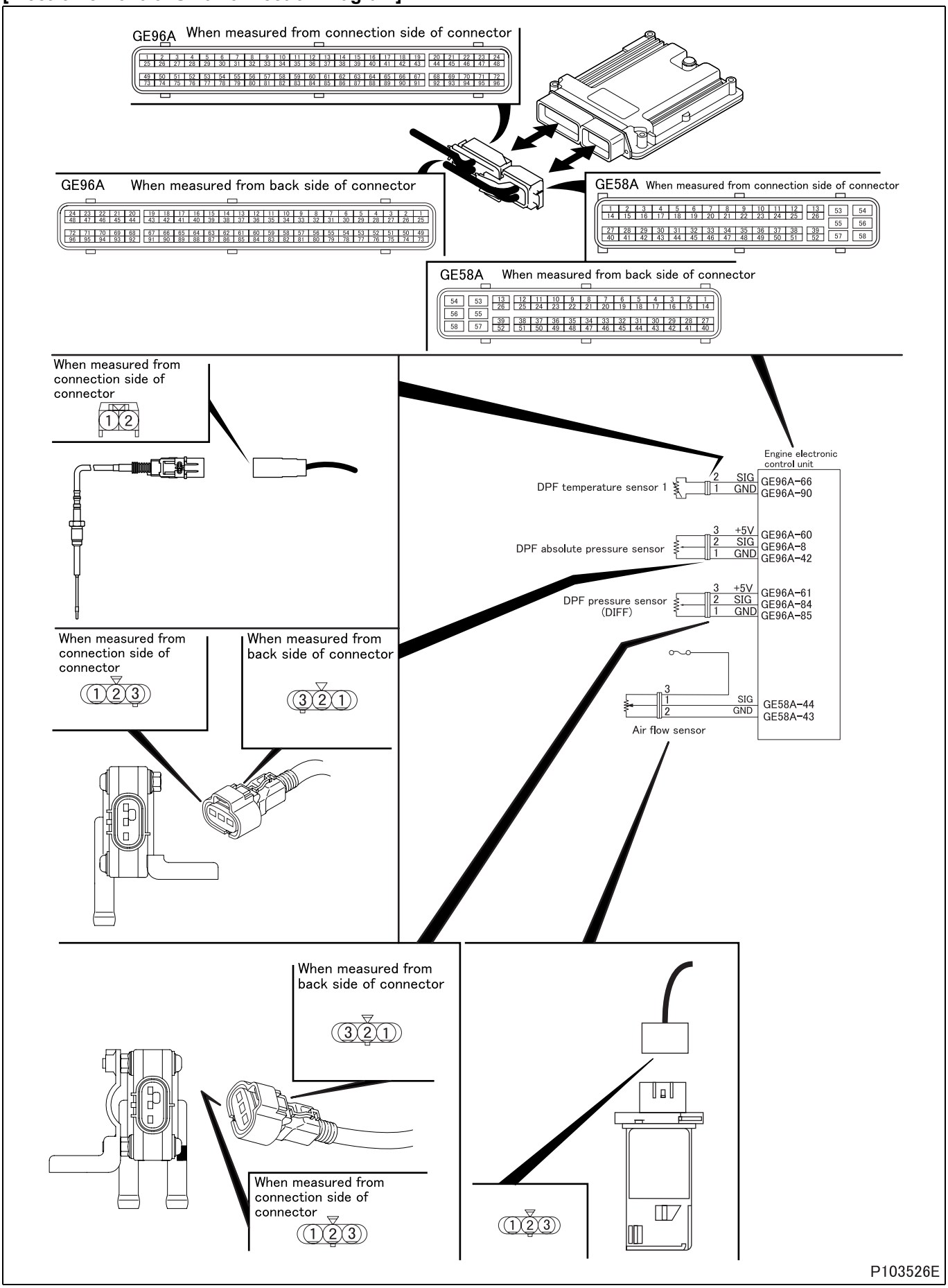
[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the engine model.
<Except FE83>
- Engine torque is limited.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

<FE83>
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

[Probable cause of trouble]
- Damage of ceramic filter
- Failure of diesel particulate filter indicator lamp
- Failure of diesel particulate filter cleaning switch
- Manual diesel particulate filter regeneration is not performed.
- Excessive smoke emission (due to malfunction of engine proper, common rail or exhaust gas recirculation system)
- Malfunction of air flow sensor
- Malfunction of DPF absolute pressure sensor or DPF pressure sensor (DIFF)

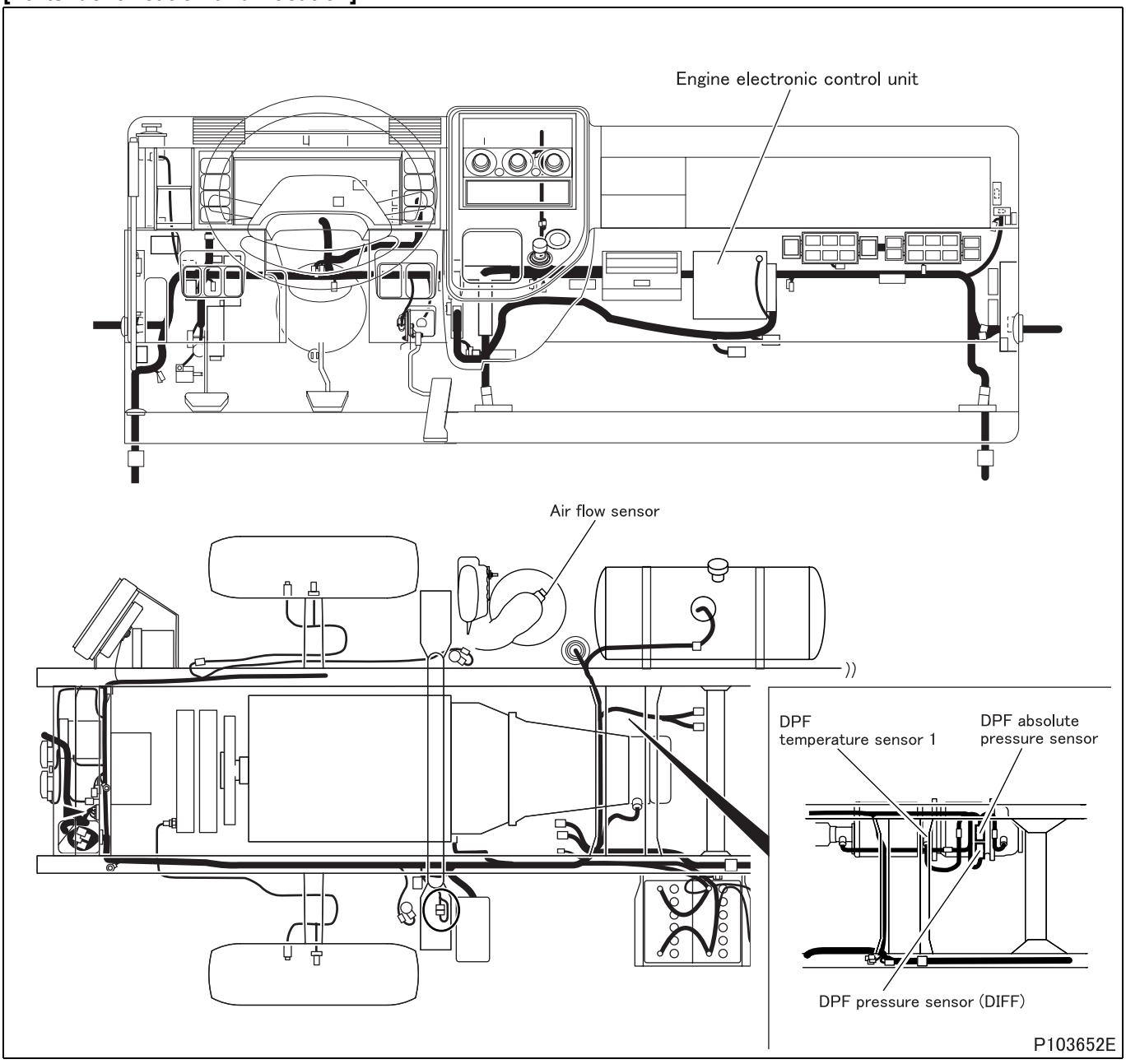
[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



P103526E

[Parts Identification and Location]

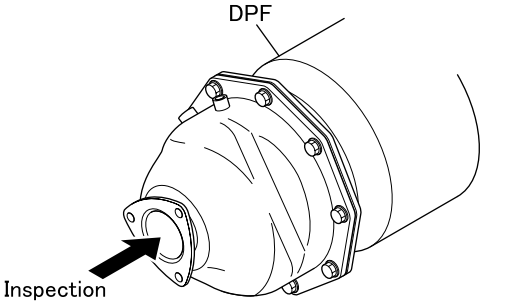


[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information.

<Step 1 inspection diagram>



Step 2	Inspection items		Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”
	Inspection condition		Perform the following preparatory works. • Place the transmission in neutral. (place the automatic transmission in P range) • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F}. (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”)
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection
		NO	Go to step 3.

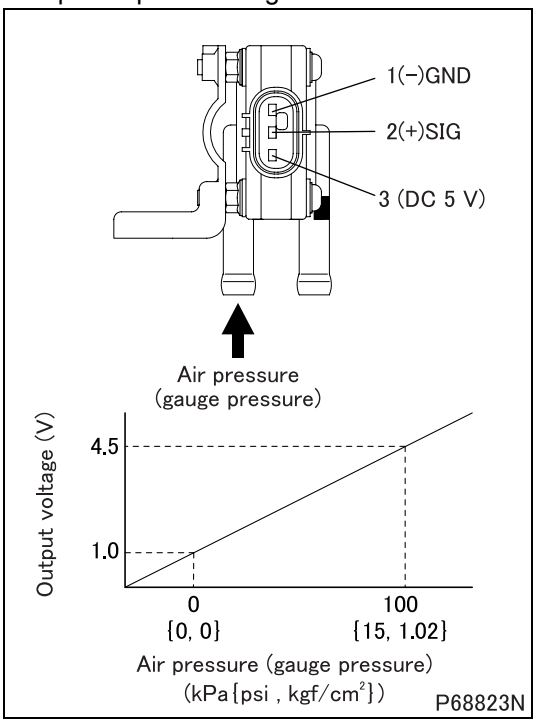
Step 3	Inspection items		Inspection by control data
	Maintenance item		Measure item No. B8 “DPF Indicator Lamp” of Service Data.
	Inspection condition		Perform Multi-Use Tester actuator test item No. A6 “DPF Lamp”.
	Requirements		Diesel particulate filter indicator lamp illuminates (automatic reset after 15 seconds)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of engine electronic control unit

Step 4	Inspection items		Inspection by control data
	Maintenance item		Measure item No. A4 “DPF SW” of Service Data.
	Inspection condition		–
	Requirements		Press diesel particulate filter cleaning switch and check that “DPF SW” display switches from OFF to ON.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of diesel particulate filter cleaning switch or engine electronic control unit

Step 5	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	After correction and replacement of hose, go to step 6.

Step 6	Inspection items		Inspection of DPF pressure sensor (DIFF)
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of DPF pressure sensor (DIFF)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of air flow sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of air flow sensor

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	• Inspection of exhaust gas recirculation system (exhaust gas recirculation pipe, exhaust gas recirculation cooler, exhaust gas recirculation valve) • Inspection of engine
		NO	Replacement of injector

[Fault code]
Diagnosis code: P1440/Flash code: 92
[Monitor]
For counter recording of diagnosis code P1412, P1413, P1414
[Fault (outline)]
Plausibility
[Diagnosis check]
- Exhaust gas temperature during automatic diesel particulate filter regeneration is monitored through DPF temperature sensor 1 for abnormality arising from transient diesel particulate filter temperature control failure or very slow vehicle run.

[Code generation condition]
- Insufficient temperature rise occurred during automatic filter regeneration.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).

[Probable cause of trouble]
- Diesel particulate filter temperature control failure (caused by transient fault)
- If automatic regeneration is difficult due to long-time idling or very slow vehicle run.

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp and diagnosis code is cleared simultaneously with recovery.)

[Fault diagnosis]
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P1412 “DPF Temp Abnormal1 (Auto)(Low)” • P1413 “DPF Temp Abnormal2 (Auto)(Low)” • P1414 “DPF Temp Abnormal3 (Auto)(High)”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P1441/Flash code: 92
[Monitor]
For counter recording of diagnosis code P1416, P1417, P1418
[Fault (outline)]
High signal range check
[Diagnosis check]
- Temperature in diesel particulate filter during manual diesel particular filter regeneration is monitored through DPF temperature sensor 1.

[Code generation condition]
- Insufficient temperature rise occurred during manual filter regeneration.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped.

[Probable cause of trouble]
- Diesel particulate filter temperature control failure (caused by transient fault)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp and diagnosis code is cleared simultaneously with recovery.)

[Fault diagnosis]
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P1416 “DPF Temp Abnormal1 (Auto)(Low)” • P1417 “DPF Temp Abnormal2 (Auto)(Low)” • P1418 “DPF Temp Abnormal3 (Auto)(High)”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P1632/Flash code: 73
[Monitor]
Abnormality in controller area network 2 communication
[Fault (outline)]
Message timeout
[Diagnosis check]
- Controller area network communication between engine electronic control unit and exhaust gas recirculation electronic drive unit is monitored for abnormality.

[Code generation condition]
- Engine electronic control unit fails to receive controller area network signal concerning throttle control from exhaust gas recirculation electronic drive unit within specified time (controller area network bus OFF).
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

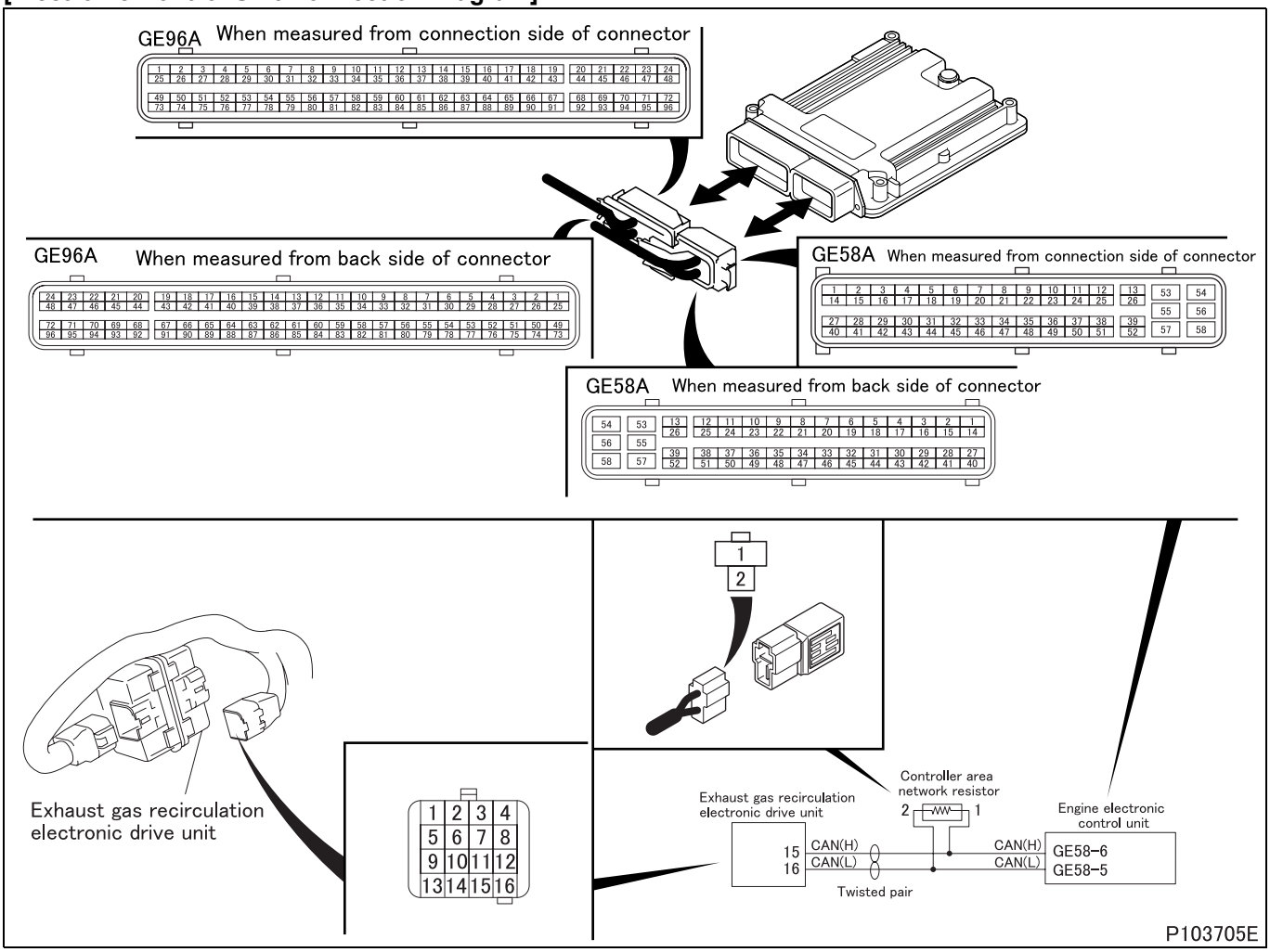
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

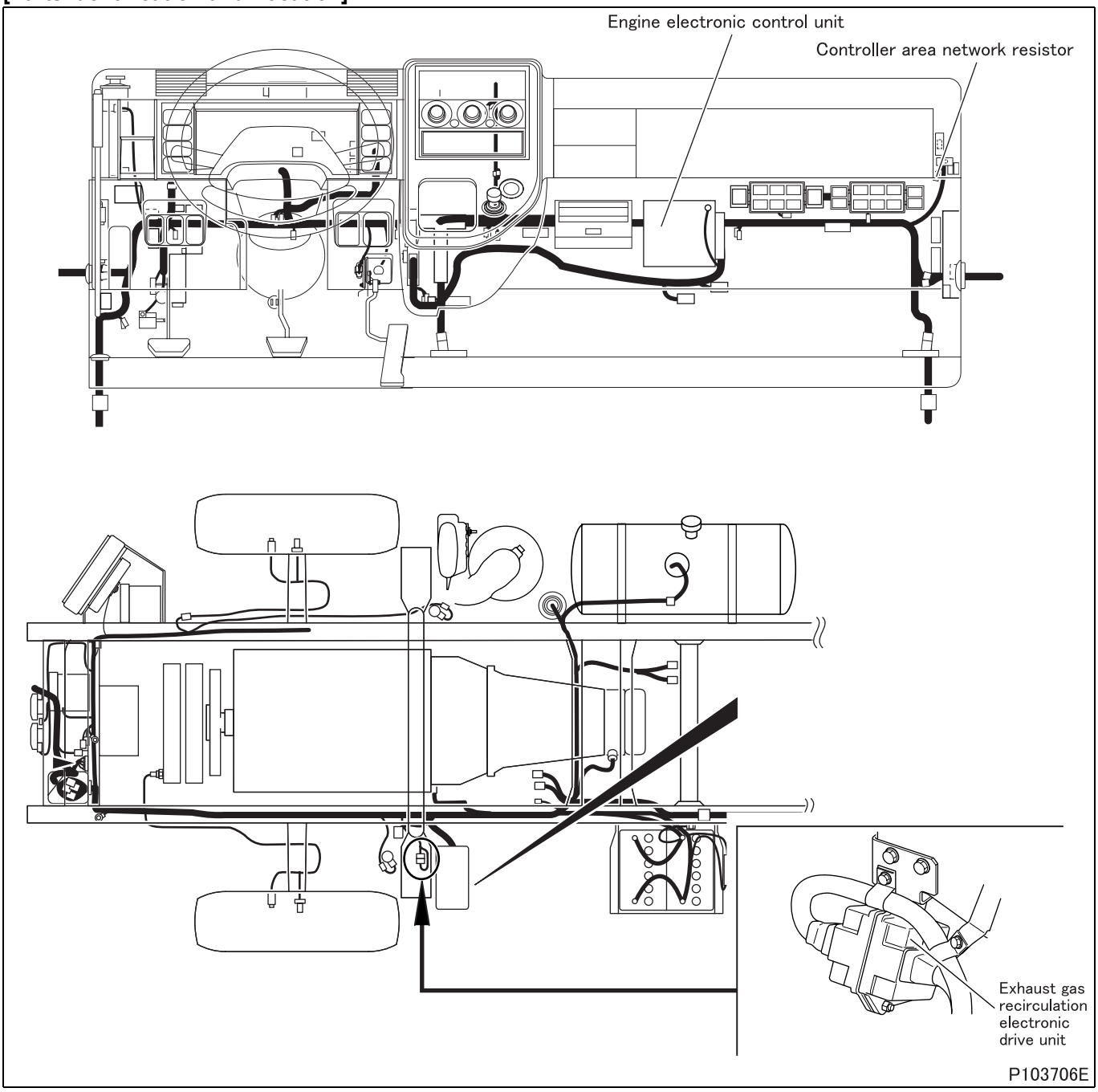
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between engine electronic control unit and exhaust gas recirculation electronic drive unit
- Malfunction of each connector
- Malfunction of engine electronic control unit
- Malfunction of exhaust gas recirculation electronic drive unit
- Malfunction of controller area network resistor

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

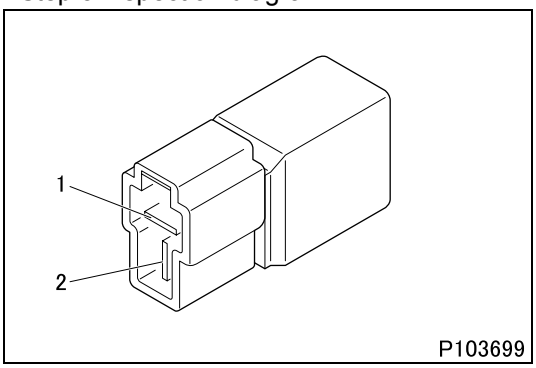
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by engine electronic control unit connector
	Maintenance item		Measure value of resistance between engine electronic control unit connector (GE58A) terminal No. 5 and 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		Disconnect connector and measure resistor side.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of controller area network resistor

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and engine electronic control unit connector (GE58A) terminal No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and engine electronic control unit connector (GE58A) terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and electronic drive unit connector terminal No. 15
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between engine electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and electronic drive unit connector terminal No. 16
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replace the engine electronic control unit as well if this diagnosis code occurs after the replacement of electronic drive unit.
		NO	Modify connector.

[Fault code]
Diagnosis code: P1635/Flash code: 74
[Monitor]
Abnormality in controller area network 2 communication
[Fault (outline)]
Message timeout
[Diagnosis check]
- Controller area network communication between engine electronic control unit and throttle electronic drive unit is monitored for abnormality.

[Code generation condition]
- Engine electronic control unit fails to receive controller area network signal concerning throttle control from throttle electronic drive unit within specified time (controller area network bus OFF).
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

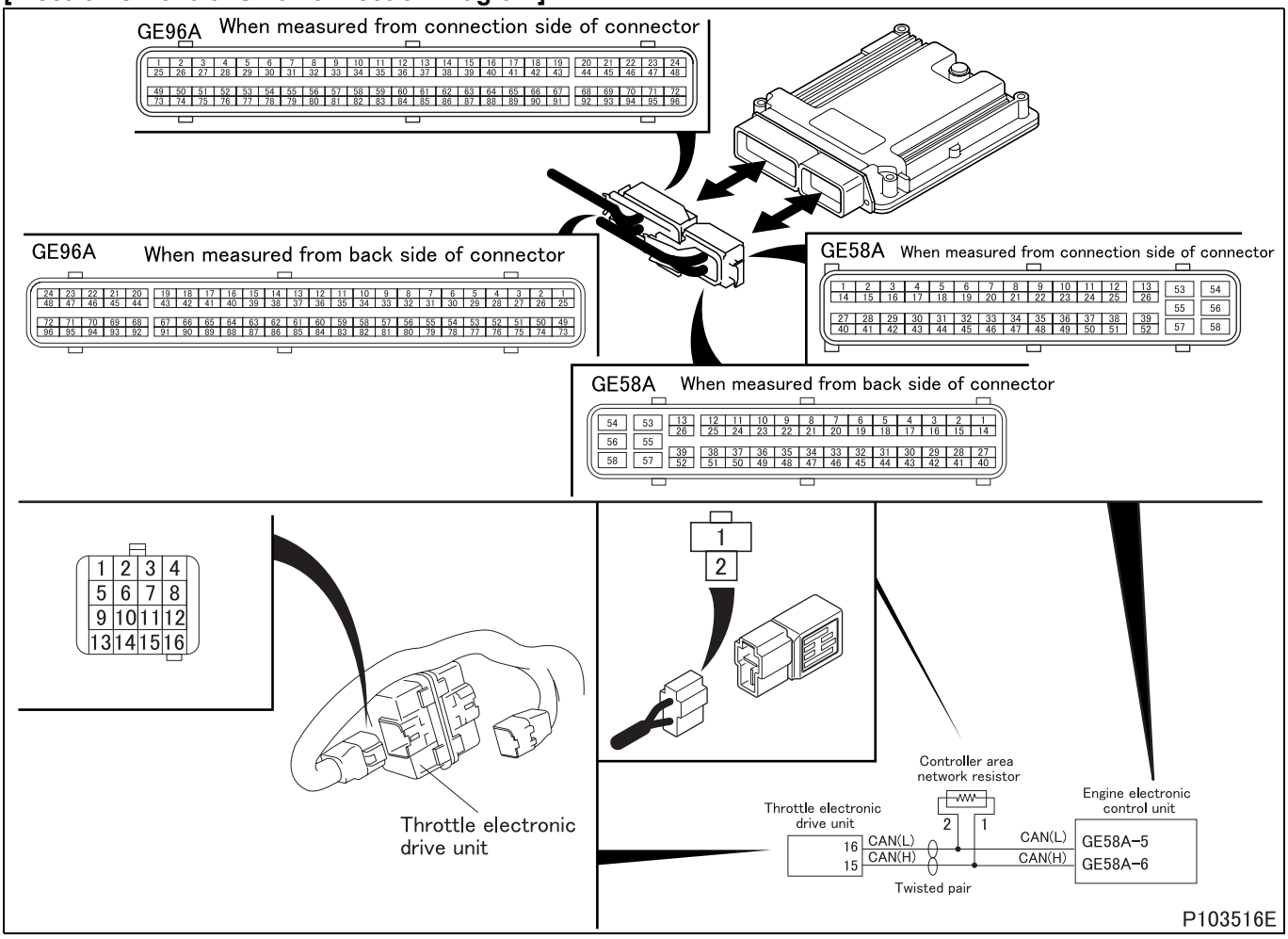
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Intake throttle actuator test is inhibited.
- Related fault check is stopped.

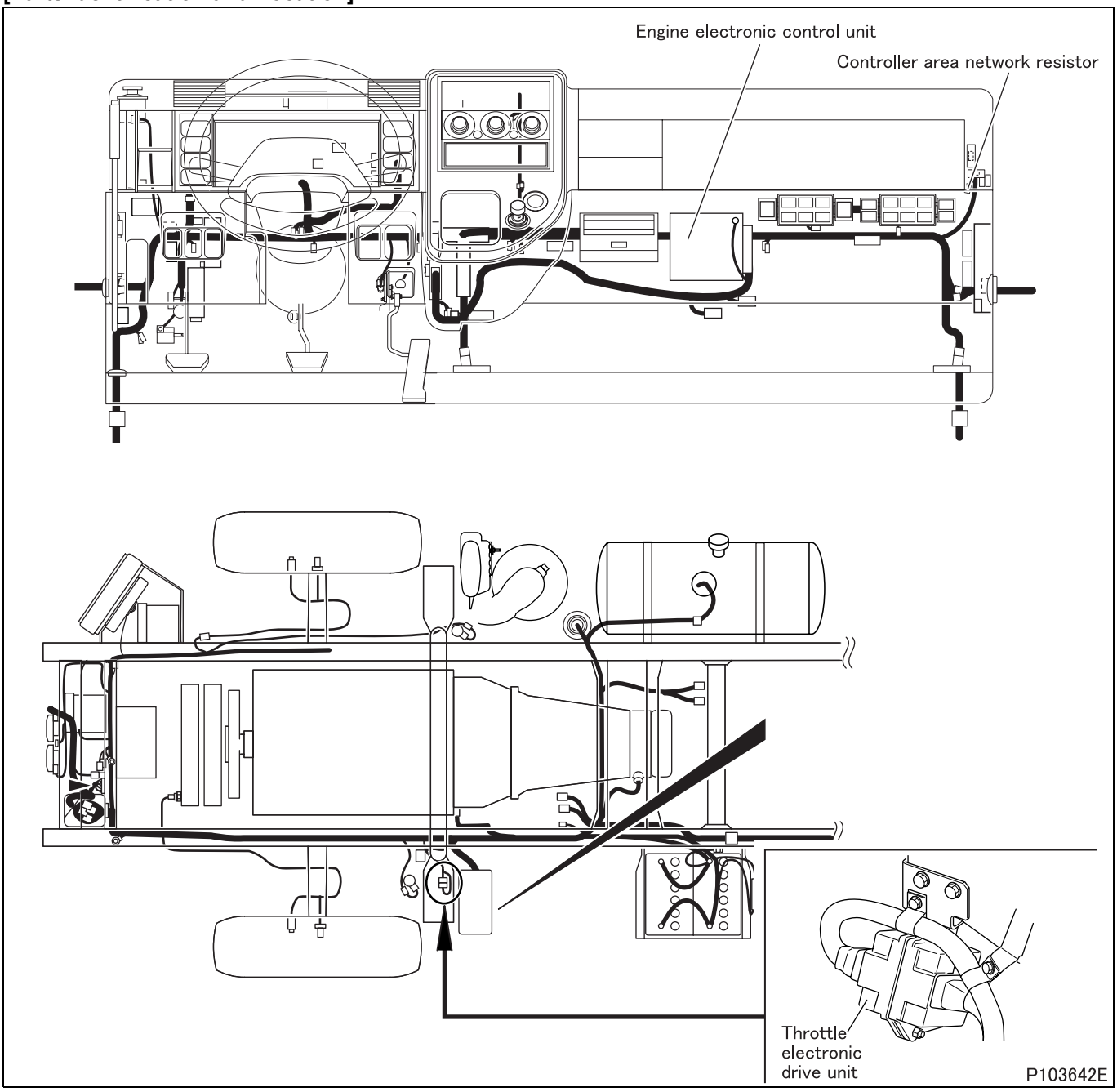
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between engine electronic control unit and throttle electronic drive unit
- Malfunction of each connector
- Malfunction of engine electronic control unit
- Malfunction of throttle electronic drive unit
- Malfunction of controller area network resistor

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

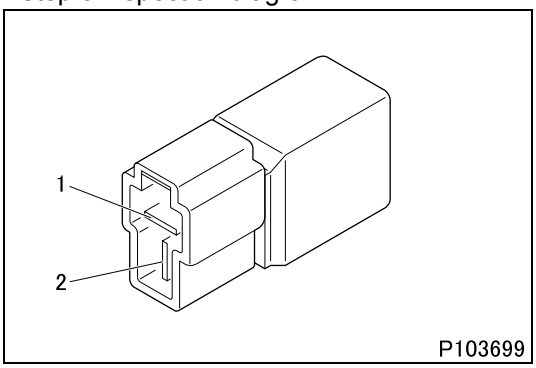
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by engine electronic control unit connector
	Maintenance item		Measure value of resistance between engine electronic control unit connector (GE58A) terminal No. 5 and 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		Disconnect connector and measure resistor side.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of controller area network resistor

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and engine electronic control unit connector (GE58A) terminal No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and engine electronic control unit connector (GE58A) terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and electronic drive unit connector terminal No. 15
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between engine electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and electronic drive unit connector terminal No. 16
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replace the engine electronic control unit as well if this diagnosis code occurs after the replacement of electronic drive unit.
		NO	Modify connector.

[Fault code]
Diagnosis code: P1640/Flash code: 75
[Monitor]
Abnormality in controller area network 2 communication
[Fault (outline)]
Time out
[Diagnosis check]
- Controller area network communication between engine electronic control unit and turbocharger electronic drive unit is monitored for abnormality.

[Code generation condition]
- Engine electronic control unit fails to receive controller area network signal concerning turbocharger control from turbocharger electronic drive unit within specified time (controller area network bus OFF).
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

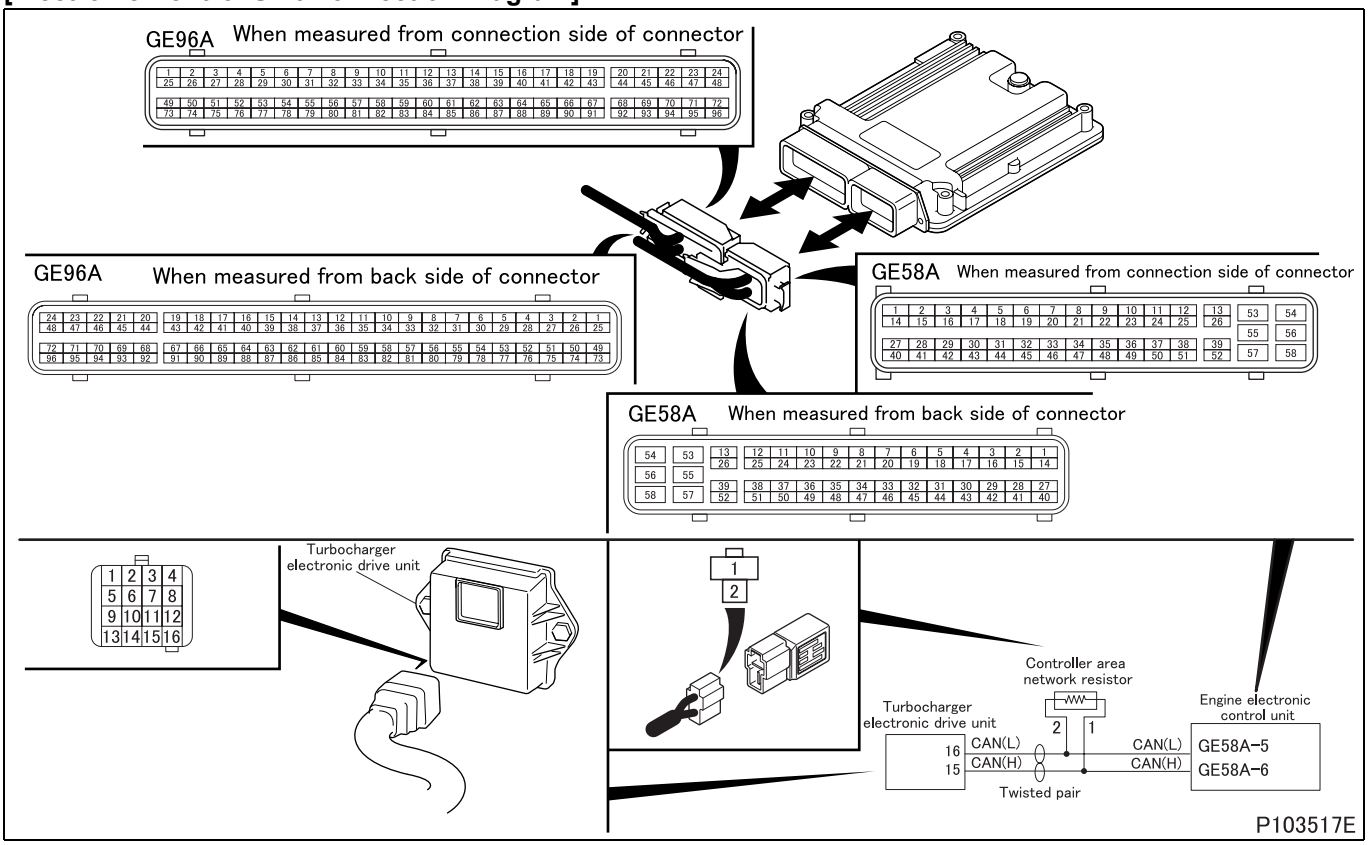
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

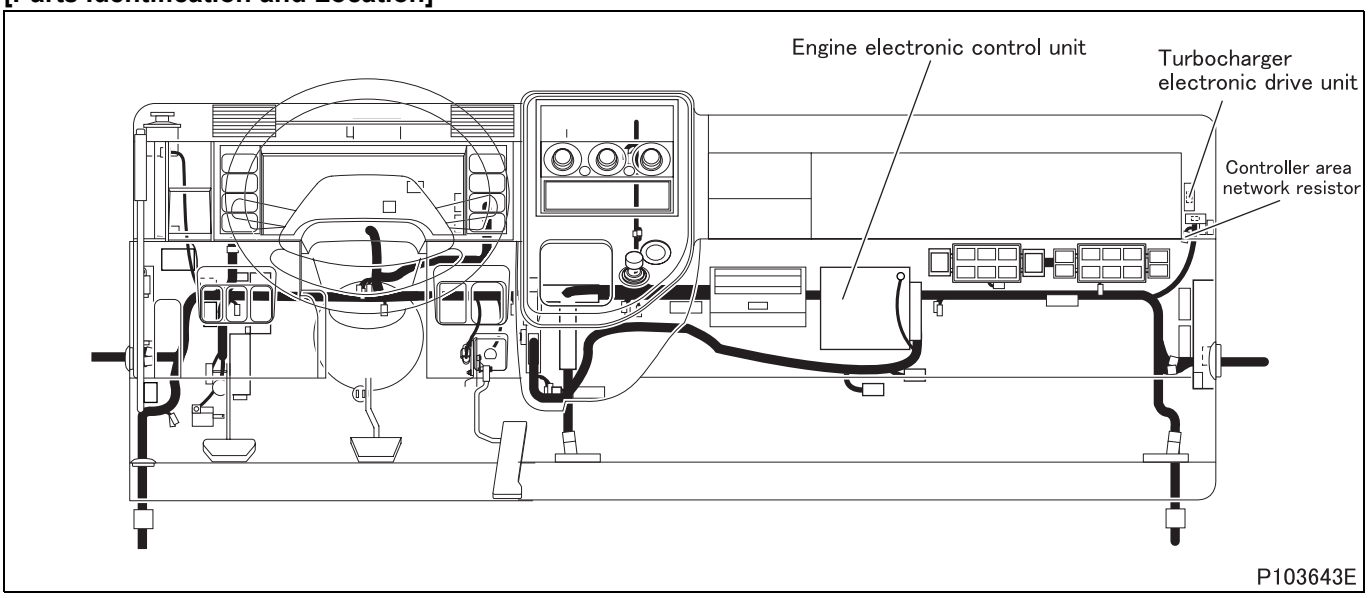
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between engine electronic control unit and turbocharger electronic drive unit
- Malfunction of each connector
- Malfunction of engine electronic control unit
- Malfunction of turbocharger electronic drive unit
- Malfunction of controller area network resistor

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

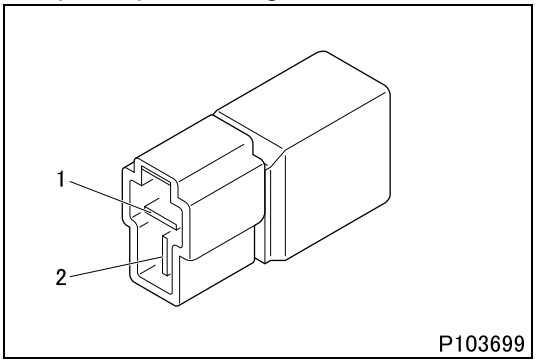
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by engine electronic control unit connector
	Maintenance item		Measure value of resistance between engine electronic control unit connector (GE58A) terminal No. 5 and 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		Disconnect connector and measure resistor side.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of controller area network resistor

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and engine electronic control unit connector (GE58A) terminal No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and engine electronic control unit connector (GE58A) terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and electronic drive unit connector terminal No. 15
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between engine electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and electronic drive unit connector terminal No. 16
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replace the engine electronic control unit as well if this diagnosis code occurs after the replacement of electronic drive unit.
		NO	Modify connector.

[Fault code]
Diagnosis code: P1660/Flash code: 29
[Monitor]
Failure of diesel particulate filter indicator lamp
[Fault (outline)]
- Short circuit battery
- Short circuit ground
- Open circuit
- Overload

[Diagnosis check]
- Diesel particulate filter indicator lamp circuit is monitored for fault.

[Code generation condition]
- Diesel particulate filter indicator lamp circuit remains open, shorted or overcurrent as detected for 0.2 second. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.
- Fault diagnosis is performed each time when the control is halted.

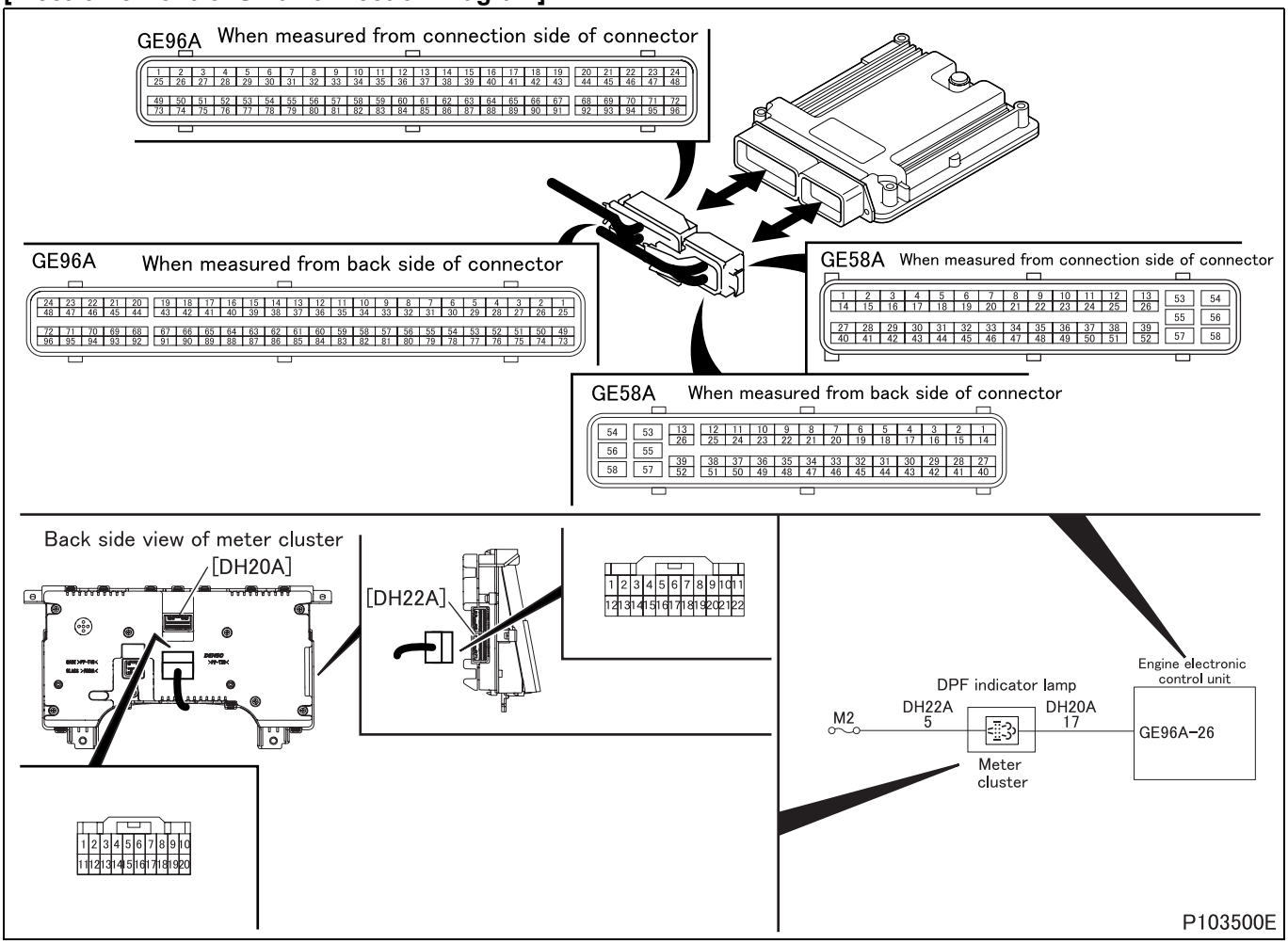
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

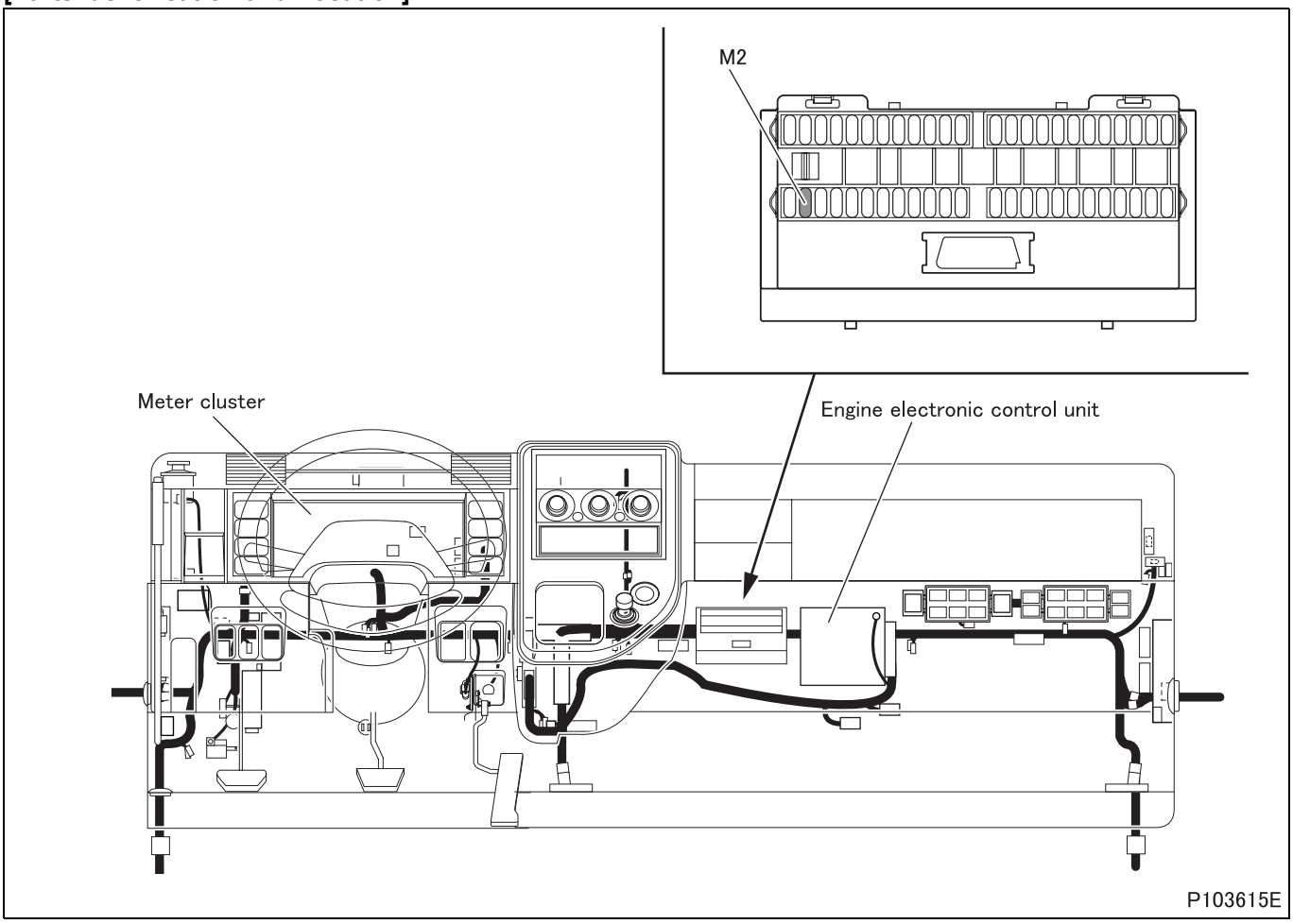
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and diesel particulate filter indicator lamp
- Malfunction of each connector
- Malfunction of diesel particulate filter indicator lamp
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position. (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. B8 “DPF Indicator Lamp” of Service Data.
	Inspection condition		Perform Multi-Use Tester actuator test item No. A6 “DPF Lamp”.
	Requirements		Diesel particulate filter indicator lamp lit (automatic reset after 15 seconds).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Ground connector (GE96A) terminal No. 26.
	Inspection condition		It wires for the ground harness from the other side of the connector.
	Requirements		Diesel particulate filter indicator lamp illuminates
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between fuse and meter cluster
	Maintenance item		Check circuit between fuse M2 and meter cluster connector (DH22A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between electronic control unit and meter cluster
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 26 and meter cluster connector (DH20A) terminal No. 10.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of meter cluster
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of meter cluster or lamp
		NO	Modify connector.

[Fault code]
Diagnosis code: P2002/Flash code: 92
[Monitor]
Diesel particulate filter clogged
[Fault (outline)]
Efficiency below threshold (leaking diesel particulate filter)
[Diagnosis check]
- Ceramic filter is monitored for failure through DPF pressure sensor (DIFF) during operation of diesel particulate filter regeneration function.

[Code generation condition]
- Difference between maximum pressure calculated by electronic control unit and actual diesel particulate filter pressure remains out of control map for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine operating mode: normal (engine in operation)
- Pressure adjustment in DPF pressure sensor (DIFF):
  Has been carried out this drive cycle ; for drift correction, the following conditions exist for >5s :
  - Engine speed: less than 875 rpm
  - Fuel injection quantity: below 25 mg/cyc
  - Exhaust flow rate: less than 90 m^3/h
  - Exhaust gas recirculation valve position: more than 8 mm {0.3 in.}
- Exhaust volume-flow rate: 500 to 900 m^3/h
- Diesel particulate filter inlet temperature: 200 to 400°C {392 to 752°F}
- Water temperature: 65 to 110°C {149 to 230°F}
- Atmospheric pressure: more than 750 mbar {10.87 psi}
- Approximate environment atmospheric temperature: –7 to 50°C {19 to 122°F}
- Frequency of diesel particulate filter regeneration control: less than 3 times (discontinued after start of diesel particulate filter regeneration control)
- Soot deposit: 15 to 30 g {0.53 to 1.06 oz}
- Diesel particulate filter regeneration control: not effected
- Controller area network communication of exhaust gas recirculation electronic drive unit: in order
- DPF pressure sensor (DIFF): in order
- Air flow sensor: in order
- Atmospheric pressure sensor: in order
- Water temperature sensor: in order
- Intake air temperature sensor: in order
- Catalytic temperature sensor: in order
- DPF temperature sensor 1: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order

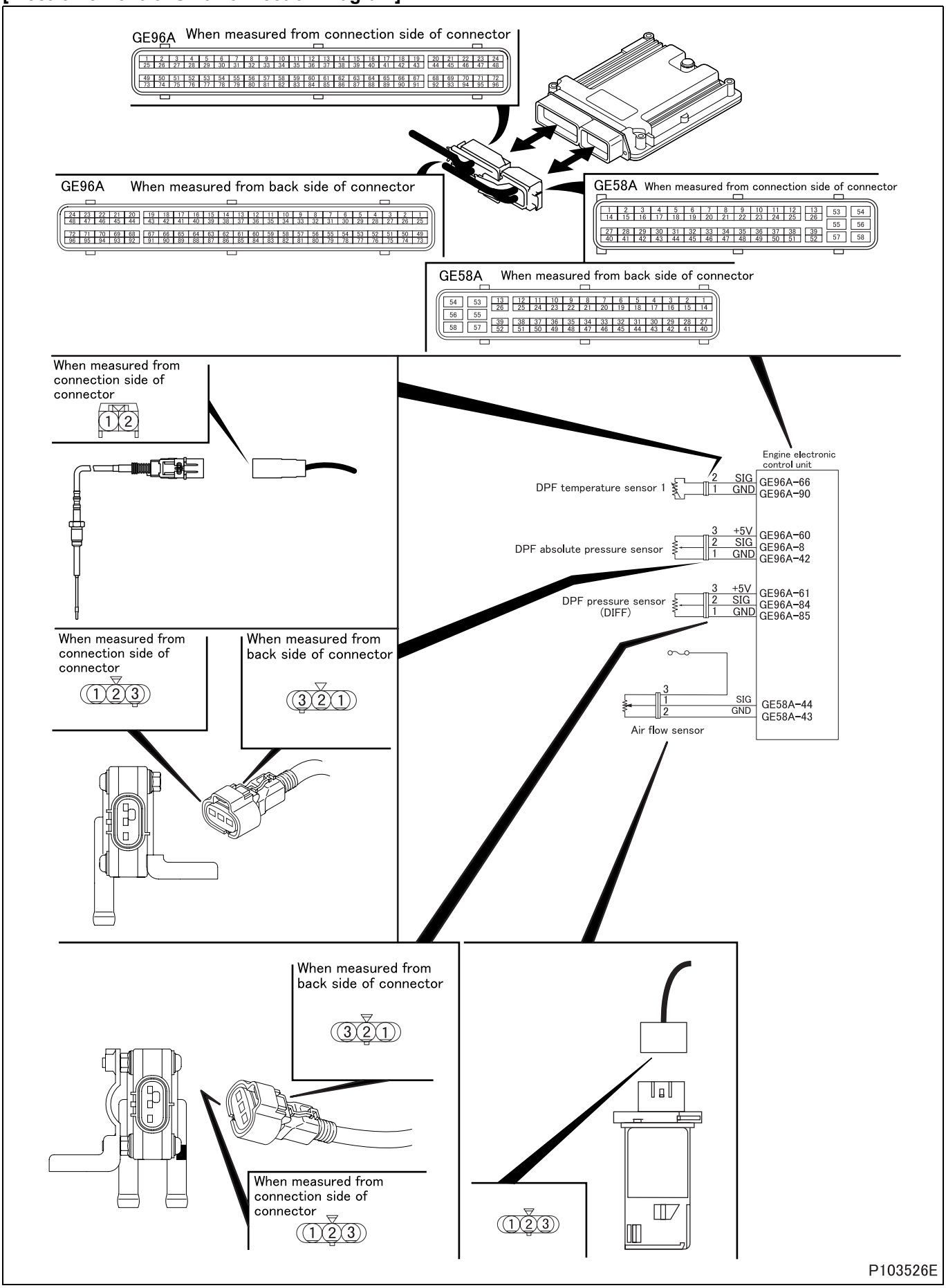
[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the engine model.
<Except FE83>
- Engine torque is limited.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

<FE83>
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

[Probable cause of trouble]
- Failure of diesel particulate filter indicator lamp
- Failure of diesel particulate filter cleaning switch
- Manual diesel particulate filter regeneration is not performed.
- Excessive smoke emission (due to malfunction of engine proper, common rail or exhaust gas recirculation system)
- Malfunction of air flow sensor
- Malfunction of DPF absolute pressure sensor and DPF pressure sensor (DIFF)
- Malfunction of diesel particulate filter

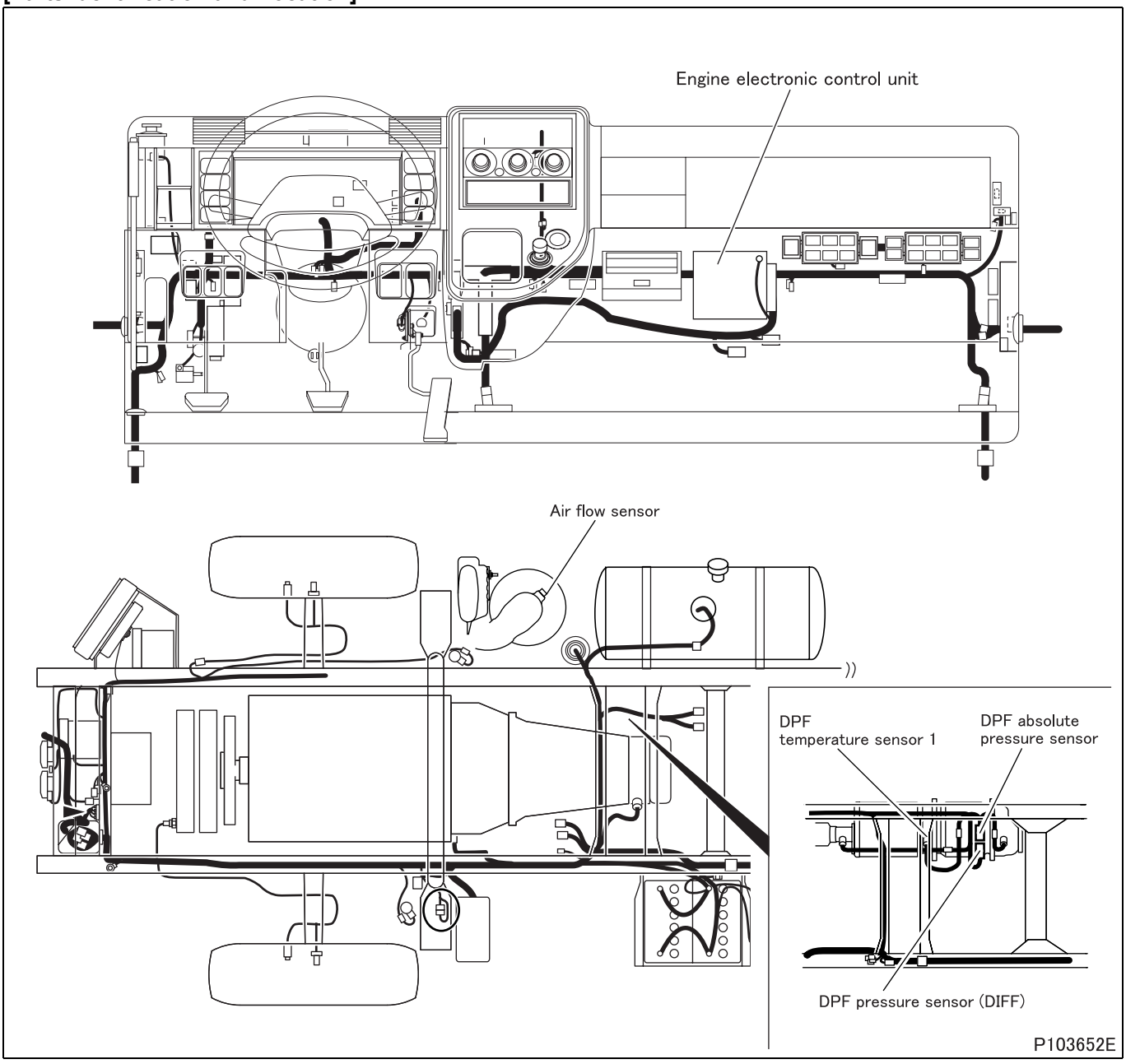
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



P103526E

[Parts Identification and Location]

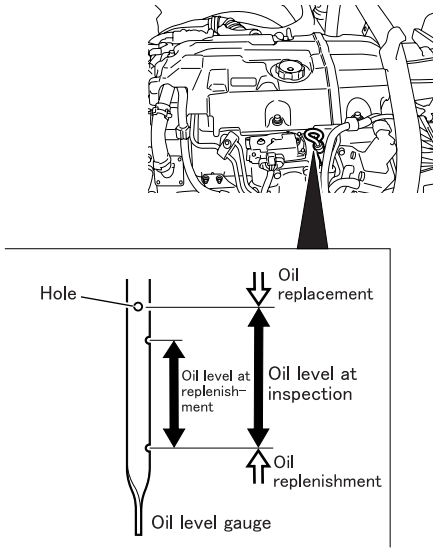


[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine stopped
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	After replacement of oil, go to step 2

<Step 1 inspection diagram>

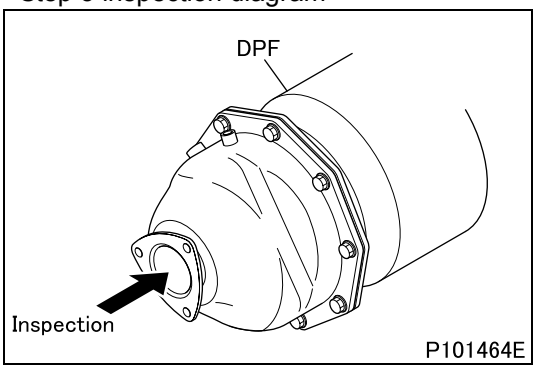


P103677E

Step 2	Inspection items		Inspection by manual diesel particulate filter regeneration
	Maintenance item		Perform Multi-Use Tester actuator test item No. A5 “DPF Regeneration (Manual)”, and clean ceramic diesel particulate filter.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Engine: idling • Place the transmission in neutral. (place the automatic transmission in P range) • Parking brake: vehicle parked (parking brake switch: ON) • After engine warm-up
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection
		NO	Go to step 3.

Step 3	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information.

<Step 3 inspection diagram>



Step 4	Inspection items		Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”
	Inspection condition		Perform the following preparatory works. • Place the transmission in neutral. (place the automatic transmission in P range) • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F}. (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”)
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection
		NO	Go to step 5.

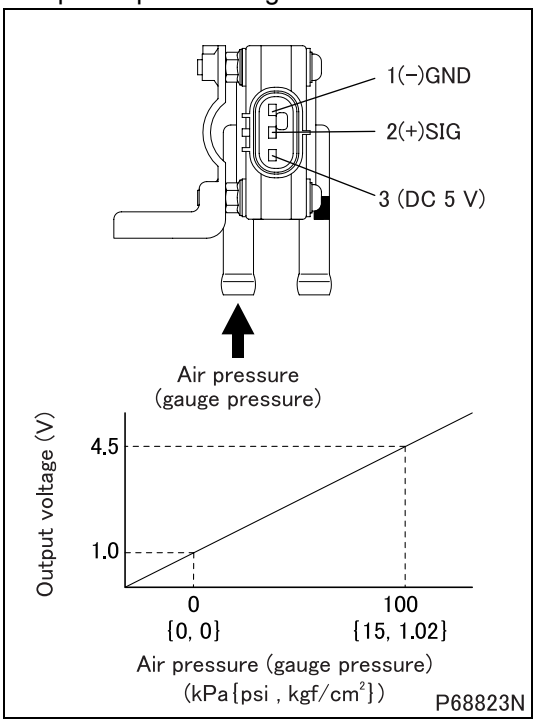
Step 5	Inspection items		Inspection by control data
	Maintenance item		Measure item No. B8 “DPF Indicator Lamp” of Service Data.
	Inspection condition		Perform Multi-Use Tester actuator test item No. A6 “DPF Lamp”.
	Requirements		Diesel particulate filter indicator lamp illuminates (automatic reset after 15 seconds)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of engine electronic control unit

Step 6	Inspection items		Inspection by control data
	Maintenance item		Measure item No. A4 “DPF SW” of Service Data.
	Inspection condition		–
	Requirements		Press diesel particulate filter cleaning switch and check that “DPF SW” display switches from OFF to ON.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of diesel particulate filter cleaning switch or engine electronic control unit

Step 7	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	After correction and replacement of hose, go to step 8.

Step 8	Inspection items		Inspection of DPF pressure sensor (DIFF)
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2} : 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2} : 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of DPF pressure sensor (DIFF)

<Step 8 inspection diagram>



Step 9	Inspection items		Inspection of air flow sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of air flow sensor

Step 10	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	• Inspection of exhaust gas recirculation system (exhaust gas recirculation pipe, exhaust gas recirculation cooler, exhaust gas recirculation valve) • Inspection of engine
		NO	Replacement of injector

[Fault code]
Diagnosis code: P2031/Flash code: 88
[Monitor]
Characteristic abnormality of DPF temperature sensor 2
[Fault (outline)]
Gain and offset drift
[Diagnosis check]
- Difference in temperature output between DPF temperature sensors (1 and 2) is monitored for clogging of ceramic filter during stop of diesel particulate filter regeneration function (with vehicle in normal condition).

[Code generation condition]
- Difference in temperature output remains excessively high (over 150°C {302°F}) or low (below –150°C {–238°F}) for 10 seconds <Relative check> and 20 seconds <Separate check> .
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Diesel particulate filter regeneration control: not effected
- Engine running time: more than 300 seconds
- Time after diesel particulate filter regeneration control was effected: more than 1500 seconds
- Engine speed and load: logical output is 1
- Time till above conditions were met: more than 30 seconds
- Catalytic temperature sensor: normal in output signal
- DPF temperature sensor 1: normal in output signal
- DPF temperature sensor 2: normal in output signal
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order

[Control effected by electronic control unit during fault]
- Effects no special control.

[Probable cause of trouble]
- Malfunction of DPF temperature sensor 2

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P2032/Flash code: 88
[Monitor]
Failure of DPF temperature sensor 2
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Output voltage of DPF temperature sensor 2 is monitored.

[Code generation condition]
- Output voltage of DPF temperature sensor 2 remains below 0.36 V for 3 seconds. (sensor temperature: 1000°C {1832°F} or more)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

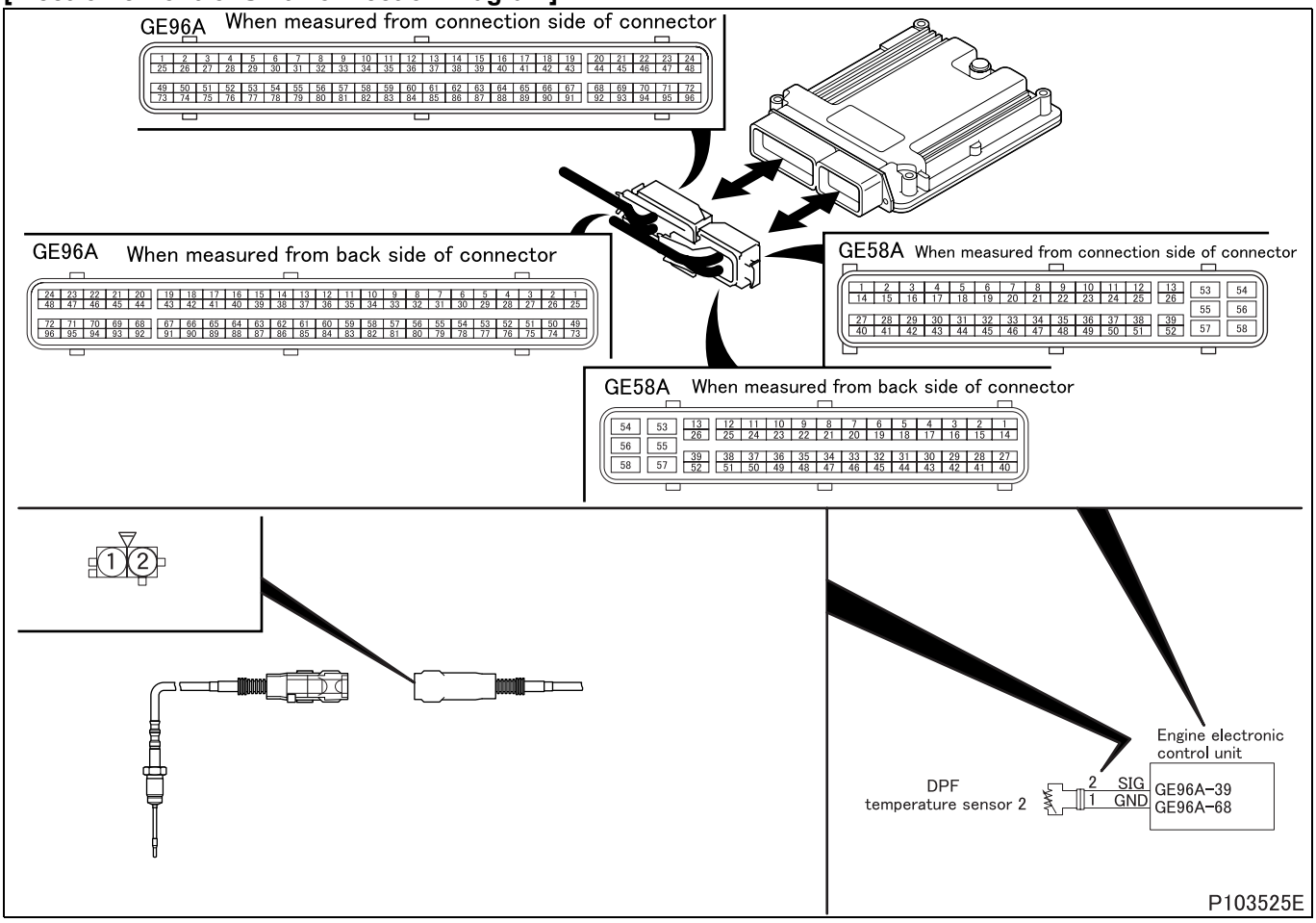
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Pressure after ceramic diesel particulate filter is fixed at backup value.
- Related fault check is stopped.

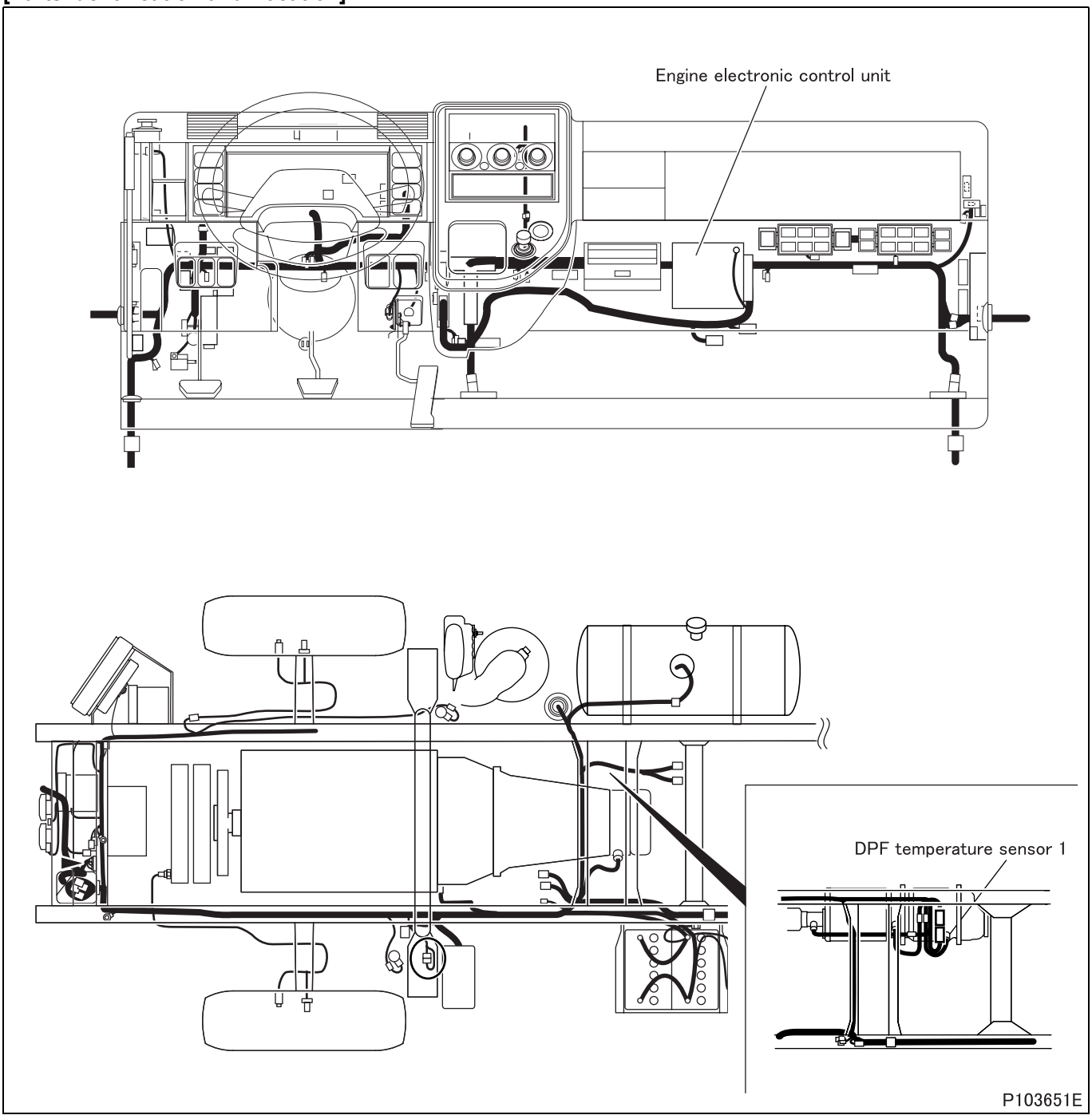
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of DPF temperature sensor 2
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 26 “DPF Temperature (DownStream)” of Service Data.
	Inspection condition		During warm-up
	Requirements		Gradually increased
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

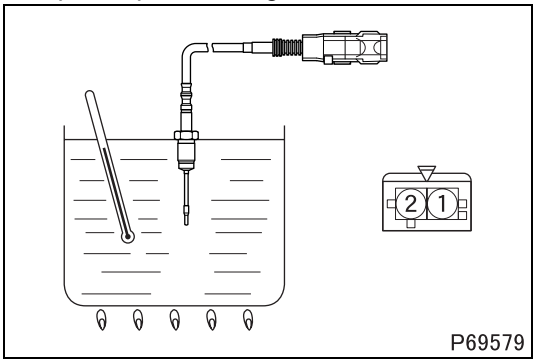
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 39 and 68.
	Inspection condition		• Starter switch: OFF • Disconnect electronic control unit from harness and measure at vehicle side connector.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.58 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of DPF temperature sensor 2 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 2 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.58 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 39 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 68 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 26 “DPF Temperature (DownStream)” of Service Data.
	Inspection condition		During warm-up
	Requirements		Gradually increased
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2033/Flash code: 88
[Monitor]
Failure of DPF temperature sensor 2
[Fault (outline)]
High signal range check
[Diagnosis check]
- Output voltage of DPF temperature sensor 2 is monitored.

[Code generation condition]
- Output voltage of DPF temperature sensor 2 remains over 4.93 V for 30 seconds. (sensor temperature: 40°C {118°F} or less).
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

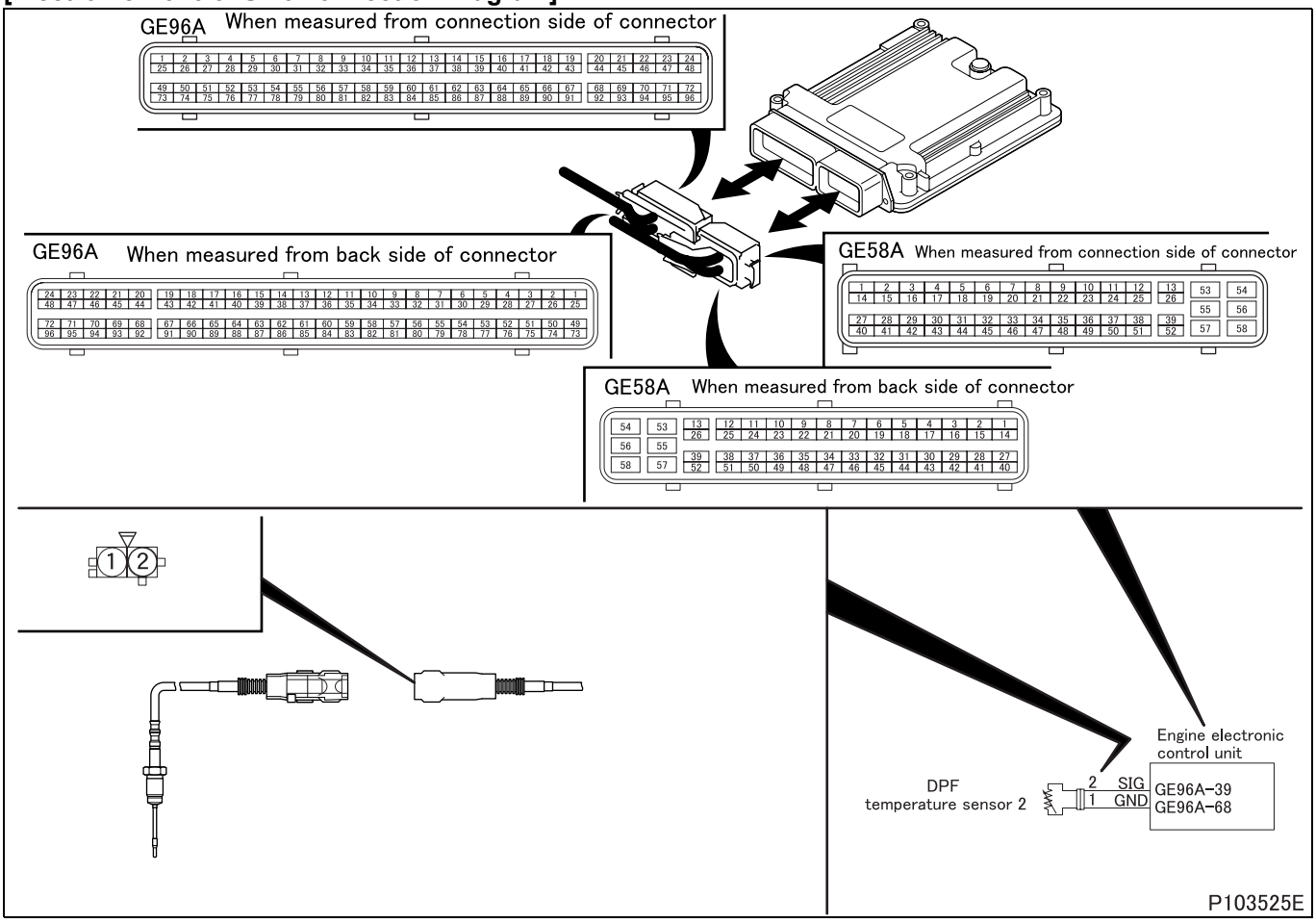
[Diagnostic requirement]
- Engine speed: 1400 to 5000 rpm
- Fuel injection quantity: 35 to 200 mg/cyc
- Water temperature: above 35°C {95°F}

[Control effected by electronic control unit during fault]
- Pressure after ceramic diesel particulate filter is fixed at backup value.
- Related fault check is stopped.

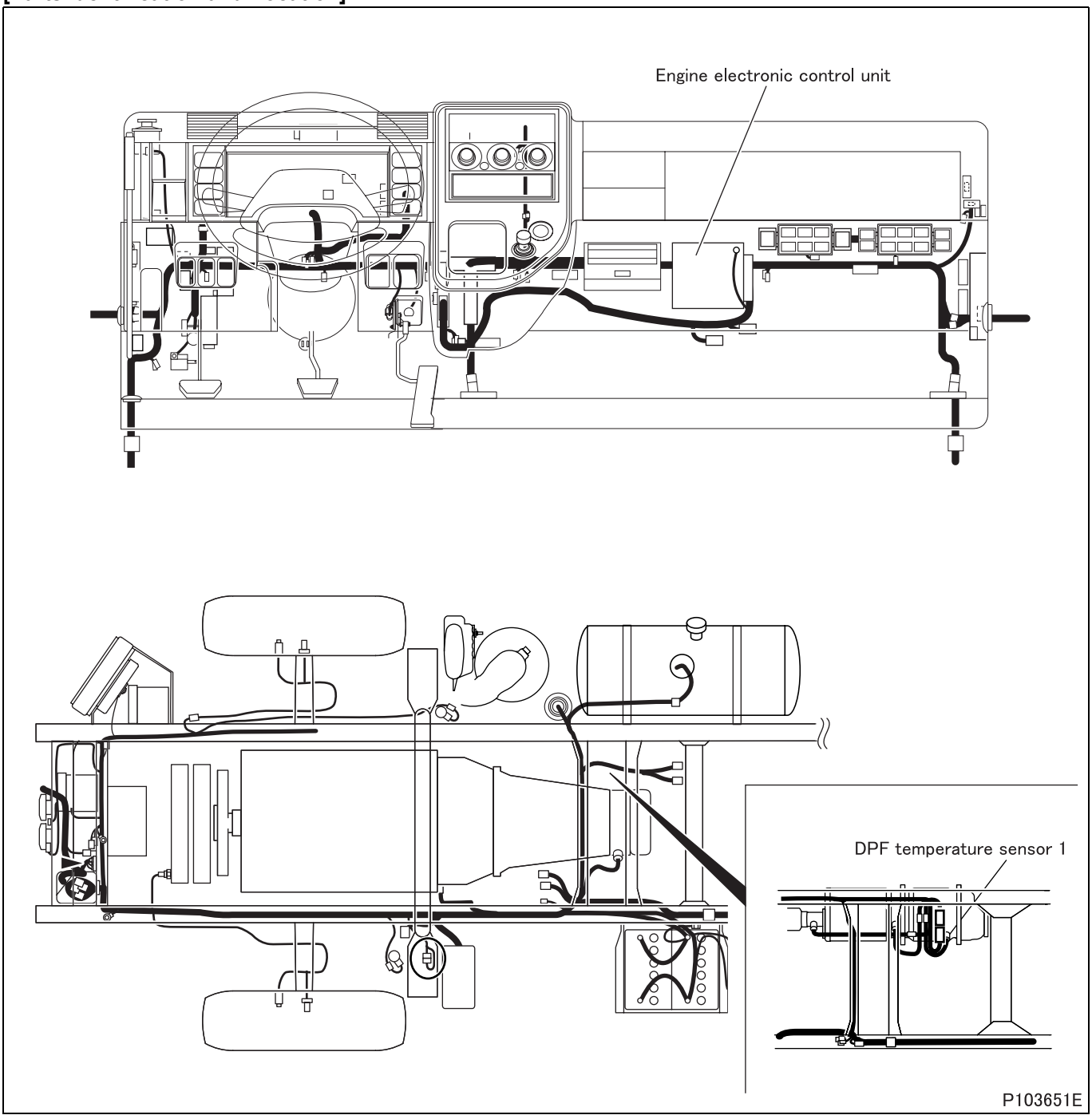
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of DPF temperature sensor 2
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 26 “DPF Temperature (DownStream)” of Service Data.
	Inspection condition		During warm-up
	Requirements		Gradually increased
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

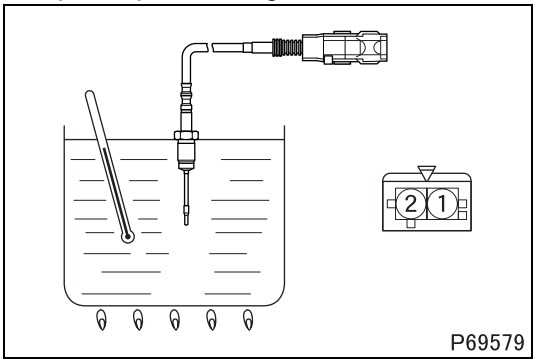
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 39 and 68.
	Inspection condition		• Starter switch: OFF • Disconnect electronic control unit from harness and measure at vehicle side connector.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.58 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of DPF temperature sensor 2 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 2 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F} : 241.8 kΩ • 50°C {122°F} : 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F} : 33.58 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F} : 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F} : 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 39 and sensor connector terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 68 and sensor connector terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Measure item No. 26 “DPF Temperature (DownStream)” of Service Data.
	Inspection condition		During warm-up
	Requirements		Gradually increased
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2080/Flash code: 42
[Monitor]
Relative check between catalytic temperature sensor and DPF temperature sensor 1
[Fault (outline)]
Gain and offset drift
[Diagnosis check]
- Relative temperature check is made between catalytic temperature sensor and DPF temperature sensor 1 during stop of diesel particulate filter regeneration function (with vehicle in normal condition).

[Code generation condition]
- Difference in temperature output remains high (over 150°C {302°F}) or low (below –150°C {–238°F}) for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Diesel particulate filter regeneration control: not effected
- Engine running time: more than 300 seconds
- Time after diesel particulate filter regeneration control was effected: more than 1500 seconds
- Engine speed and load: logical output is 1
- Time till above conditions were met: more than 30 seconds
- Catalytic temperature sensor: normal in output signal
- DPF temperature sensor 1: normal in output signal
- DPF temperature sensor 2: normal in output signal
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- When catalytic temperature sensor and DPF temperature sensor 2 are the same in output.

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
<If diagnosis code P0284 was not recorded at the same time>
- Malfunction of catalytic temperature sensor

<If diagnosis code P0284 was recorded at the same time>
- Malfunction of DPF temperature sensor 2

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P2084/Flash code: 92
[Monitor]
Relative check between DPF temperature sensors (1 and 2)
[Fault (outline)]
Gain and offset drift
[Diagnosis check]
- Relative temperature check is made between DPF temperature sensors (1 and 2) during stop of diesel particulate filter regeneration function (with vehicle in normal condition).

[Code generation condition]
- Temperature difference remains for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Diesel particulate filter regeneration control: not effected
- Engine running time: more than 300 seconds
- Time after diesel particulate filter regeneration control was effected: more than 1500 seconds
- Engine speed and load: logical output is 1
- Time till above conditions were met: more than 30 seconds
- Catalytic temperature sensor: normal in output signal
- DPF temperature sensor 1: normal in output signal
- DPF temperature sensor 2: normal in output signal
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- When catalytic temperature sensor and DPF temperature sensor 2 are the same in output.

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
<If diagnosis code P2080 was not recorded at the same time>
- Malfunction of DPF temperature sensor 1

<If diagnosis code P2080 was recorded at the same time>
- Malfunction of DPF temperature sensor 2

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P2100/Flash code: 28
[Monitor]
Failure of intake throttle system
[Fault (outline)]
Circuit check
[Diagnosis check]
- Throttle electronic drive unit monitors built in motor of intake throttle for circuit fault and sends fault information to engine electronic control unit through controller area network communication.
- Monitoring by throttle electronic drive unit is performed from initial operational status of motor at starter switch ON.

[Code generation condition]
- Motor circuit remains open as detected by electronic drive unit for 2 seconds (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition).

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

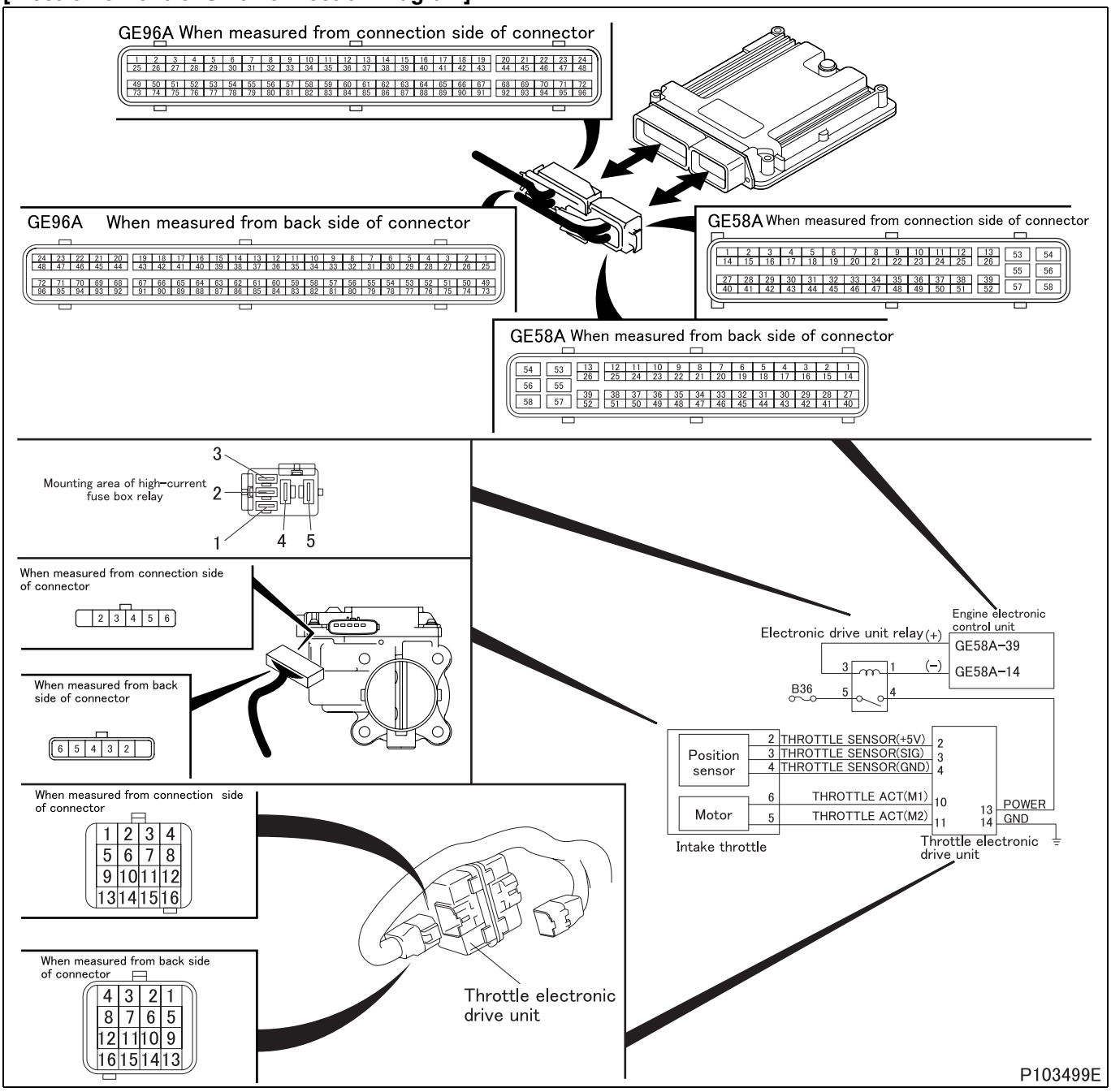
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Intake throttle actuator test is inhibited.
- Related fault check is stopped.

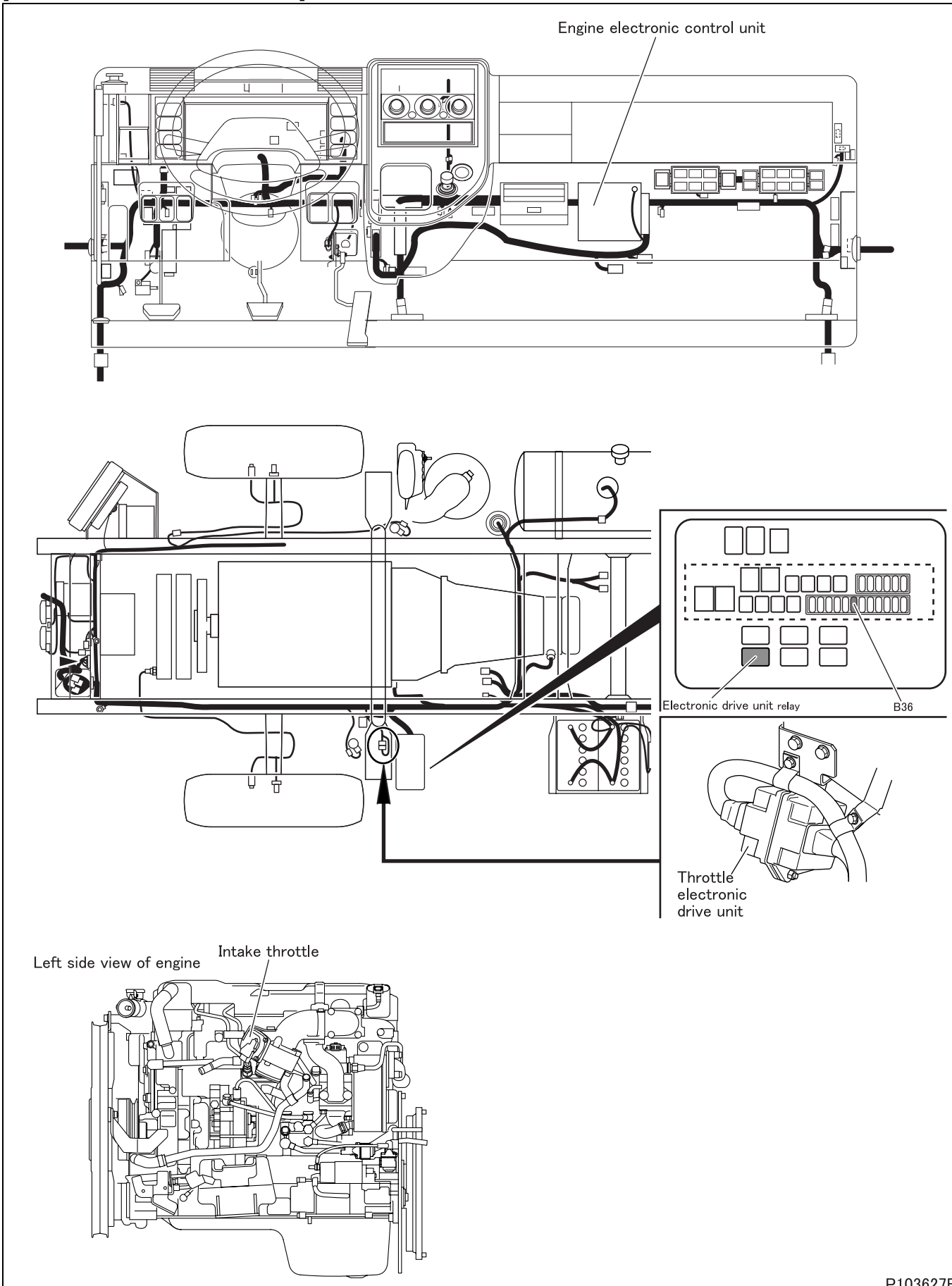
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and throttle actuator
- Malfunction of each connector
- Malfunction of throttle motor (built in throttle actuator)
- Malfunction of throttle position sensor (built in throttle actuator)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A3 “Intake Throttle 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “53: Actual Intake Throttle Position”).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of throttle actuator connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Disconnect connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of relay, go to step 9
		NO	Modify harness.

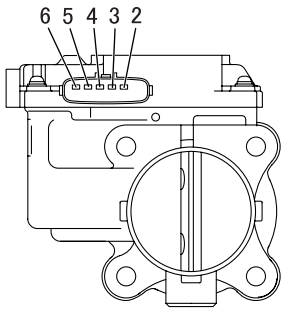
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector terminals. • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor ground: terminal No. 4 and 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between connector terminal No. 10 and 11.
	Inspection condition		Disconnect connector and measure from harness side.
	Requirements		0.3 to 80 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and throttle actuator (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (1): electronic drive unit connector terminal No. 10 - throttle actuator connector terminal No. 6 • Motor (2): electronic drive unit connector terminal No. 11 - throttle actuator connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of throttle actuator unit (motor)
	Maintenance item		Measure value of resistance between connector terminal No. 5 and 6.
	Inspection condition		• Keep throttle actuator installed on vehicle. • Disconnect connector and measure throttle actuator side.
	Requirements		0.3 to 80 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of throttle actuator

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of throttle actuator connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 4 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 4 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON • Perform actuator test item No. A3 “Intake Throttle 1”.
	Requirements		• Valve fully closed: 0.5 V • Valve fully opened: 4.375 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and throttle actuator (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 2 - throttle actuator connector terminal No. 2 • Sensor (signal): electronic drive unit connector terminal No. 3 - throttle actuator connector terminal No. 3 • Sensor (ground): electronic drive unit connector terminal No. 4 - throttle actuator connector terminal No. 4
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of throttle actuator, go to step 16
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A3 “Intake Throttle 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “53: Actual Intake Throttle Position”).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P2101/Flash code: 28
[Monitor]
Failure of intake throttle system
[Fault (outline)]
- Intake throttle valve slow response/steady state position deviation
- Circuit check

[Diagnosis check]
- Throttle electronic drive unit monitors built in motor of intake throttle for sticking and sends fault information to engine electronic control unit through controller area network communication.
- Throttle electronic drive unit detects valve opening by position sensor output data and calculates target opening from such data.

[Code generation condition]
Diagnosis code is generated under either of the following conditions (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition).
- Difference in valve opening between target and actual values remains more than 20 degrees for 2 seconds.
- Motor remains stuck as detected by electronic drive unit for 2 seconds.

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

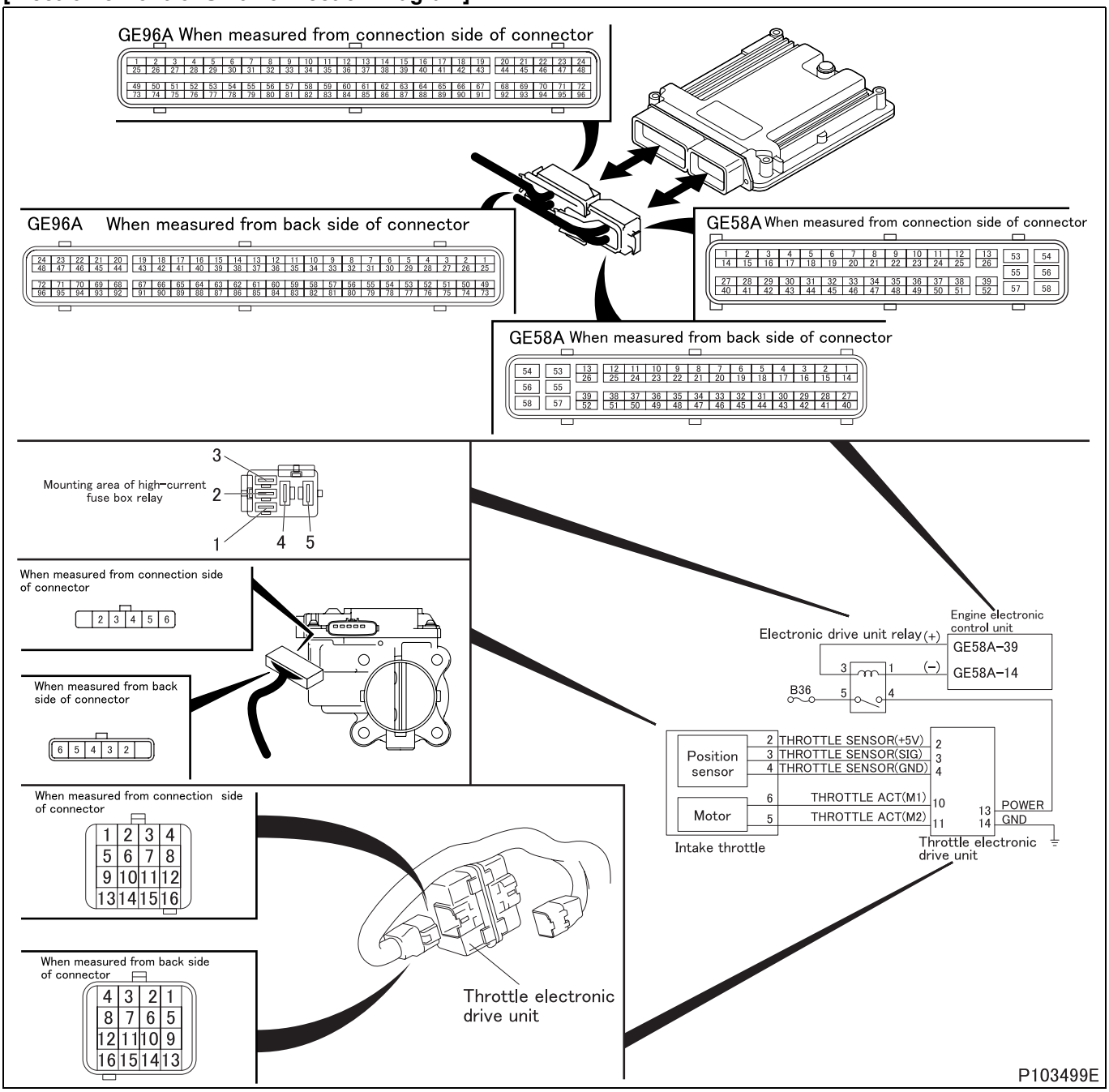
[Diagnostic requirement]
- Battery voltage: in order
- Exhaust gas recirculation valve: in order
- Electronic drive unit controller area network: in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Intake throttle actuator test is inhibited.
- Related fault check is stopped.

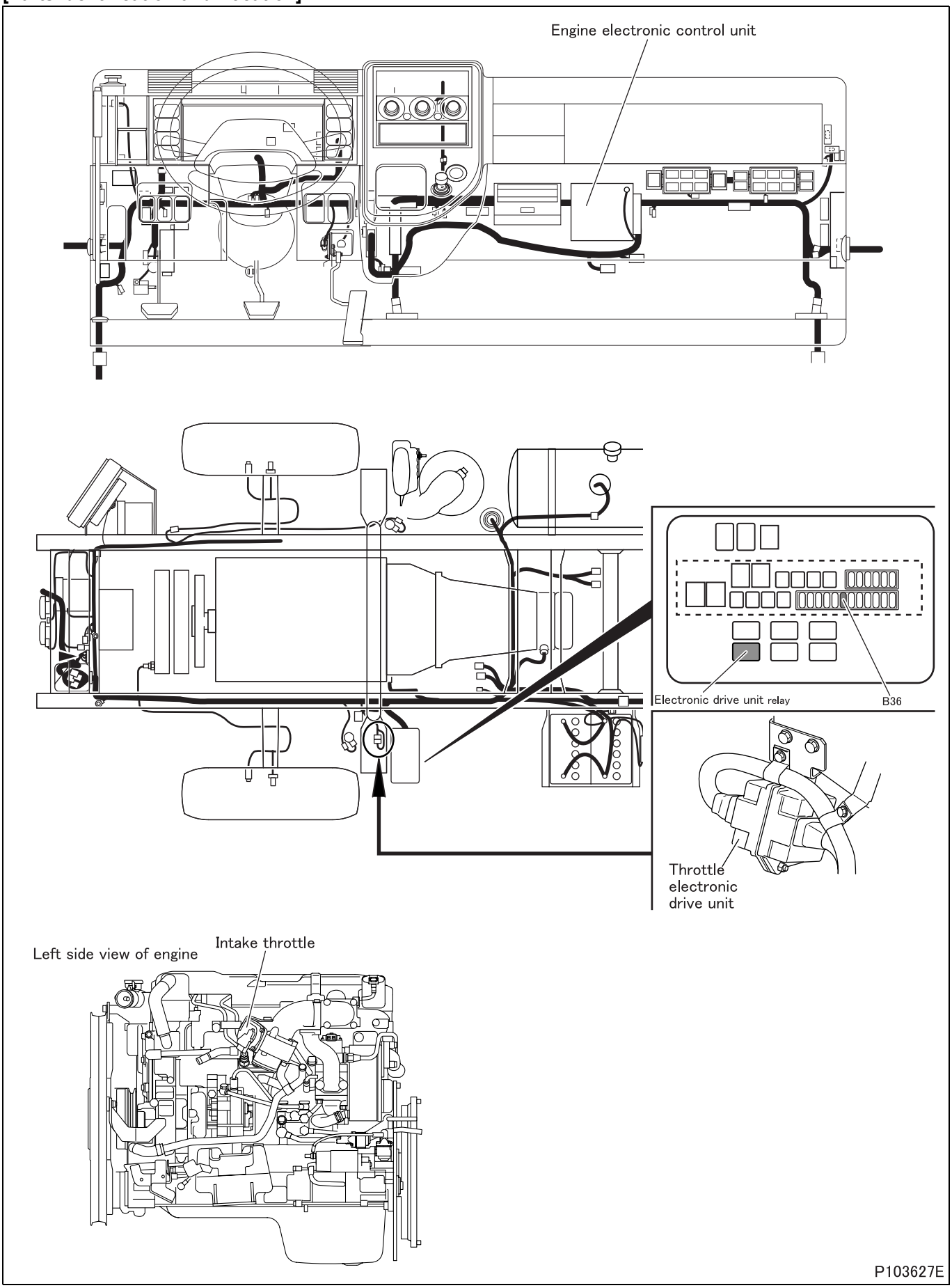
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and throttle actuator
- Malfunction of each connector
- Malfunction of throttle motor (built in throttle actuator)
- Malfunction of throttle position sensor (built in throttle actuator)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A3 “Intake Throttle 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “53: Actual Intake Throttle Position”).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of throttle actuator connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Disconnect connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of relay, go to step 9
		NO	Modify harness.

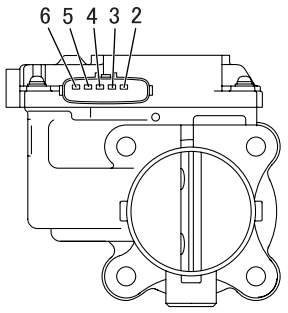
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector terminals. • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor ground: terminal No. 4 and 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between connector terminal No. 10 and 11.
	Inspection condition		Disconnect connector and measure from harness side.
	Requirements		0.3 to 80 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and throttle actuator (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (1): electronic drive unit connector terminal No. 10 - throttle actuator connector terminal No. 6 • Motor (2): electronic drive unit connector terminal No. 11 - throttle actuator connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of throttle actuator unit (motor)
	Maintenance item		Measure value of resistance between connector terminal No. 5 and 6.
	Inspection condition		• Keep throttle actuator installed on vehicle. • Disconnect connector and measure throttle actuator side.
	Requirements		0.3 to 80 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of throttle actuator

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of throttle actuator connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 4 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 4 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON • Perform actuator test item No. A3 “Intake Throttle 1”.
	Requirements		• Valve fully closed: 0.5 V • Valve fully opened: 4.375 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and throttle actuator (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 2 - throttle actuator connector terminal No. 2 • Sensor (signal): electronic drive unit connector terminal No. 3 - throttle actuator connector terminal No. 3 • Sensor (ground): electronic drive unit connector terminal No. 4 - throttle actuator connector terminal No. 4
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of throttle actuator, go to step 16
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A3 “Intake Throttle 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “53: Actual Intake Throttle Position”).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P2102/Flash code: 28
[Monitor]
Failure of intake throttle system
[Fault (outline)]
Circuit check
[Diagnosis check]
- Throttle electronic drive unit monitors built in motor of intake throttle for circuit fault and sends fault information to engine electronic control unit through controller area network communication.
- Monitoring by throttle electronic drive unit is performed from internal current detection circuit.

[Code generation condition]
- Motor circuit remains short as detected by electronic drive unit for 2 seconds. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

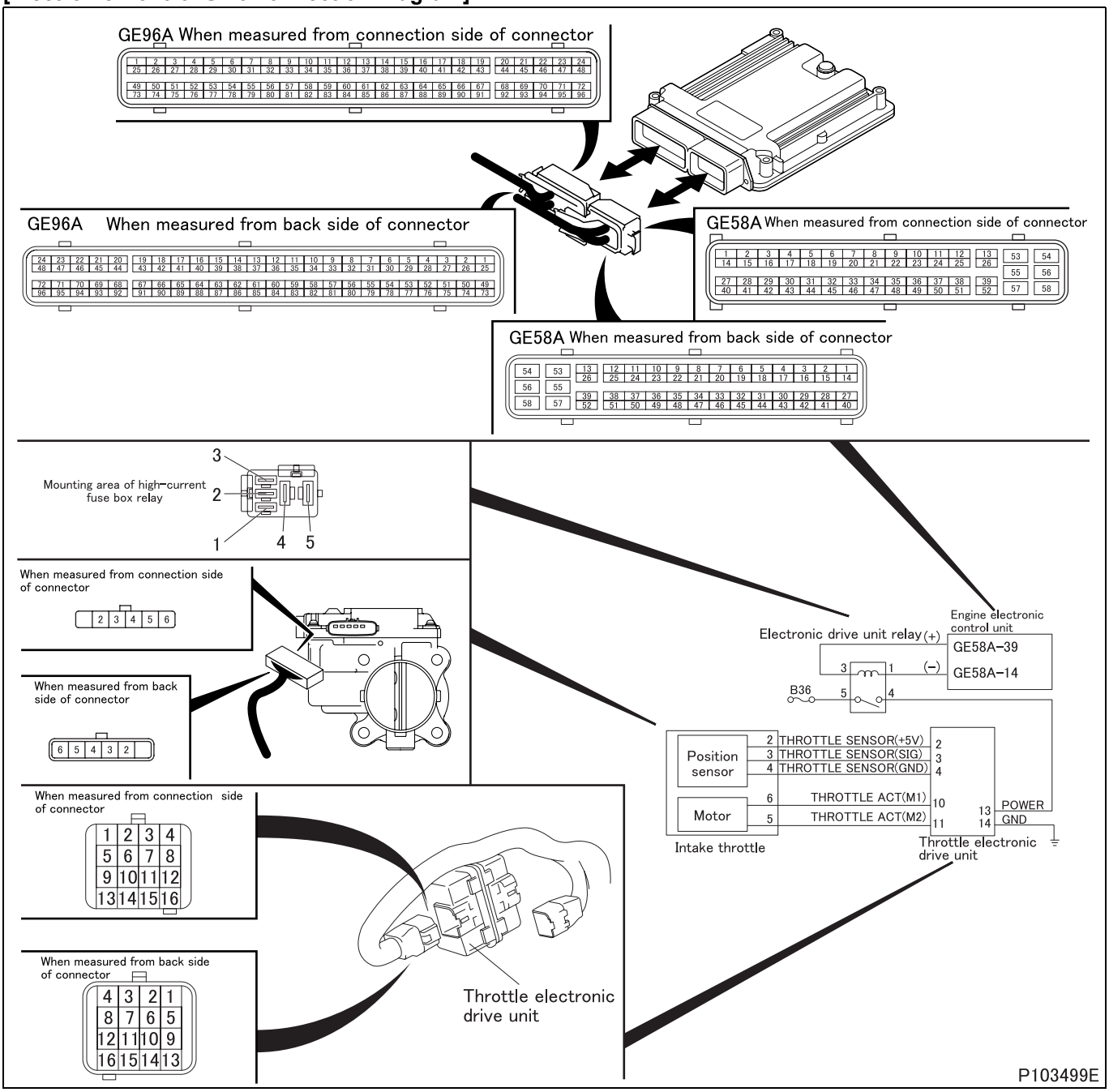
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Intake throttle actuator test is inhibited.
- Related fault check is stopped.

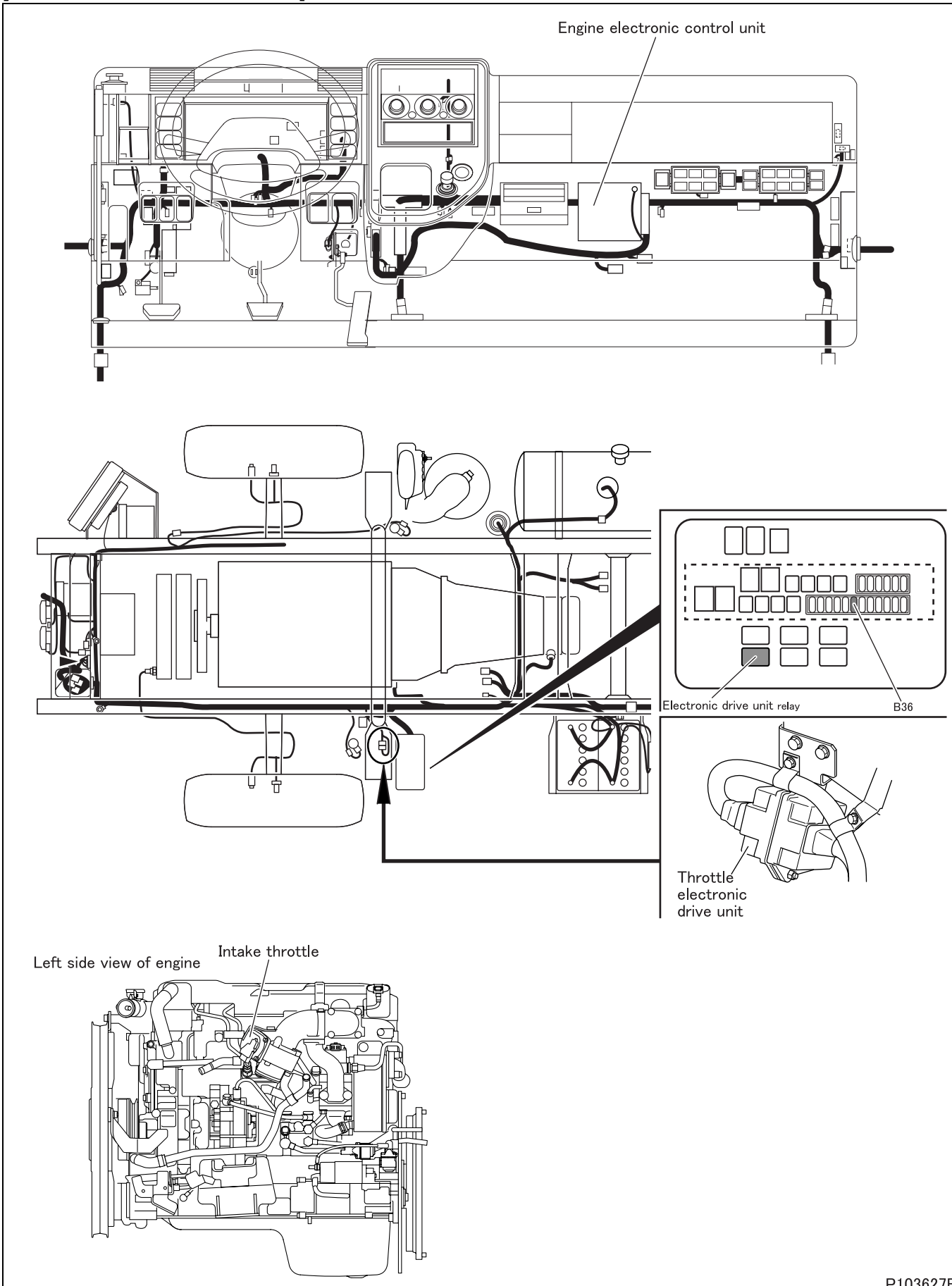
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and throttle actuator
- Malfunction of each connector
- Malfunction of throttle motor (built in throttle actuator)
- Malfunction of throttle position sensor (built in throttle actuator)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A3 “Intake Throttle 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “53: Actual Intake Throttle Position”).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of throttle actuator connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Disconnect connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of relay, go to step 9
		NO	Modify harness.

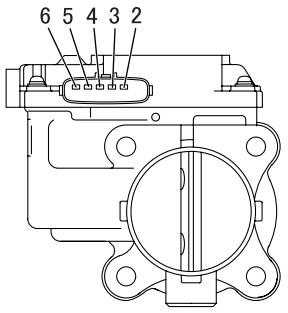
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector terminals. • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor ground: terminal No. 4 and 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between connector terminal No. 10 and 11.
	Inspection condition		Disconnect connector and measure from harness side.
	Requirements		0.3 to 80 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and throttle actuator (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (1): electronic drive unit connector terminal No. 10 - throttle actuator connector terminal No. 6 • Motor (2): electronic drive unit connector terminal No. 11 - throttle actuator connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of throttle actuator unit (motor)
	Maintenance item		Measure value of resistance between connector terminal No. 5 and 6.
	Inspection condition		• Keep throttle actuator installed on vehicle. • Disconnect connector and measure throttle actuator side.
	Requirements		0.3 to 80 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of throttle actuator

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of throttle actuator connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 4 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 4 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON • Perform actuator test item No. A3 “Intake Throttle 1”.
	Requirements		• Valve fully closed: 0.5 V • Valve fully opened: 4.375 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and throttle actuator (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 2 - throttle actuator connector terminal No. 2 • Sensor (signal): electronic drive unit connector terminal No. 3 - throttle actuator connector terminal No. 3 • Sensor (ground): electronic drive unit connector terminal No. 4 - throttle actuator connector terminal No. 4
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of throttle actuator, go to step 16
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A3 “Intake Throttle 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “53: Actual Intake Throttle Position”).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P2108/Flash code: 28
[Monitor]
Failure of intake throttle system
[Fault (outline)]
Plausibility
[Diagnosis check]
- Degree of intake throttle butterfly valve opening is detected through position sensor as actual stop opening and compared with target opening for control by engine electronic control unit.

[Code generation condition]
- Target valve position calculated by engine electronic control unit remains out of specified limits (upper limit: 90 degrees, lower limit: 6 degrees) for 1 second. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

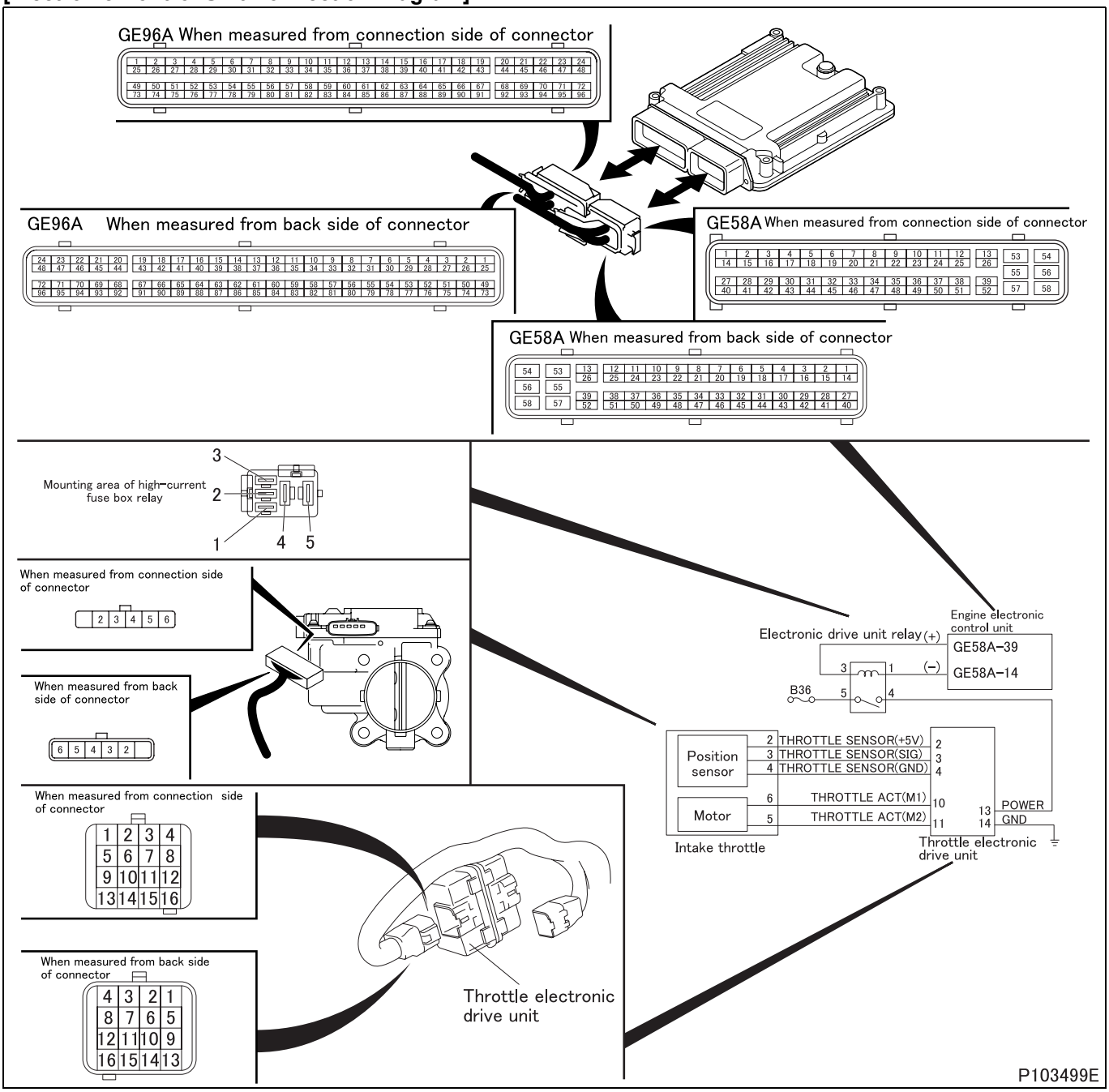
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Intake throttle actuator test is inhibited.
- Related fault check is stopped.

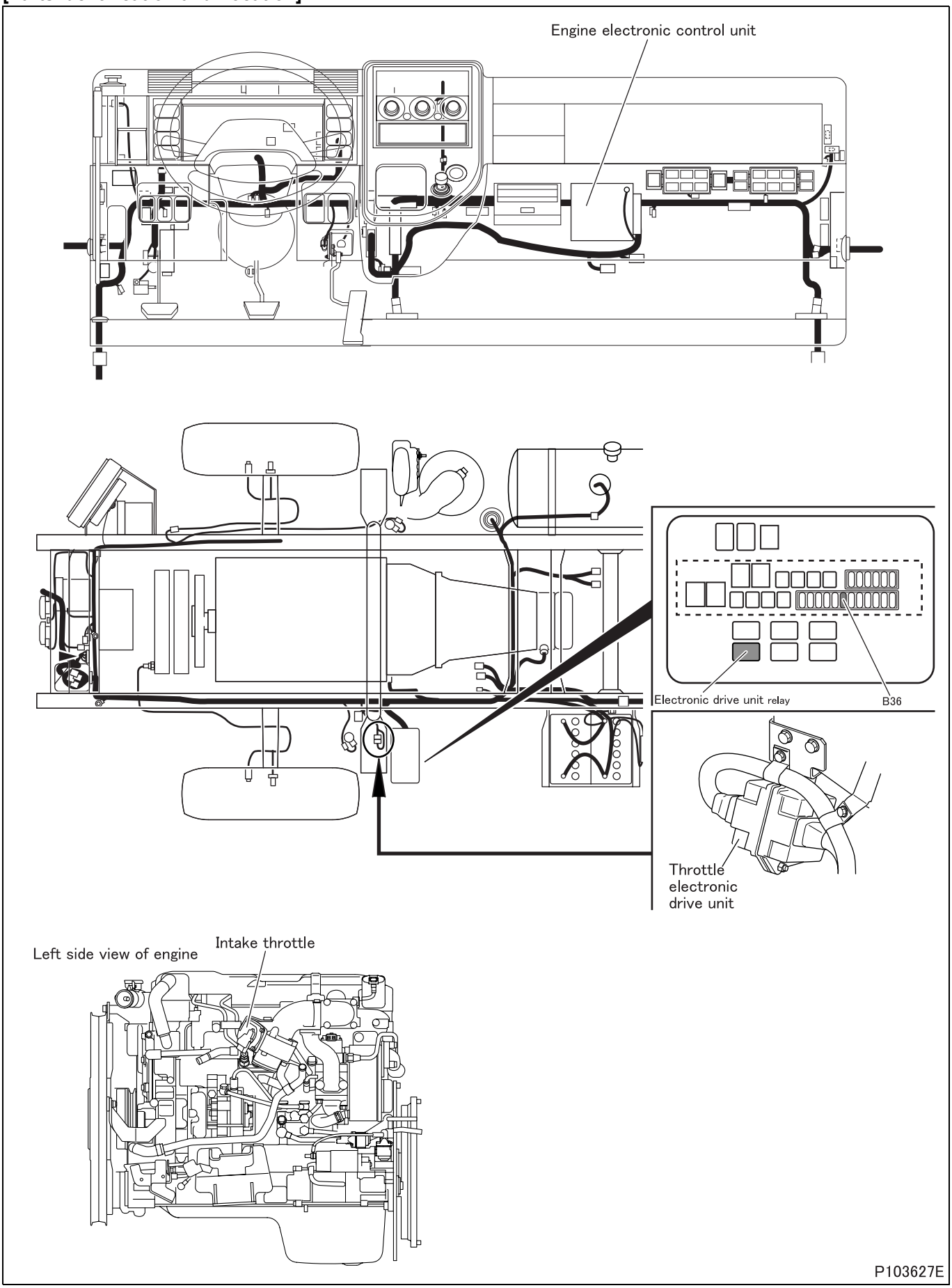
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and throttle actuator
- Malfunction of each connector
- Malfunction of throttle motor (built in throttle actuator)
- Malfunction of throttle position sensor (built in throttle actuator)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A3 “Intake Throttle 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “53: Actual Intake Throttle Position”).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of throttle actuator connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Disconnect connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of relay, go to step 9
		NO	Modify harness.

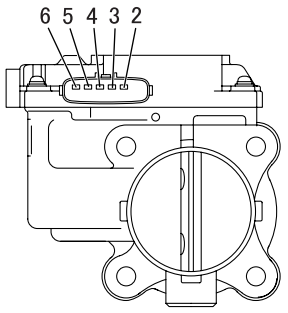
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector terminals. • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor ground: terminal No. 4 and 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between connector terminal No. 10 and 11.
	Inspection condition		Disconnect connector and measure from harness side.
	Requirements		0.3 to 80 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and throttle actuator (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (1): electronic drive unit connector terminal No. 10 - throttle actuator connector terminal No. 6 • Motor (2): electronic drive unit connector terminal No. 11 - throttle actuator connector terminal No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of throttle actuator unit (motor)
	Maintenance item		Measure value of resistance between connector terminal No. 5 and 6.
	Inspection condition		• Keep throttle actuator installed on vehicle. • Disconnect connector and measure throttle actuator side.
	Requirements		0.3 to 80 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of throttle actuator

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of throttle actuator connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 4 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 4 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON • Perform actuator test item No. A3 “Intake Throttle 1”.
	Requirements		• Valve fully closed: 0.5 V • Valve fully opened: 4.375 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and throttle actuator (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 2 - throttle actuator connector terminal No. 2 • Sensor (signal): electronic drive unit connector terminal No. 3 - throttle actuator connector terminal No. 3 • Sensor (ground): electronic drive unit connector terminal No. 4 - throttle actuator connector terminal No. 4
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of throttle actuator, go to step 16
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A3 “Intake Throttle 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “53: Actual Intake Throttle Position”).
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P2120/Flash code: 65
[Monitor]
Failure of accelerator pedal switch
[Fault (outline)]
Plausibility
[Diagnosis check]
- Pedal depressing angle output from accelerator pedal position sensor is monitored for abnormality in ON/OFF status of accelerator switch.

[Code generation condition]
- Accelerator switch remains OFF for 1 second at 30% depression of accelerator pedal. (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

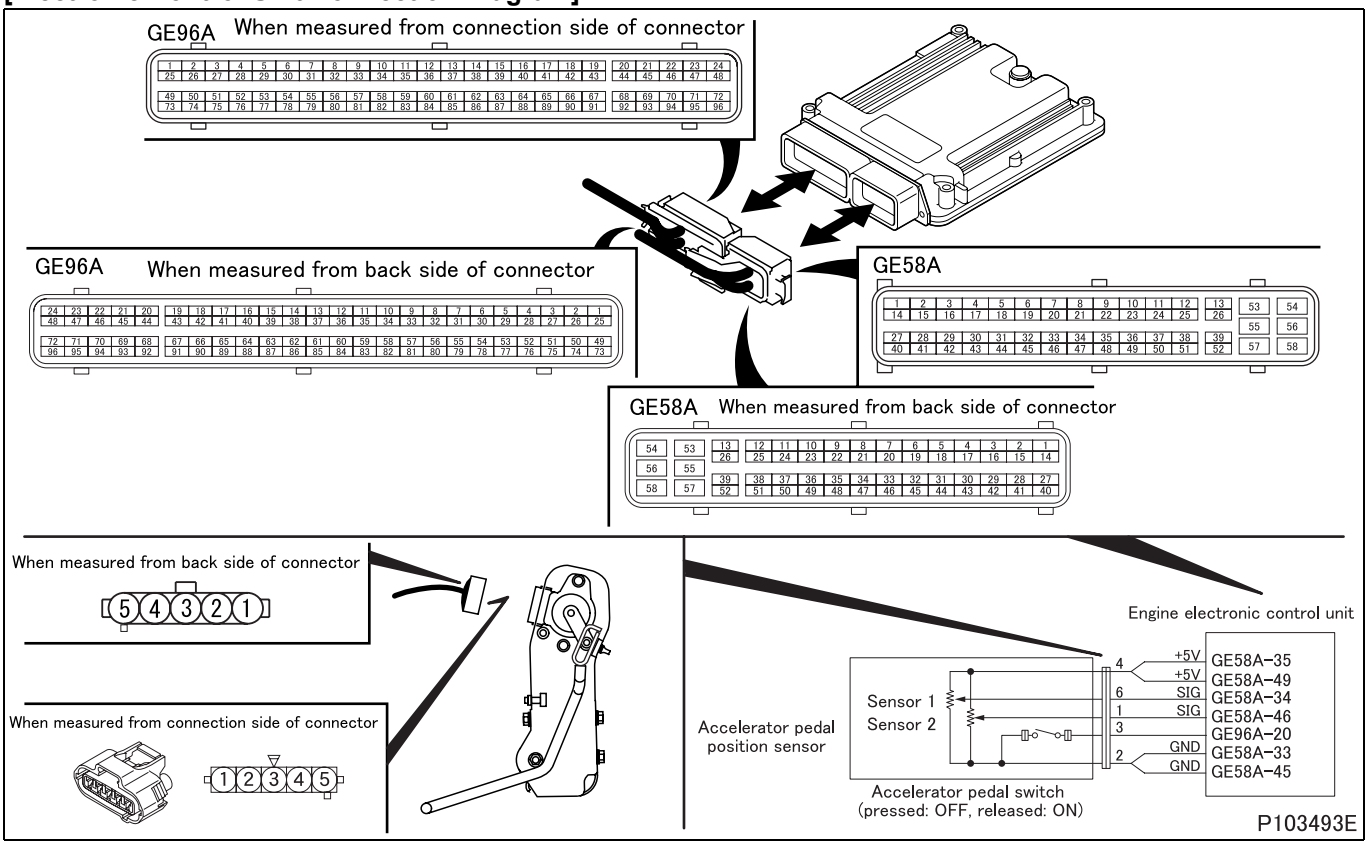
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Effects no special control.

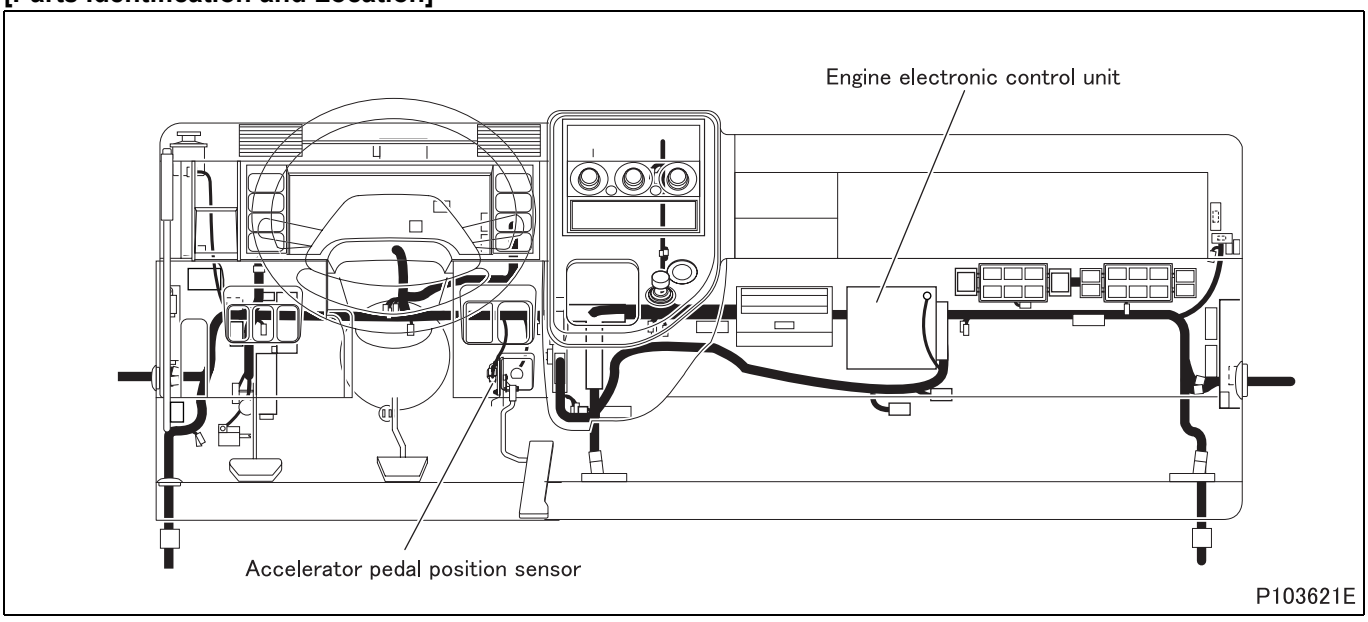
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and accelerator pedal position sensor (switch)
- Malfunction of each connector
- Malfunction of accelerator pedal position sensor (switch)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

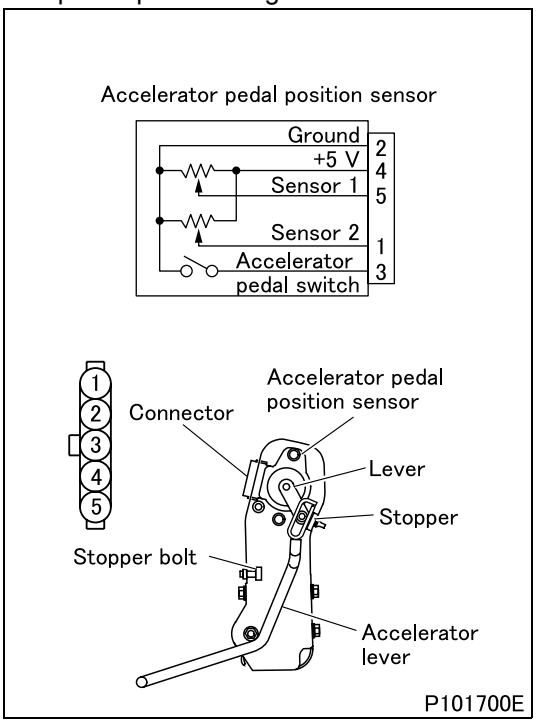
Step 1	Inspection items		Inspection by control data
	Maintenance item		Measure item No. A2 “Accel SW” of Service Data.
	Inspection condition		–
	Requirements		• Accelerator pedal released: ON • Accelerator pedal pressed: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

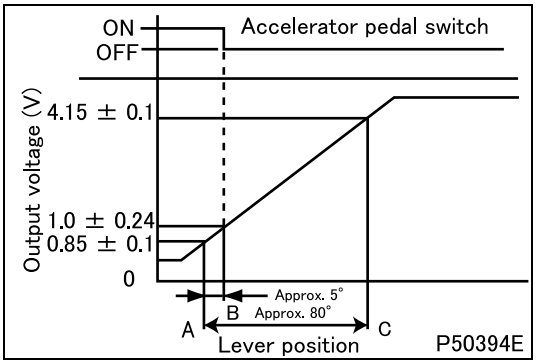
Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of accelerator switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of accelerator switch unit
	Maintenance item		Check continuity between connector terminal No. 2 and 3.
	Inspection condition		Disconnect connector and measure switch side.
	Requirements		• Accelerator pedal released: There is continuity. • Accelerator pedal pressed: There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Adjustment of accelerator pedal position sensor

<Step 4 inspection diagram>





Step 5	Inspection items		Inspection of harness (power supply)
	Maintenance item		Check circuit between accelerator switch connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 20.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness (ground)
	Maintenance item		Check circuit between accelerator switch connector terminal No. 2 and electronic control unit connector (GE58A) terminal No. 33 or 45.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		Measure item No. A2 “Accel SW” of Service Data.
	Inspection condition		–
	Requirements		• Accelerator pedal released: ON • Accelerator pedal pressed: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2135/Flash code: 16, 24, 58
[Monitor]
Failure of accelerator pedal position sensors (1 and 2)
[Fault (outline)]
Gain and offset drift
[Diagnosis check]
- Difference in output voltage between accelerator pedal position sensors 1 and 2 is monitored for deviation from specified value.

[Code generation condition]
- Difference in output voltage between accelerator pedal position sensors 1 and 2 remains more than 10% out of specification for 6 seconds. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Accelerator pedal position sensor 1>
- Accelerator pedal position sensor 2 is computed with accelerator pedal position sensor 1 only.
- In-use performance counter is stopped.
- Related fault check is stopped.

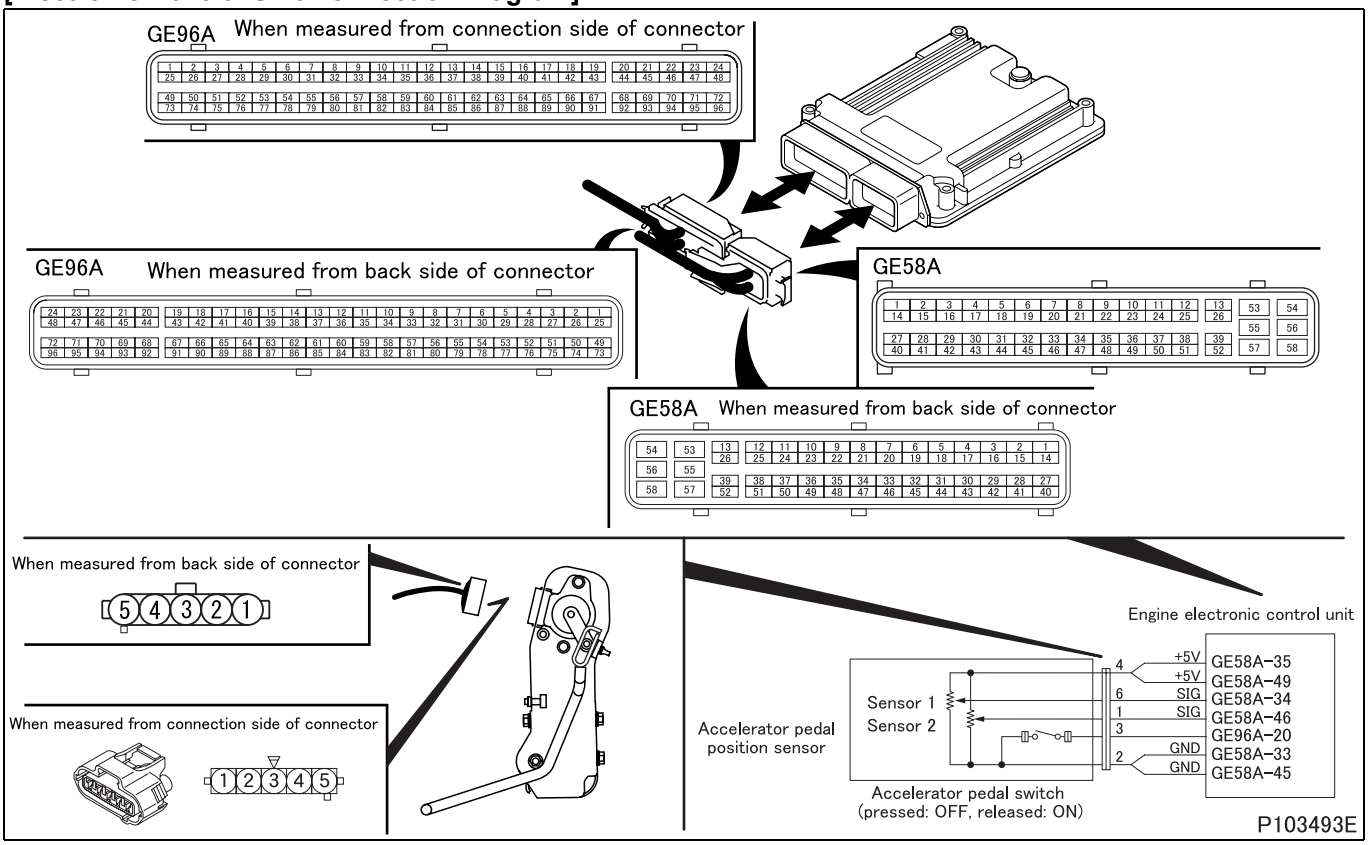
<Accelerator pedal position sensor 2>
- Accelerator pedal position sensor 1 is computed with accelerator pedal position sensor 2 only.
- In-use performance counter is stopped.
- Related fault check is stopped.

<Accelerator pedal position sensors 1 and 2>
- Related fault check is stopped.

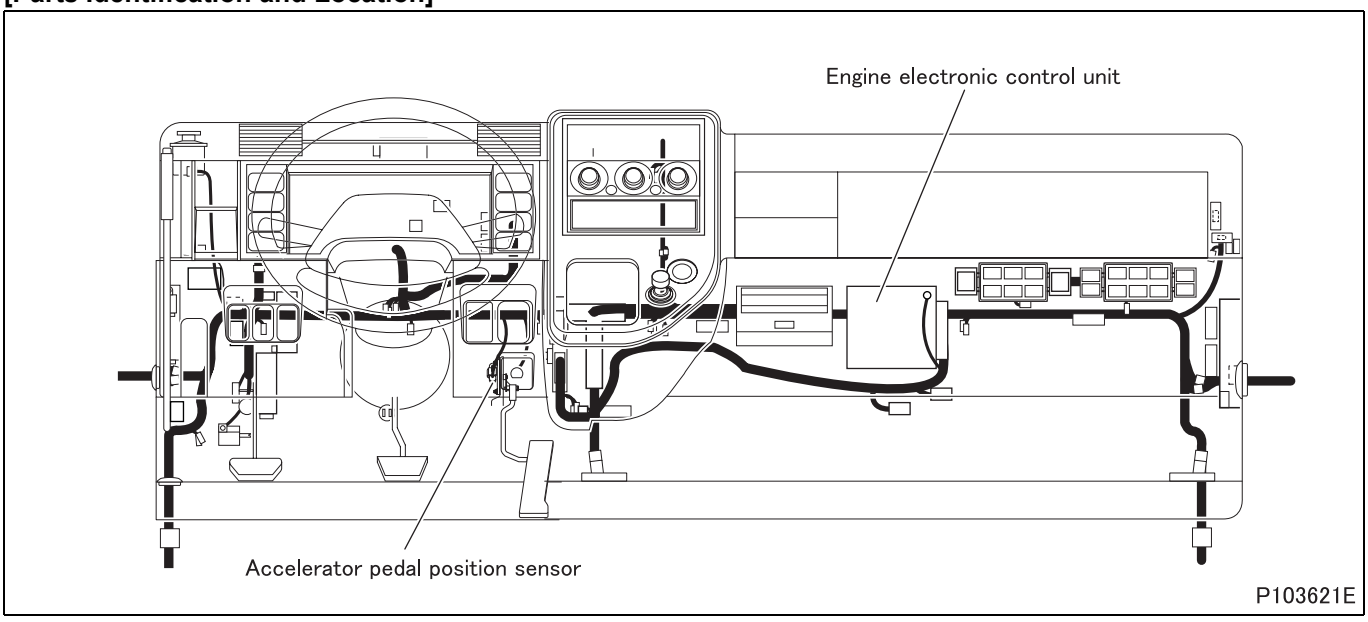
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** Measurement of following service data • Sensor 1: Item “Accelerator Pedal Position 1” • Sensor 2: Item “Accelerator Pedal Position 2” **<Multi-Use Tester used>** Measurement of following service data • Sensor 1: Item No. 40 “Accelerator sensor voltage 1”. • Sensor 2: Item No. 41 “Accelerator sensor voltage 2”.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal released: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal released: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure values of voltage between following connector (GE58A) terminals • Sensor 1: 34 (+) - 33 (–) • Sensor 2: 46 (+) - 45 (–)
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		• Accelerator pedal released: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure values of voltage between following connector (GE58A) terminals • Sensor 1: 35 (+) - 33 (–) • Sensor 2: 49 (+) - 45 (–)
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

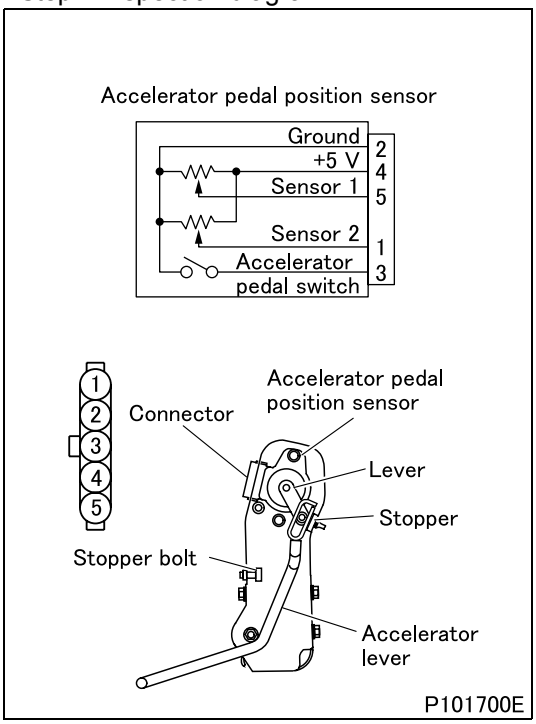
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure values of voltage between following connector (GE58A) terminals • Sensor 1: 33 (+) - 53 (–) • Sensor 2: 45 (+) - 53 (–)
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

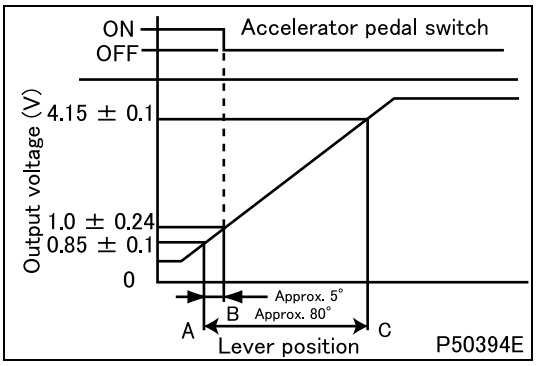
Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure values of voltage between the following connector terminals. • Sensor 1: 5 (+) - 2 (–) • Sensor 2: 1 (+) - 2 (–)
	Inspection condition		Apply voltage DC 5 V across terminals No. 4 (+) and 2 (–).
	Requirements		• Idling position A: 0.85 ± 0.1 V • Accelerator switch operating position B: 1.0 ± 0.24 V • Full-load position C: 4.15 ± 0.1 V A: When accelerator lever is in contact with stopper B: When accelerator pedal is pressed until there is no continuity between terminals 2 and 3. C: When accelerator lever is in contact with full load stopper bolt
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Adjustment of sensor

<Step 7 inspection diagram>





Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between sensor connector terminal No. 4 (+) and 2 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between following connector terminals. • Sensor 1: sensor connector terminal No. 4 - electronic control unit connector (GE58A) terminal No. 35 • Sensor 2: sensor connector terminal No. 4 - electronic control unit connector (GE58A) terminal No. 49
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between following connector terminals. • Sensor 1: sensor connector terminal No. 2 - electronic control unit connector (GE58A) terminal No. 33 • Sensor 2: sensor connector terminal No. 2 - electronic control unit connector (GE58A) terminal No. 45
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between following connector terminals. • Sensor 1: sensor connector terminal No. 5 - electronic control unit connector (GE58A) terminal No. 34 • Sensor 2: sensor connector terminal No. 1 - electronic control unit connector (GE58A) terminal No. 46
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** Measurement of following service data • Sensor 1: Item “Accelerator Pedal Position 1” • Sensor 2: Item “Accelerator Pedal Position 2” **<Multi-Use Tester used>** Measurement of following service data • Sensor 1: Item No. 40 “Accelerator sensor voltage 1”. • Sensor 2: Item No. 41 “Accelerator sensor voltage 2”.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal released: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal released: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2138/Flash code: 58
[Monitor]
Failure of accelerator pedal position sensors (1 and 2)
[Fault (outline)]
- Low signal range check
- High signal range check
- Plausibility

[Diagnosis check]
- Status of accelerator pedal position sensor 1 and 2 is monitored for simultaneous fault.

[Code generation condition]
Diagnosis code is generated under either of the following conditions. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)
- Output signal error (high, low) in accelerator pedal position sensors 1 and 2
- Different errors in accelerator pedal position sensors 1 and 2
- Relative check error between accelerator pedal position sensors 1 and 2

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

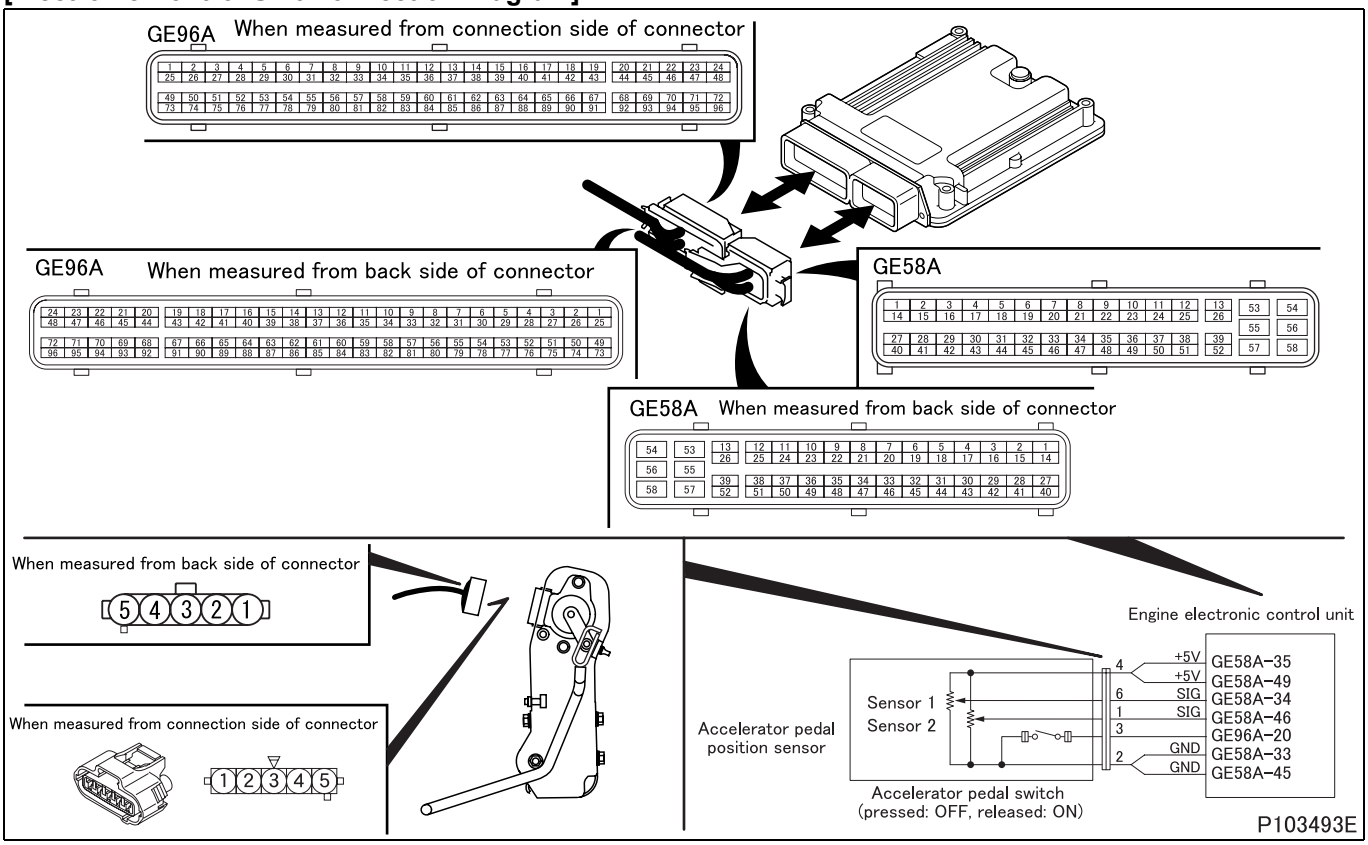
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Accelerator pedal position is computed with accelerator switch.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

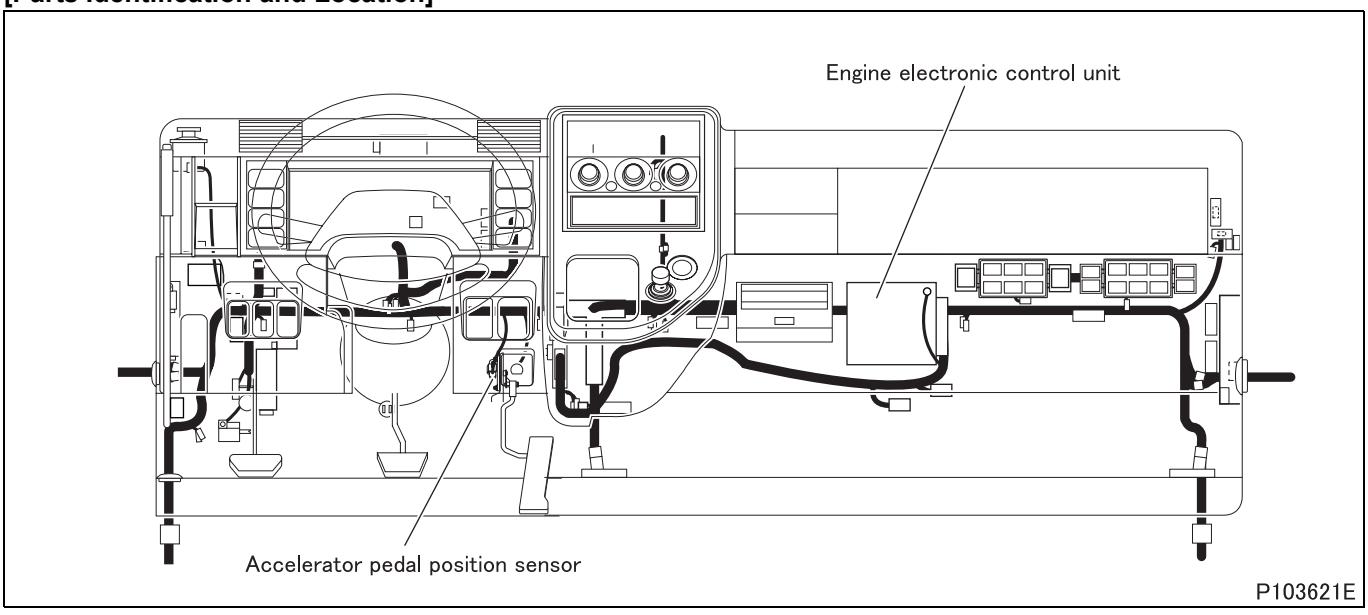
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** Measurement of following service data • Sensor 1: Item “Accelerator Pedal Position 1” • Sensor 2: Item “Accelerator Pedal Position 2” **<Multi-Use Tester used>** Measurement of following service data • Sensor 1: Item No. 40 “Accelerator sensor voltage 1”. • Sensor 2: Item No. 41 “Accelerator sensor voltage 2”.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal released: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal released: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure values of voltage between following connector (GE58A) terminals • Sensor 1: 34 (+) - 33 (–) • Sensor 2: 46 (+) - 45 (–)
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		• Accelerator pedal released: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure values of voltage between following connector (GE58A) terminals • Sensor 1: 35 (+) - 33 (–) • Sensor 2: 49 (+) - 45 (–)
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

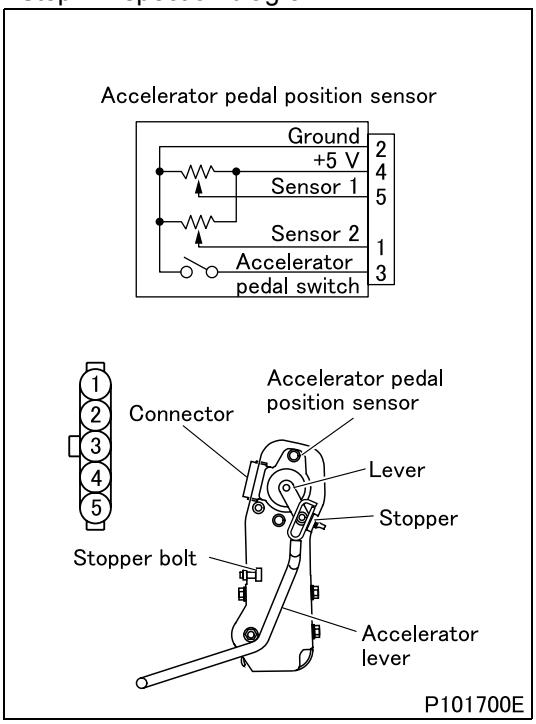
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure values of voltage between following connector (GE58A) terminals • Sensor 1: 33 (+) - 53 (–) • Sensor 2: 45 (+) - 53 (–)
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

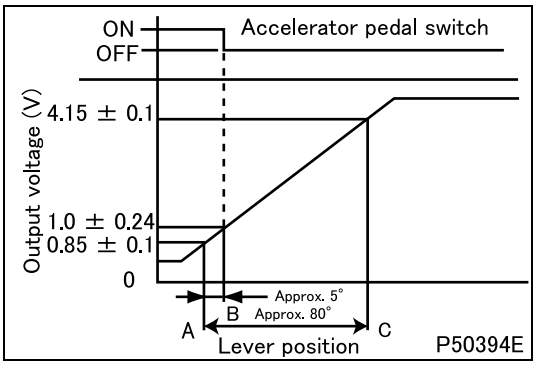
Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure values of voltage between the following connector terminals. • Sensor 1: 5 (+) - 2 (–) • Sensor 2: 1 (+) - 2 (–)
	Inspection condition		Apply voltage DC 5 V across terminals No. 4 (+) and 2 (–).
	Requirements		• Idling position A: 0.85 ± 0.1 V • Accelerator switch operating position B: 1.0 ± 0.24 V • Full-load position C: 4.15 ± 0.1 V A: When accelerator lever is in contact with stopper B: When accelerator pedal is pressed until there is no continuity between terminals 2 and 3. C: When accelerator lever is in contact with full load stopper bolt
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Adjustment of sensor

<Step 7 inspection diagram>





Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between sensor connector terminal No. 4 (+) and 2 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between following connector terminals. • Sensor 1: sensor connector terminal No. 4 - electronic control unit connector (GE58A) terminal No. 35 • Sensor 2: sensor connector terminal No. 4 - electronic control unit connector (GE58A) terminal No. 49
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between following connector terminals. • Sensor 1: sensor connector terminal No. 2 - electronic control unit connector (GE58A) terminal No. 33 • Sensor 2: sensor connector terminal No. 2 - electronic control unit connector (GE58A) terminal No. 45
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between following connector terminals. • Sensor 1: sensor connector terminal No. 5 - electronic control unit connector (GE58A) terminal No. 34 • Sensor 2: sensor connector terminal No. 1 - electronic control unit connector (GE58A) terminal No. 46
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** Measurement of following service data • Sensor 1: Item “Accelerator Pedal Position 1” • Sensor 2: Item “Accelerator Pedal Position 2” **<Multi-Use Tester used>** Measurement of following service data • Sensor 1: Item No. 40 “Accelerator sensor voltage 1”. • Sensor 2: Item No. 41 “Accelerator sensor voltage 2”.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • Accelerator pedal released: 0% • Accelerator pedal pressed: 100% **<Multi-Use Tester used>** • Accelerator pedal released: 0.85 ± 0.1 V • Accelerator pedal pressed: 4.15 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2147/Flash code: 82
[Monitor]
Injector magnetic valve
[Fault (outline)]
Injector short circuit (No.1 and 3 cylinders)
[Diagnosis check]
- Injector magnetic valve (No. 1, 3 cylinders) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 1, 3 cylinders) circuit remains shorted to ground as detected for 3 consecutive cycles (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition).

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

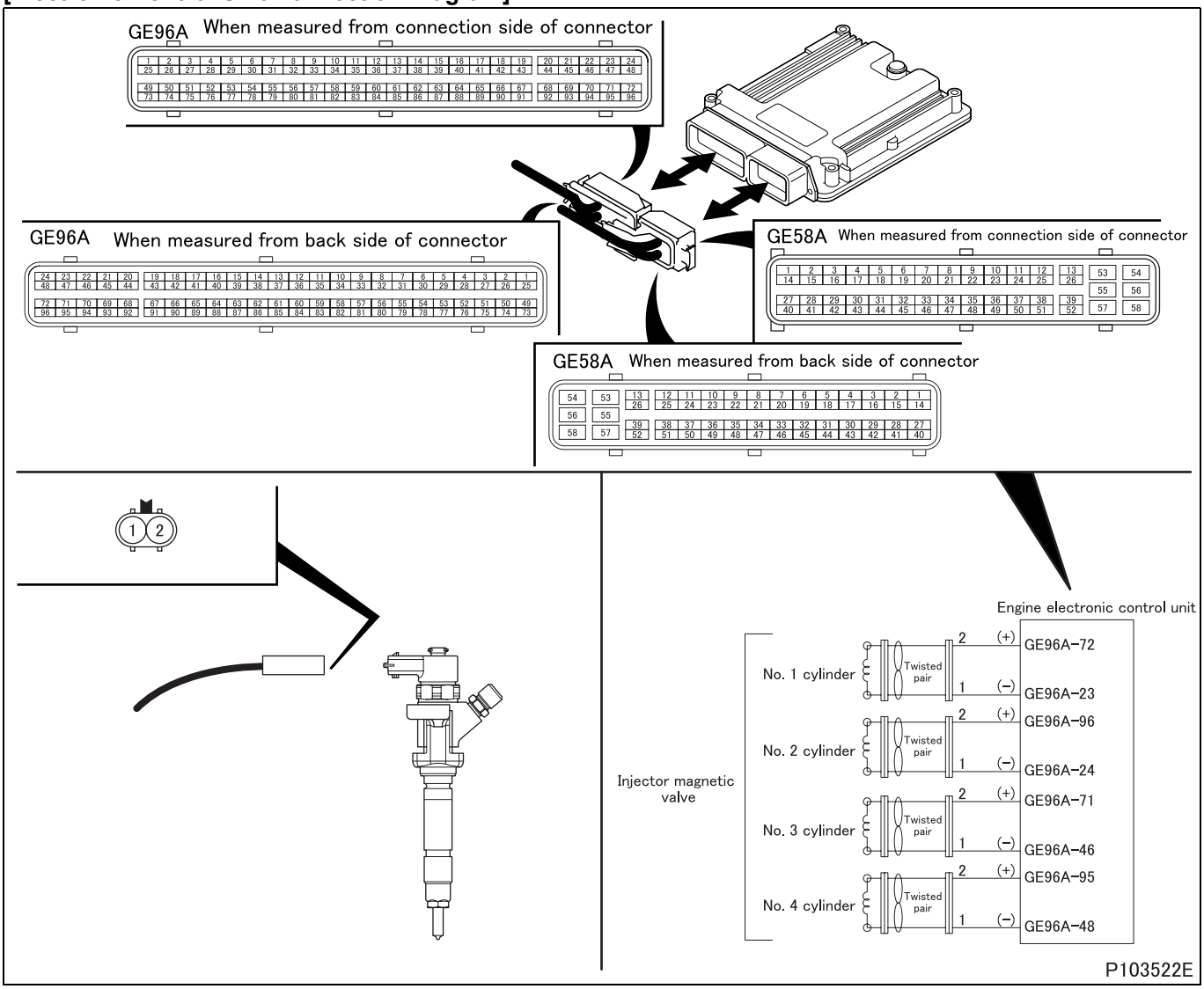
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 1 and No. 4 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Injector actuator test is inhibited.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

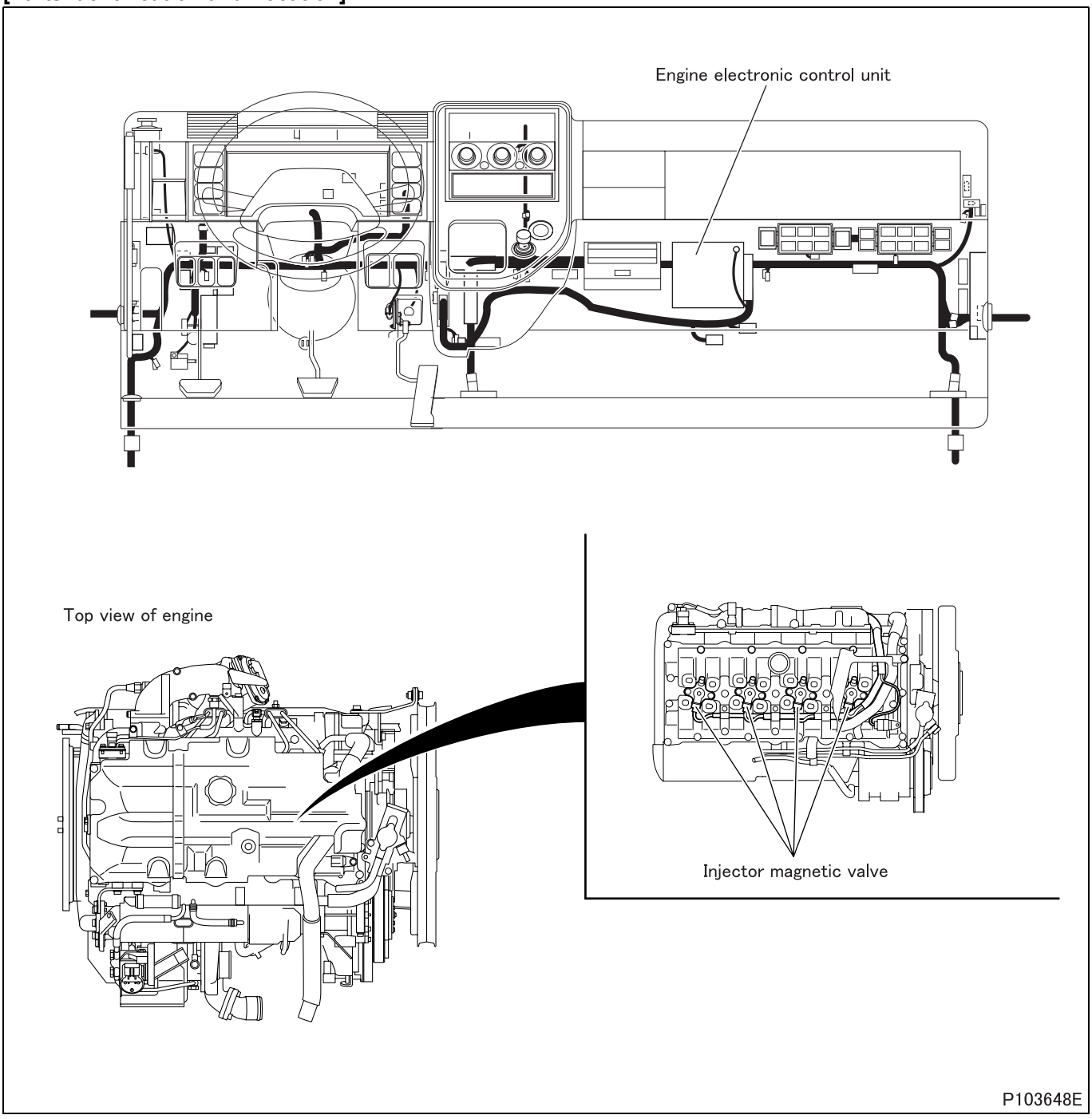
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform following actuator test. • Injector magnetic valve (No. 1 cylinder): Perform item No. BB “Injector Test 1”. • Injector magnetic valve (No. 4 cylinder): Perform item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) or Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

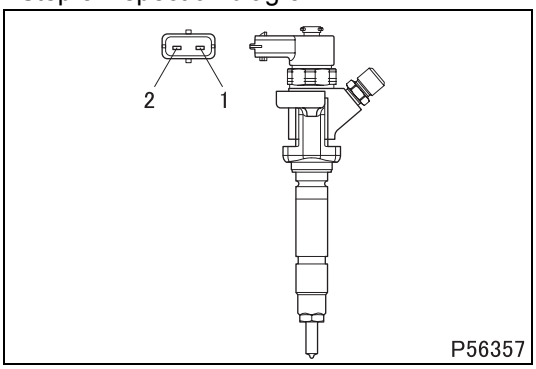
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure values of resistance between following connector (GE96A) terminals • Injector magnetic valve (No. 1 cylinder): 72 (+) - 23 (–) • Injector magnetic valve (No. 3 cylinder): 71 (+) - 46 (–)
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 1 cylinder): magnetic valve terminal No. 2 - electronic control unit (GE96A) terminal No. 72 • Injector magnetic valve (No. 3 cylinder): magnetic valve terminal No. 2 - electronic control unit (GE96A) terminal No. 71
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 1 cylinder): magnetic valve terminal No. 1 - electronic control unit (GE96A) terminal No. 23 • Injector magnetic valve (No. 3 cylinder): magnetic valve terminal No. 1 - electronic control unit (GE96A) terminal No. 46
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform following actuator test. • Injector magnetic valve (No. 1 cylinder): Perform item No. BB “Injector Test 1”. • Injector magnetic valve (No. 4 cylinder): Perform item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) or Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2148/Flash code: 82
[Monitor]
Injector magnetic valve
[Fault (outline)]
Injector short circuit (No. 1 and 3 cylinders)
[Diagnosis check]
- Injector magnetic valve (No. 1, 3 cylinders) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 1, 3 cylinders) circuit remains shorted to power supply as detected for 3 consecutive cycles (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition).

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

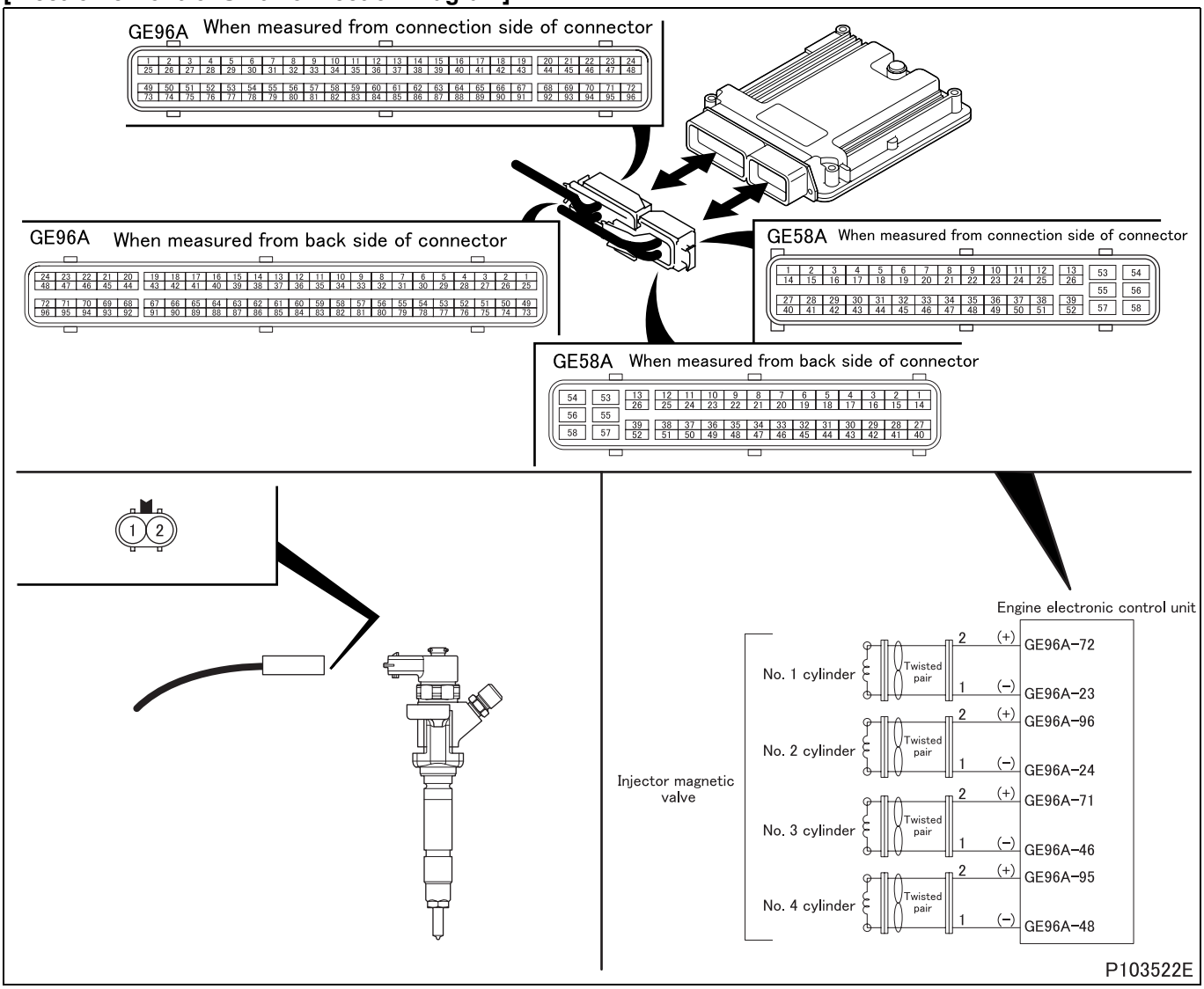
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 1 and No. 4 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Injector actuator test is inhibited.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

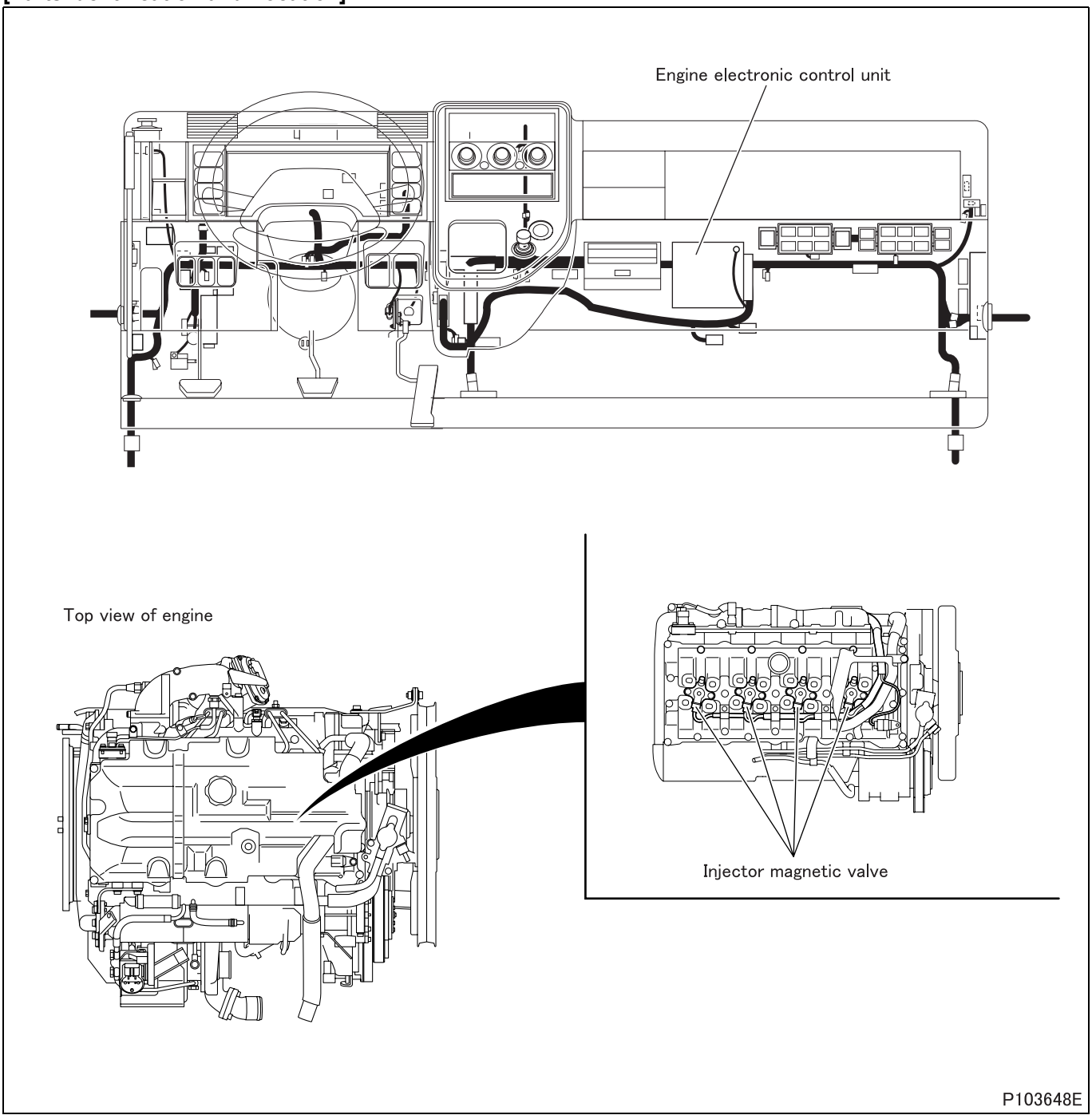
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform following actuator test. • Injector magnetic valve (No. 1 cylinder): Perform item No. BB “Injector Test 1”. • Injector magnetic valve (No. 4 cylinder): Perform item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) or Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

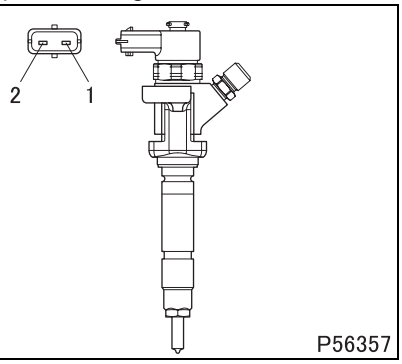
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure values of resistance between following connector (GE96A) terminals • Injector magnetic valve (No. 1 cylinder): 72 (+) - 23 (–) • Injector magnetic valve (No. 3 cylinder): 71 (+) - 46 (–)
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 1 cylinder): magnetic valve terminal No. 2 - electronic control unit (GE96A) terminal No. 72 • Injector magnetic valve (No. 3 cylinder): magnetic valve terminal No. 2 - electronic control unit (GE96A) terminal No. 71
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 1 cylinder): magnetic valve terminal No. 1 - electronic control unit (GE96A) terminal No. 23 • Injector magnetic valve (No. 3 cylinder): magnetic valve terminal No. 1 - electronic control unit (GE96A) terminal No. 46
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform following actuator test. • Injector magnetic valve (No. 1 cylinder): Perform item No. BB “Injector Test 1”. • Injector magnetic valve (No. 4 cylinder): Perform item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 1 cylinder) or Injector (No. 3 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2150/Flash code: 82
[Monitor]
Injector magnetic valve
[Fault (outline)]
Injector short circuit (No. 2 and 4 cylinders)
[Diagnosis check]
- Injector magnetic valve (No. 2, 4 cylinders) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 2, 4 cylinders) circuit remains shorted to ground as detected for 3 consecutive cycles (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition).

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

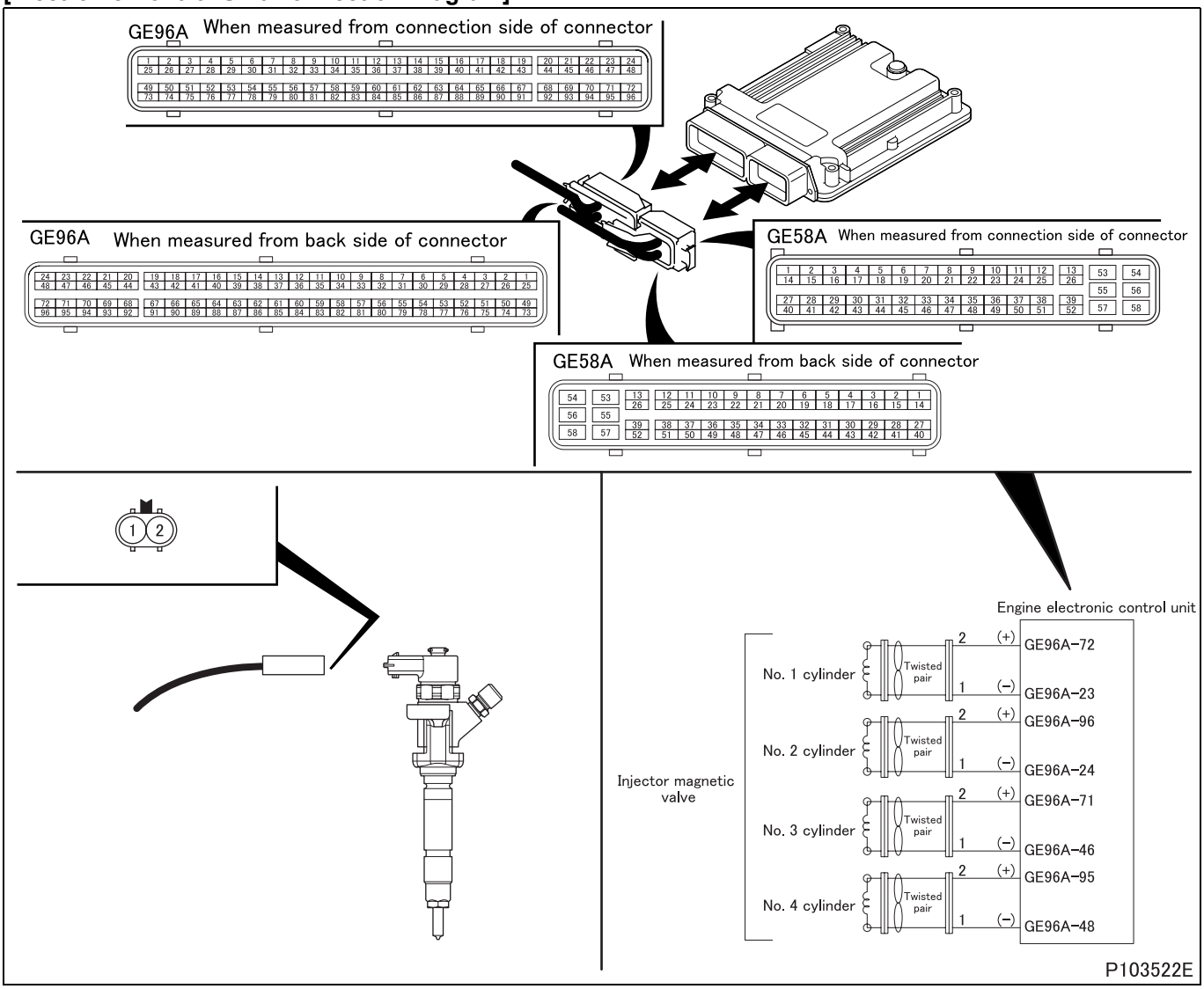
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 2 and No. 3 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Injector actuator test is inhibited.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

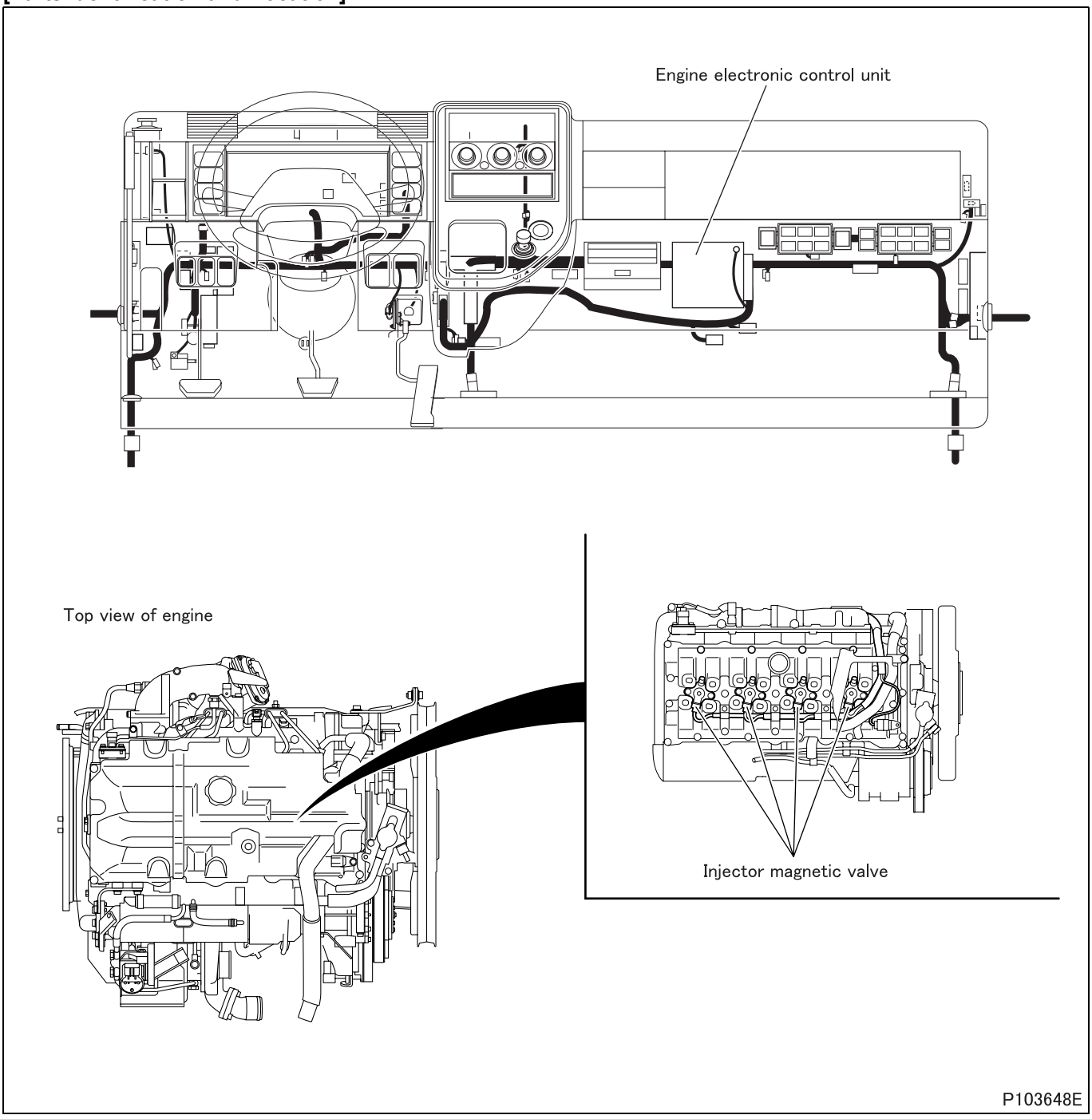
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform following actuator test. • Injector magnetic valve (No. 2 cylinder): Perform item No. BD “Injector Test 3”. • Injector magnetic valve (No. 4 cylinder): Perform item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) or Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

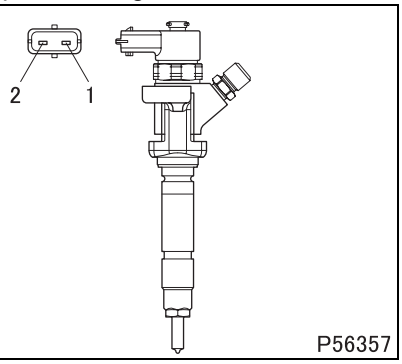
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure values of resistance between following connector (GE96A) terminals • Injector magnetic valve (No. 2 cylinder): 96 (+) - 24 (–) • Injector magnetic valve (No. 4 cylinder): 95 (+) - 48 (–)
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 2 cylinder): magnetic valve terminal No. 2 - electronic control unit (GE96A) terminal No. 96 • Injector magnetic valve (No. 4 cylinder): magnetic valve terminal No. 2 - electronic control unit (GE96A) terminal No. 95
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 2 cylinder): magnetic valve terminal No. 1 - electronic control unit (GE96A) terminal No. 24 • Injector magnetic valve (No. 4 cylinder): magnetic valve terminal No. 1 - electronic control unit (GE96A) terminal No. 48
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform following actuator test. • Injector magnetic valve (No. 2 cylinder): Perform item No. BD “Injector Test 3”. • Injector magnetic valve (No. 4 cylinder): Perform item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) or Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2151/Flash code: 82
[Monitor]
Injector magnetic valve
[Fault (outline)]
Injector short circuit (No. 2 and 4 cylinders)
[Diagnosis check]
- Injector magnetic valve (No. 2, 4 cylinders) circuit is monitored for fault.

[Code generation condition]
- Injector magnetic valve (No. 2, 4 cylinders) circuit remains shorted to power supply as detected for 3 consecutive cycles (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition).

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

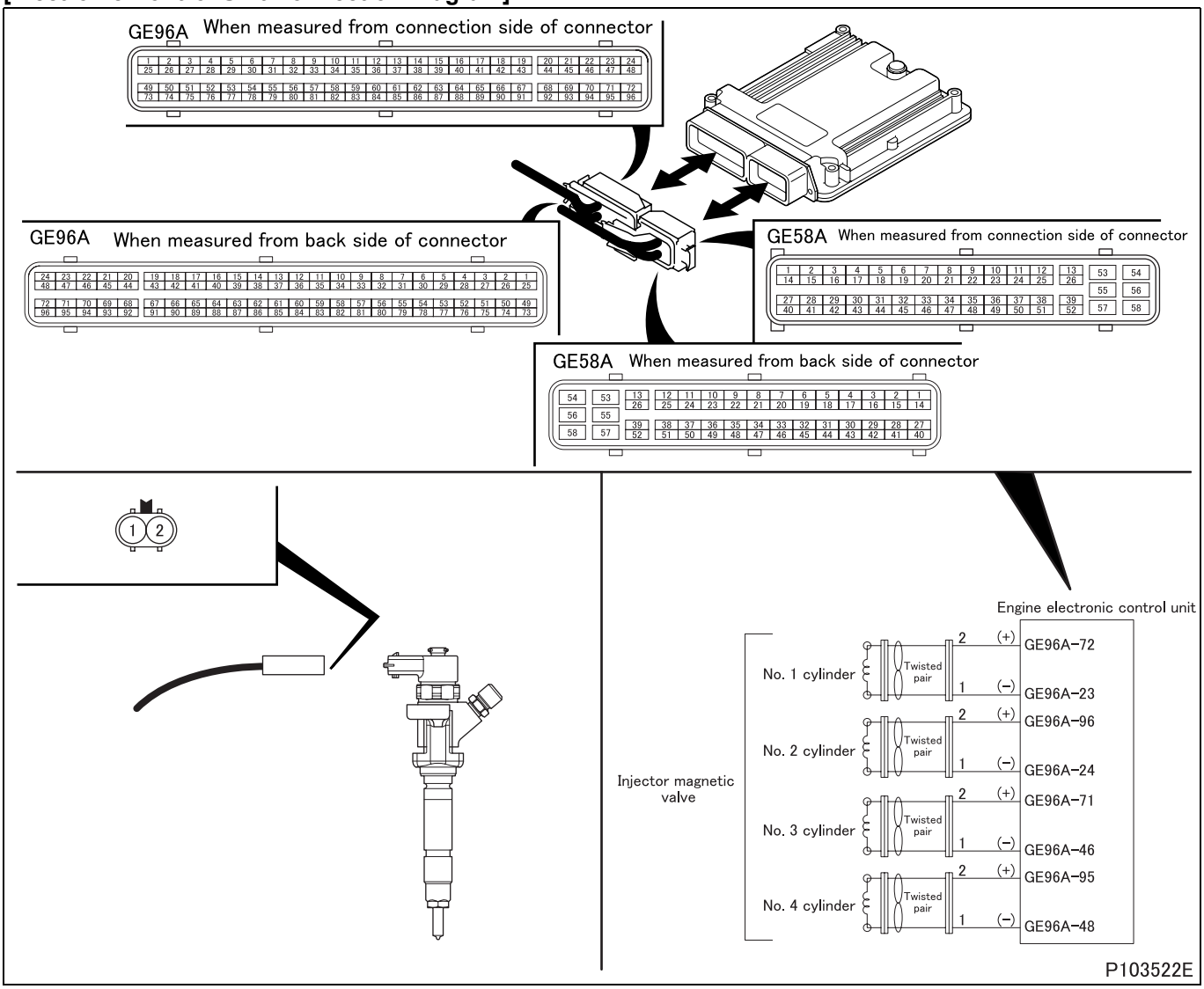
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Injector magnetic valve (No. 2 and No. 3 cylinder) is stopped.
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Misfire detection is stopped.
- Auto cruise control stopped
- Diesel particulate filter regeneration is stopped.
- Injector actuator test is inhibited.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

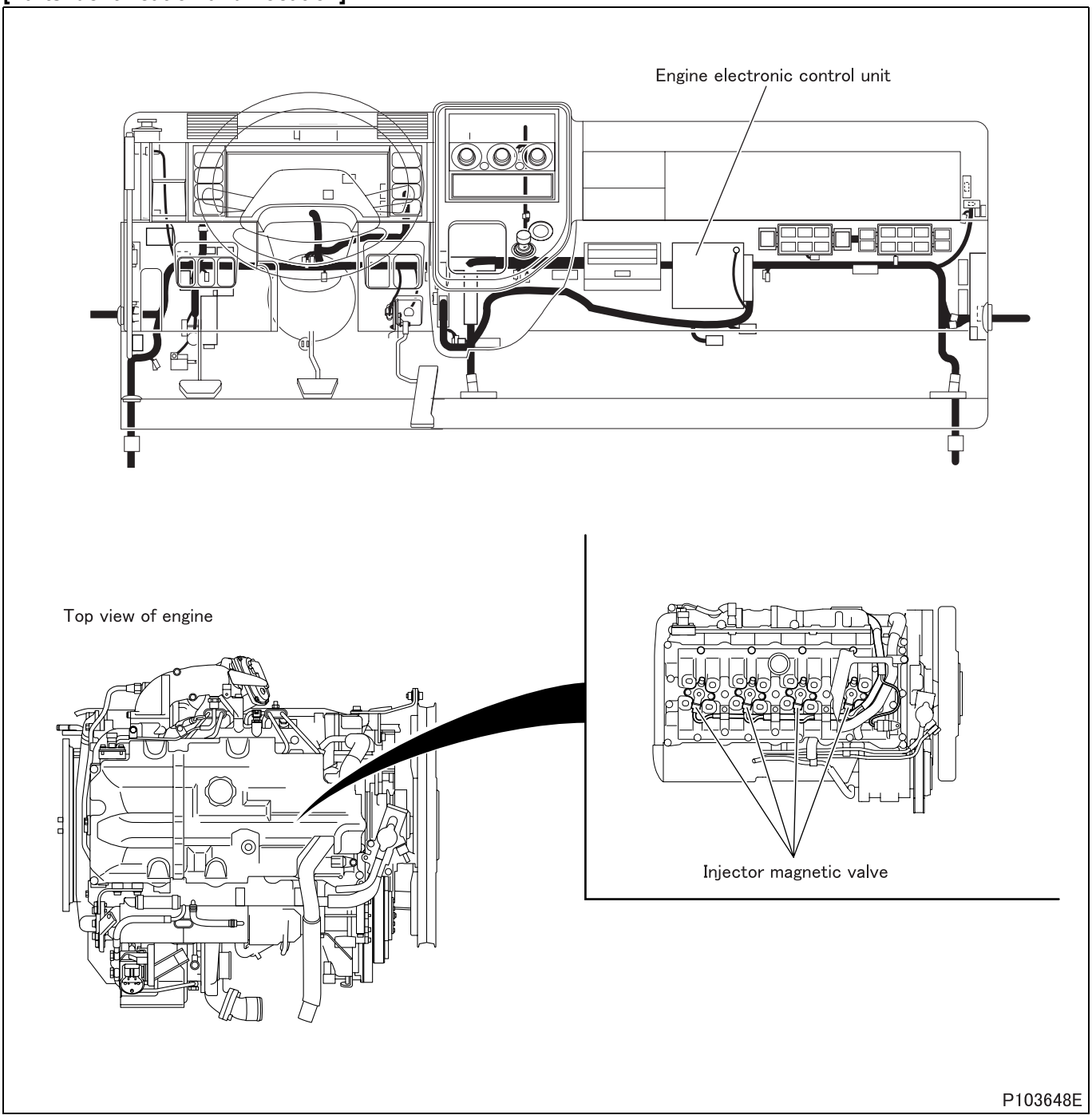
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and injector magnetic valve
- Malfunction of each connector
- Malfunction of injector magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform following actuator test. • Injector magnetic valve (No. 2 cylinder): Perform item No. BD “Injector Test 3”. • Injector magnetic valve (No. 4 cylinder): Perform item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) or Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

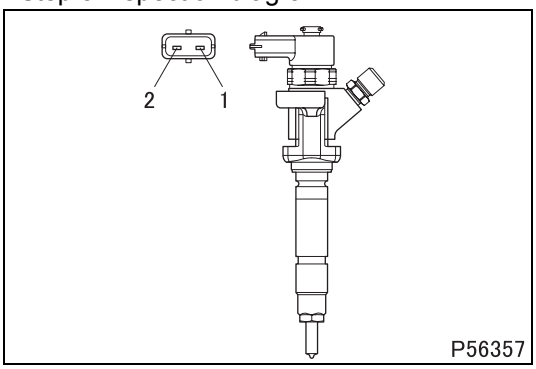
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure values of resistance between following connector (GE96A) terminals • Injector magnetic valve (No. 2 cylinder): 96 (+) - 24 (–) • Injector magnetic valve (No. 4 cylinder): 95 (+) - 48 (–)
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of injector magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of injector magnetic valve unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		–
	Requirements		0.255 ± 0.04 Ω (20°C {68°F})
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of injector

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 2 cylinder): magnetic valve terminal No. 2 - electronic control unit (GE96A) terminal No. 96 • Injector magnetic valve (No. 4 cylinder): magnetic valve terminal No. 2 - electronic control unit (GE96A) terminal No. 95
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between injector magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between following connector terminals. • Injector magnetic valve (No. 2 cylinder): magnetic valve terminal No. 1 - electronic control unit (GE96A) terminal No. 24 • Injector magnetic valve (No. 4 cylinder): magnetic valve terminal No. 1 - electronic control unit (GE96A) terminal No. 48
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform following actuator test. • Injector magnetic valve (No. 2 cylinder): Perform item No. BD “Injector Test 3”. • Injector magnetic valve (No. 4 cylinder): Perform item No. BC “Injector Test 2”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.
	Requirements		Injector (No. 2 cylinder) or Injector (No. 4 cylinder) stops injection and engine vibrations become slightly larger.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2169/Flash code: 93
[Monitor]
Failure of exhaust shutter 3-way magnetic valve
[Fault (outline)]
Open circuit
[Diagnosis check]
- Exhaust shutter 3-way magnetic valve circuit is monitored for fault.

[Code generation condition]
- Exhaust shutter 3-way magnetic valve circuit remains open or overloaded as detected for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.
- Fault diagnosis is performed each time when the control is halted.

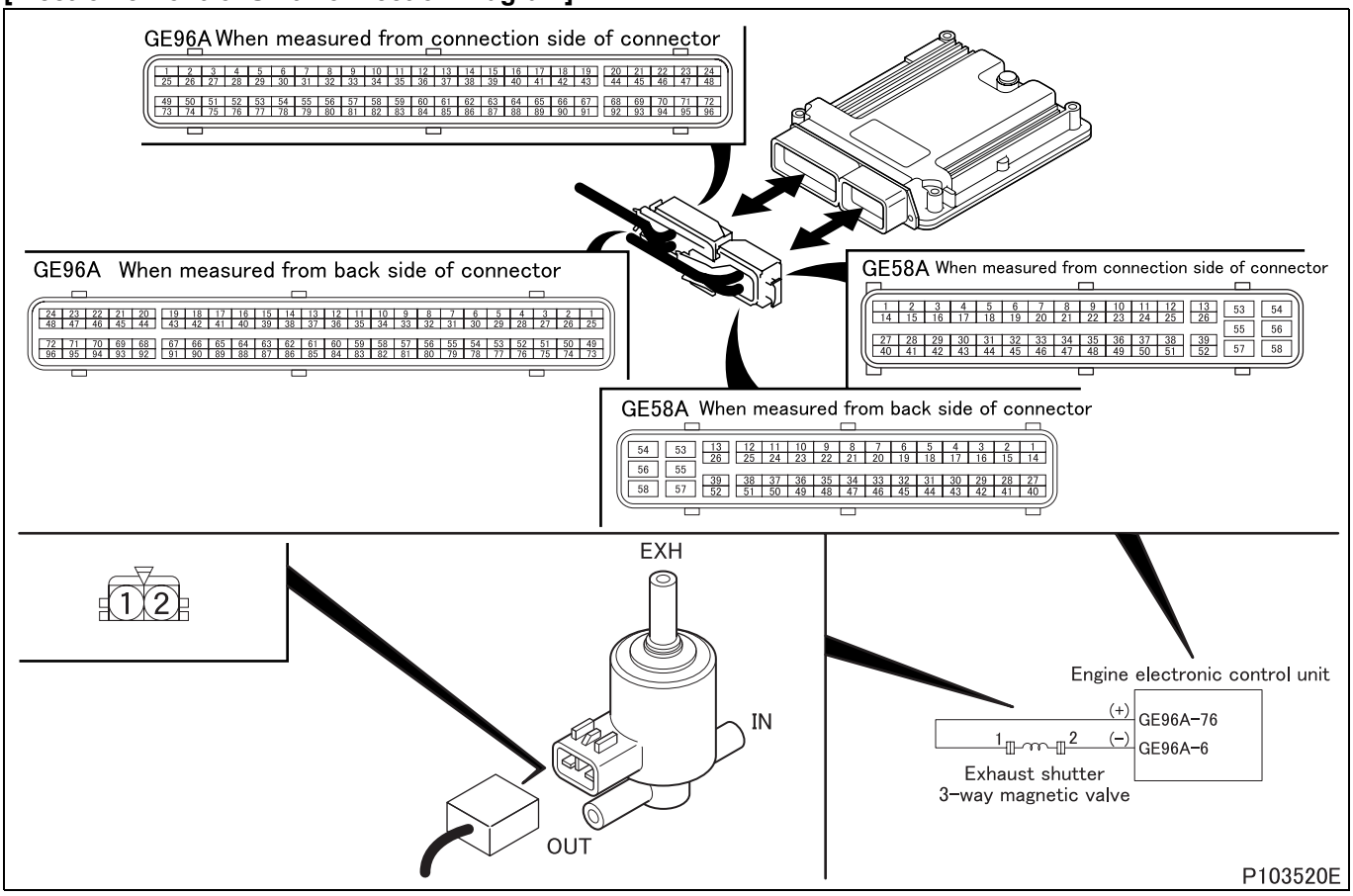
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Auxiliary brake control is stopped.
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

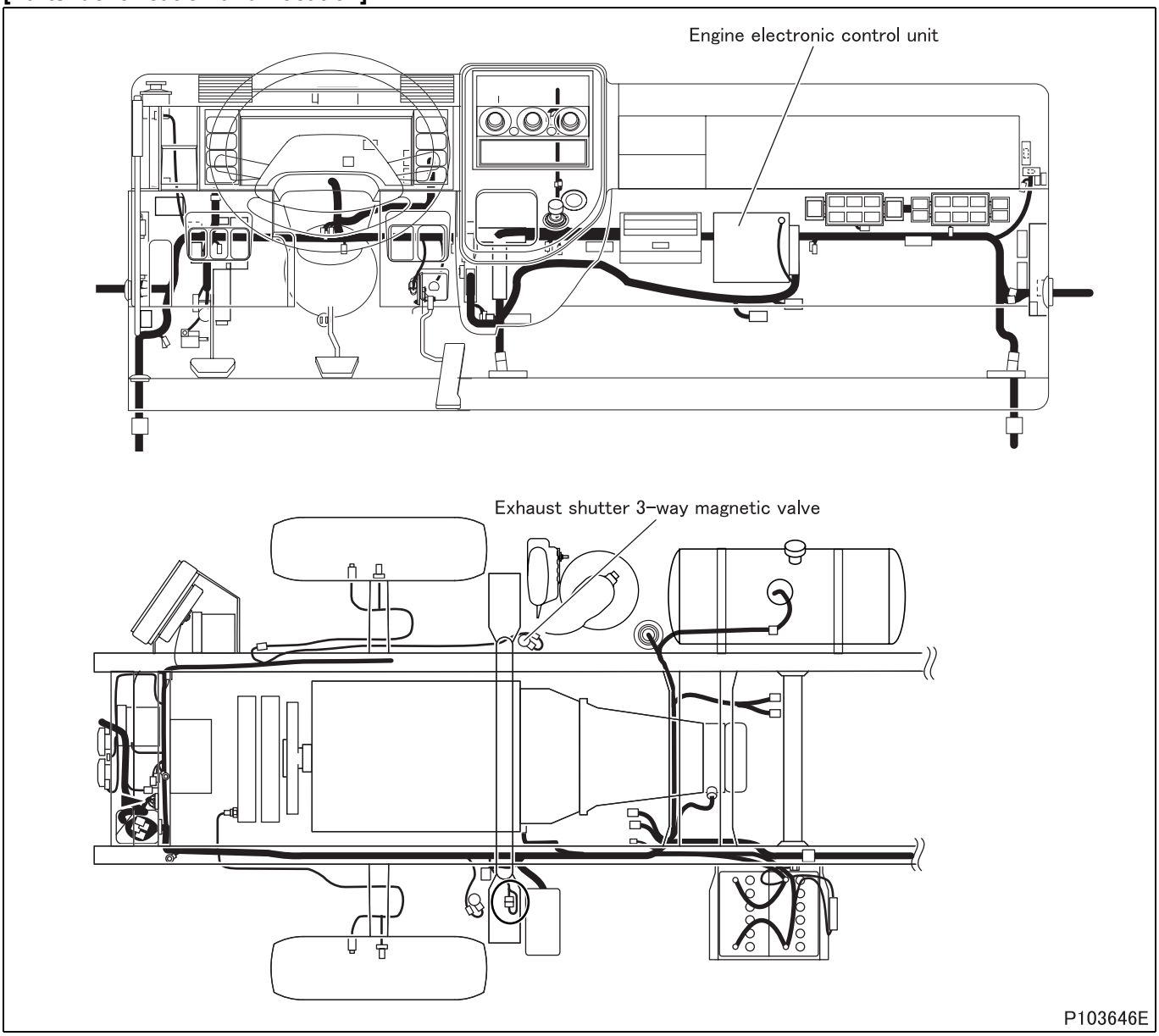
[Probable cause of trouble]
- Open-circuit of harness between electronic control unit and exhaust shutter 3-way magnetic valve
- Malfunction of each connector
- Malfunction of exhaust shutter 3-way magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

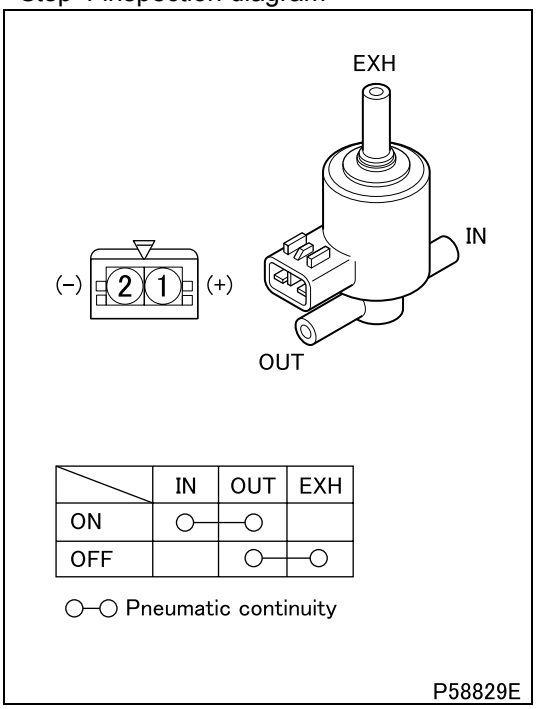
Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 6 and 76.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		48 Ω or more
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of 3-way magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of 3-way magnetic valve unit
	Maintenance item		Measure minimum operating voltage when 3-way magnetic valve operates (judge by operation sound).
	Inspection condition		Gradually increase from zero the voltage applied to terminals No. 1 (+) and 2 (–).
	Requirements		11 V or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of 3-way magnetic valve

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 76.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 1 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AA “Auxiliary Brake M/V 1”.
	Inspection condition		Starter switch: ON
	Requirements		3-way magnetic valve operation sound is noted
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2170/Flash code: 93
[Monitor]
Failure of exhaust shutter 3-way magnetic valve
[Fault (outline)]
Short circuit ground
[Diagnosis check]
- Exhaust shutter 3-way magnetic valve circuit is monitored for fault.

[Code generation condition]
- Exhaust shutter 3-way magnetic valve circuit remains shorted to ground as detected for 1 second. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is halted.

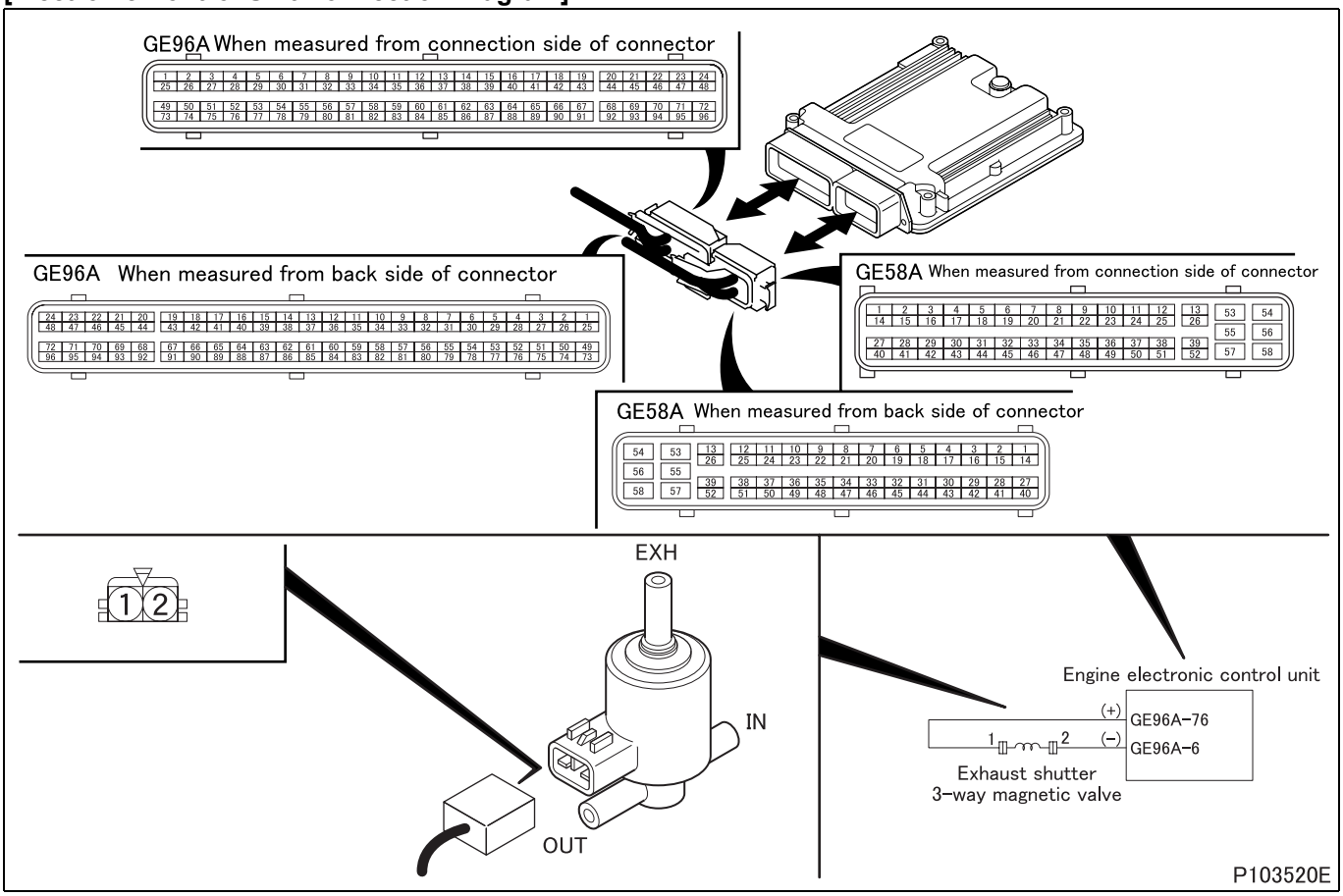
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Auxiliary brake control is stopped.
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

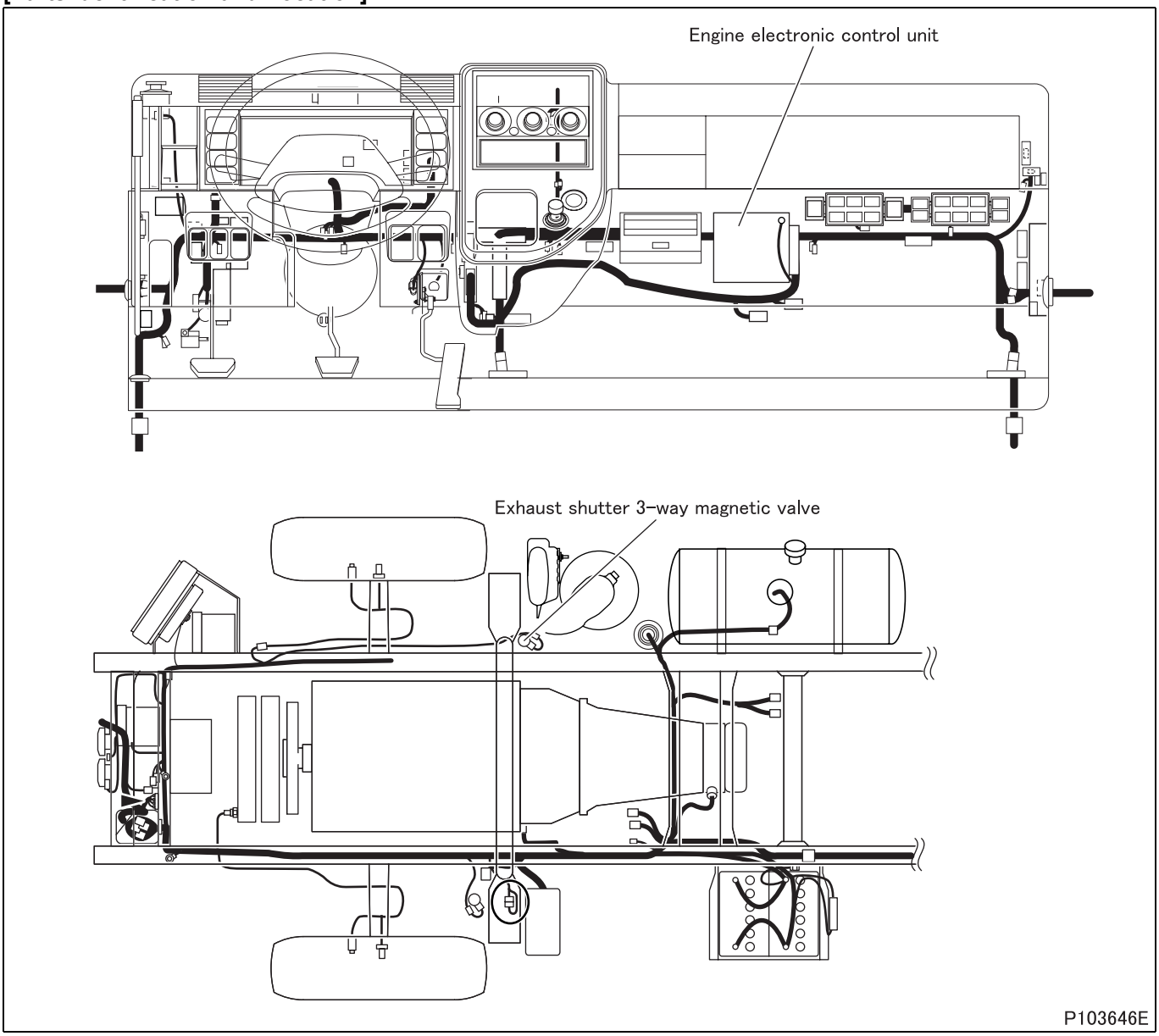
[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and exhaust shutter 3-way magnetic valve
- Malfunction of each connector
- Malfunction of exhaust shutter 3-way magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

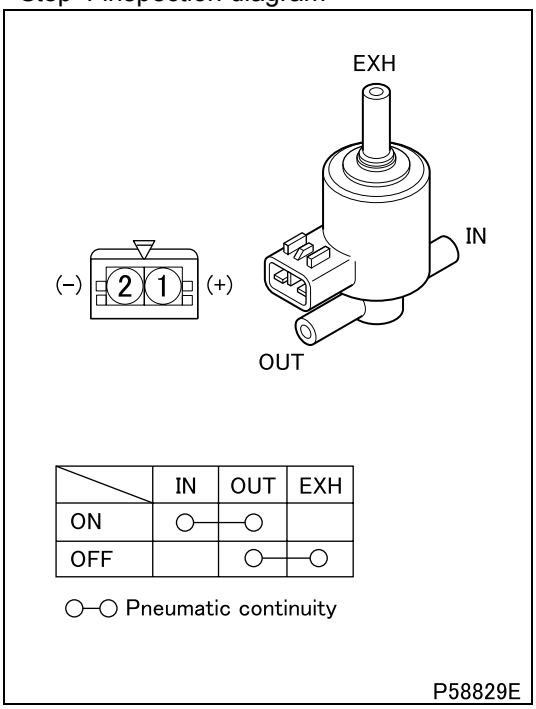
Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 6 and 76.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		48 Ω or more
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of 3-way magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of 3-way magnetic valve unit
	Maintenance item		Measure minimum operating voltage when 3-way magnetic valve operates (judge by operation sound).
	Inspection condition		Gradually increase from zero the voltage applied to terminals No. 1 (+) and 2 (–).
	Requirements		11 V or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of 3-way magnetic valve

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 76.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 1 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AA “Auxiliary Brake M/V 1”.
	Inspection condition		Starter switch: ON
	Requirements		3-way magnetic valve operation sound is noted
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2171/Flash code: 93
[Monitor]
Failure of exhaust shutter 3-way magnetic valve
[Fault (outline)]
Short circuit battery
[Diagnosis check]
- Exhaust shutter 3-way magnetic valve circuit is monitored for fault.

[Code generation condition]
- Exhaust shutter 3-way magnetic valve circuit remains shorted to power supply as detected for 1 second. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is initiated.

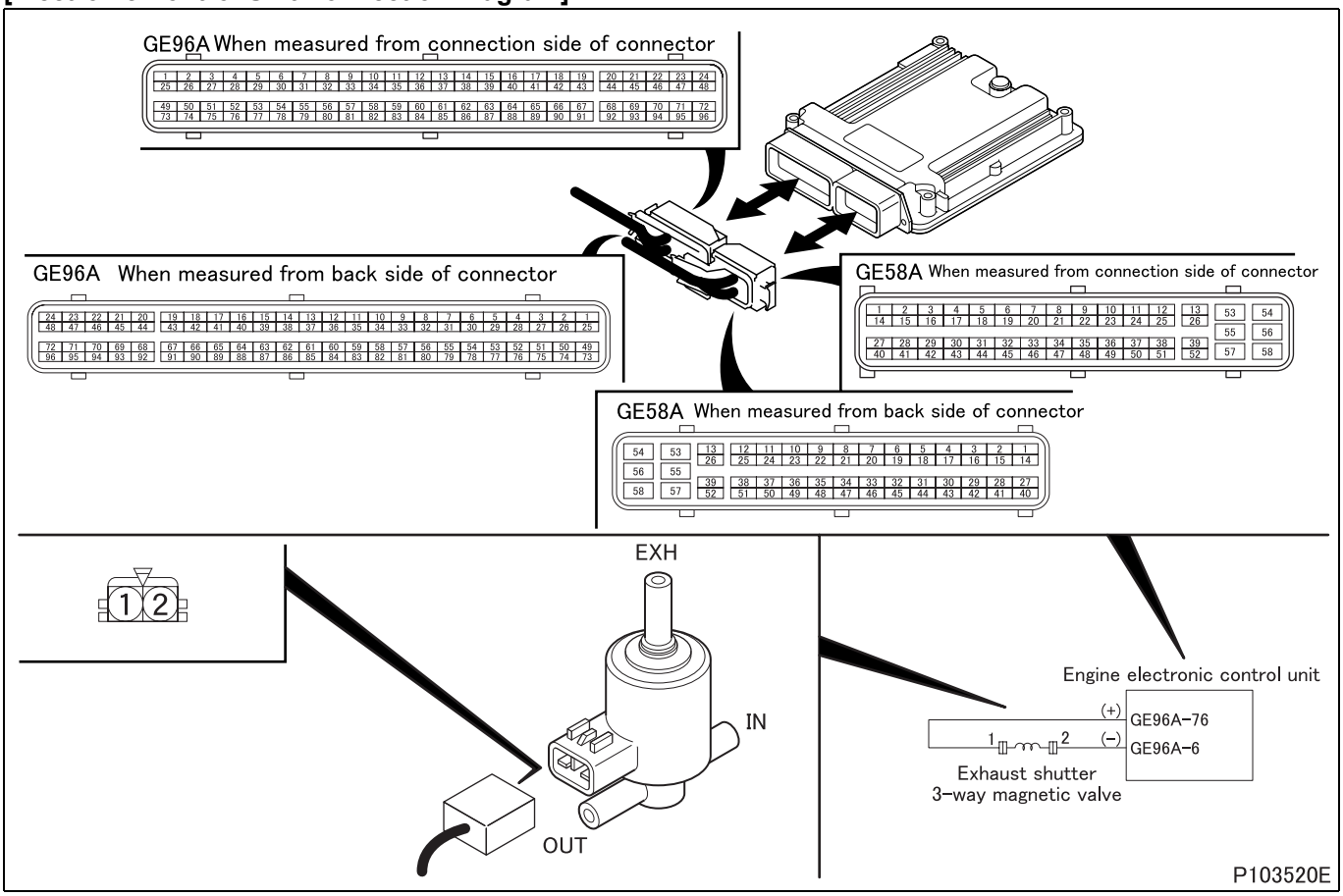
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Auxiliary brake control is stopped.
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

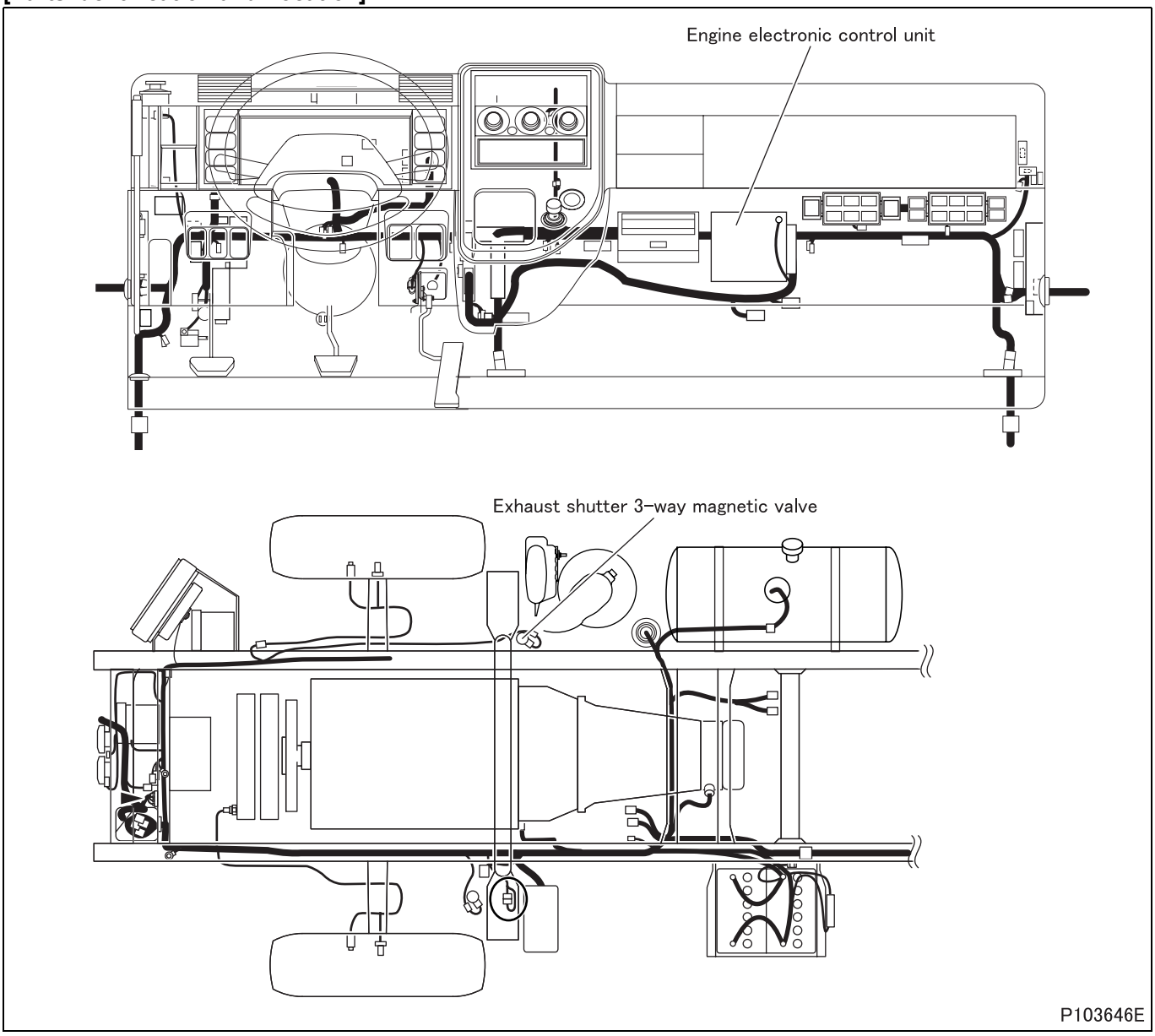
[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and exhaust shutter 3-way magnetic valve
- Malfunction of each connector
- Malfunction of exhaust shutter 3-way magnetic valve
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

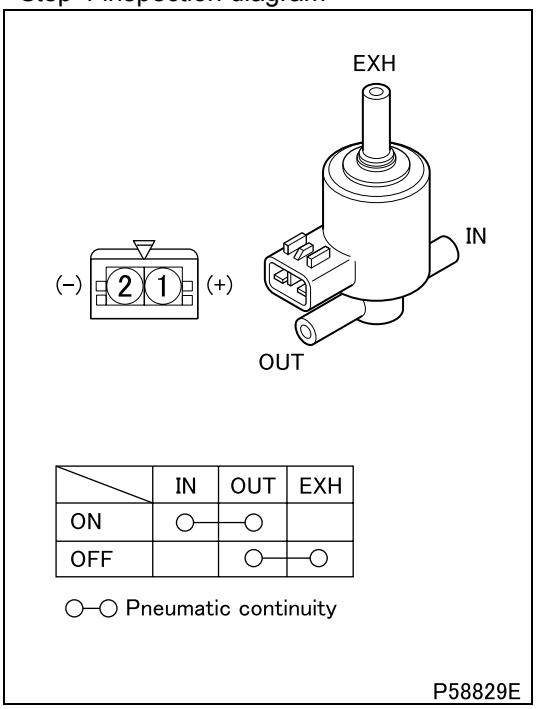
Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 6 and 76.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		48 Ω or more
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of 3-way magnetic valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of 3-way magnetic valve unit
	Maintenance item		Measure minimum operating voltage when 3-way magnetic valve operates (judge by operation sound).
	Inspection condition		Gradually increase from zero the voltage applied to terminals No. 1 (+) and 2 (–).
	Requirements		11 V or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of 3-way magnetic valve

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 76.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (power supply)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 1 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between exhaust shutter 3-way magnetic valve and electronic control unit (ground)
	Maintenance item		Check circuit between exhaust shutter 3-way magnetic valve connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. AA “Auxiliary Brake M/V 1”.
	Inspection condition		Starter switch: ON
	Requirements		3-way magnetic valve operation sound is noted
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2184/Flash code: 21
[Monitor]
Failure of water temperature sensor 2
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Output voltage of water temperature sensor 2 is monitored.

[Code generation condition]
- Voltage of water temperature sensor 2 remains below 0.1 V for 1 second. (sensor temperature: 150°C {302°F} or more) (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

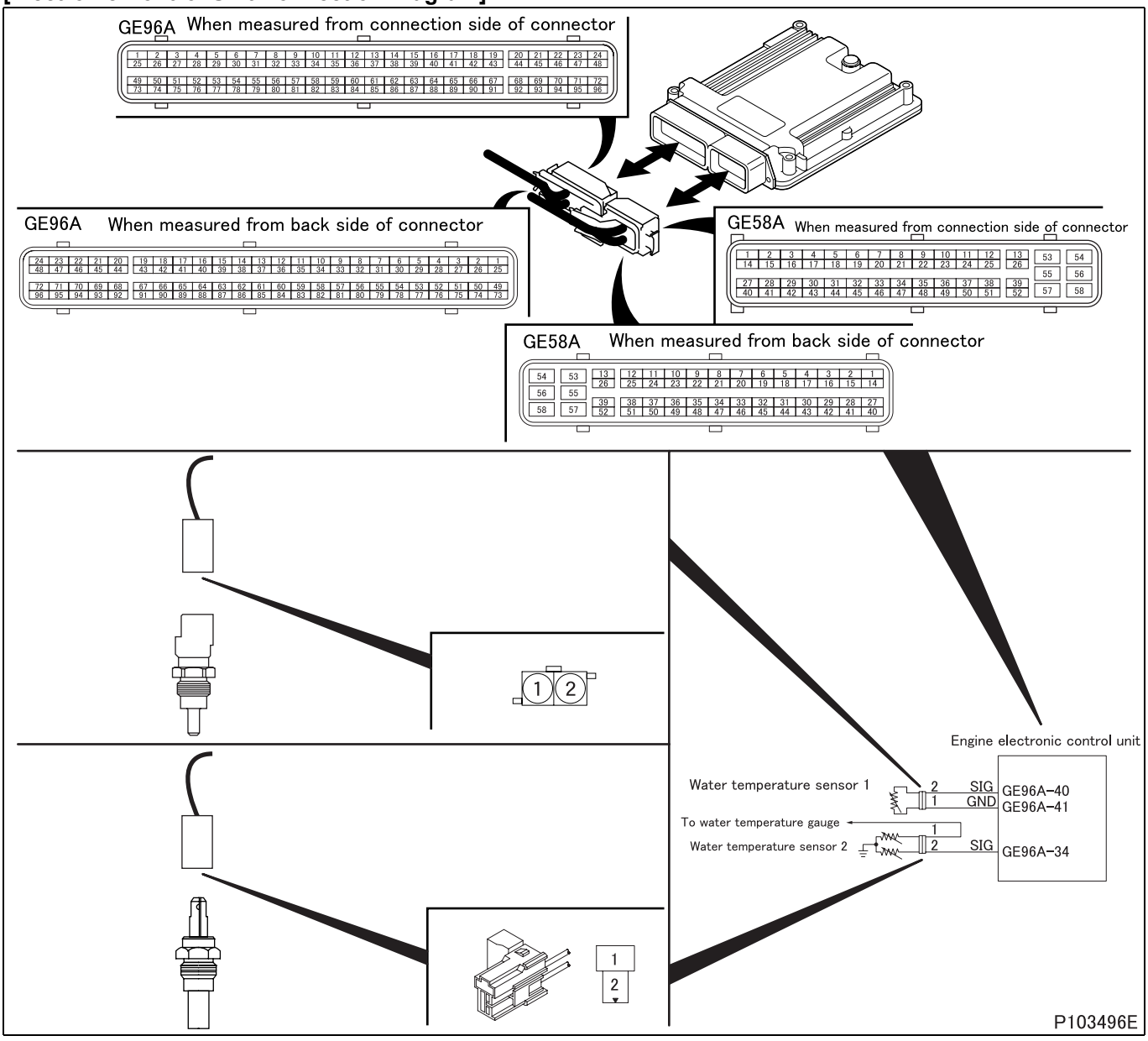
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

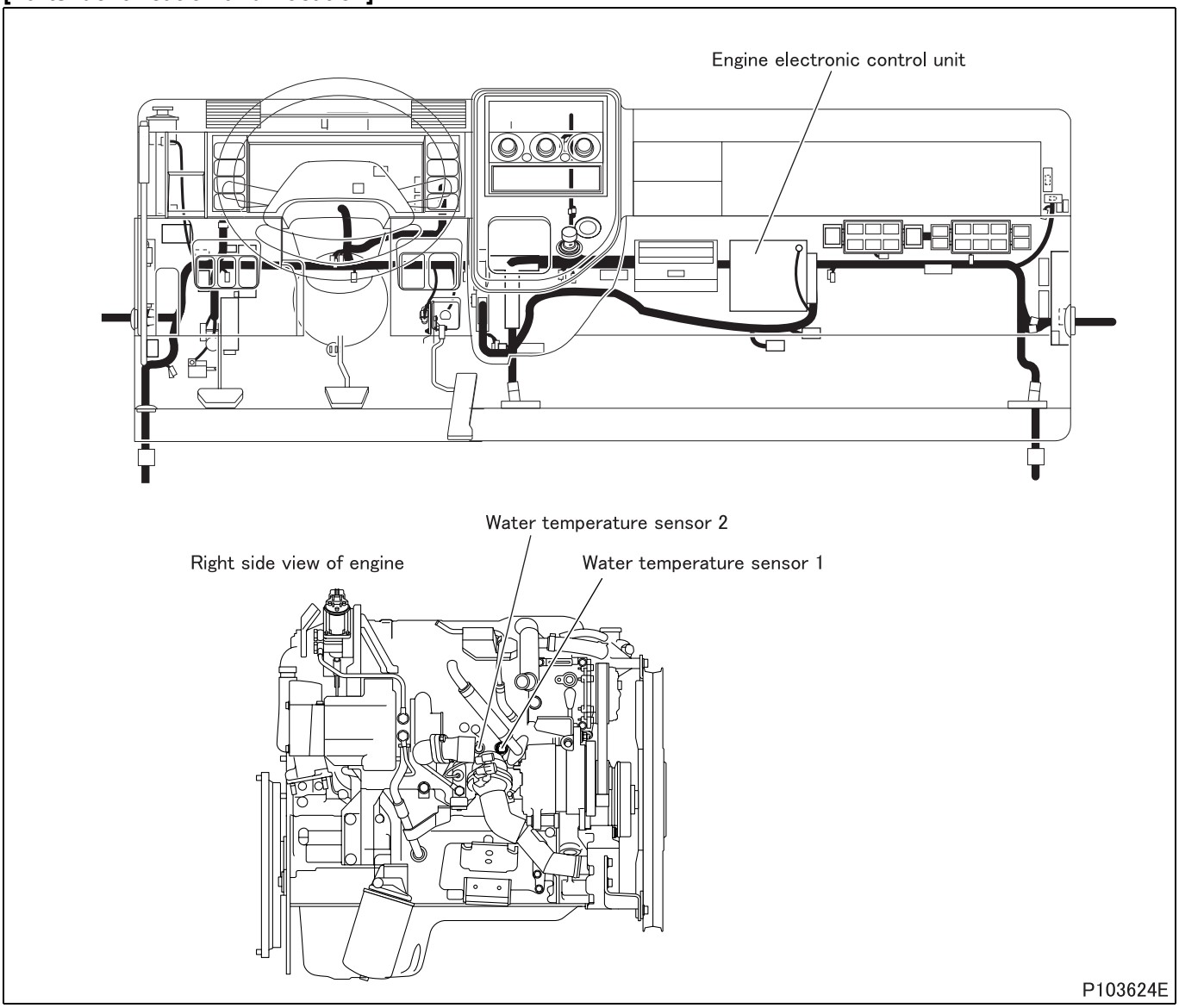
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and water temperature sensor 2
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measurement of item “Engine Coolant Temperature”. **<Multi-Use Tester used>** • Measure item No. 32 “Water Temperature 2” of Service Data.
	Inspection condition		–
	Requirements		• Cold engine: Equivalent to outside air temperature • During warm-up: Temperature gradually increased. • When engine is stopped after warm-up: Temperature gradually declines.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

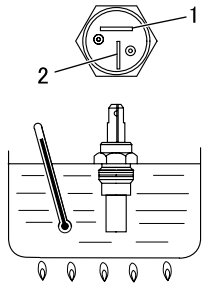
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 34 and ground.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• –20°C {–4°F} : 24.8 ± 2.5 kΩ • 0°C {32°F} : 8.62 kΩ (reference value) • 20°C {68°F} : 3.25 ± 0.33 kΩ • 60°C {140°F} : 620 Ω (reference value) • 80°C {176°F} : 300 Ω (reference value)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of water temperature sensor 2 connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of water temperature sensor 2 unit
	Maintenance item		Measure value of resistance between connector terminal No. 2 and body.
	Inspection condition		• Put water temperature sensor 2 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• –20°C {–4°F} : 24.8 ± 2.5 kΩ • 0°C {32°F} : 8.62 kΩ (reference value) • 20°C {68°F} : 3.25 ± 0.33 kΩ • 60°C {140°F} : 620 Ω (reference value) • 80°C {176°F} : 300 Ω (reference value)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6
		NO	Replacement of sensor

<Step 5 inspection diagram>



P19463

Step 6	Inspection items		Inspection of harness between electronic control unit and sensor
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 34.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measurement of item “Engine Coolant Temperature”. **<Multi-Use Tester used>** • Measure item No. 32 “Water Temperature 2” of Service Data.
	Inspection condition		–
	Requirements		• Cold engine: Equivalent to outside air temperature • During warm-up: Temperature gradually increased. • When engine is stopped after warm-up: Temperature gradually declines.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2185/Flash code: 21
[Monitor]
Failure of water temperature sensor 2
[Fault (outline)]
High signal range check
[Diagnosis check]
- Output voltage of water temperature sensor 2 is monitored.

[Code generation condition]
- Output voltage of water temperature sensor 2 remains over 4.9 V for 1 second. (sensor temperature: –37°C {–34.6°F} or less)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

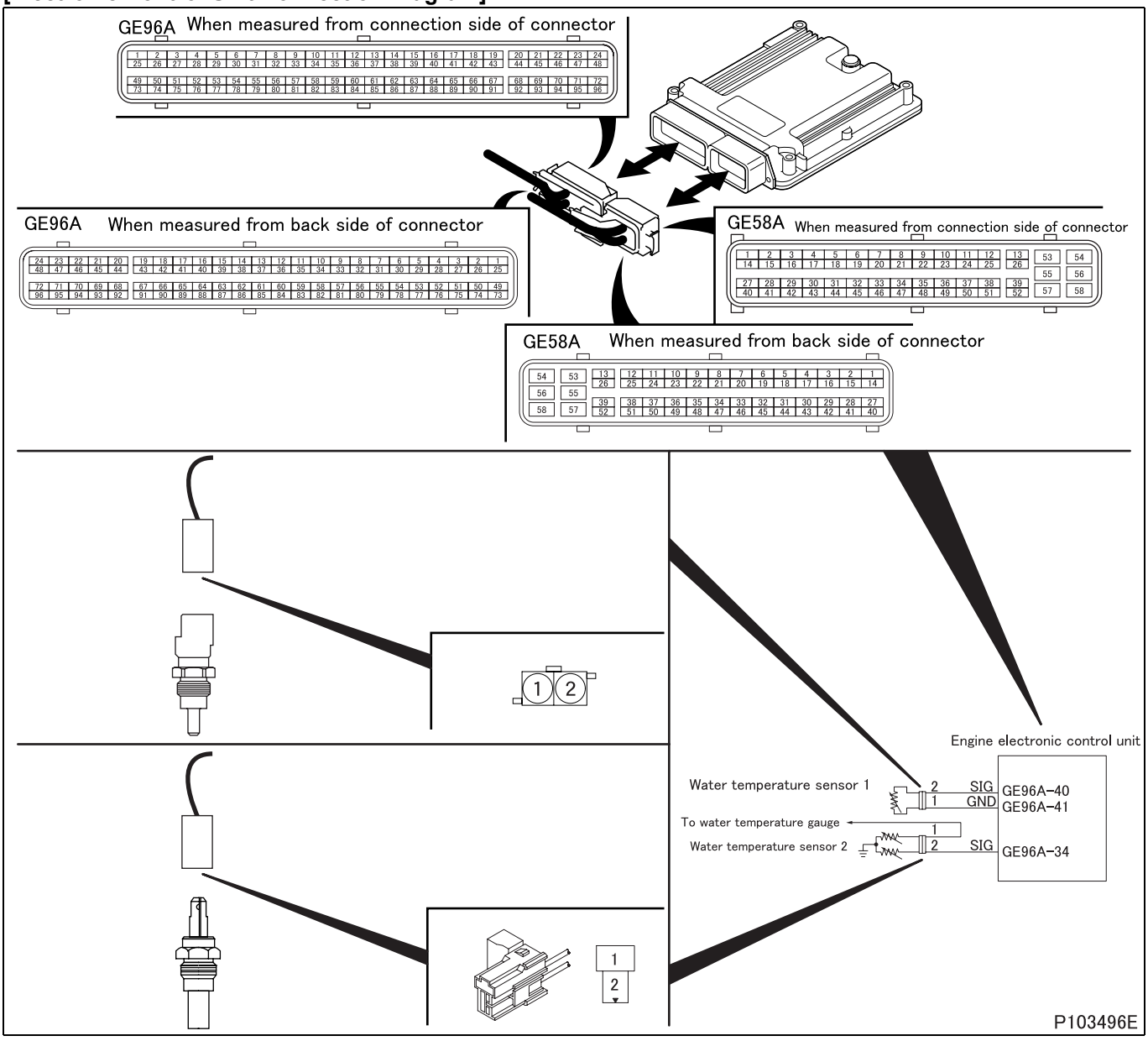
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

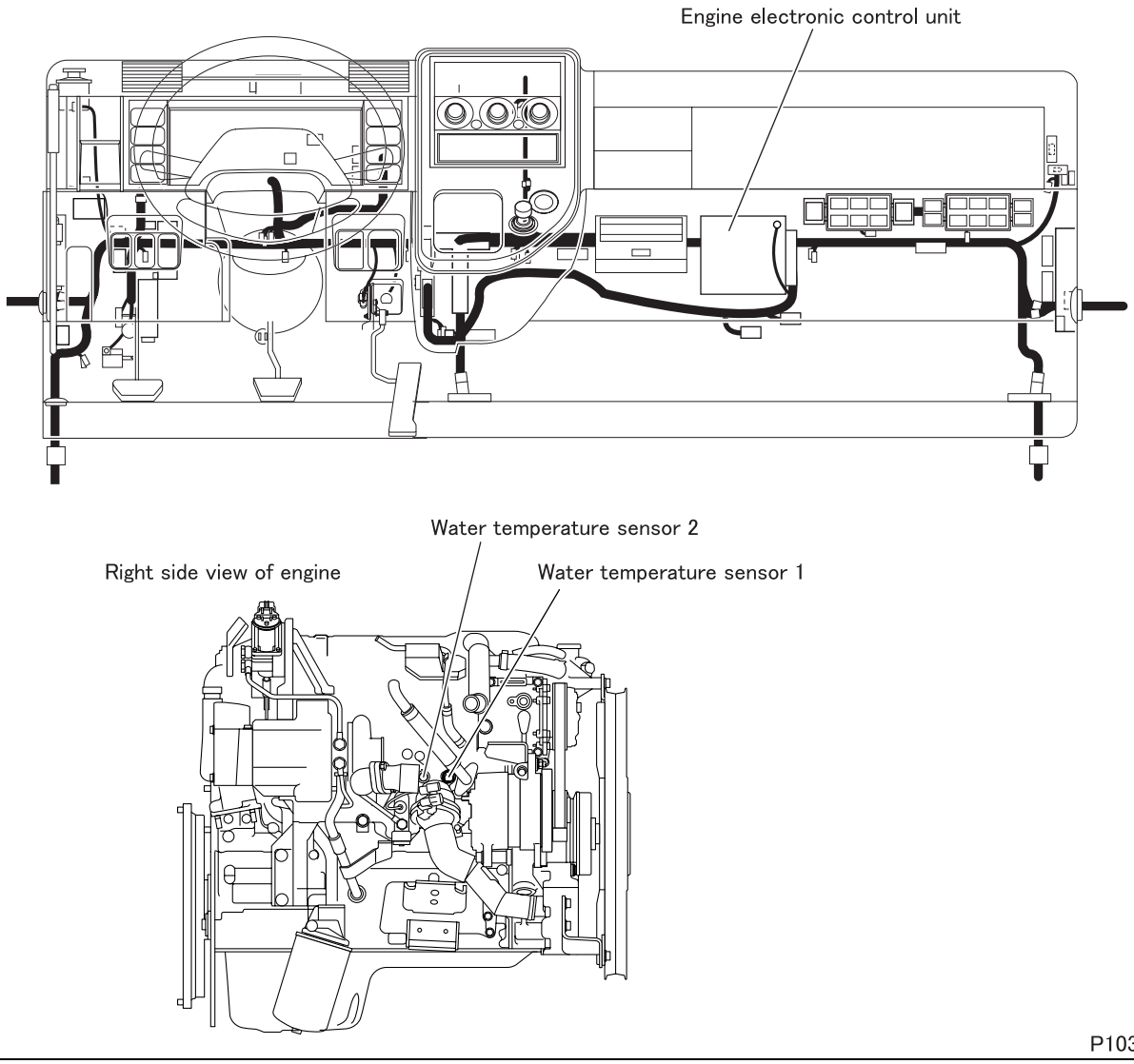
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and water temperature sensor 2
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measurement of item “Engine Coolant Temperature”. **<Multi-Use Tester used>** • Measure item No. 32 “Water Temperature 2” of Service Data.
	Inspection condition		–
	Requirements		• Cold engine: Equivalent to outside air temperature • During warm-up: Temperature gradually increased. • When engine is stopped after warm-up: Temperature gradually declines.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

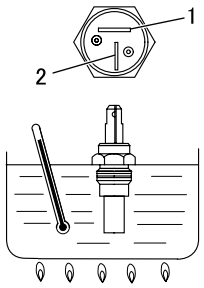
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE96A) terminal No. 34 and ground.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• –20°C {–4°F}: 24.8 ± 2.5 kΩ • 0°C {32°F}: 8.62 kΩ (reference value) • 20°C {68°F}: 3.25 ± 0.33 kΩ • 60°C {140°F}: 620 Ω (reference value) • 80°C {176°F}: 300 Ω (reference value)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of water temperature sensor 2 connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of water temperature sensor 2 unit
	Maintenance item		Measure value of resistance between connector terminal No. 2 and body.
	Inspection condition		• Put water temperature sensor 2 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• –20°C {–4°F}: 24.8 ± 2.5 kΩ • 0°C {32°F}: 8.62 kΩ (reference value) • 20°C {68°F}: 3.25 ± 0.33 kΩ • 60°C {140°F}: 620 Ω (reference value) • 80°C {176°F}: 300 Ω (reference value)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



P19463

Step 6	Inspection items		Inspection of harness between electronic control unit and sensor
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 34.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measurement of item “Engine Coolant Temperature”. **<Multi-Use Tester used>** • Measure item No. 32 “Water Temperature 2” of Service Data.
	Inspection condition		–
	Requirements		**<General Scanning Tool used>** • During warm-up: Value of resistance gradually declines. • When engine is stopped after warm-up: Value of resistance gradually increased. **<Multi-Use Tester used>** • Cold engine: Equivalent to outside air temperature • During warm-up: Temperature gradually increased. • When engine is stopped after warm-up: Temperature gradually declines.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2187/Flash code: 52
[Monitor]
Abnormality in idling control
[Fault (outline)]
Idle fuelling too low
[Diagnosis check]
- Injection quantity during idling is monitored.

[Code generation condition]
- Actual injection quantity during idling remains below 3 mg/cycle for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Warming-up control: normal
- PTO SW: OFF
- Water temperature: above 55°C {131°F}
- Diesel particulate filter regeneration control: not effected

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P2188/Flash code: 52
[Monitor]
Abnormality in idling control
[Fault (outline)]
Idle fuelling too high
[Diagnosis check]
- Injection quantity during idling is monitored.

[Code generation condition]
- Actual injection quantity during idling remains excessive for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Warming-up control: normal
- PTO SW: OFF
- Water temperature: above 55°C {131°F}
- Diesel particulate filter regeneration control: not effected

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of injector

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault code]
Diagnosis code: P2199/Flash code: 44
[Monitor]
Characteristic abnormality of intake air temperature sensor
[Fault (outline)]
Gain and offset drift
[Diagnosis check]
- Difference in temperature between intake air temperature sensor and boost air temperature sensor is monitored for deviation from specified value.

[Code generation condition]
- Difference in output voltage remains below 0°C {32°F} or over 35°C {95°F} for 10 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine operating mode: normal (engine in operation)
- Engine speed: 400 to 2000 rpm
- Fuel injection quantity: 3 to 50 mg/cyc
- Water temperature: 65 to 110°C {149 to 230°F}
- Time till above conditions were met: more than 5 seconds
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Exhaust gas recirculation flow rate and exhaust gas recirculation valve operation: in order
- Air flow sensor: in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: normal in output signal
- Intake air temperature sensor: normal in output signal
- Boost air temperature sensor: in order
- Exhaust gas recirculation system: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- Injector: in order
- MPROP (rail pressure control valve): in order
- Fuel feed when engine is idling: in order
- Exhaust shutter 3-way magnetic valve: in order
- Exhaust gas recirculation temperature remains unchanged.

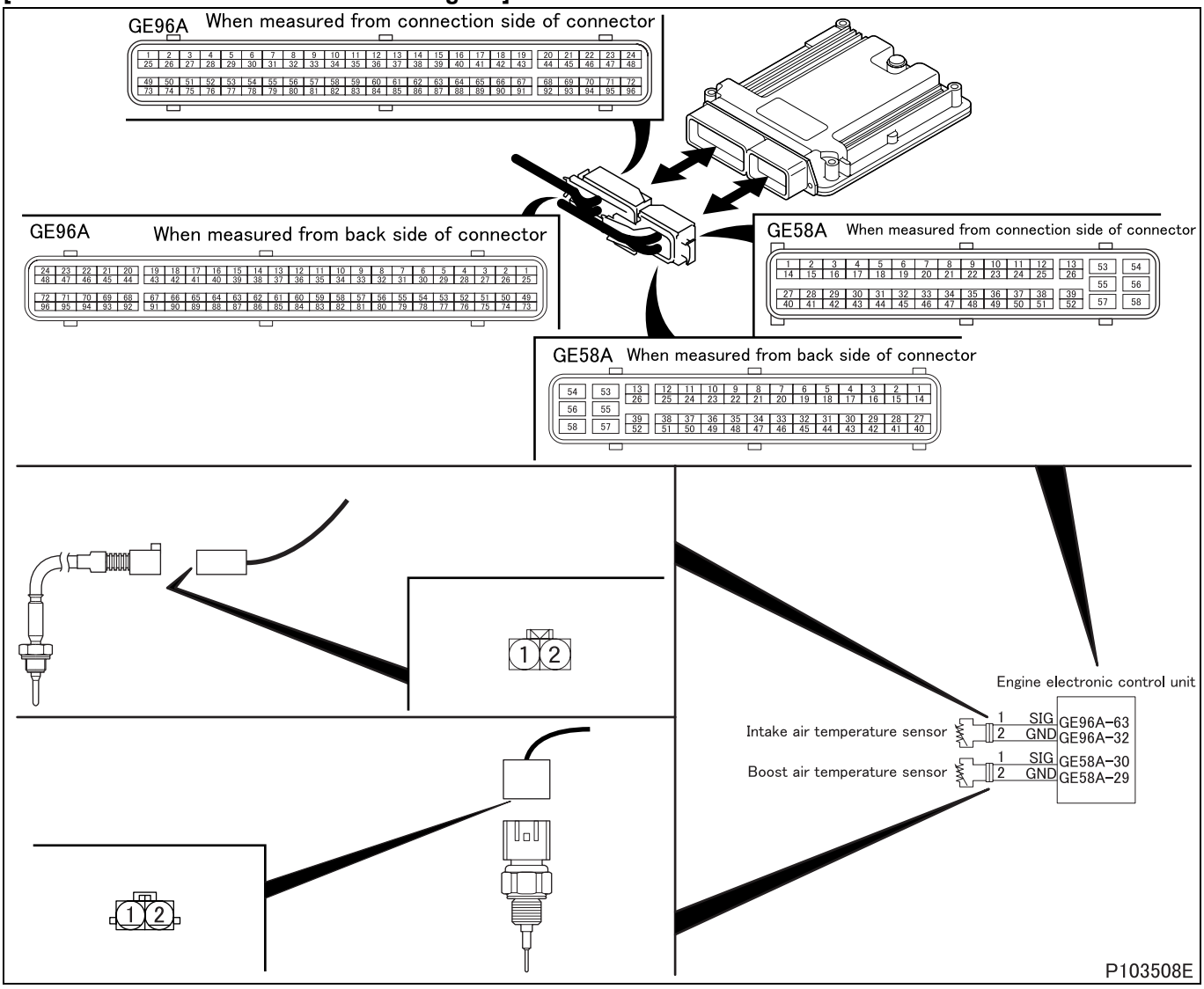
[Control effected by electronic control unit during fault]
- Intake air temperature is fixed at backup value.
- Related fault check is stopped.

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and boost air temperature sensor and intake air temperature sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

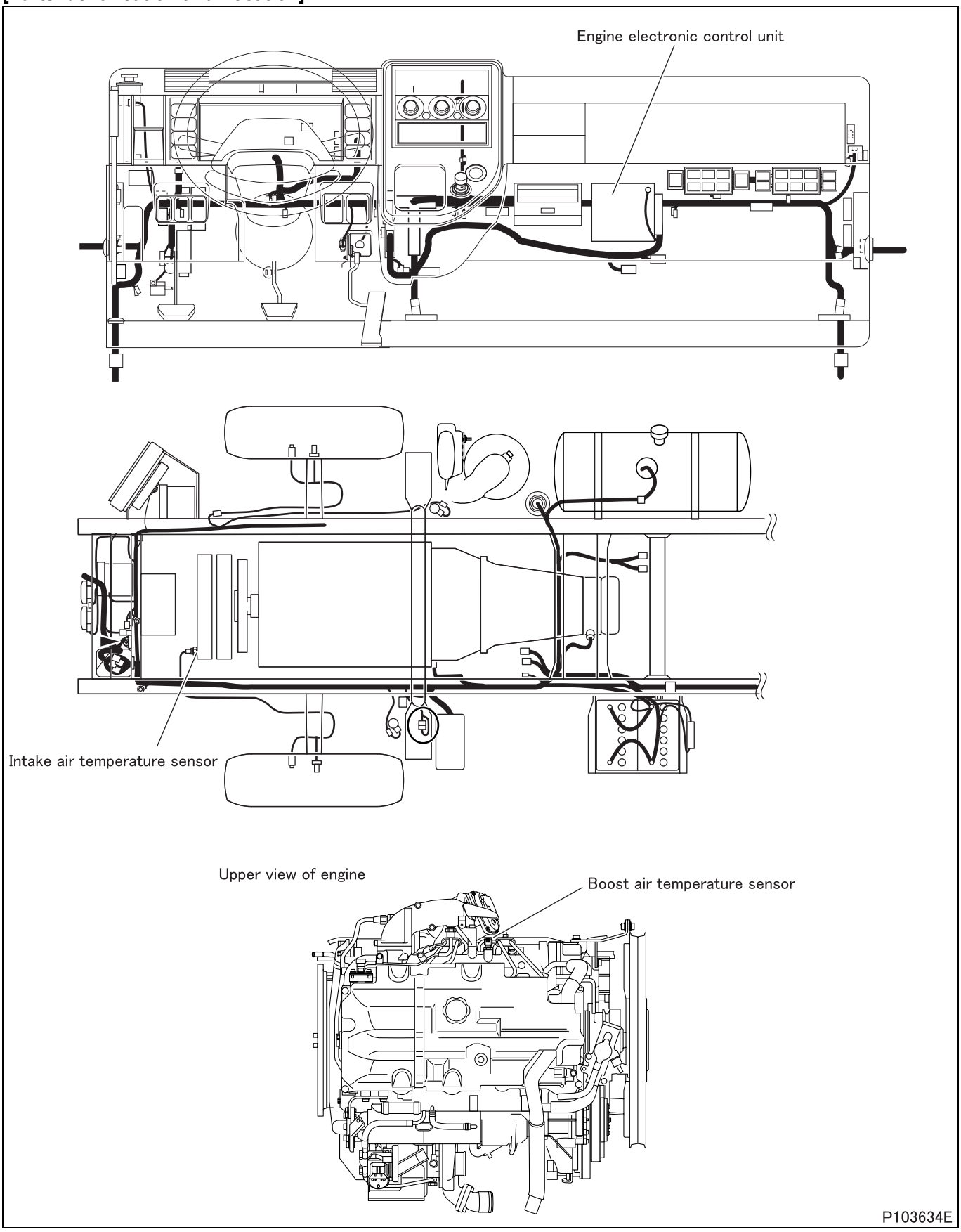
[Recoverability]

- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake Air Temperature”. **<Multi-Use Tester used>** • Measure item No. 10 “Intake Air Temperature (EGR)” of Service Data.
	Inspection condition		–
	Requirements		Cold engine: Equivalent to outside air temperature
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 2.

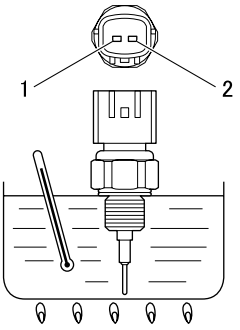
Step 2	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (GE58A) terminal No. 29 and 30.
	Inspection condition		Disconnect electronic control unit from harness and measure from connection side of harness connector.
	Requirements		• 0°C {32°F}: 162.3 $^{+48.8}_{-36.5}$ kΩ • 20°C {68°F}: 61.47 $^{+15.99}_{-12.35}$ kΩ • 80°C {176°F}: 6.120 $^{+1.095}_{-0.907}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of boost air temperature sensor
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of boost air temperature sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and No. 2.
	Inspection condition		• Put boost air temperature sensor in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 0°C {32°F}: 162.3 $^{+48.8}_{-36.5}$ kΩ • 20°C {68°F}: 61.47 $^{+15.99}_{-12.35}$ kΩ • 80°C {176°F}: 6.120 $^{+1.095}_{-0.907}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE58A) terminal No. 30.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE58A) terminal No. 29.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Intake Air Temperature”. **<Multi-Use Tester used>** • Measure item No. 10 “Intake Air Temperature (EGR)” of Service Data.
	Inspection condition		–
	Requirements		Cold engine: Equivalent to outside air temperature
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2228/Flash code: 19
[Monitor]
Failure of atmospheric pressure sensor (inside engine electronic control unit)
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Output voltage of atmospheric pressure sensor (built in engine electronic control unit) is monitored.

[Code generation condition]
- Voltage from atmospheric pressure sensor (built in engine electronic control unit) remains below 2 V for 1 second. (sensor pressure: 507 mbar {7.35 psi} or less)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- In-use performance counter is stopped.
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of atmospheric pressure sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Barometric Pressure”. **<Multi-Use Tester used>** • Measure item No. 20 “Atmospheric Pressure” of Service Data.
	Inspection condition		–
	Requirements		Standard atmospheric pressure (around 101.3 kPa {15 psi, 1.0 kgf/cm^2})
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2229/Flash code: 19
[Monitor]
Failure of atmospheric pressure sensor (inside engine electronic control unit)
[Fault (outline)]
High signal range check
[Diagnosis check]
- Output voltage of atmospheric pressure sensor (built in engine electronic control unit) is monitored.

[Code generation condition]
- Voltage from atmospheric pressure sensor (built in engine electronic control unit) remains over 4.8 V for 1 second. (sensor pressure: 1215 mbar {17.62 psi} or more)
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- In-use performance counter is stopped.
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of atmospheric pressure sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure item “Barometric Pressure”. **<Multi-Use Tester used>** • Measure item No. 20 “Atmospheric Pressure” of Service Data.
	Inspection condition		–
	Requirements		Standard atmospheric pressure (around 101.3 kPa {15 psi, 1.0 kgf/cm^2})
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2263/Flash code: 51
[Monitor]
Turbocharger actuator system
[Fault (outline)]
- Turbocharger actuator slow response/steady state position deviation
- Plausibility
- Motor lock

[Diagnosis check]
- Turbocharger actuator shaft position is detected as actual position through position sensor and compared with target position for control by engine electronic control unit.

[Code generation condition]
Diagnosis code is generated under either of the following conditions. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)
- Actual position remains larger than target position by 15% or more for 5 seconds.
- Difference between actual position and target position remains less than 0 {0 in.} mm and more than 23 {0.9 in.} mm for 1 second.
- Initialization error remains for 1 second.

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
- Battery voltage: in order
- Turbocharger actuator: in order
- Controller area network communication of turbocharger electronic drive unit: in order

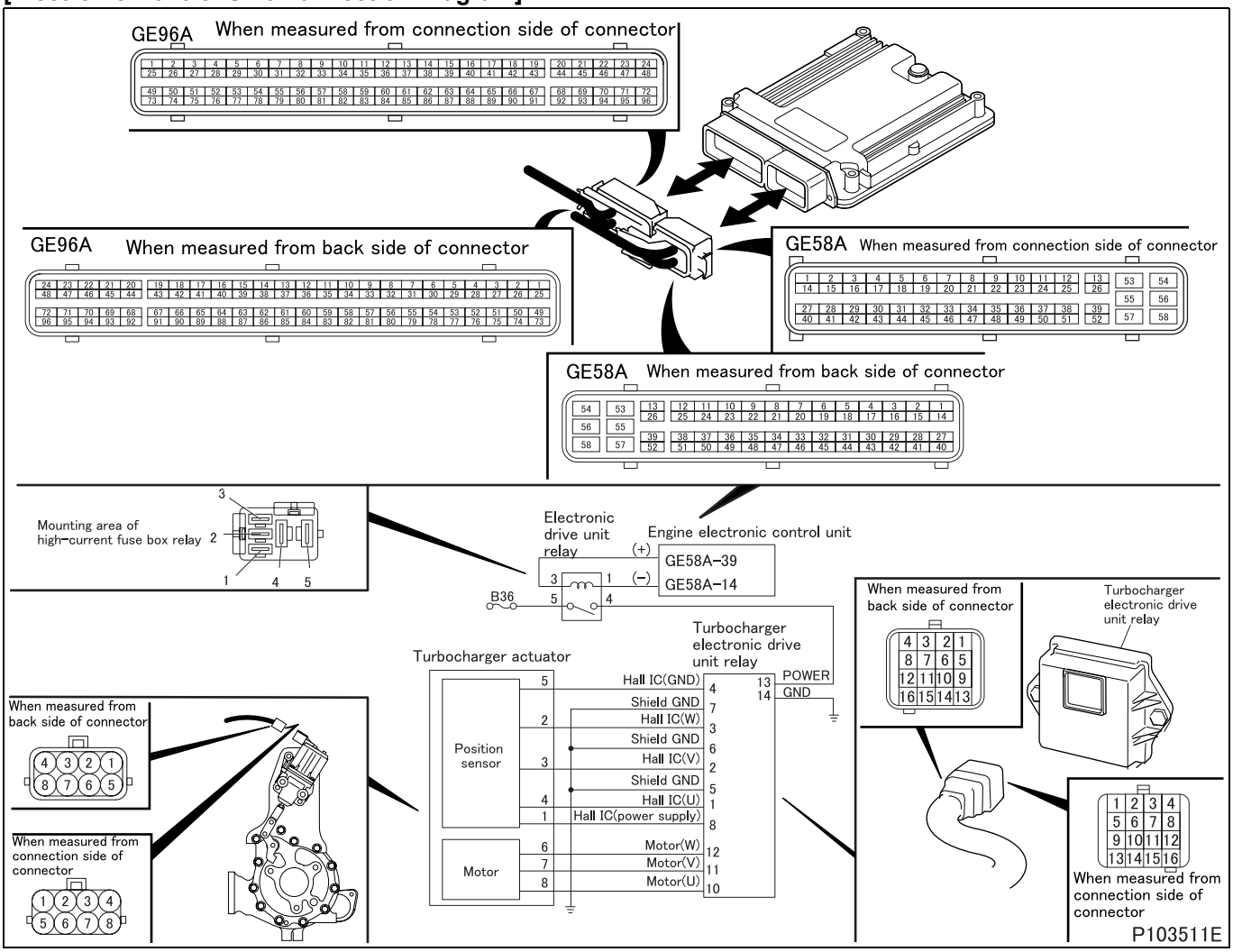
[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Deviation in position, wiping (sliding)>
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Turbocharger control is stopped.
- Diesel particulate filter regeneration is stopped.
- Turbocharger actuator test is inhibited.
- Related fault check is stopped.

<Target value>
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

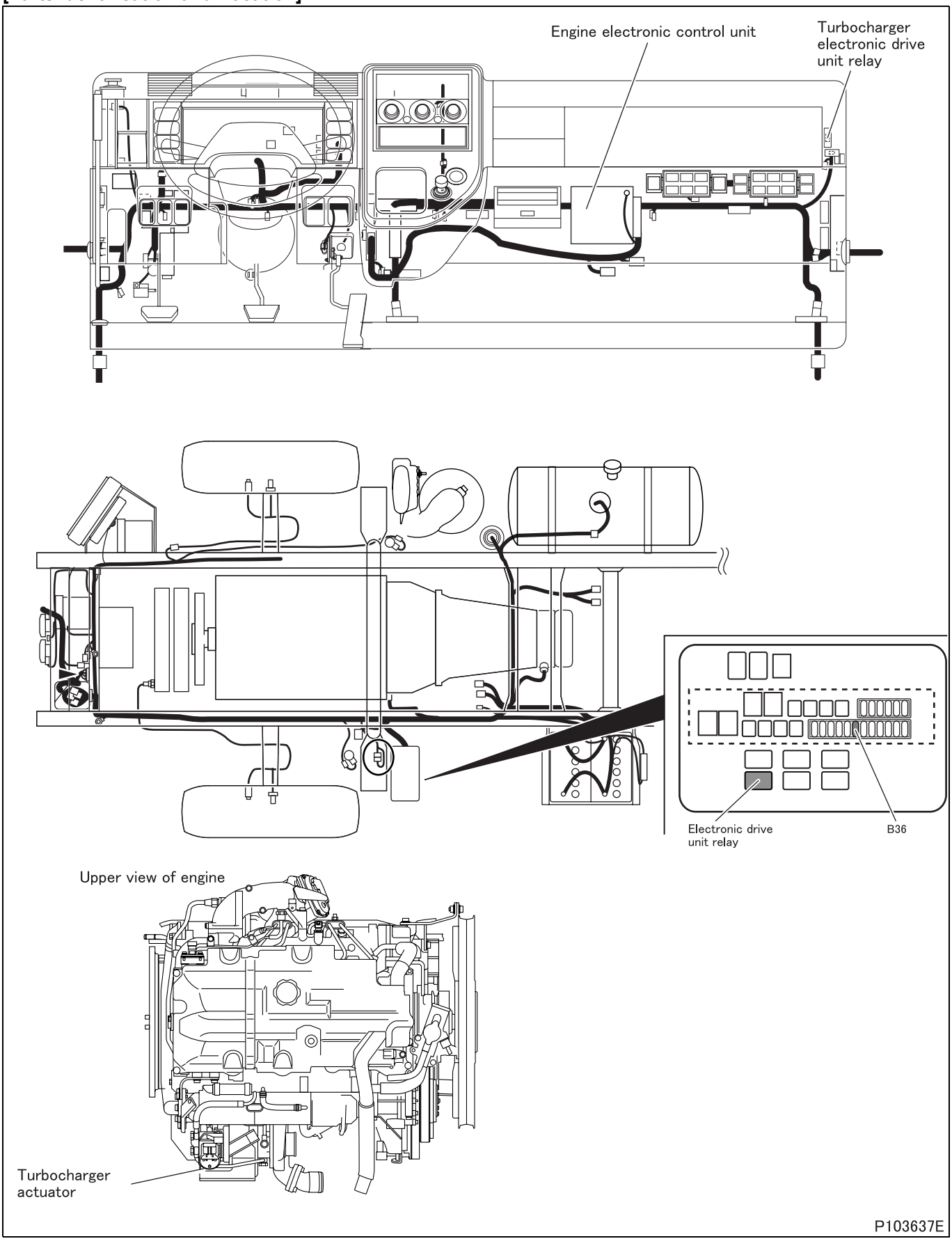
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and turbocharger actuator
- Malfunction of each connector
- Malfunction of turbocharger motor (built in turbocharger actuator)
- Malfunction of turbocharger position sensor (built in turbocharger actuator)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A4 “VGT 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “54: Target VGT Position, 55: Actual VGT Position”). **NOTE** • **Set turbocharger opening to the range of 20 to 80%.** • **As initial operational check of turbocharger actuator is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of turbocharger actuator connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Inspect diagnosis code that is occurring.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Disconnect connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of electronic drive unit relay, go to step 9.
		NO	Modify harness.

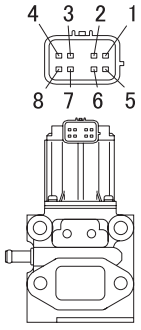
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector terminals. • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor shield ground (U): terminal No. 5 - 14 • Sensor shield ground (V): terminal No. 6 - 14 • Sensor shield ground (W): terminal No. 7 - 14 • Sensor ground: terminal No. 4 - 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between following connector terminals • Between U - V: 10 - 11 • Between U - W: 10 - 12 • Between V - W: 11 - 12
	Inspection condition		–
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and turbocharger actuator (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (U): electronic drive unit connector terminal No. 10 - turbocharger actuator connector No. 8 • Motor (V): electronic drive unit connector terminal No. 11 - turbocharger actuator connector No. 7 • Motor (W): electronic drive unit connector terminal No. 12 - turbocharger actuator connector No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of turbocharger actuator unit (motor)
	Maintenance item		Measure value of resistance between following turbocharger actuator connector terminals • Between U - V: 8 - 7 • Between U - W: 8 - 6 • Between V - W: 7 - 6
	Inspection condition		• Keep turbocharger actuator installed on vehicle. • Remove harness connector and measure turbocharger actuator side.
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of turbocharger actuator

<Step 12 inspection diagram>



Step 13	Inspection items		Inspection of turbocharger actuator connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 1 (+) and 5 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		10 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure values of voltage between the following electronic drive unit connector terminals. • U signal output: terminal 1 (+) - 4 (–) • V signal output: terminal 2 (+) - 4 (–) • W signal output: terminal 3 (+) - 4 (–)
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON • Perform actuator test item No. A4 “VGT 1”.
	Requirements		8 to 11 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and turbocharger actuator (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 8 - turbocharger actuator connector No. 1 • Sensor (U): electronic drive unit connector terminal No. 1 - turbocharger actuator connector No. 4 • Sensor (V): electronic drive unit connector terminal No. 2 - turbocharger actuator connector No. 3 • Sensor (W): electronic drive unit connector terminal No. 3 - turbocharger actuator connector No. 2 • Sensor (ground): electronic drive unit connector terminal No. 4 - turbocharger actuator connector No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of turbocharger, go to step 16.
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A4 “VGT 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “54: Target VGT Position, 55: Actual VGT Position”). **NOTE** • **Set turbocharger opening to the range of 20 to 80%.** • **As initial operational check of turbocharger actuator is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P2413/Flash code: 67, 95
[Monitor]
Abnormality in exhaust gas recirculation valve position
[Fault (outline)]
- Exhaust gas recirculation valve slow response/steady state position deviation
- Plausibility

[Diagnosis check]
- Exhaust gas recirculation valve position is detected as actual position through position sensor and compared with target position for control by engine electronic control unit.

[Code generation condition]
Diagnosis code is generated under either of the following conditions. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)
- Difference between actual valve position and target valve position remains more than 2 mm {0.08 in.} for 5 seconds.
- Target valve position calculated by engine electronic control unit remains out of specified limits (upper limit: 10 mm {0.39 in.}; lower limit: 0 mm {0 in.}) for 1 second.

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
- Battery voltage: in order
- Exhaust gas recirculation valve: in order
- Controller area network of electronic drive unit: in order

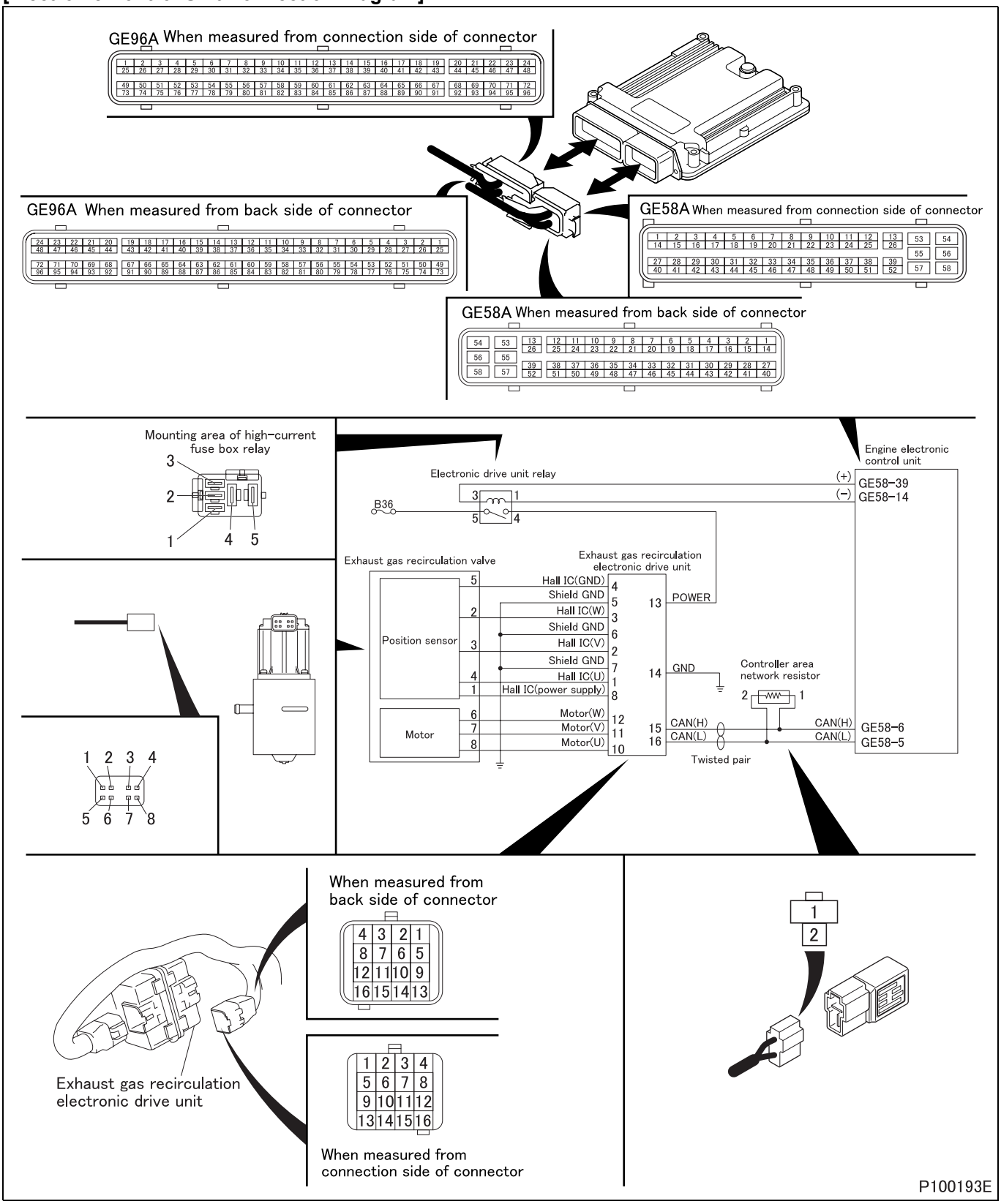
[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Deviation in position>
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Turbocharger control is stopped.
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

<Target value>
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped (manual regeneration is feasible).
- Related fault check is stopped.

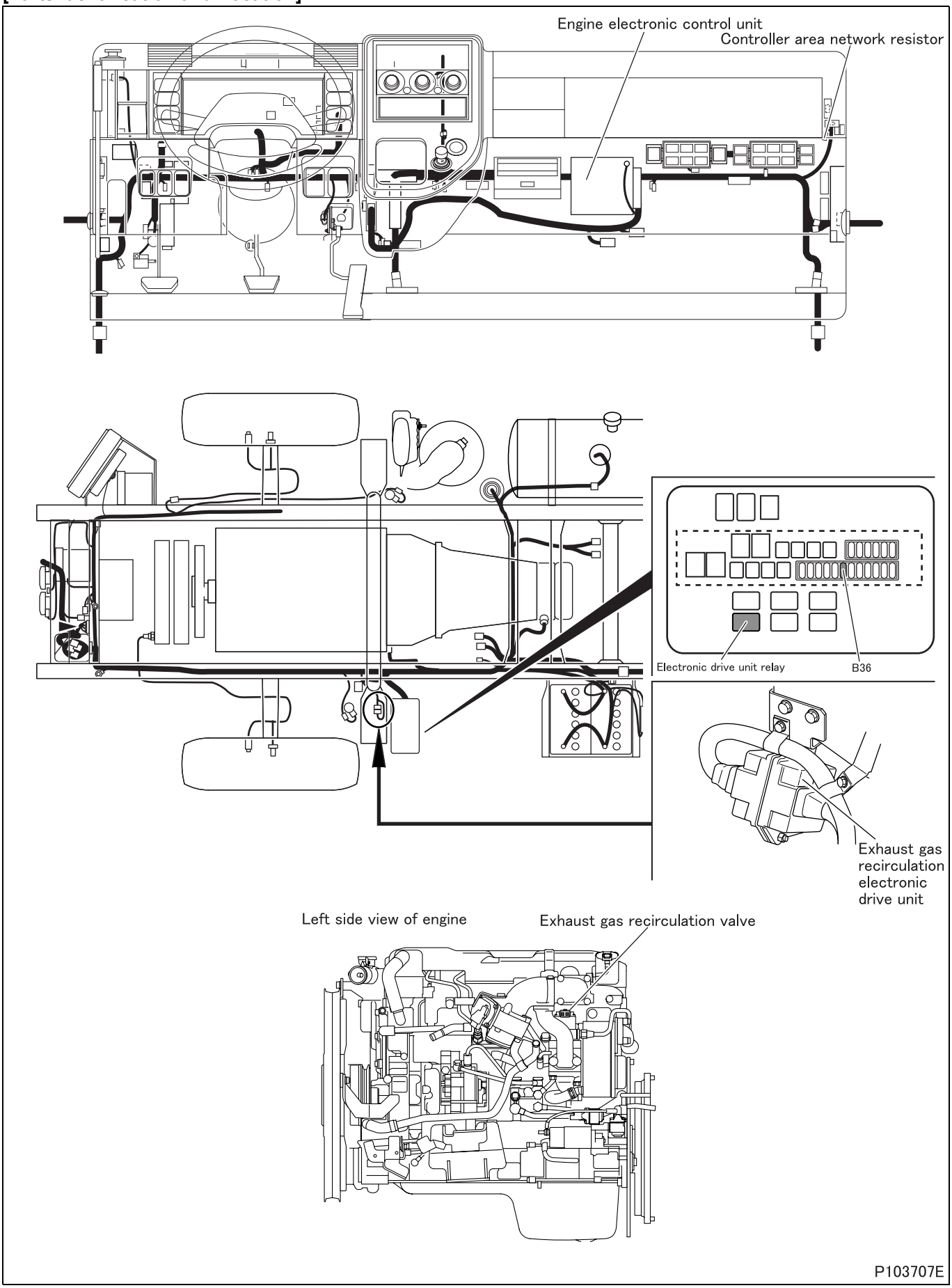
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and exhaust gas recirculation valve
- Malfunction of each connector
- Malfunction of exhaust gas recirculation motor (built in exhaust gas recirculation valve)
- Malfunction of exhaust gas recirculation position sensor (built in exhaust gas recirculation valve)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. A0 “EGR 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “51: Actual EGR Valve Position”). **NOTE** • **As initial operational check of exhaust gas recirculation valve is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of exhaust gas recirculation valve connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)”
	Inspection condition		Starter switch: ON
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Inspect diagnosis code that is occurring.

Step 5	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Disconnect connector and measure from harness side. • Starter switch: ON • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 6.

Step 6	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B35 and relay connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of electronic drive unit relay, go to step 9.
		NO	Modify harness.

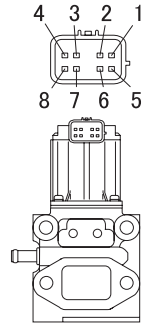
Step 9	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between following electronic drive unit connector terminals. • Electronic drive unit ground: terminal No. 14 - chassis ground • Sensor shield ground (U): terminal No. 5 - 14 • Sensor shield ground (V): terminal No. 6 - 14 • Sensor shield ground (W): terminal No. 7 - 14 • Sensor ground: terminal No. 4 - 14
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection of electronic drive unit connector (motor)
	Maintenance item		Measure value of resistance between following connector terminals • Between U - V: 10 - 11 • Between U - W: 10 - 12 • Between V - W: 11 - 12
	Inspection condition		–
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Go to step 11.

Step 11	Inspection items		Inspection of harness between electronic drive unit and turbocharger actuator (motor)
	Maintenance item		Check circuit between following connector terminals. • Motor (U): electronic drive unit connector terminal No. 10 - turbocharger actuator connector No. 8 • Motor (V): electronic drive unit connector terminal No. 11 - turbocharger actuator connector No. 7 • Motor (W): electronic drive unit connector terminal No. 12 - turbocharger actuator connector No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of exhaust gas recirculation valve unit (motor)
	Maintenance item		Measure value of resistance between following exhaust gas recirculation valve connector terminals • Between U - V: 8 - 7 • Between U - W: 8 - 6 • Between V - W: 7 - 6
	Inspection condition		• Keep exhaust gas recirculation valve installed on vehicle. • Remove harness connector and measure exhaust gas recirculation valve side.
	Requirements		2.1 ± 0.3 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Replacement of turbocharger actuator

<Step 12 inspection diagram>



P68994

Step 13	Inspection items		Inspection of exhaust gas recirculation valve connector (position sensor: power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 1 (+) and 5 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		10 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Go to step 15.

Step 14	Inspection items		Inspection of electronic drive unit connector (position sensor: signal)
	Maintenance item		Measure values of voltage between the following electronic drive unit connector terminals. • U signal output: terminal 1 (+) - 4 (–) • V signal output: terminal 2 (+) - 4 (–) • W signal output: terminal 3 (+) - 4 (–)
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON • Perform actuator test item No. A0 “EGR 1”.
	Requirements		8 to 11 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 16.
		NO	Go to step 15.

Step 15	Inspection items		Inspection of harness between electronic drive unit and exhaust gas recirculation valve (position sensor)
	Maintenance item		Check circuit between following connector terminals. • Sensor (power supply): electronic drive unit connector terminal No. 8 - exhaust gas recirculation valve connector No. 1 • Sensor (U): electronic drive unit connector terminal No. 1 - exhaust gas recirculation valve connector No. 4 • Sensor (V): electronic drive unit connector terminal No. 2 - exhaust gas recirculation valve connector No. 3 • Sensor (W): electronic drive unit connector terminal No. 3 - exhaust gas recirculation valve connector No. 2 • Sensor (ground): electronic drive unit connector terminal No. 4 - exhaust gas recirculation valve connector No. 5
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of exhaust gas recirculation, go to step 16.
		NO	Modify harness.

Step 16	Inspection items		Inspection by control data
	Maintenance item		• Perform actuator test item No. A0 “EGR 1”.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral (parking satisfactory for automatic transmission) • Diagnosis switch: OFF (fuse removed)
	Requirements		Actual position matches with target value set by Multi-Use Tester (check with service data “51: Actual EGR Valve Position”). **NOTE** • **As initial operational check of exhaust gas recirculation valve is automatically effected immediately after starter switch is ON, perform actuator test by Multi-Use Tester after that check (approximately 5 seconds later).**
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic drive unit

[Fault code]
Diagnosis code: P2423/Flash code: 46
[Monitor]
Failure of front oxidation catalyst
[Fault (outline)]
Inactive (unable to generate exotherm for diesel particulate filter regeneration)
[Diagnosis check]
- Heating condition of catalyst is monitored during diesel particulate filter regeneration.
- Actual post injection quantity during diesel particulate filter regeneration and post injection quantity estimated by engine electronic control unit are compared.

[Code generation condition]
Either of the following occurs. (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)
- Post injection quantity used for diesel particulate filter regeneration exceeds 14.8 g {0.52 oz}.
- Difference in total between actual post injection quantity and estimated post injection quantity is more than specified value.
- When all of the following conditions occur;
  - Diesel particulate filter inlet temperature is below 450°C {842°F}.
  - Diesel particulate filter inlet temperature after start of filter regeneration is below 100°C {212°F}.
  - Difference between diesel particulate filter inlet temperature and catalytic inlet temperature is less than 150°C {302°F}.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the diesel particulate filter regeneration control is activated.

[Diagnostic requirement]
- Diesel particulate filter regeneration control: normal (automatic or manual regeneration)
- Fuel injection quantity: above 2.5 mg/cyc
- Engine speed: 600 to 3000 rpm
- Water temperature: 65 to 110°C {149 to 230°F}
- Post injection quantity: above 0.05 mg/cyc
- Diesel particulate filter inlet temperature: above 250°C {482°F}
- Engine operating mode: normal (engine in operation)
- Time till above conditions were met: more than 3 seconds
- Once monitor has been enabled, monitoring continues unless any above conditions are not met for at time: >3s
- Estimated post injection quantity: more than 40 mg (automatic diesel particulate filter regeneration); more than 30 mg (manual diesel particulate filter regeneration)
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Water temperature sensor: in order
- DPF temperature sensor 1: in order
- Catalytic temperature sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order

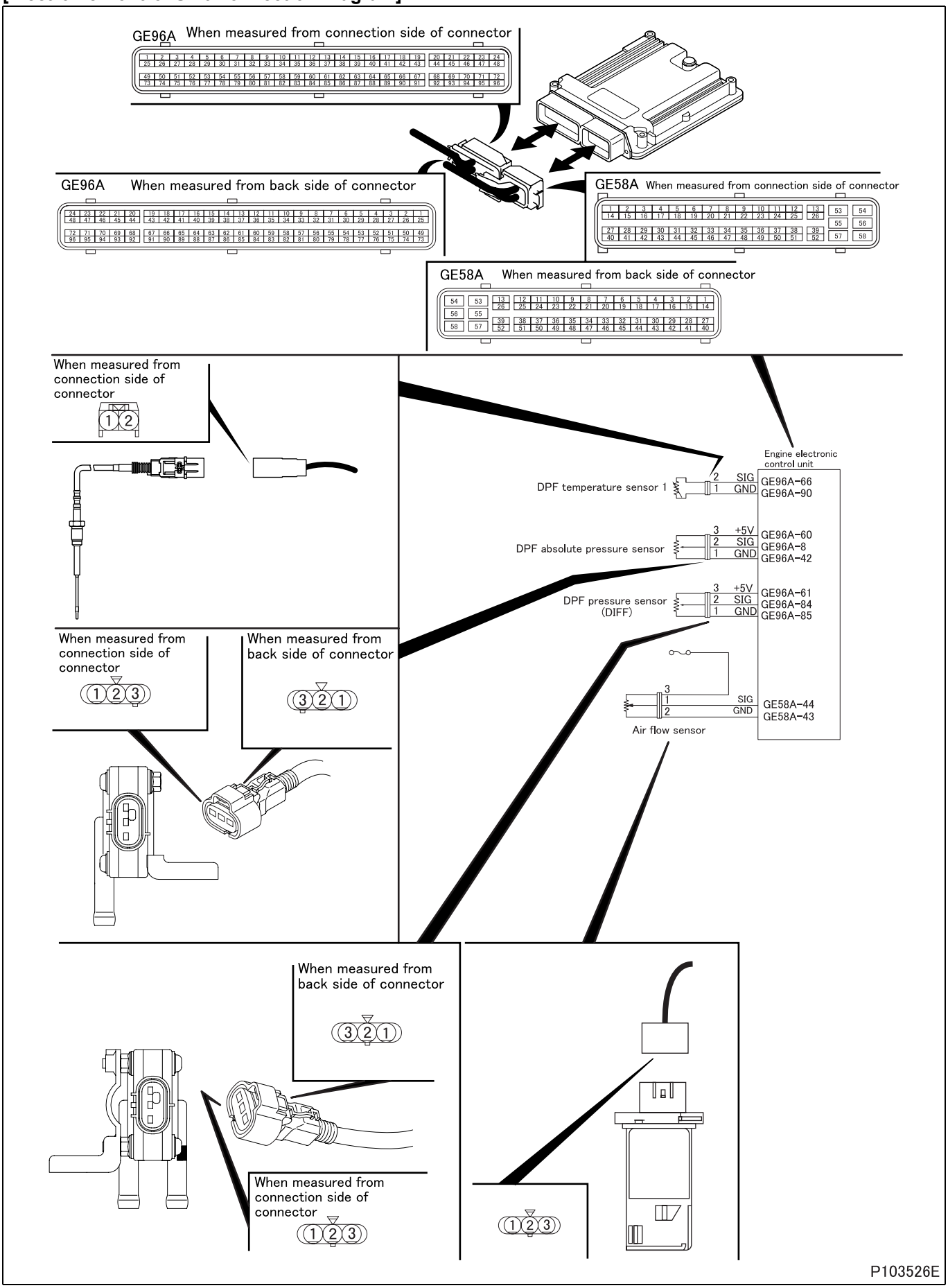
[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped.

[Probable cause of trouble]
- Deterioration of diesel particulate filter (front oxidation catalyst)

[Recoverability]

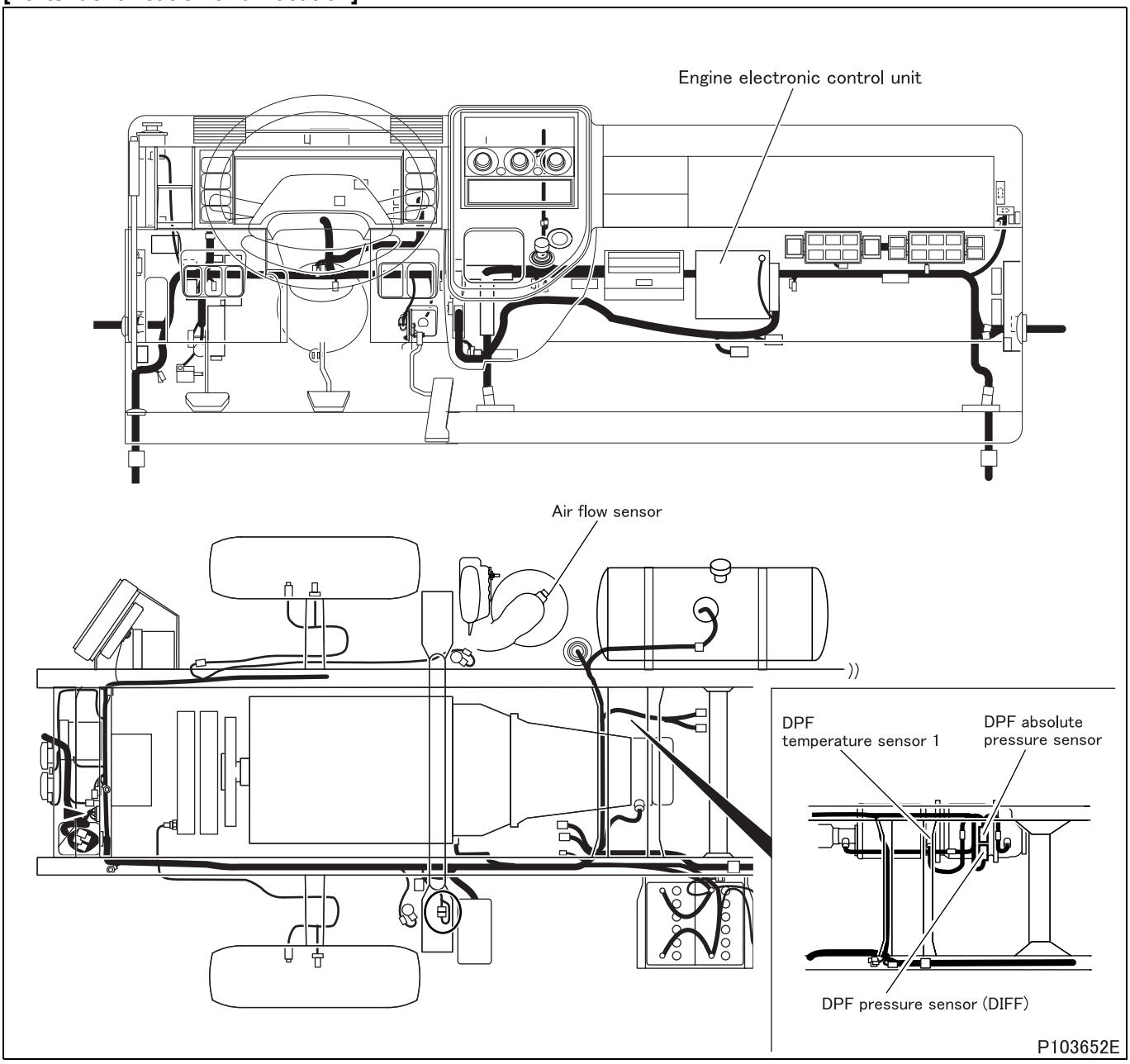
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



P103526E

[Parts Identification and Location]



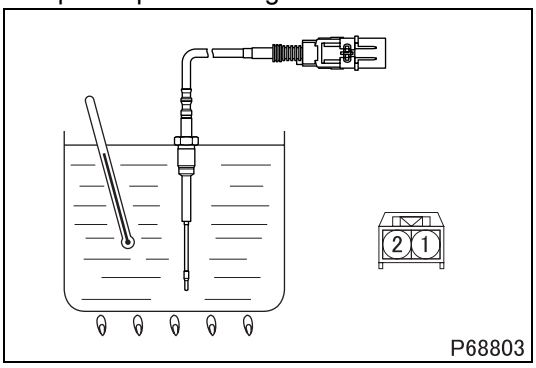
[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0045 “VGT Actuator (Open)” • P0046 “VGT Actuator (Performance)” • P0047 “VGT Actuator (Low)” • P0102 “Airflow Sensor (Low)” • P0103 “Airflow Sensor (High)” • P0426 “EXH Gas Temp SNSR1 (Plausibility)” • P0427 “EXH Gas Temp SNSR1 (Low)” • P0428 “EXH Gas Temp SNSR1 (High)” • P0545 “DPF Temp SNSR (upstream) Low” • P0546 “DPF Temp SNSR (upstream) High” • P1430 “DPF Regeneration Switch” • P1660 “DPF Lamp Control Circuit (Low)” • P2031 “Exhaust Gas Temp” • P2032 “Exhaust Gas Temp (Low)” • P2033 “Exhaust Gas Temp (High)” • P2453 “DPF Diff SNSR (Plausi) & MFF” • P2454 “DPF Diff SNSR (Low) & MFF” • P2455 “DPF Diff SNSR (High) & MFF”
	Inspection condition		Ensure that each sensor mounting condition is free of abnormalities.
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring and go to step 2.
		NO	Go to step 2.

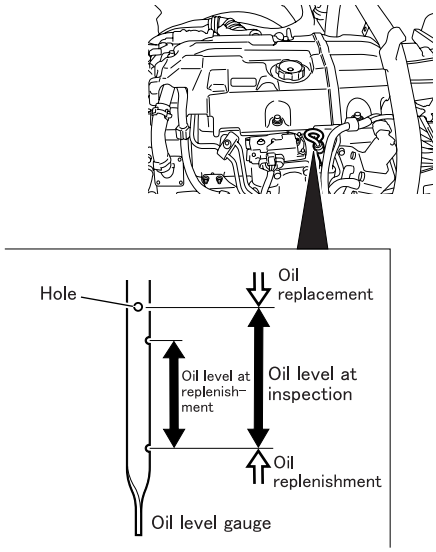
Step 2	Inspection items		Inspection of DPF temperature sensor 1 unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and 2.
	Inspection condition		• Put DPF temperature sensor 1 in container filled with engine oil. • Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
	Requirements		• 20°C {68°F}: 241.8 kΩ • 50°C {122°F}: 106.2 $^{+74.3}_{-41.8}$ kΩ • 100°C {212°F}: 33.56 $^{+17.60}_{-10.60}$ kΩ • 150°C {302°F}: 13.90 $^{+5.36}_{-3.60}$ kΩ • 200°C {392°F}: 6.896 $^{+2.064}_{-1.252}$ kΩ
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Cleaning of sensor

<Step 2 inspection diagram>



Step 3	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine stopped
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of oil, go to step 4.

<Step 3 inspection diagram>

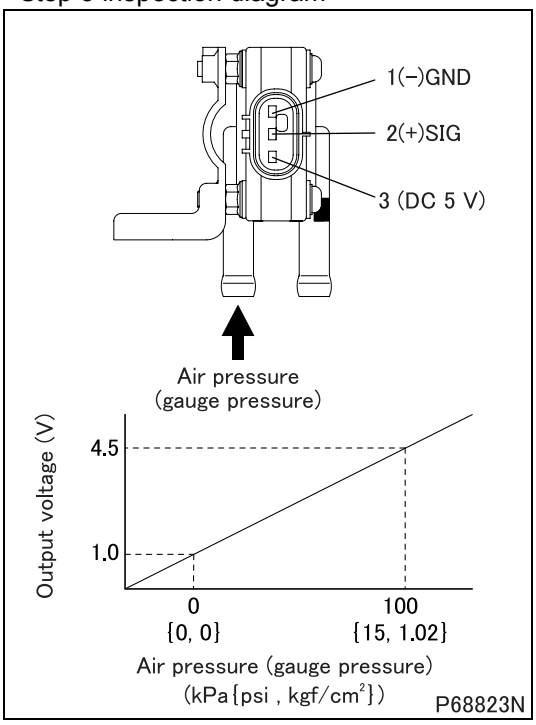


P103677E

Step 4	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	After correction and replacement of hose, go to step 5.

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of sensor

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of diesel particulate filter
		NO	Replacement of injector

[Fault code]
Diagnosis code: P2453/Flash code: 97
[Monitor]
Failure of DPF pressure sensor (DIFF)
[Fault (outline)]
- Dynamic check
- Offset check

[Diagnosis check]
Either of the following is monitored.
<Initial>
- Pressure output from DPF pressure sensor (DIFF) is monitored for 0 mbar {0 psi} during engine after run.

<During vehicle operation>
- Diesel particulate filter pressure calculated by engine electronic control unit is monitored for abnormality.

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Initial>
- Pressure output from DPF pressure sensor (DIFF) exceeds 70 mbar {1.015 psi}.
  (Warning lamp (red) is lit and diagnosis code is displayed on third establishment of code generation condition.)

<During vehicle operation>
- Pressure output from DPF pressure sensor (DIFF) remains over –4 mbar {–0.058 psi} and below 3 mbar {0.043 psi} for 1 second.
  (Warning lamp (orange) is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
<Initial>
- Engine status: after-run

<During vehicle operation>
- Variation of exhaust volume-flow rate: more than 150 m^3/h/s or less than –200 m^3/h/s
- Air flow sensor: in order
- Atmospheric pressure sensor: in order
- Boost air temperature sensor: in order
- Intake air temperature sensor: in order
- DPF absolute pressure sensor: normal in output signal
- DPF pressure sensor (DIFF): normal in output signal
- DPF temperature sensor 1: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Diesel particulate filter regeneration control: in order

[Control effected by electronic control unit during fault]
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit
- Dissolution, blockage, and damage of diesel particulate filter

[Recoverability]

- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

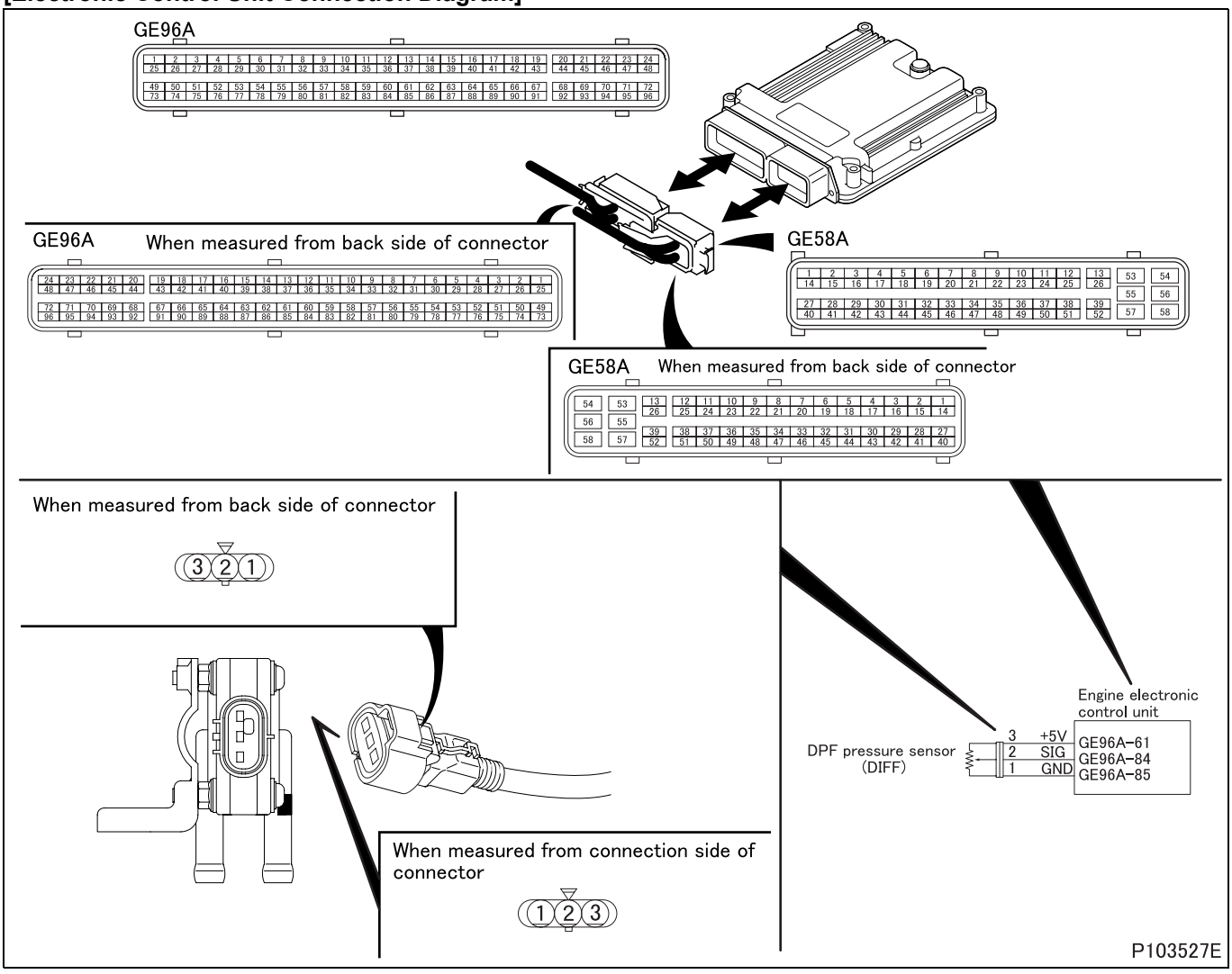
<Initial>

- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

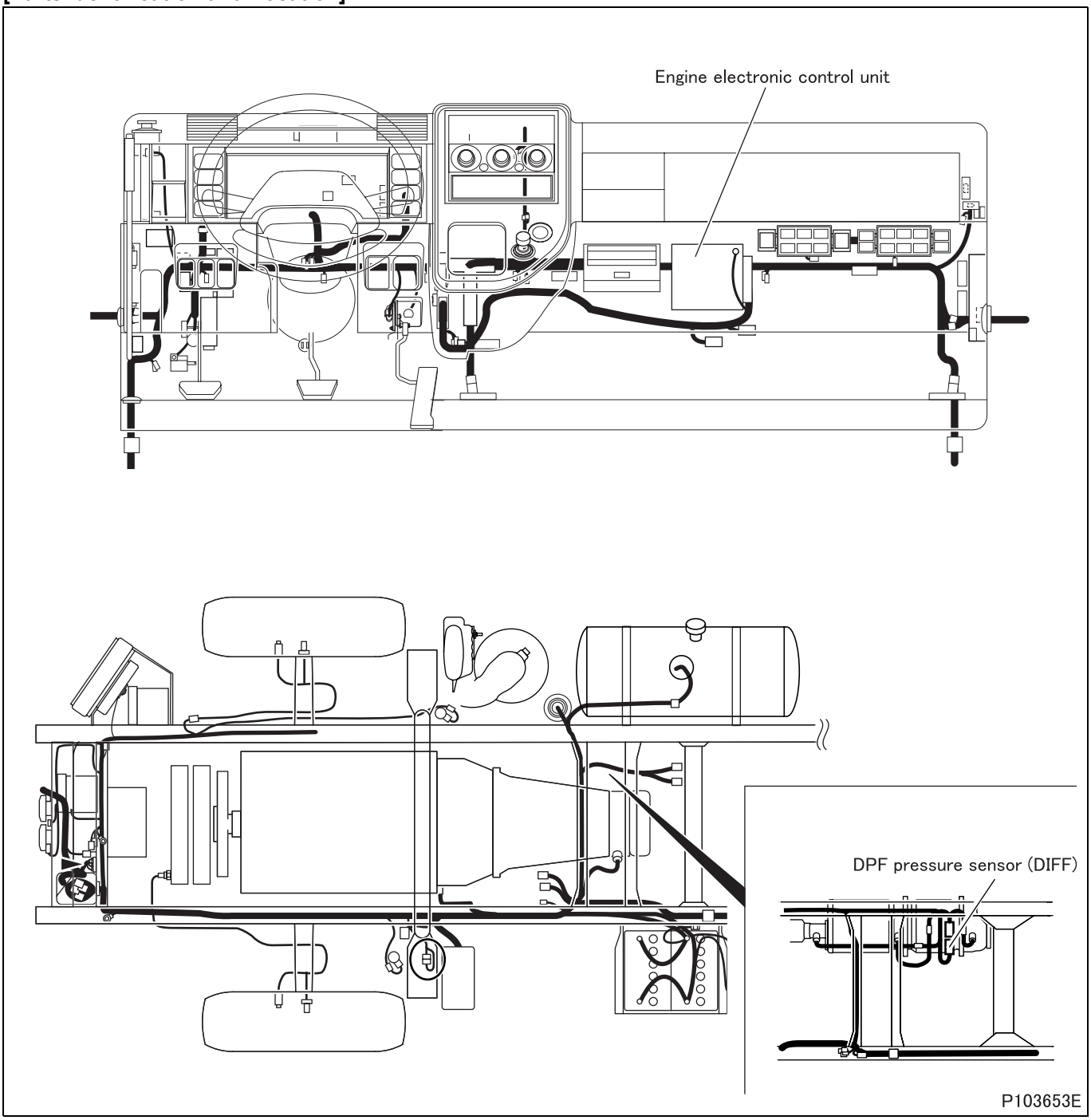
<During vehicle operation>

- Lamp is extinguished and code is cleared simultaneously with recovery.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measurement of item No. 22 “Difference pressure across DPF” of Service Data.
	Inspection condition		Past failures include diesel particulate filter pressure sensor, while the current failures do not include diesel particulate filter pressure sensor.
	Requirements		When engine is stationary: 0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 84 (+) and 85 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		1 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 61 (+) and 85 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

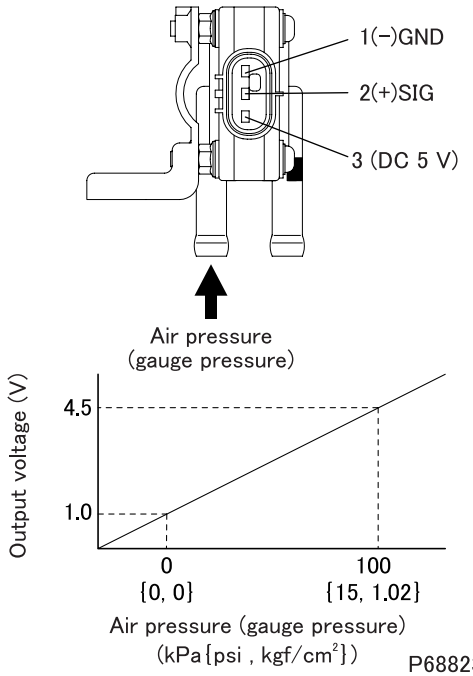
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 85 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 1 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 61.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 85.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 84.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		Measurement of item No. 22 “Difference pressure across DPF”
	Inspection condition		Past failures include diesel particulate filter pressure sensor, while the current failures do not include diesel particulate filter pressure sensor.
	Requirements		When engine is stationary: 0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2454/Flash code: 97
[Monitor]
Failure of DPF pressure sensor (DIFF)
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Output voltage of DPF pressure sensor (DIFF) is monitored.

[Code generation condition]
- Pressure output from DPF pressure sensor (DIFF) remains below –179 hpa for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

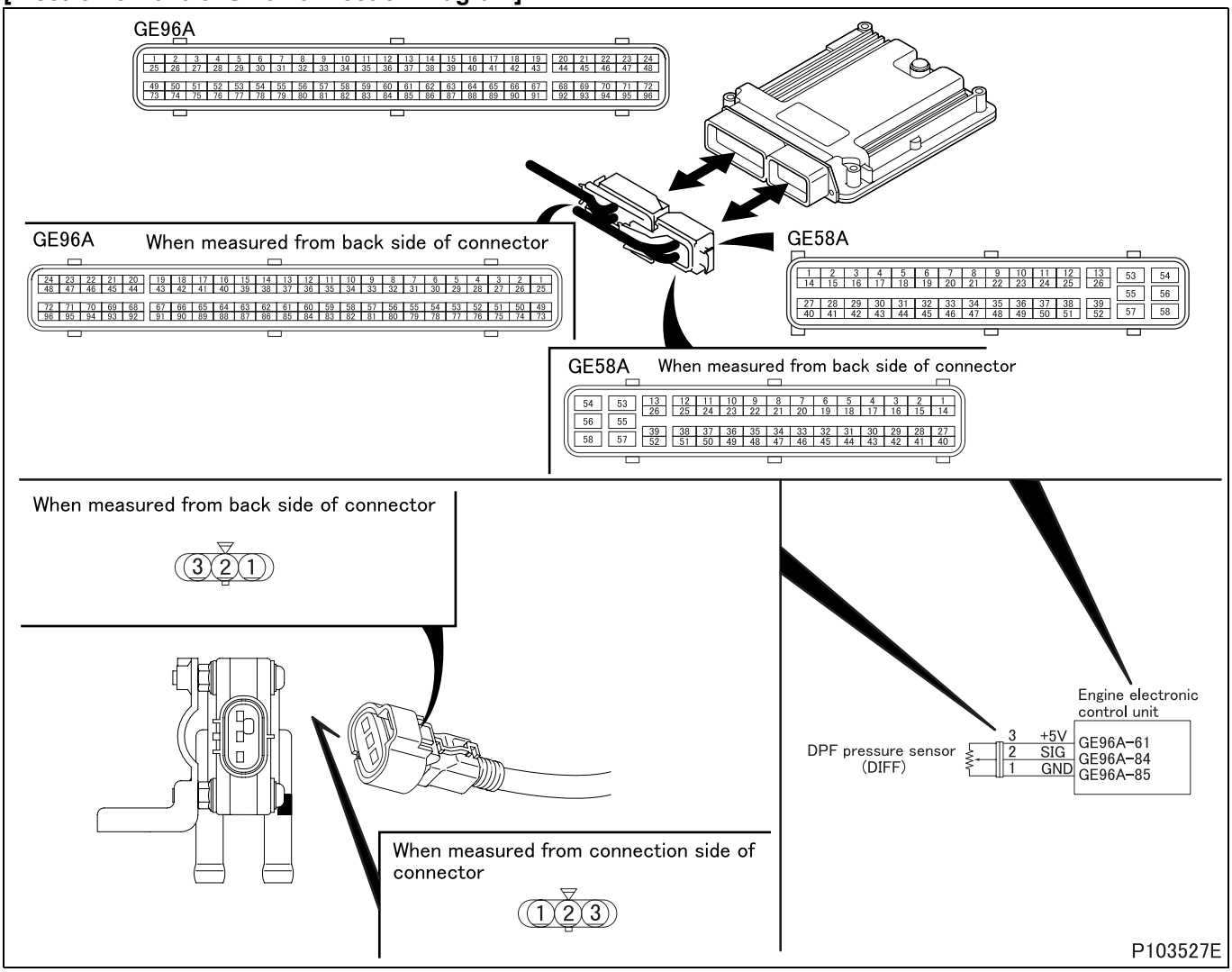
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter differential pressure is fixed at backup value.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

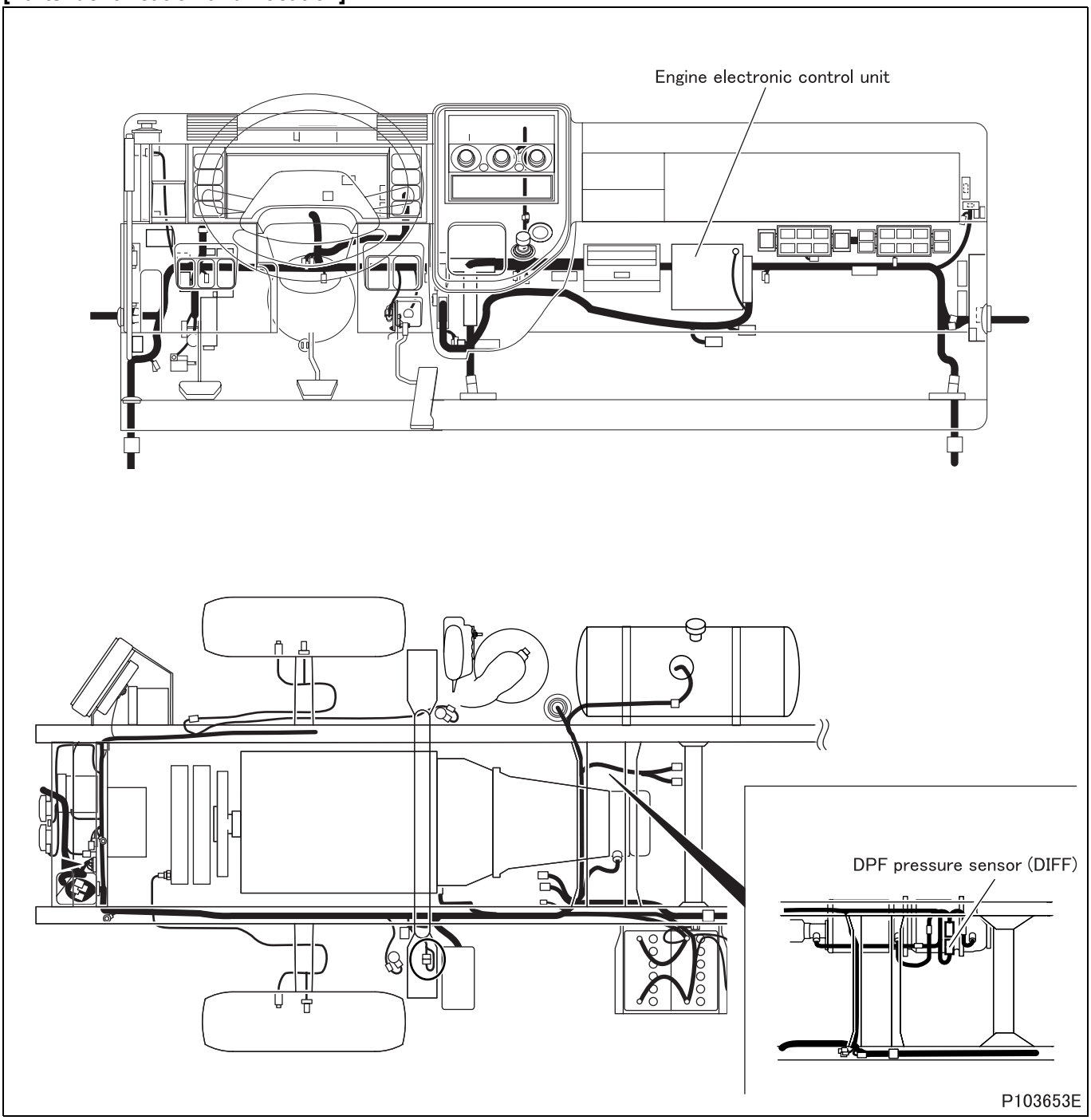
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measurement of item No. 22 “Difference pressure across DPF” of Service Data.
	Inspection condition		Past failures include diesel particulate filter pressure sensor, while the current failures do not include diesel particulate filter pressure sensor.
	Requirements		When engine is stationary: 0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 84 (+) and 85 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		1 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 61 (+) and 85 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

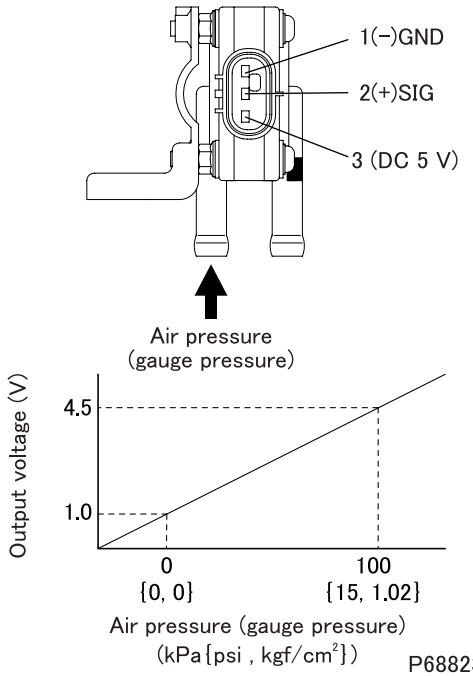
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 85 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 1 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 61.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 85.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 84.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		Measurement of item No. 22 “Difference pressure across DPF”
	Inspection condition		Past failures include diesel particulate filter pressure sensor, while the current failures do not include diesel particulate filter pressure sensor.
	Requirements		When engine is stationary: 0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2455/Flash code: 97
[Monitor]
Failure of DPF pressure sensor (DIFF)
[Fault (outline)]
High signal range check
[Diagnosis check]
- Output voltage of DPF pressure sensor (DIFF) is monitored.

[Code generation condition]
- Pressure output from DPF pressure sensor (DIFF) remains below 1108 hpa for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

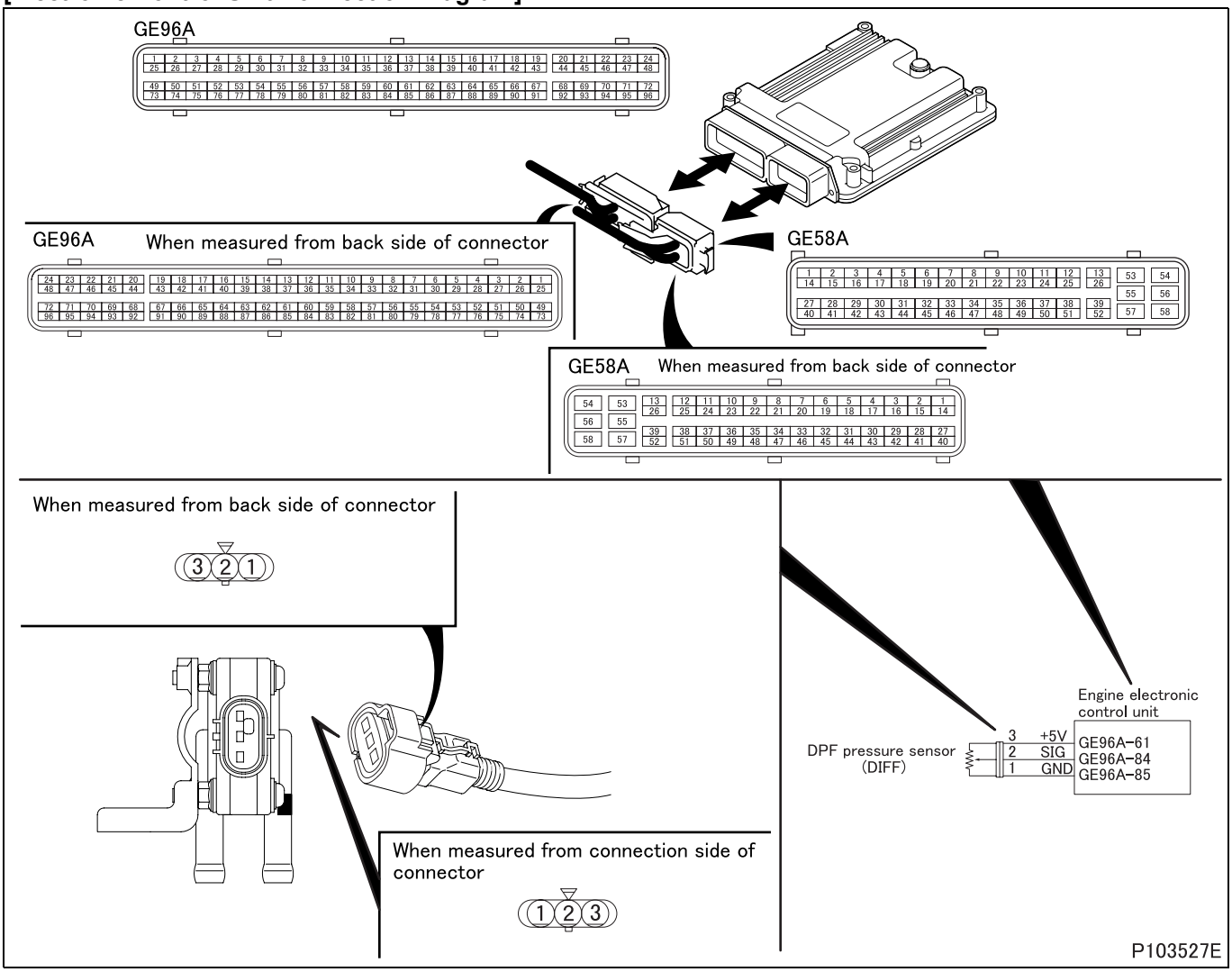
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Diesel particulate filter differential pressure is fixed at backup value.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

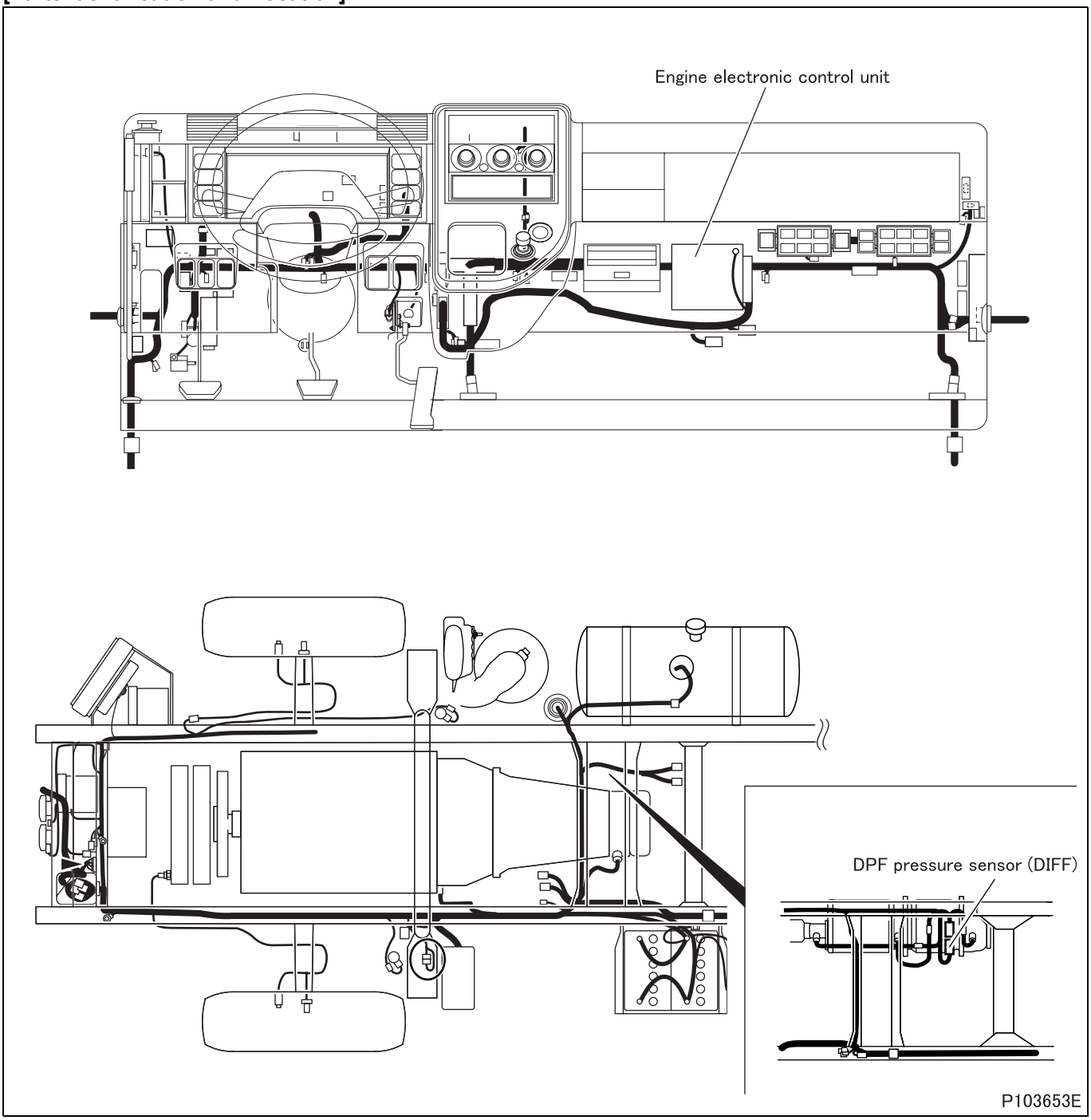
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and sensor
- Malfunction of each connector
- Malfunction of sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measurement of item No. 22 “Difference pressure across DPF” of Service Data.
	Inspection condition		Past failures include diesel particulate filter pressure sensor, while the current failures do not include diesel particulate filter pressure sensor.
	Requirements		When engine is stationary: 0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 84 (+) and 85 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		1 to 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 61 (+) and 85 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

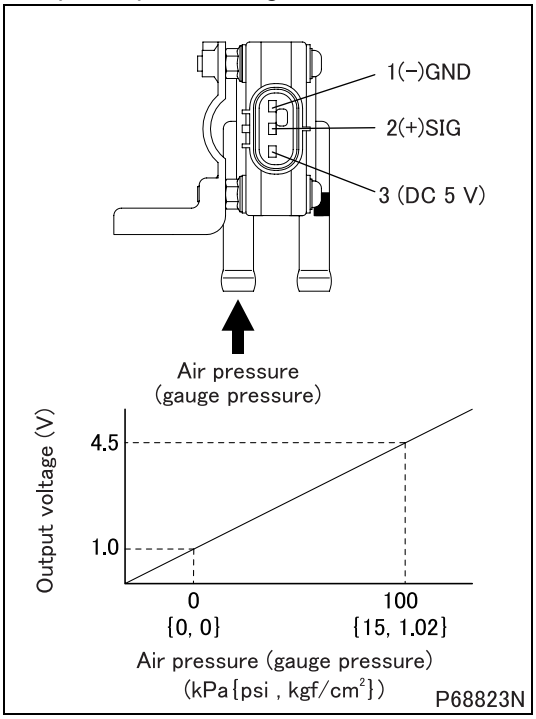
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 85 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 3 (+) and 1 (–).
	Inspection condition		• Measure from back side of harness connector with each device connected to harness. • Starter switch: ON
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between sensor connector terminal No. 3 and electronic control unit connector (GE96A) terminal No. 61.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (GE96A) terminal No. 85.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (GE96A) terminal No. 84.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		Measurement of item No. 22 “Difference pressure across DPF”
	Inspection condition		Past failures include diesel particulate filter pressure sensor, while the current failures do not include diesel particulate filter pressure sensor.
	Requirements		When engine is stationary: 0 kPa {0 psi, 0 kgf/cm^2}
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2457/Flash code: 2
[Monitor]
Failure of exhaust gas recirculation cooler
[Fault (outline)]
Exhaust gas recirculation cooler failure
[Diagnosis check]
Cooling performance of exhaust gas recirculation cooler is monitored, with exhaust gas recirculation system temperature detected through boost air temperature sensor under the following conditions and compared with target temperature for control by engine electronic control unit.
- Engine: started
- Exhaust brake: OFF

[Code generation condition]
- Temperature output from boost air temperature sensor remains over maximum target temperature for 10 seconds. (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

[Diagnostic requirement]
- Engine speed: 500 to 2700 rpm
- Variation in engine speed: less than 300 rpm/s
- Exhaust shutter: open
- Time till above conditions were met: more than 15 seconds

<Conditions after above conditions are met>
- Water temperature: below 95°C {203°F}
- Exhaust gas recirculation cooler temperature: –7 to 60°C {19 to 140°F}
- Engine running time: more than 60 seconds
- Exhaust gas recirculation valve: in order
- Intake throttle: in order
- Turbocharger actuator: in order
- Controller area network communication of each electronic drive unit (exhaust gas recirculation, intake throttle and turbocharger): in order
- Exhaust gas recirculation flow rate and exhaust gas recirculation valve operation: in order
- Atmospheric pressure sensor: in order
- Boost pressure sensor: in order
- Water temperature sensor: in order
- Boost air temperature sensor: in order
- Sensor 5 V power supply: in order
- Battery voltage: in order
- MPROP (rail pressure control valve): in order
- Injector: in order
- Intercooler: in order
- Starter switch circuit: in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

[Probable cause of trouble]
- Malfunction of exhaust gas recirculation cooler (breakage, clogging)
- Malfunction of exhaust gas recirculation pipe and hose (breakage, clogging)

[Recoverability]

- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0403 “EGR1 (Actuator Circuit)” • P0409 “EGR1 (Position Sensor)” • P0562 “Power Supply Voltage (Low)” • P0563 “Power Supply Voltage (High)” • P0600 “CAN Communication” • P0607 “ECU System” • P060B “A/D Converter” • P061B “ECU Performance (Calc)” • P061C “ECU Performance (Ne)” • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)” • P2413 “EGR System”
	Inspection condition		• Starter switch: ON • Do not start engine
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Inspection of exhaust gas recirculation system (exhaust gas recirculation pipe, exhaust gas recirculation cooler, exhaust gas recirculation valve)

[Fault code]
Diagnosis code: P2459/Flash code: 92
[Monitor]
Frequent diesel particulate filter regeneration
[Fault (outline)]
Excessive diesel particulate filter regeneration frequency (diesel particulate filter clogged up)
[Diagnosis check]
- Diesel particulate filter is monitored for early clogging through measurement of traveled time and distance from last diesel particulate filter regeneration.

[Code generation condition]
- If regenerative control was effected 2 consecutive times within 90 minutes in traveled time and 80 km {49.7 miles} in traveled distance.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the diesel particulate filter regeneration control is activated.

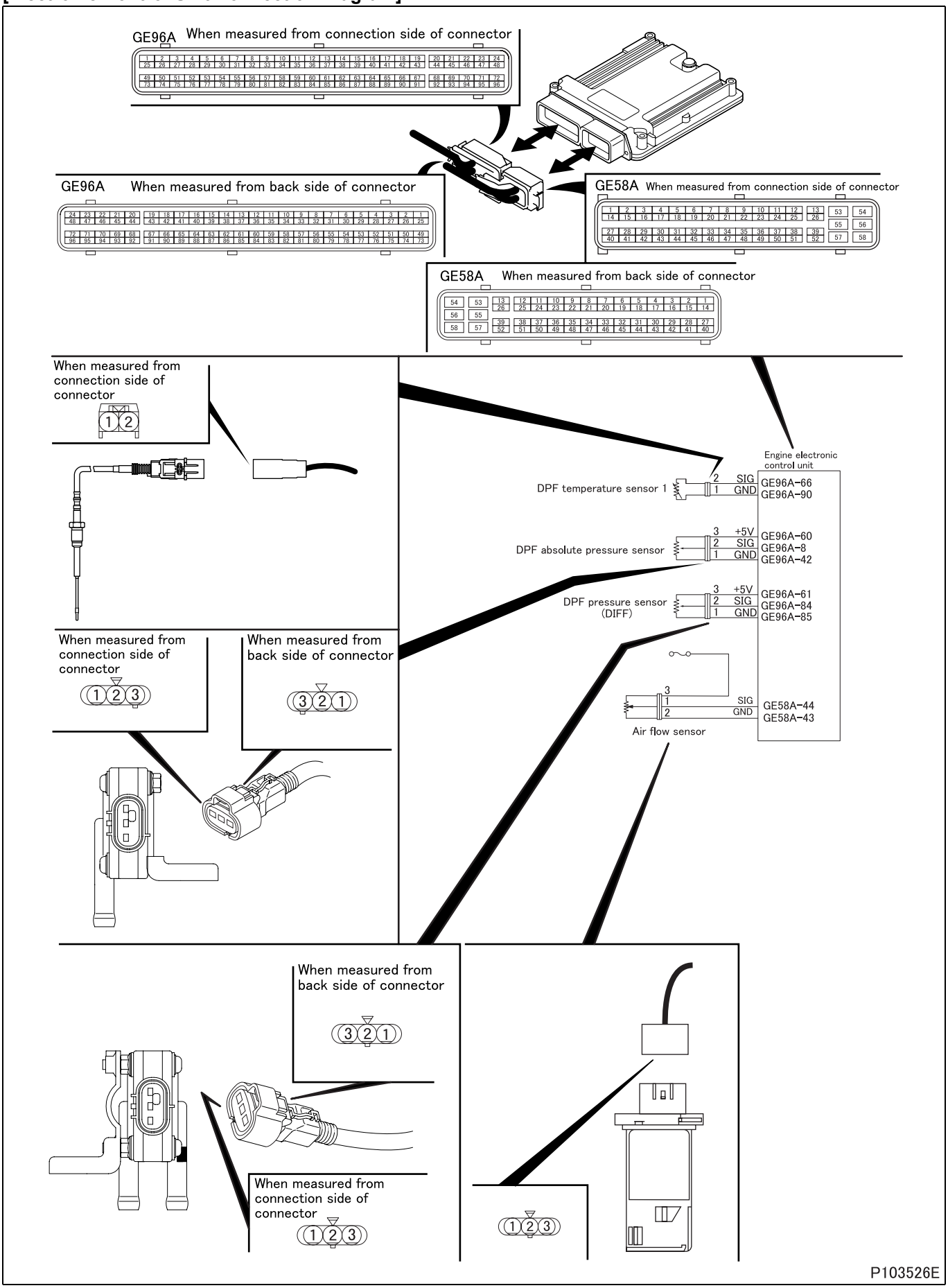
[Diagnostic requirement]
- Diesel particulate filter regeneration control: active

[Control effected by electronic control unit during fault]
- Engine torque is limited.
- Auto cruise control stopped
- Traction control is stopped. <Automatic transmission>
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

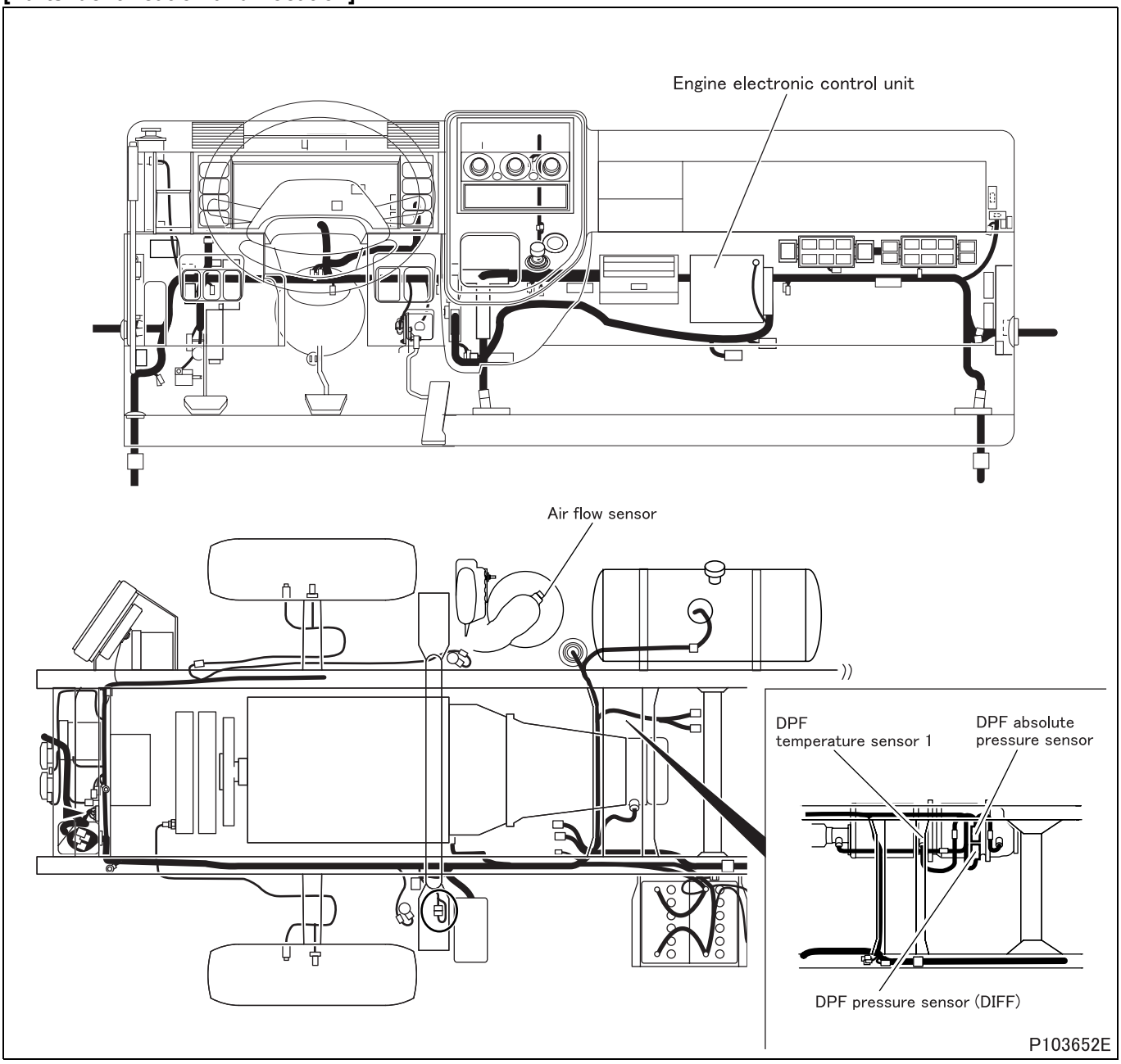
[Probable cause of trouble]
- Failure of diesel particulate filter indicator lamp
- Failure of diesel particulate filter cleaning switch
- Manual diesel particulate filter regeneration is not performed.
- Excessive smoke emission (due to malfunction of engine proper, common rail or exhaust gas recirculation system)
- Malfunction of air flow sensor
- Malfunction of DPF absolute pressure sensor and DPF pressure sensor (DIFF)
- Malfunction of diesel particulate filter

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]

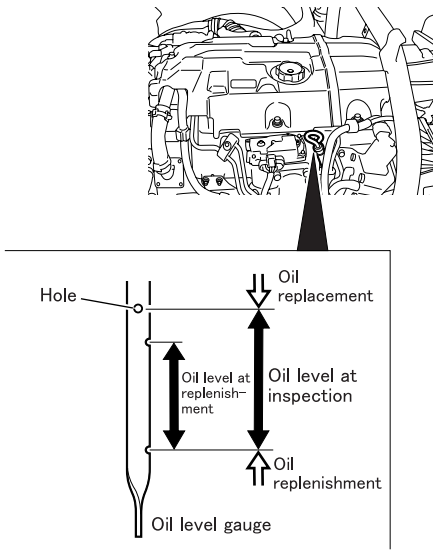


[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection of oil level
	Maintenance item		Inspection of engine oil level
	Inspection condition		Engine stopped
	Requirements		Oil level for inspection is not exceeded.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	After replacement of oil, go to step 2.

<Step 1 inspection diagram>

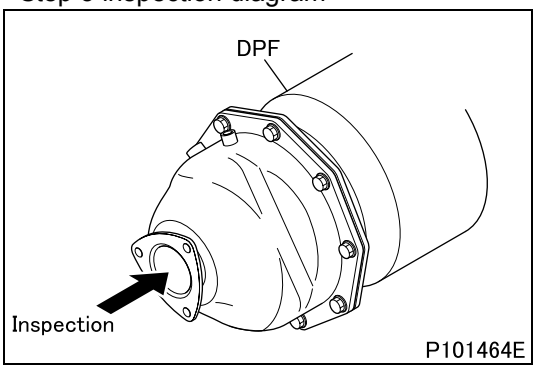


P103677E

Step 2	Inspection items		Inspection by manual diesel particulate filter regeneration
	Maintenance item		Perform Multi-Use Tester actuator test item No. A5 “DPF Regeneration (Manual)”, and clean ceramic diesel particulate filter.
	Inspection condition		• Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Engine: Idling • Place the transmission in neutral. (place the automatic transmission in P range) • Parking brake: vehicle parked (parking brake switch: ON) • After engine warm-up
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection
		NO	Go to step 3.

Step 3	Inspection items		Unit inspection of diesel particulate filter
	Maintenance item		Check the exhaust passage inside the diesel particulate filter for adhesion of soot in large quantity.
	Inspection condition		Remove diesel particulate filter.
	Requirements		No soot is deposited.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	After replacement of ceramic filter, perform resetting the DPF-related information.

<Step 3 inspection diagram>



Step 4	Inspection items		Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit
	Maintenance item		See Gr15 “Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit”.
	Inspection condition		Perform the following preparatory works. • Place the transmission in neutral. (place the automatic transmission in P range) • Turn the steering wheel in neutral position and securely apply the parking brake. • Turn off air conditioner not to increase the engine speed. • Check diagnosis code of each electronic control system. If any fault exists, rectify it. • Resetting the DPF-related information (perform “History reset” of Multi-Use Tester) (See Gr15 “Resetting the DPF-related information”.) • Warm up the engine until the engine coolant has been heated to more than 70°C {158°F}. (verify from Service Data “Engine Coolant Temperature” or “31: Water Temperature”)
	Requirements		This diagnosis code does not occur again.
	Inspection result (Is the judging standard satisfied?)	YES	End of inspection
		NO	Go to step 5.

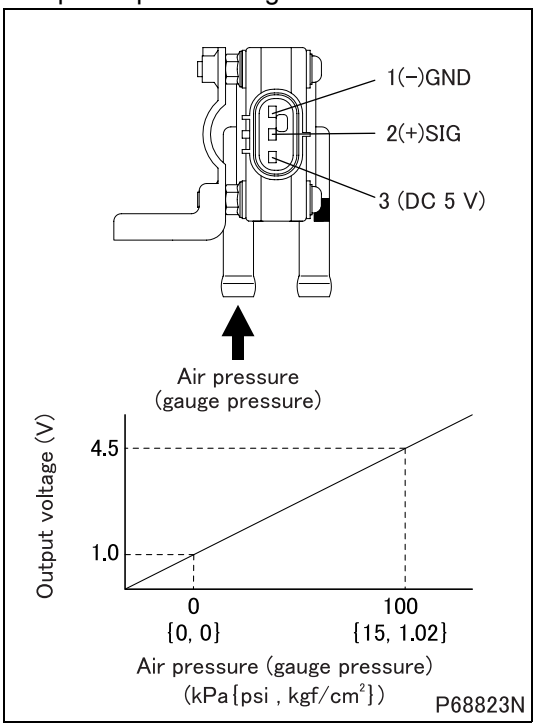
Step 5	Inspection items		Inspection by control data
	Maintenance item		Measure item No. B8 “DPF Indicator Lamp” of Service Data.
	Inspection condition		Perform Multi-Use Tester actuator test item No. A6 “DPF Lamp”.
	Requirements		Diesel particulate filter indicator lamp illuminates (automatic reset after 15 seconds)
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of engine electronic control unit

Step 6	Inspection items		Inspection by control data
	Maintenance item		Measure item No. A4 “DPF SW” of Service Data.
	Inspection condition		–
	Requirements		Press diesel particulate filter cleaning switch and check that “DPF SW” display switches from OFF to ON.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of diesel particulate filter cleaning switch or engine electronic control unit

Step 7	Inspection items		Inspection of pressure hose
	Maintenance item		Check pressure hose of DPF absolute pressure sensor and DPF pressure sensor (DIFF) for connection and cracks.
	Inspection condition		–
	Requirements		Nothing abnormal detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	After correction and replacement of hose, go to step 8.

Step 8	Inspection items		Inspection of DPF pressure sensor (DIFF)
	Maintenance item		Measure value of voltage between connector terminal No.2 (+) and 1 (–).
	Inspection condition		• Apply voltage DC 5 V across terminals No. 3 (+) and 1 (–). • Gradually increase applied air pressure.
	Requirements		• 0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}: 1 V • 100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}: 4.5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of DPF pressure sensor (DIFF)

<Step 8 inspection diagram>



Step 9	Inspection items		Inspection of air flow sensor unit
	Maintenance item		Since inspection of single part is not easy, whether characteristics are deteriorated or not must be checked for the sensor mounted on the current vehicle by measuring and comparing the amount of sensor intake air of the sensor currently mounted on vehicle and that replaced with new one by the service data. **(1) Prepare for inspection** • Clean or replace air cleaner element. • Prepare a new air flow sensor. • Warm up the engine fully. **(2) Measure the intake air of current sensor** • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure the following items from among “Service data”. **<General Scanning Tool used>** • Engine speed: “Ne” (rpm) • Intake air flow rate: “Air Flow Rate from MAFS” (g/s) **<Multi-Use Tester used>** • Engine speed: 01 “Engine Revolution” (rpm) • Intake air flow rate: 60 “Air mass flow” (g/s) **(3) Measure the intake air of new sensor** • Replace the currently mounted sensor with a new sensor. • Keep pressing the accelerator pedal until it bottom the stopper bolt from the idling state. (no load maximum rotation) • Measure intake air flow at the same rpm as that of engine revolution in item (2) of “Service data”. **(4) Comparison whether characteristics are deteriorated** • Calculate the characteristics deterioration factor (%) by the following equation. • Characteristics deterioration factor (%) = (intake air of new item – current intake air) × 100/intake air of new item.
	Inspection condition		–
	Requirements		10% or less
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of air flow sensor

Step 10	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	• Inspection of exhaust gas recirculation system (exhaust gas recirculation pipe, exhaust gas recirculation cooler, exhaust gas recirculation valve) • Inspection of engine
		NO	Replacement of injector

[Fault code]
Diagnosis code: P2533/Flash code: 66
[Monitor]
Failure of starter switch
[Fault (outline)]
Open circuit at electronic control unit inout
[Diagnosis check]
- Operational relation between starter switch and engine start is monitored.

[Code generation condition]
- Engine starts (engine revolutions are counted) without start signal from starter switch.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed only once during the driving cycle.

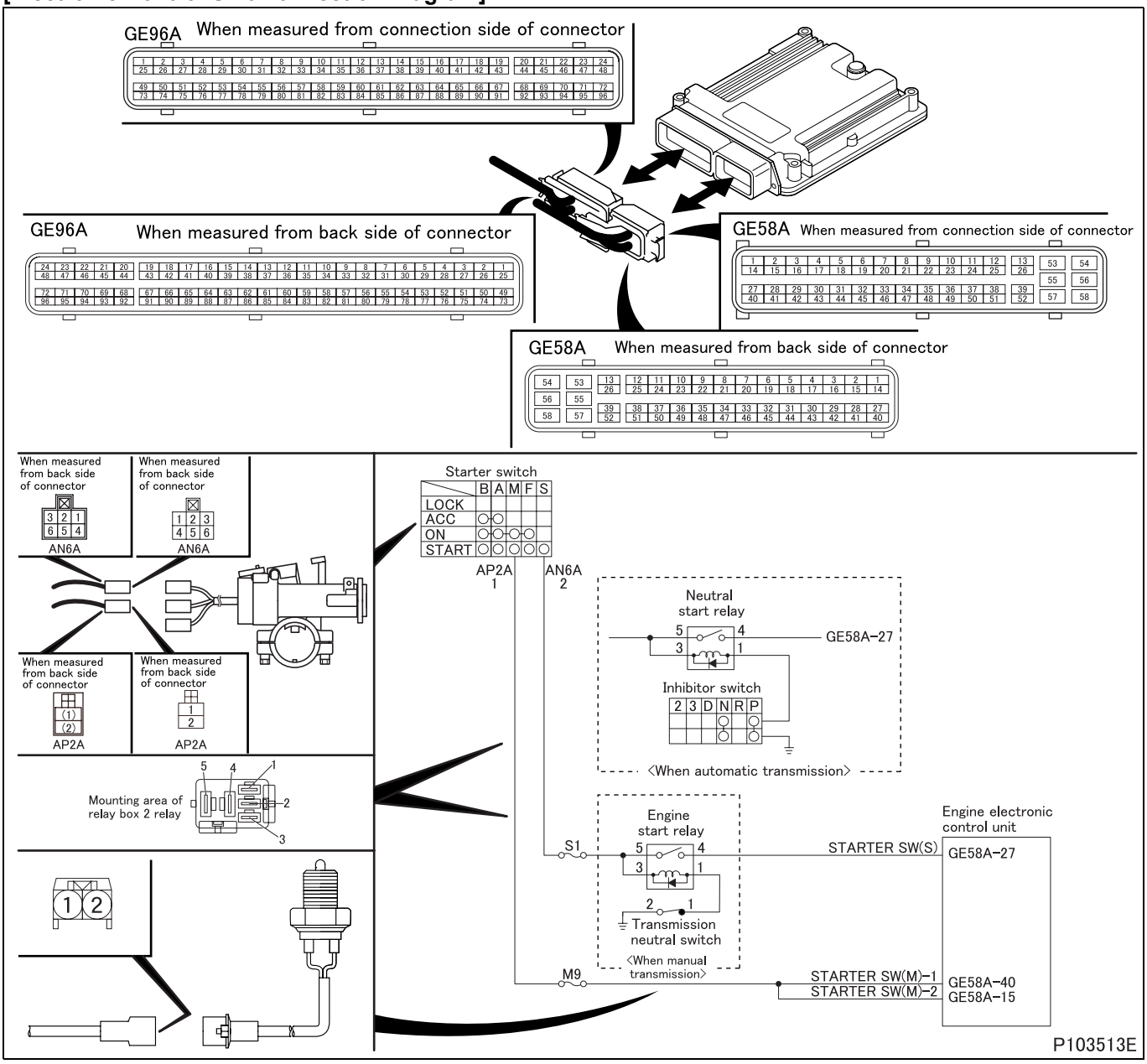
[Diagnostic requirement]
- Engine operating mode: starting
- Previous engine operation mode: OFF
- Speed increase from engine speed sensor: more than 100 rpm
- Speed increase from cylinder recognition sensor: more than 100 rpm
- Vehicle speed: less than 1 km/h {0.62 MPH}
- Vehicle speed sensor: in order

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

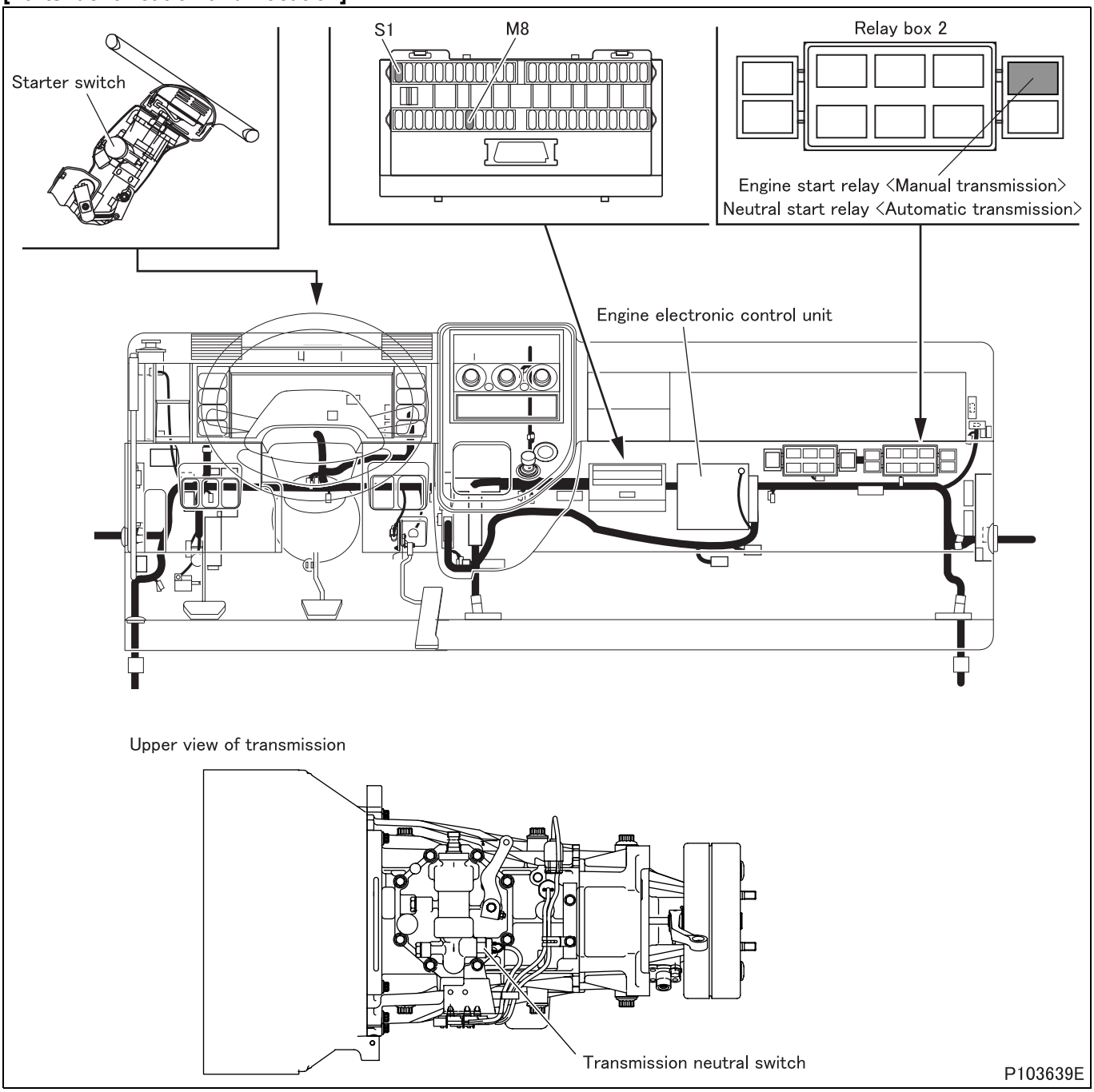
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and starter switch
- Malfunction of each connector
- Malfunction of starter switch
- Malfunction of engine start relay <Manual transmission>
- Malfunction of neutral start relay <Automatic transmission>
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<General Scanning Tool used>** • Measure value of voltage between electronic control unit connector (GE58A) terminal No. 27 (+) and ground (–). **<Multi-Use Tester used>** • Measure item No. A0 “Starter SW (S)” of Service Data.
	Inspection condition		• Transmission: neutral or P range • Starter switch: start
	Requirements		**<General Scanning Tool used>** • Same as battery voltage. **<Multi-Use Tester used>** • Displayed as “ON”.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

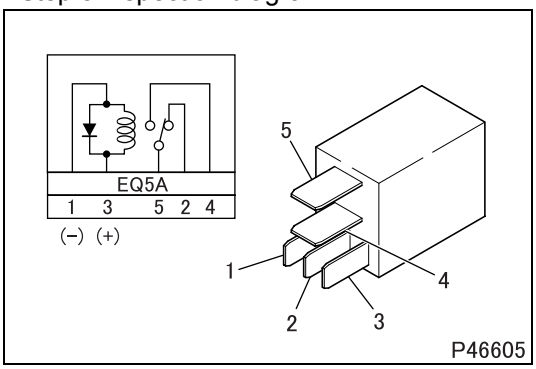
Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of relay connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 4 (+) and ground (–).
	Inspection condition		• Transmission: neutral or P range • Starter switch: start
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Go to step 4.

Step 4	Inspection items		Inspection of relay connector (signal)
	Maintenance item		Check transmission signal between connector terminal No. 1 (+) and ground (–).
	Inspection condition		Transmission: neutral or P range
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	• Replacement of transmission neutral switch <Manual transmission> • Replacement of inhibitor switch <Automatic transmission>

Step 5	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 4 and 5 when relay operates.
	Inspection condition		Apply battery voltage across connector terminals No. 3 (+) and 1 (–).
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of relay

<Step 5 inspection diagram>

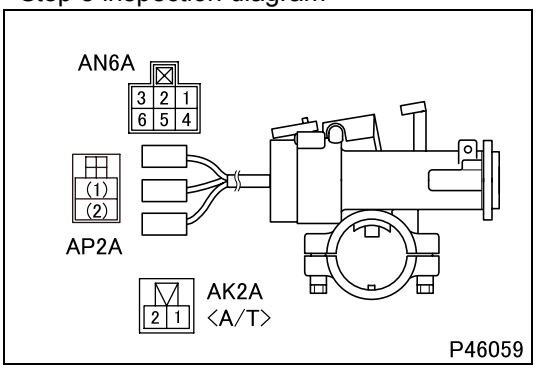


Step 6	Inspection items		Inspection of harness between starter switch and relay
	Maintenance item		Check circuit between starter switch connector (AN6A) terminal No. 2 and relay connector terminal No. 5 and 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Go to step 7.

Step 7	Inspection items		Inspection of fuse (S1)
	Maintenance item		Check open-circuit of fuse (S1)
	Inspection condition		–
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of fuse

Step 8	Inspection items		Inspection of starter switch unit
	Maintenance item		Check continuity between connector terminals.
	Inspection condition		Check presence of continuity in each switch position.
	Requirements		• LOCK: There is no continuity. • ACC: There is continuity between [2] and (3) • ON: There is continuity between [1], [2], (3) and (4) • START: There is continuity between [1], [2], (2), (3) and (4) • Terminal No. with [ ] shows connector terminal of AP2A and Terminal No. with ( ) shows connector terminal of AN6A.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of starter switch

<Step 8 inspection diagram>



Step 9	Inspection items		Inspection of harness between electronic control unit and relay
	Maintenance item		Check circuit between electronic control unit connector (GE58A) terminal No. 27 and connector terminal No. 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify harness.

[Fault code]
Diagnosis code: P253C/Flash code: 61
[Monitor]
Failure of auxiliary equipment sensor
[Fault (outline)]
Low signal range check
[Diagnosis check]
- Accelerator pedal position during cab back control is monitored through auxiliary equipment sensor for acceleration opening within specified value.

[Code generation condition]
- Voltage from auxiliary equipment sensor remains below 0.49 V for 1 second.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the power takeoff control is activated.

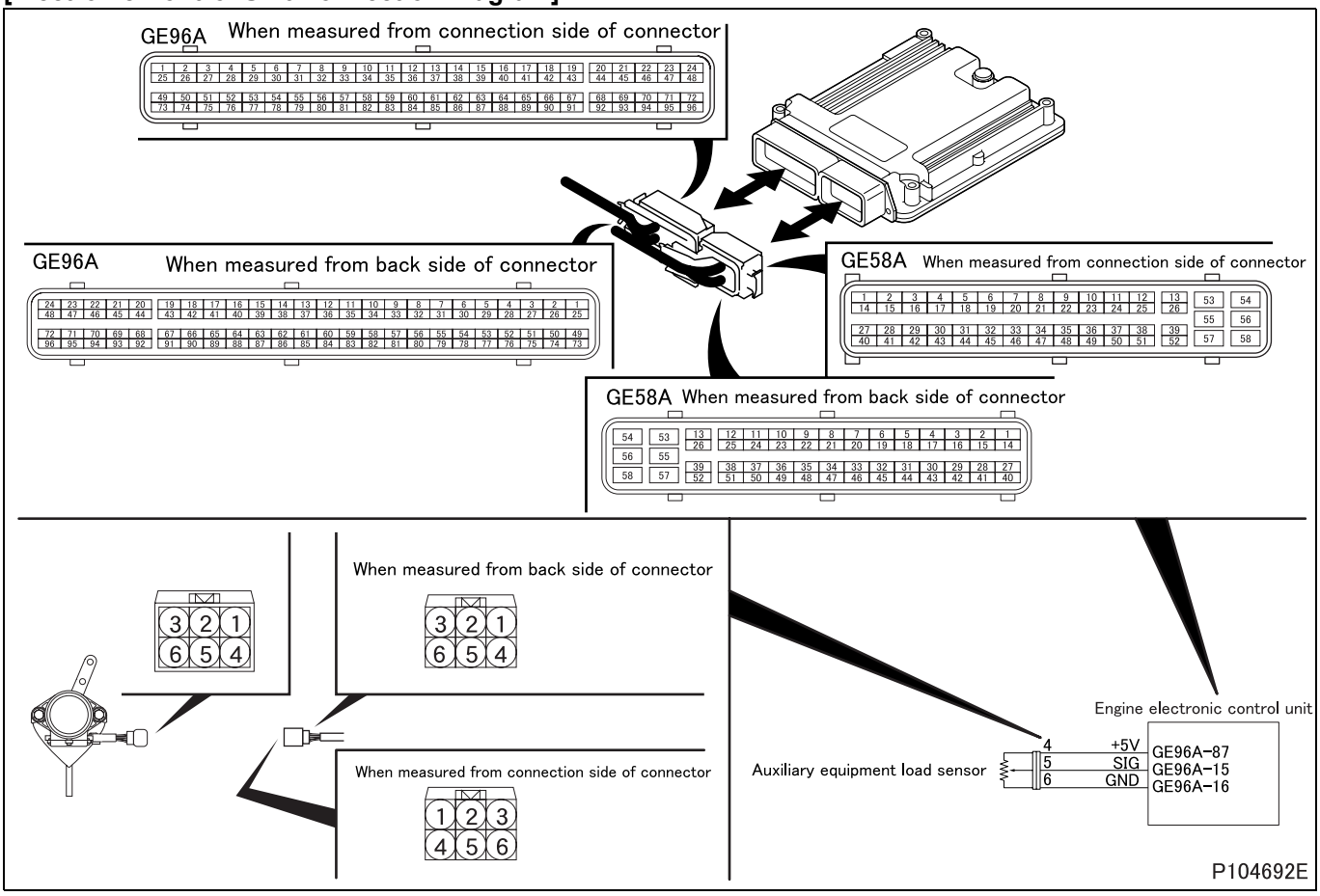
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Power take-off accelerator pedal position is fixed at backup value.

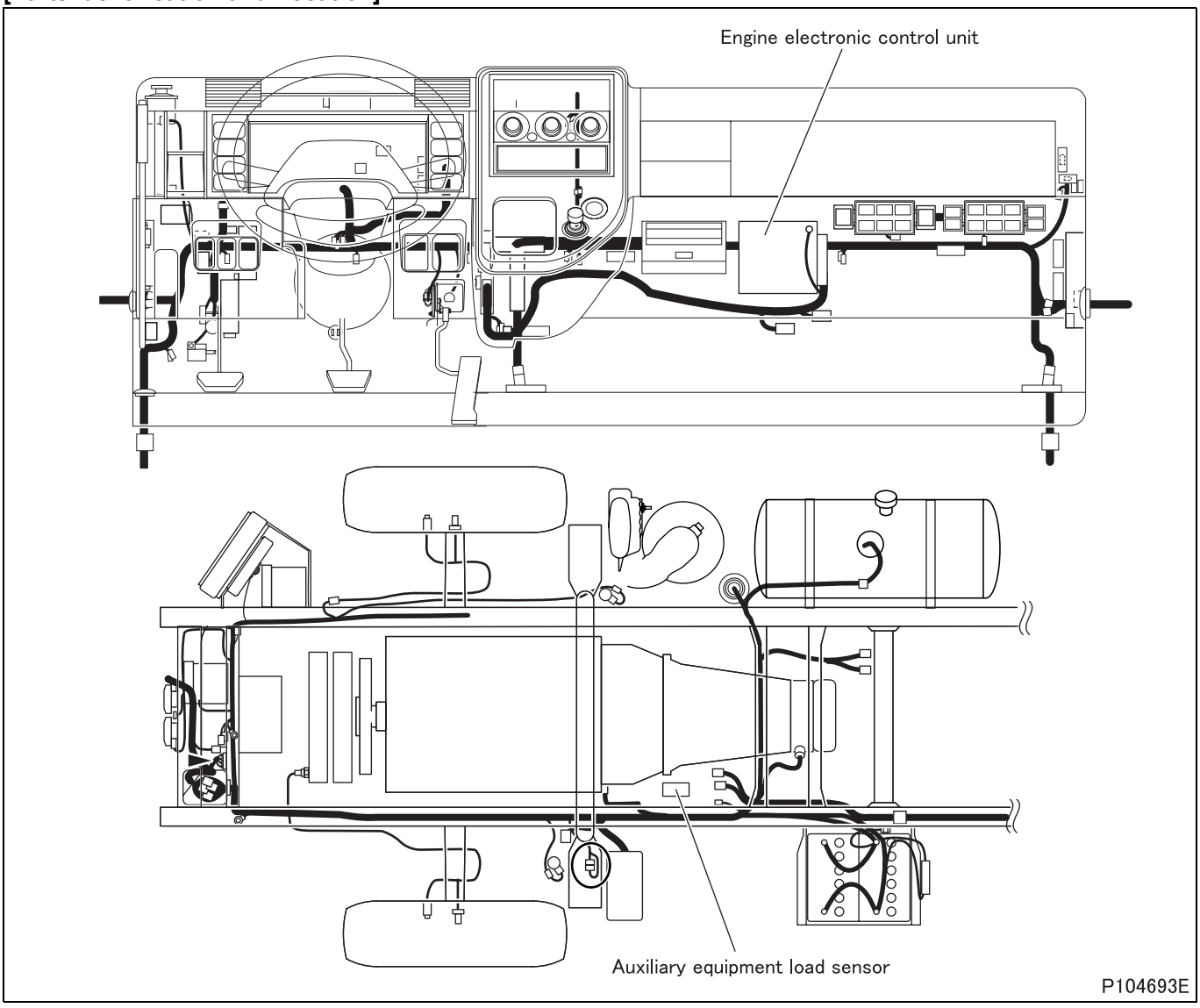
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and auxiliary equipment sensor
- Malfunction of each connector
- Malfunction of auxiliary equipment sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is ON position.
  (Warning lamp and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measurement of item No. 84 “PTO Accel Sensor Voltage” of Service Data.
	Inspection condition		–
	Requirements		• Idling position: 0.85 ± 0.1 V • Full-load position: 3.0 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 15 (+) and 16 (–).
	Inspection condition		• Starter switch: ON (Do not start engine) • Measure from back side of harness connector with each device connected to harness.
	Requirements		• Idling position: 0.85 ± 0.1 V • Full-load position: 3.0 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 87 (+) and 16 (–).
	Inspection condition		• Starter switch: ON (Do not start engine) • Measure from back side of harness connector with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

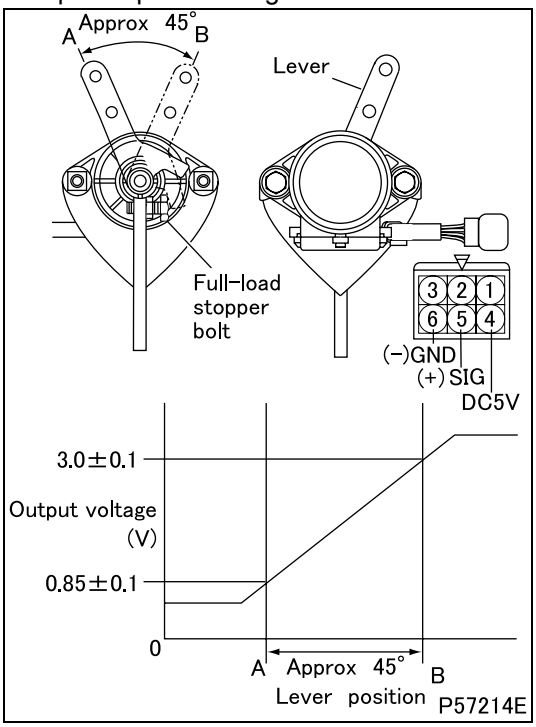
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 16 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Starter switch: ON (Do not start engine) • Measure from back side of harness connector with each device connected to harness.
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of auxiliary equipment sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 5 (+) and 6 (–).
	Inspection condition		Apply voltage DC 5 V across connector terminals No.4 (+) and 6 (–).
	Requirements		• Idling position: 0.85 ± 0.1 V • Full-load position: 3.0 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection by sensor connector
	Maintenance item		Measure value of voltage between connector terminal No. 4 (+) and 6 (–).
	Inspection condition		• Starter switch: ON (Do not start engine) • Measure from back side of harness connector with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 87 and sensor connector terminal No. 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 6 and electronic control unit connector (GE96A) terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 5 and electronic control unit connector (GE96A) terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		Measurement of item No. 84 “PTO Accel Sensor Voltage” of Service Data.
	Inspection condition		–
	Requirements		• Idling position: 0.85 ± 0.1 V • Full-load position: 3.0 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P253D/Flash code: 61
[Monitor]
Failure of auxiliary equipment sensor
[Fault (outline)]
High signal range check
[Diagnosis check]
- Accelerator pedal position during cab back control is monitored through auxiliary equipment sensor for acceleration opening within specified value.

[Code generation condition]
- Voltage from auxiliary equipment sensor remains over 3.49 V for 1 second.
  (Diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is performed each time when the power takeoff control is activated.

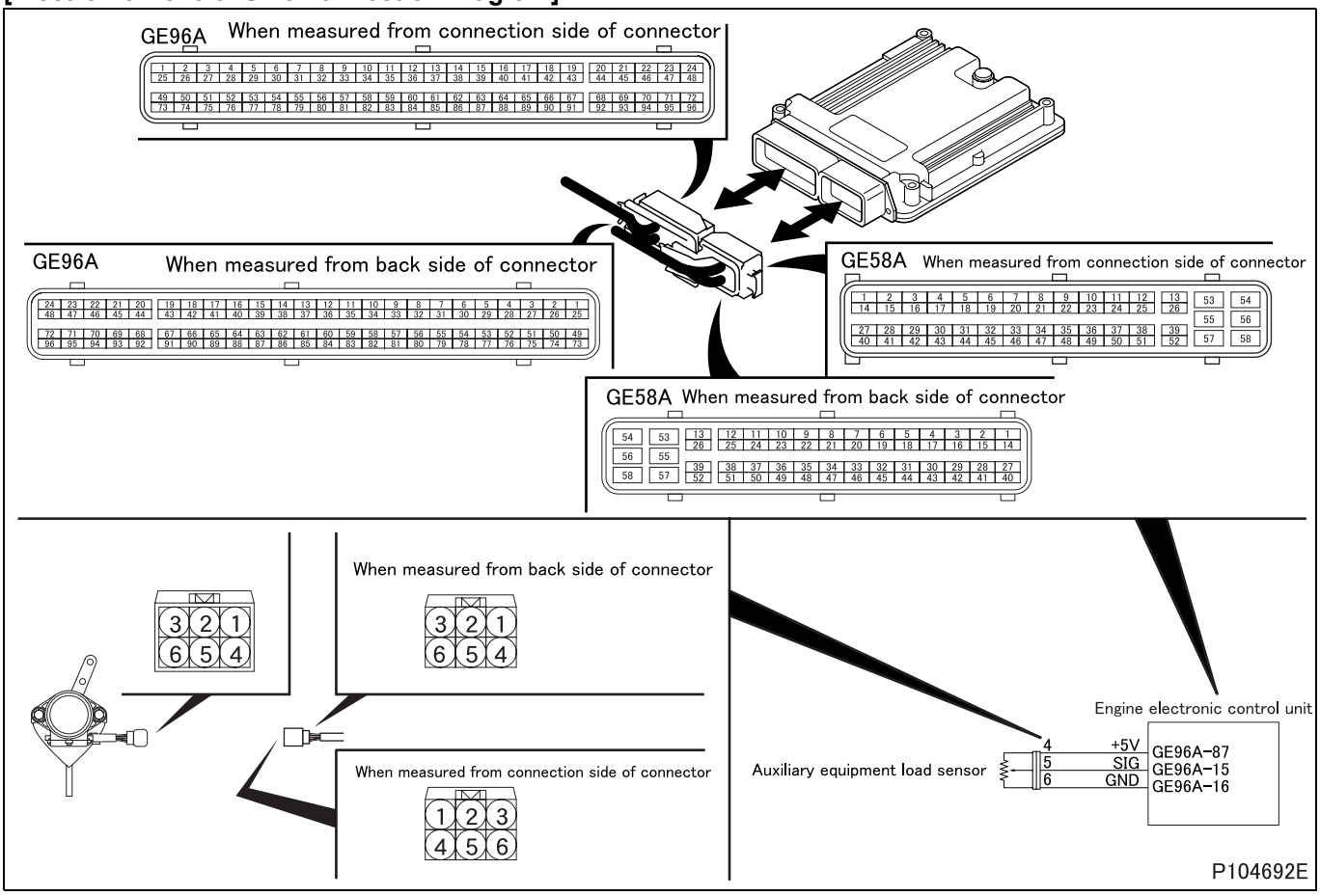
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Power take-off accelerator pedal position is fixed at backup value.

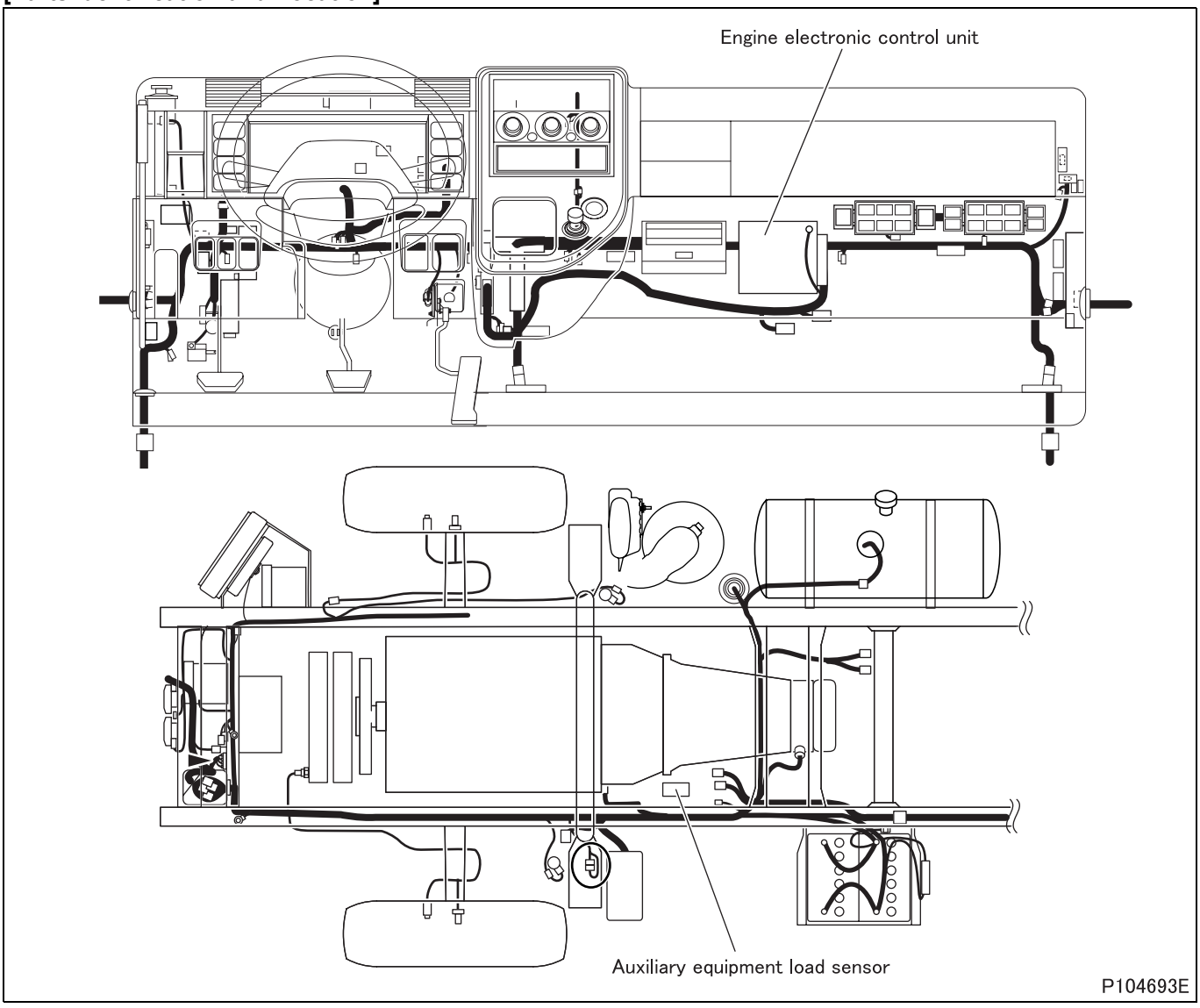
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and auxiliary equipment sensor
- Malfunction of each connector
- Malfunction of auxiliary equipment sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is ON position.
  (Warning lamp and diagnosis code is cleared simultaneously with recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Measurement of item No. 84 “PTO Accel Sensor Voltage” of Service Data.
	Inspection condition		–
	Requirements		• Idling position: 0.85 ± 0.1 V • Full-load position: 3.0 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 15 (+) and 16 (–).
	Inspection condition		• Starter switch: ON (Do not start engine) • Measure from back side of harness connector with each device connected to harness.
	Requirements		• Idling position: 0.85 ± 0.1 V • Full-load position: 3.0 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Go to step 3.

Step 3	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 87 (+) and 16 (–).
	Inspection condition		• Starter switch: ON (Do not start engine) • Measure from back side of harness connector with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

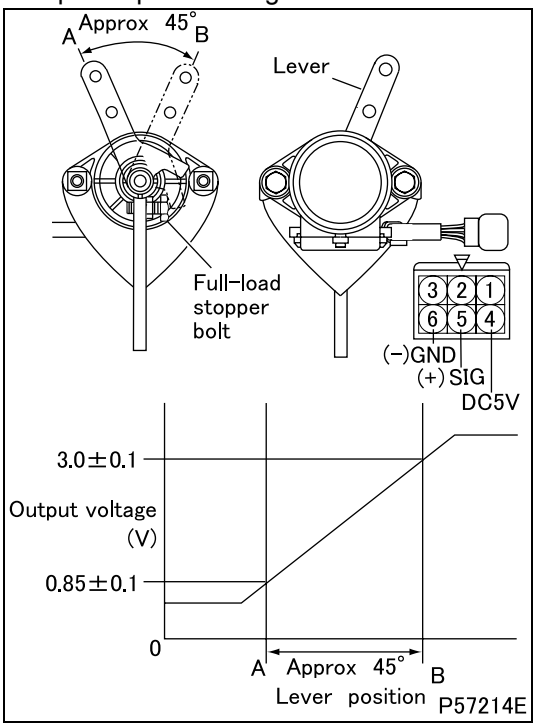
Step 4	Inspection items		Inspection by electronic control unit connector (ground)
	Maintenance item		Measure value of voltage between connector (GE96A) terminal No. 16 (+) and (GE58A) terminal No. 53 (–).
	Inspection condition		• Starter switch: ON (Do not start engine) • Measure from back side of harness connector with each device connected to harness.
	Requirements		0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 5.

Step 5	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify connector.

Step 6	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 7	Inspection items		Inspection of auxiliary equipment sensor unit
	Maintenance item		Measure value of voltage between connector terminal No. 5 (+) and 6 (–).
	Inspection condition		Apply voltage DC 5 V across connector terminals No. 4 (+) and 6 (–).
	Requirements		• Idling position: 0.85 ± 0.1 V • Full-load position: 3.0 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of sensor

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection by sensor connector
	Maintenance item		Measure value of voltage between connector terminal No. 4 (+) and 6 (–).
	Inspection condition		• Starter switch: ON (Do not start engine) • Measure from back side of harness connector with each device connected to harness.
	Requirements		5 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Go to step 9.

Step 9	Inspection items		Inspection of harness between electronic control unit and sensor (power supply)
	Maintenance item		Check circuit between electronic control unit connector (GE96A) terminal No. 87 and sensor connector terminal No. 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 10	Inspection items		Inspection of harness between electronic control unit and sensor (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 6 and electronic control unit connector (GE96A) terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between electronic control unit and sensor (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 5 and electronic control unit connector (GE96A) terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection by control data
	Maintenance item		Measurement of item No. 84 “PTO Accel Sensor Voltage” of Service Data.
	Inspection condition		–
	Requirements		• Idling position: 0.85 ± 0.1 V • Full-load position: 3.0 ± 0.1 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2563/Flash code: 51
[Monitor]
Turbocharger actuator system
[Fault (outline)]
- Low signal range check
- High signal range check

[Diagnosis check]
- Turbocharger electronic drive unit monitors turbocharger actuator internal circuit for fault (through throttle position sensor).

[Code generation condition]
- Position sensor output voltage remains 0 V (low pulse) or 8 to 11 V (high pulse) for 2 seconds.
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

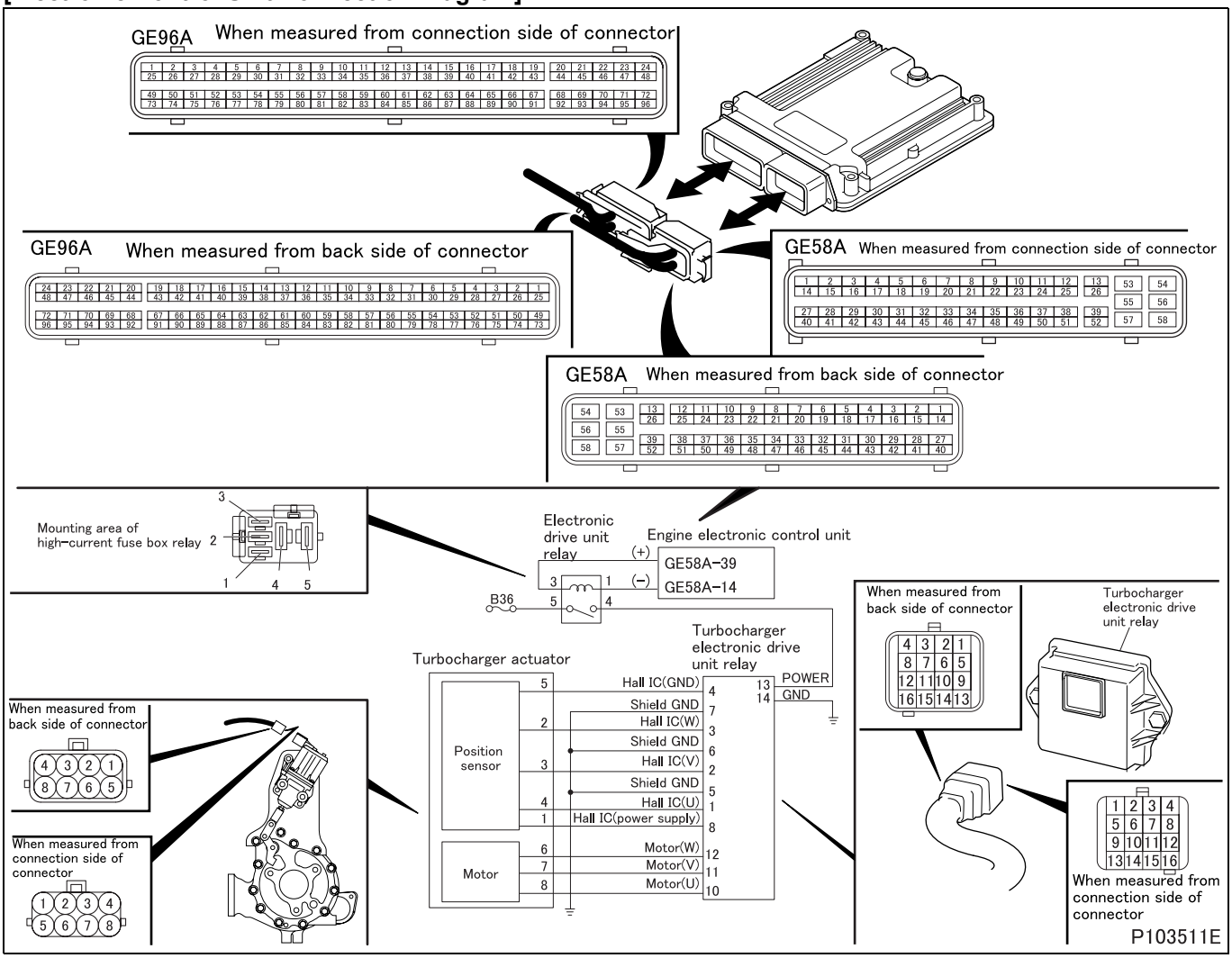
[Diagnostic requirement]
- Controller area network communication in order

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Diesel particulate filter regeneration is stopped.
- Related fault check is stopped.

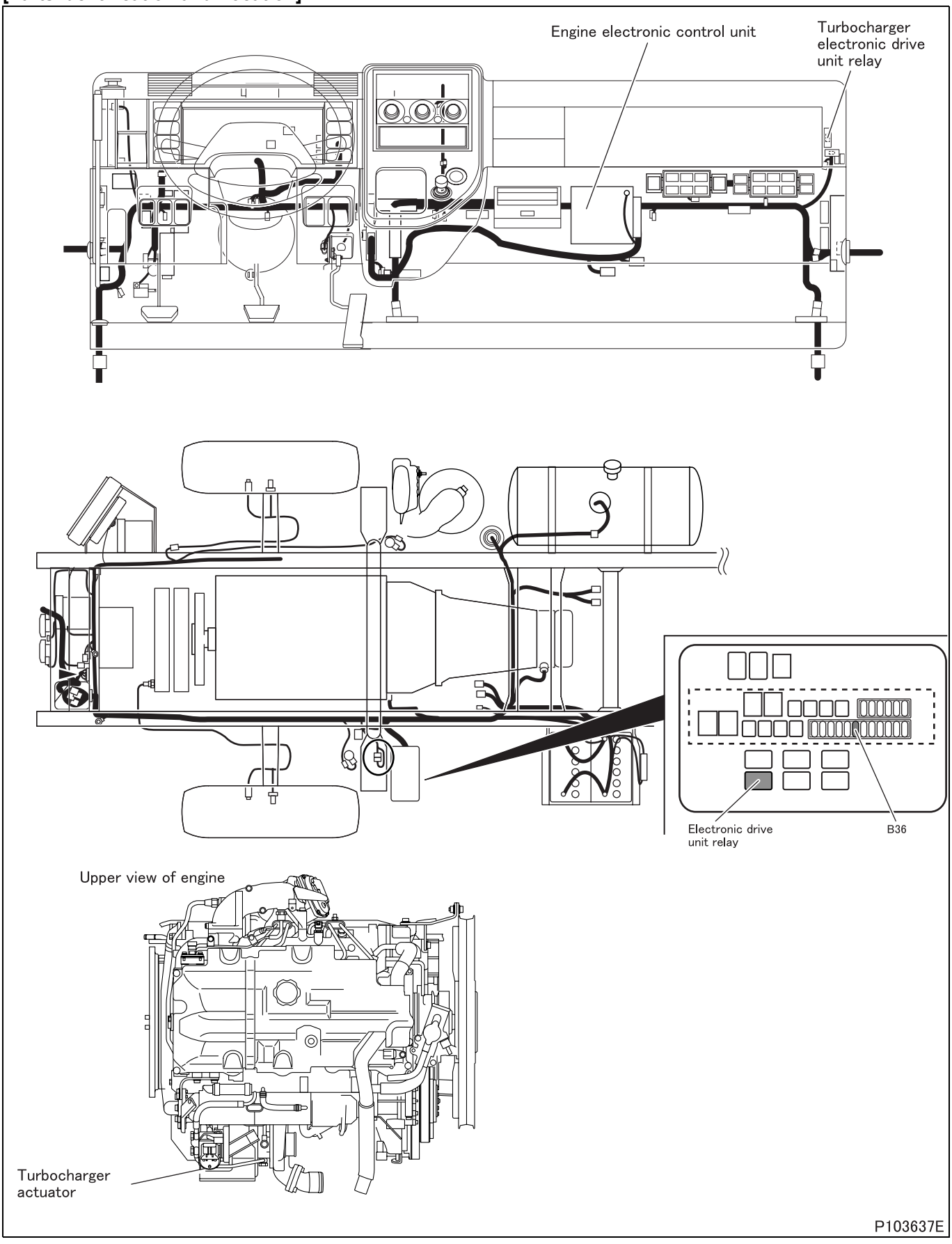
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic drive unit and turbocharger actuator
- Malfunction of each connector
- Malfunction of turbocharger motor (built in turbocharger actuator)
- Malfunction of turbocharger position sensor (built in turbocharger actuator)
- Malfunction of electronic drive unit
- Malfunction of electronic drive unit relay

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0685 “EDU Relay (Open)” • P0686 “EDU Relay (Low)” • P0687 “EDU Relay (High)” • P0688 “EDU Relay (Over Load)”
	Inspection condition		• Starter switch: ON • Engine: stopped
	Requirements		Codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Inspect diagnosis code that is occurring.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of electronic drive unit connector (power supply)
	Maintenance item		Measure value of voltage between connector terminal No. 13 (+) and 14 (–).
	Inspection condition		• Starter switch: ON • Engine: stopped • Disconnect connector and measure from harness side. • Perform actuator test item No. AF “EDU Relay”.
	Requirements		Same as battery voltage.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 4.

Step 4	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of harness between fuse and relay
	Maintenance item		Check circuit between fuse No. B36 and relay connector terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between relay and electronic drive unit
	Maintenance item		Check circuit between relay connector terminal No. 4 and electronic drive unit connector terminal No. 13.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	After replacement of electronic drive unit relay, go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between electronic drive unit and ground
	Maintenance item		Check circuit between electronic drive unit connector terminal No. 14 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic drive unit
		NO	Modify harness.

[Fault code]
Diagnosis code: P2670/Flash code: 36
[Monitor]
Abnormality of common rail pressure (comparison)
[Fault (outline)]
Short circuit ground
[Diagnosis check]
- MPROP (rail pressure control valve) power of engine electronic control unit is monitored for fault.

[Code generation condition]
- Power OFF (shorted to ground) remains as detected for 1 second.
  (Warning lamp is lit and diagnosis code is displayed on first establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Vapor smoke emission control during long-time idling is stopped.
- Diesel particulate filter regeneration is stopped.

[Probable cause of trouble]
- Malfunction of supply pump
- Malfunction of pressure limiter
- Airtight malfunction of injector
- Plugged fuel system

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared simultaneously with recovery.)

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		Check if following diagnosis codes occur simultaneously. • P0093 “CRS (Fuel Leak)” • P0148 “CRS (Fuel Delivery)” • P0191 “CRS Pressure SNSR (Plausibility)” • P0192 “CRS Pressure SNSR (Low)” • P0193 “CRS Pressure SNSR (High)” • P0201 “Injector M/V-Cylinder 1 (Load)” • P0202 “Injector M/V-Cylinder 2 (Load)” • P0203 “Injector M/V-Cylinder 3 (Load)” • P0204 “Injector M/V-Cylinder 4 (Load)” • P0261 “Injector #1-A (Low)” • P0262 “Injector #1-A (High)” • P0263 “Injector #1-A (Plausibility)” • P0264 “Injector #2-A (Low)” • P0265 “Injector #2-A (High)” • P0266 “Injector #2-A (Plausibility)” • P0267 “Injector #3-A (Low)” • P0268 “Injector #3-A (High)” • P0269 “Injector #3-A (Plausibility)” • P0270 “Injector #4-A (Low)” • P0271 “Injector #4-A (High)” • P0272 “Injector #4-A (Plausibility)” • P0562 “Power Supply Voltage (Low)” • P0563 “Power Supply Voltage (High)” • P0607 “ECU System” • P060B “A/D Converter” • P061B “ECU Performance (Calc)” • P061C “ECU Performance (Ne)”
	Inspection condition		• Starter switch: ON • Do not start engine
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Inspect diagnosis code that is occurring.

Step 2	Inspection items		Checking of engine appearance
	Maintenance item		Check fuel system for fuel leak.
	Inspection condition		Starter switch: OFF
	Requirements		There is no fuel leak.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 6.

Step 3	Inspection items		Inspection of low pressure piping (fuel tank – supply pump)
	Maintenance item		Check suction pipe or hose for bend.
	Inspection condition		Starter switch: OFF
	Requirements		There is no bend on pipe or hose.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Correct and replace suction pipe or hose.

Step 4	Inspection items		Checking of air bleeding
	Maintenance item		Bleed air from fuel filter.
	Inspection condition		Starter switch: OFF
	Requirements		Problem is solved by bleeding air.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 5.

Step 5	Inspection items		Inspection of low pressure piping
	Maintenance item		Fuel filter
	Inspection condition		Starter switch: OFF
	Requirements		Problem is solved by replacing fuel filter.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 6.

Step 6	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from supply pump.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of supply pump

Step 7	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from fuel pipe between supply pump and rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of fuel pipe

Step 8	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Replacement of rail

Step 9	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from fuel injection pipes (four) between injector and rail.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of injection pipe

Step 10	Inspection items		Inspection by control data
	Maintenance item		Perform actuator test item No. B2 “Fuel Leak Check”.
	Inspection condition		Engine start: At idle
	Requirements		There is no leak from injectors (four).
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Replacement of injector

Step 11	Inspection items		Inside inspection of combustion chamber
	Maintenance item		Check for fuel leak.
	Inspection condition		• After performing actuator test item No. B2 “Fuel Leak Check”, stop engine. • Remove glow plug, and check from glow plug mounting hole using bore scope.
	Requirements		Inside of combustion chamber is not wet.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Replacement of injector of object cylinder

Step 12	Inspection items		Replacement of rail (flow damper and pressure limiter abnormal)
	Maintenance item		–
	Inspection condition		–
	Requirements		Problem is solved by replacing rail.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Go to step 13.

Step 13	Inspection items		Replacement of supply pump
	Maintenance item		–
	Inspection condition		–
	Requirements		Problem is solved by replacing supply pump.
	Inspection result (Is the judging standard satisfied?)	YES	–
		NO	Replacement of injectors (four)

[Fault code]
Diagnosis code: U0001/Flash code: 73
[Monitor]
Abnormality in controller area network 2 communication
[Fault (outline)]
Message timeout
[Diagnosis check]
- Controller area network communication between engine electronic control unit and each electronic drive unit (turbocharger, exhaust gas recirculation, throttle) is monitored for abnormality.

[Code generation condition]
- No controller area network signal is sent from each electronic drive unit within specified time after engine start (time out).
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

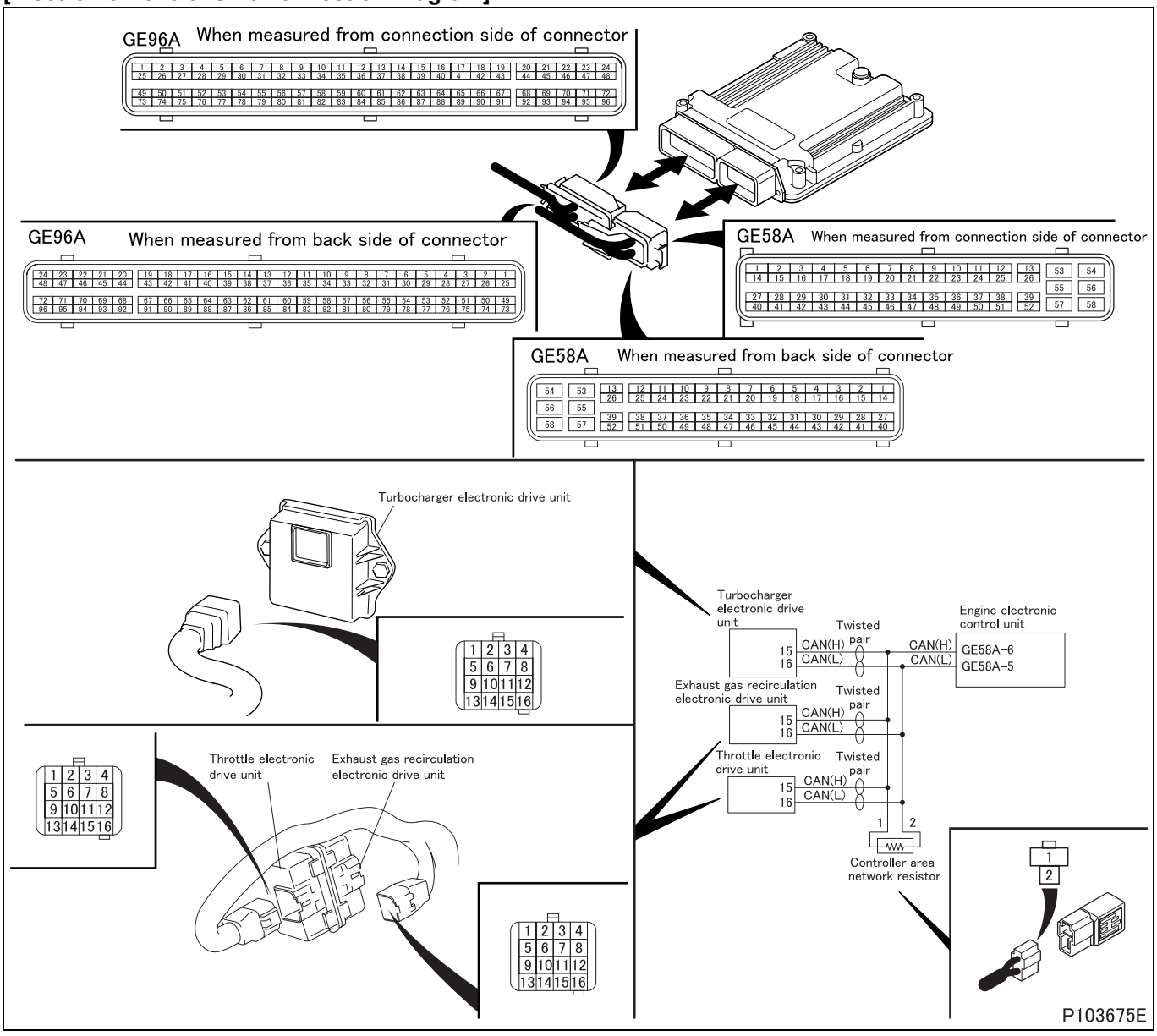
[Diagnostic requirement]
- When engine is in normal condition during period from after-run to start.

[Control effected by electronic control unit during fault]
- Related fault check is stopped.

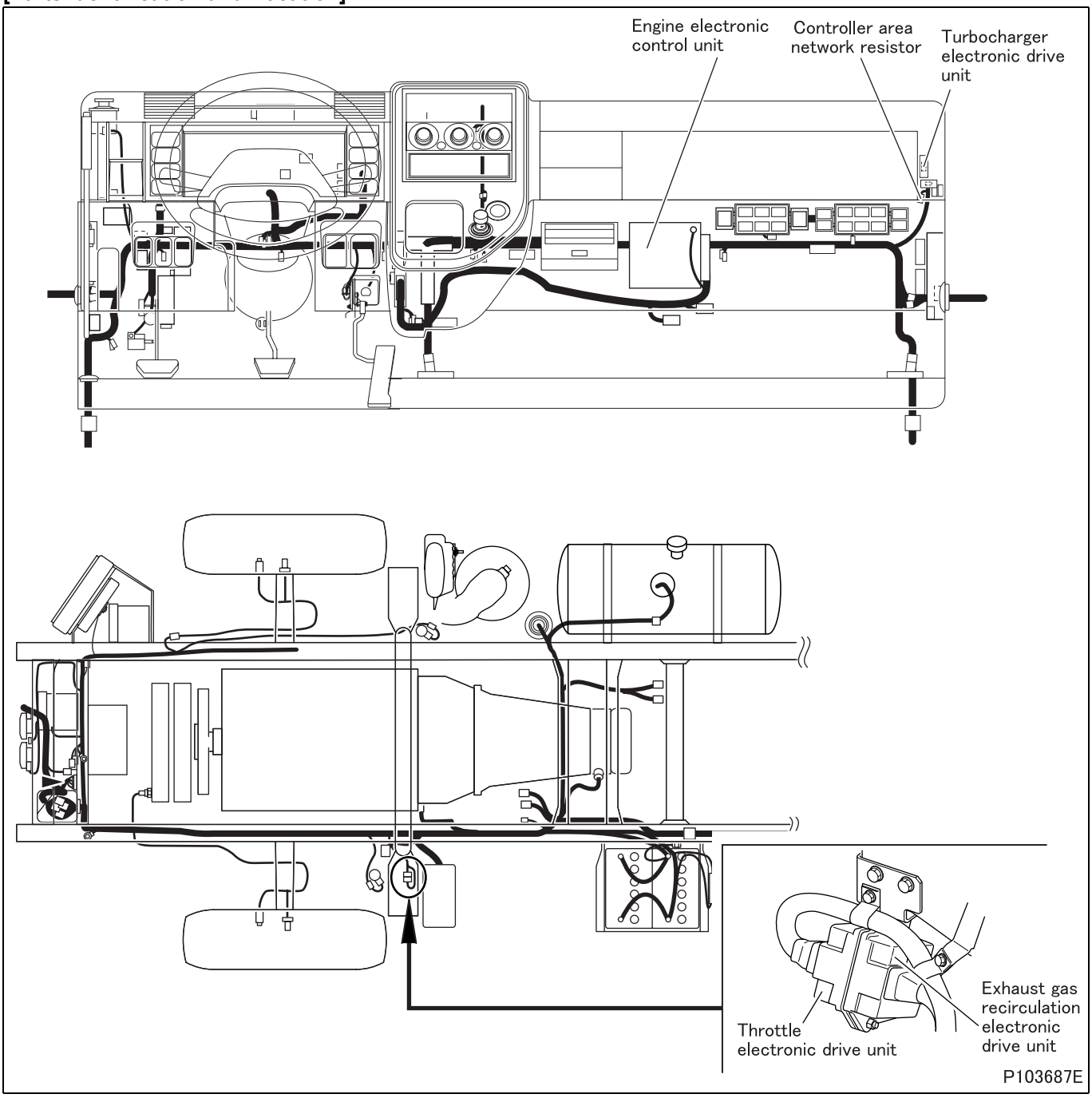
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between engine electronic control unit and each electronic drive unit (turbocharger, exhaust gas recirculation, throttle)
- Malfunction of each connector
- Malfunction of engine electronic control unit
- Malfunction of each electronic drive unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

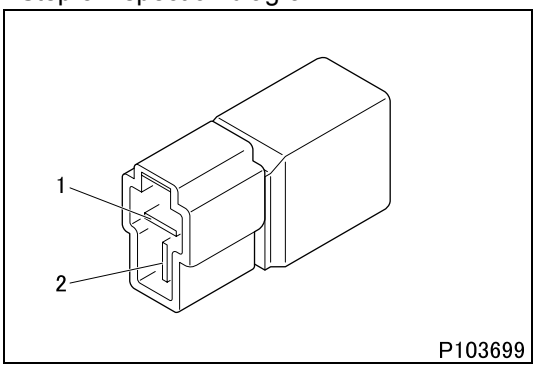
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by engine electronic control unit connector
	Maintenance item		Measure value of resistance between engine electronic control unit connector (GE58A) terminal No. 5 and 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and No. 2.
	Inspection condition		Disconnect connector and measure resistor side.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of controller area network resistor

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and engine electronic control unit connector (GE58A) terminal No. 6
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and engine electronic control unit connector (GE58A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between exhaust gas recirculation electronic drive unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and exhaust gas recirculation electronic drive unit connector terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between exhaust gas recirculation electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and exhaust gas recirculation electronic drive unit connector terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection of exhaust gas recirculation electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 10	Inspection items		Inspection of harness between throttle electronic drive unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and throttle electronic drive unit connector terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between throttle electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and throttle electronic drive unit connector terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of throttle electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify connector.

Step 13	Inspection items		Inspection of harness between turbocharger electronic drive unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and turbocharger electronic drive unit connector terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Modify harness.

Step 14	Inspection items		Inspection of harness between turbocharger electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and turbocharger electronic drive unit connector terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 15.
		NO	Modify harness.

Step 15	Inspection items		Inspection of turbocharger electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replace the engine electronic control unit as well if this diagnosis code occurs after the replacement of one of electronic drive units.
		NO	Modify connector.

[Fault code]
Diagnosis code: U0002/Flash code: 73
[Monitor]
Abnormality in controller area network 2 communication
[Fault (outline)]
Controller area network B bus off
[Diagnosis check]
- Controller area network communication between engine electronic control unit and each electronic drive unit (turbocharger, exhaust gas recirculation, throttle) is monitored for abnormality.

[Code generation condition]
- No controller area network signal is received from each electronic drive unit after engine start (controller area network bus OFF).
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

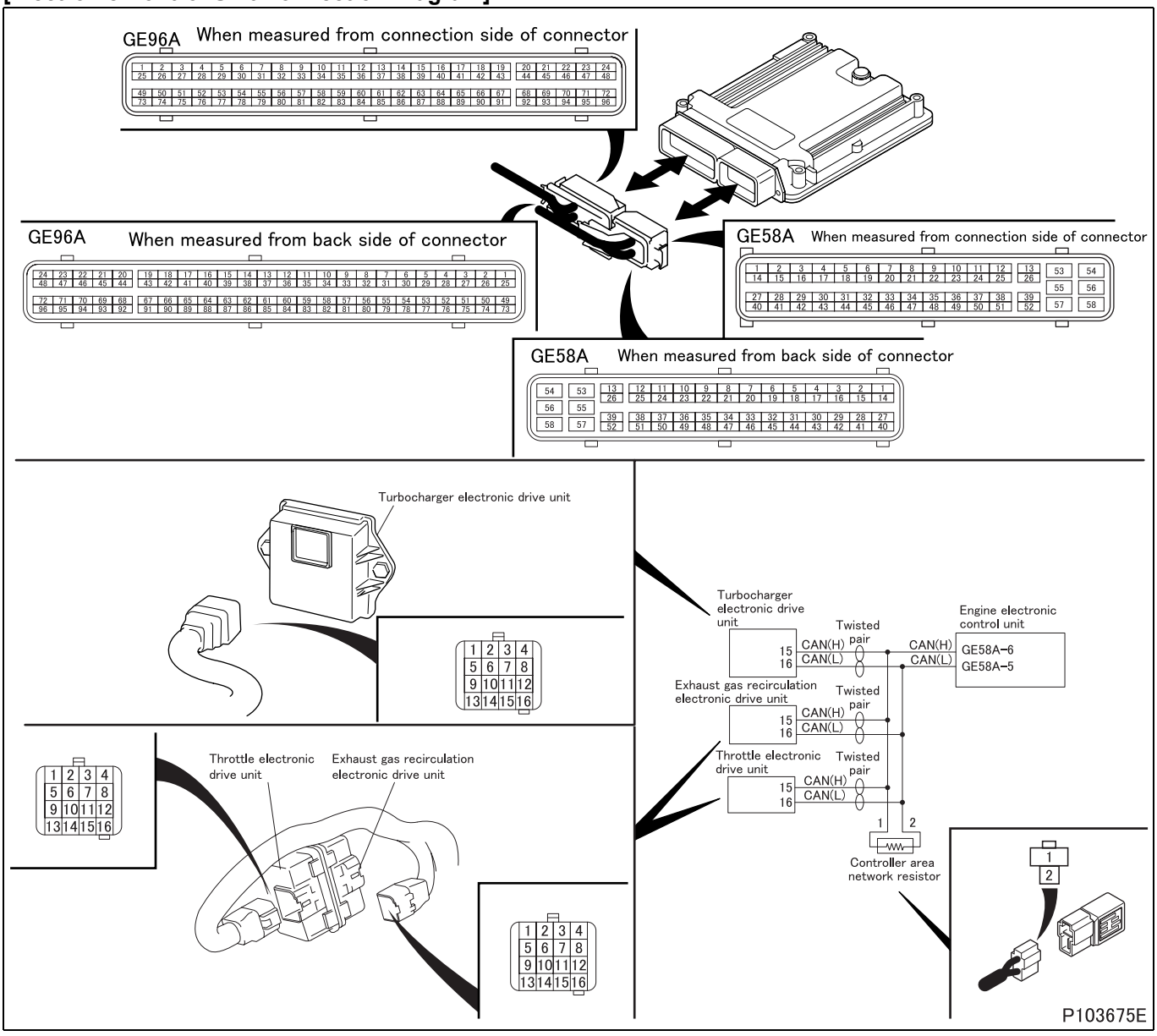
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Exhaust gas recirculation control is stopped.
- Throttle controls disabled
- Post injection is inhibited.
- Diesel particulate filter regeneration is stopped.
- Particulate matter deposit computation is stopped.
- Related fault check is stopped.

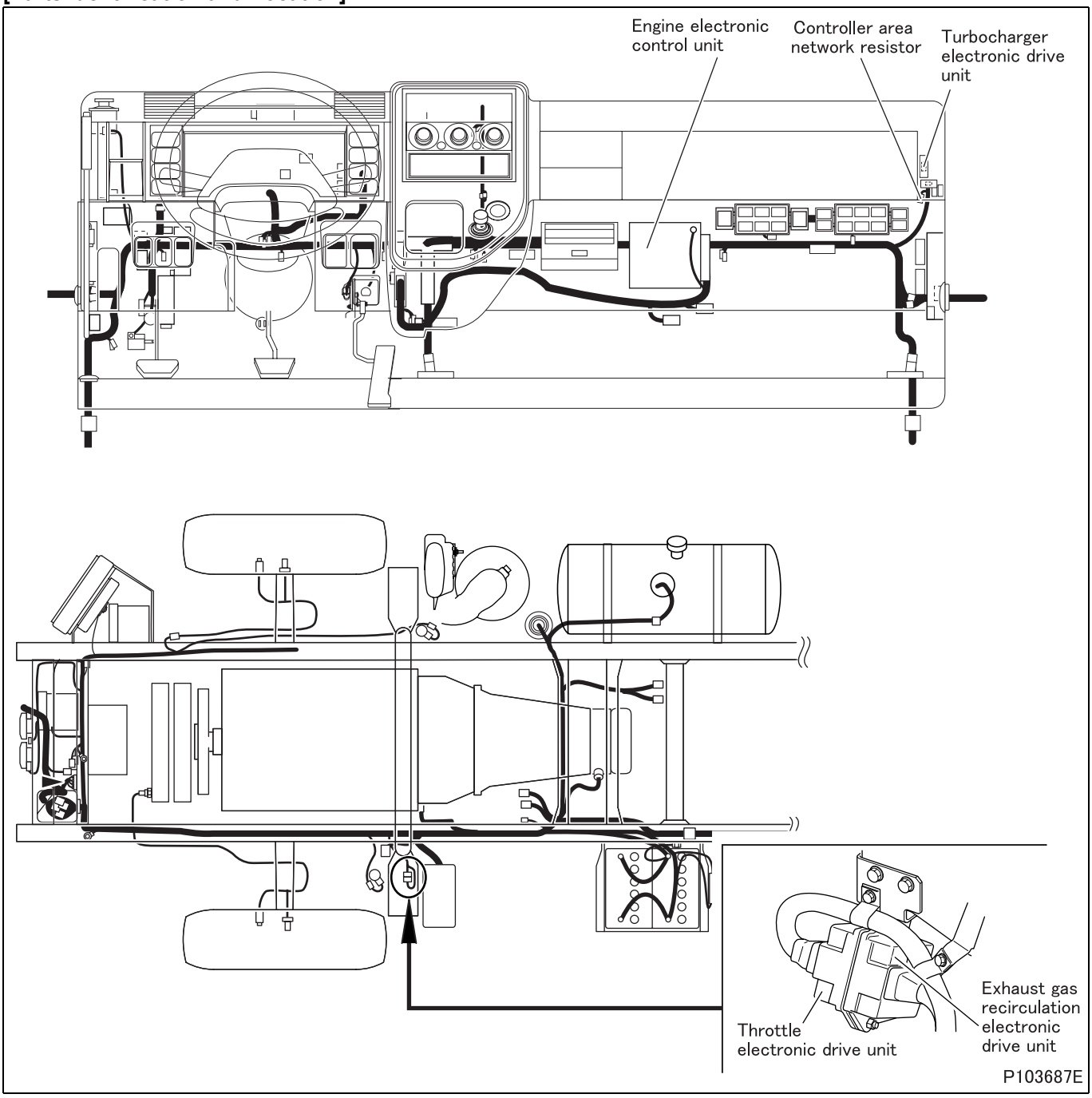
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between engine electronic control unit and each electronic drive unit (turbocharger, exhaust gas recirculation, throttle)
- Malfunction of each connector
- Malfunction of engine electronic control unit
- Malfunction of each electronic drive unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

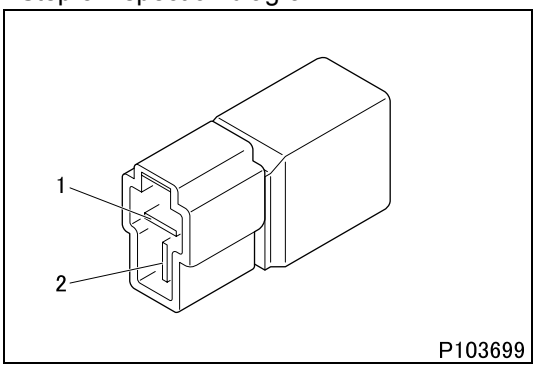
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by engine electronic control unit connector
	Maintenance item		Measure value of resistance between engine electronic control unit connector (GE58A) terminal No. 5 and 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and No. 2.
	Inspection condition		Disconnect connector and measure resistor side.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of controller area network resistor

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and engine electronic control unit connector (GE58A) terminal No. 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and engine electronic control unit connector (GE58A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between exhaust gas recirculation electronic drive unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and exhaust gas recirculation electronic drive unit connector terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between exhaust gas recirculation electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and exhaust gas recirculation electronic drive unit connector terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection of exhaust gas recirculation electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 10	Inspection items		Inspection of harness between throttle electronic drive unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and throttle electronic drive unit connector terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between throttle electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and throttle electronic drive unit connector terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of throttle electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 13.
		NO	Modify connector.

Step 13	Inspection items		Inspection of harness between turbocharger electronic drive unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and turbocharger electronic drive unit connector terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 14.
		NO	Modify harness.

Step 14	Inspection items		Inspection of harness between turbocharger electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and turbocharger electronic drive unit connector terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 15.
		NO	Modify harness.

Step 15	Inspection items		Inspection of turbocharger electronic drive unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replace the engine electronic control unit as well if this diagnosis code occurs after the replacement of one of electronic drive units.
		NO	Modify connector.

[Fault code]
Diagnosis code: U0028/Flash code: 72
[Monitor]
Abnormality in controller area network 1 communication
[Fault (outline)]
Message timeout
[Diagnosis check]
- Controller area network communication between engine electronic control unit and each electronic control unit (automatic transmission, multifunction vehicle control unit) is monitored for abnormality.

[Code generation condition]
- No controller area network signal is sent from each electronic control unit within specified time after engine start (time out).
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

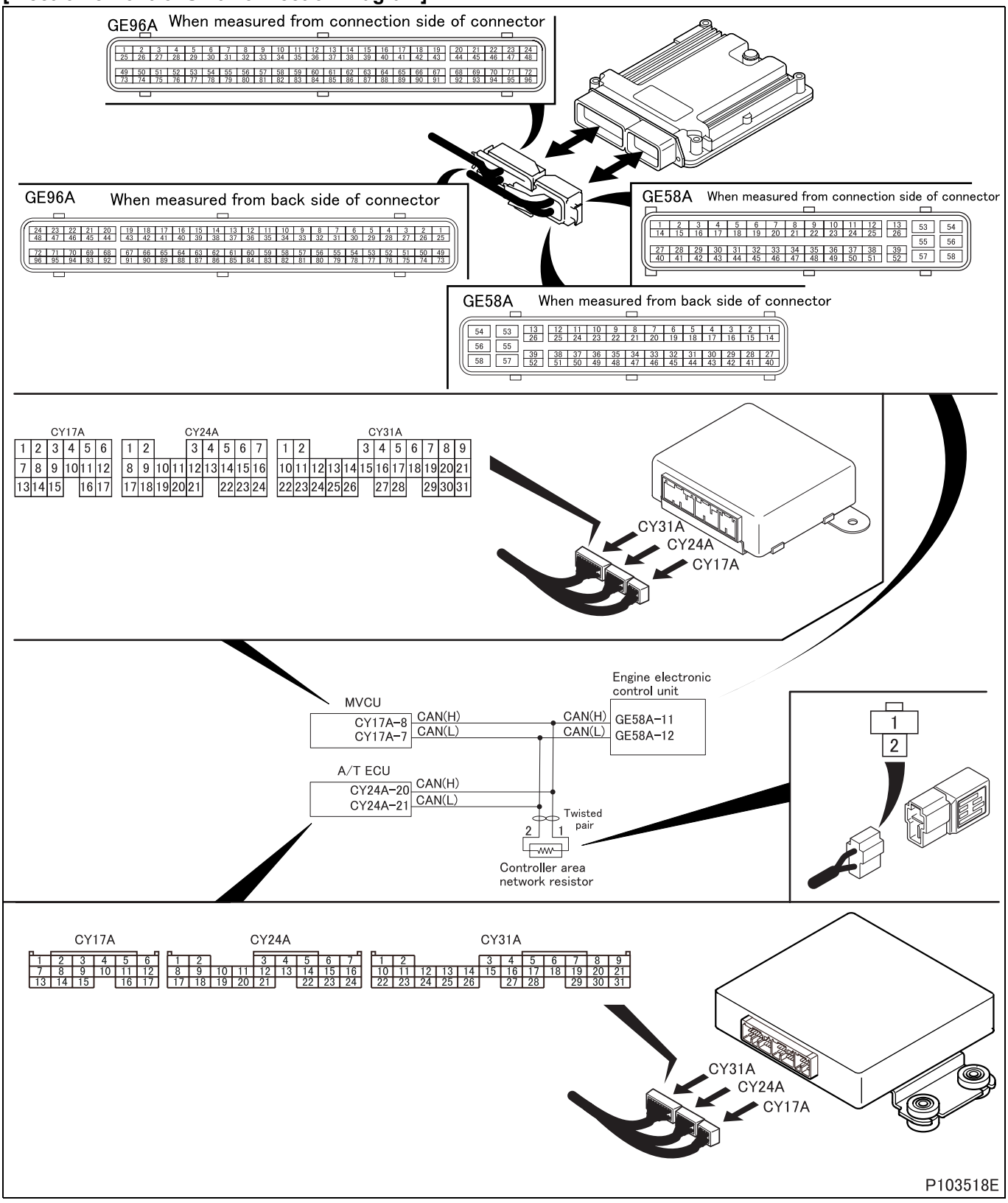
[Diagnostic requirement]
- When engine is in normal condition during period from after-run to start.

[Control effected by electronic control unit during fault]
- Effects no special control.

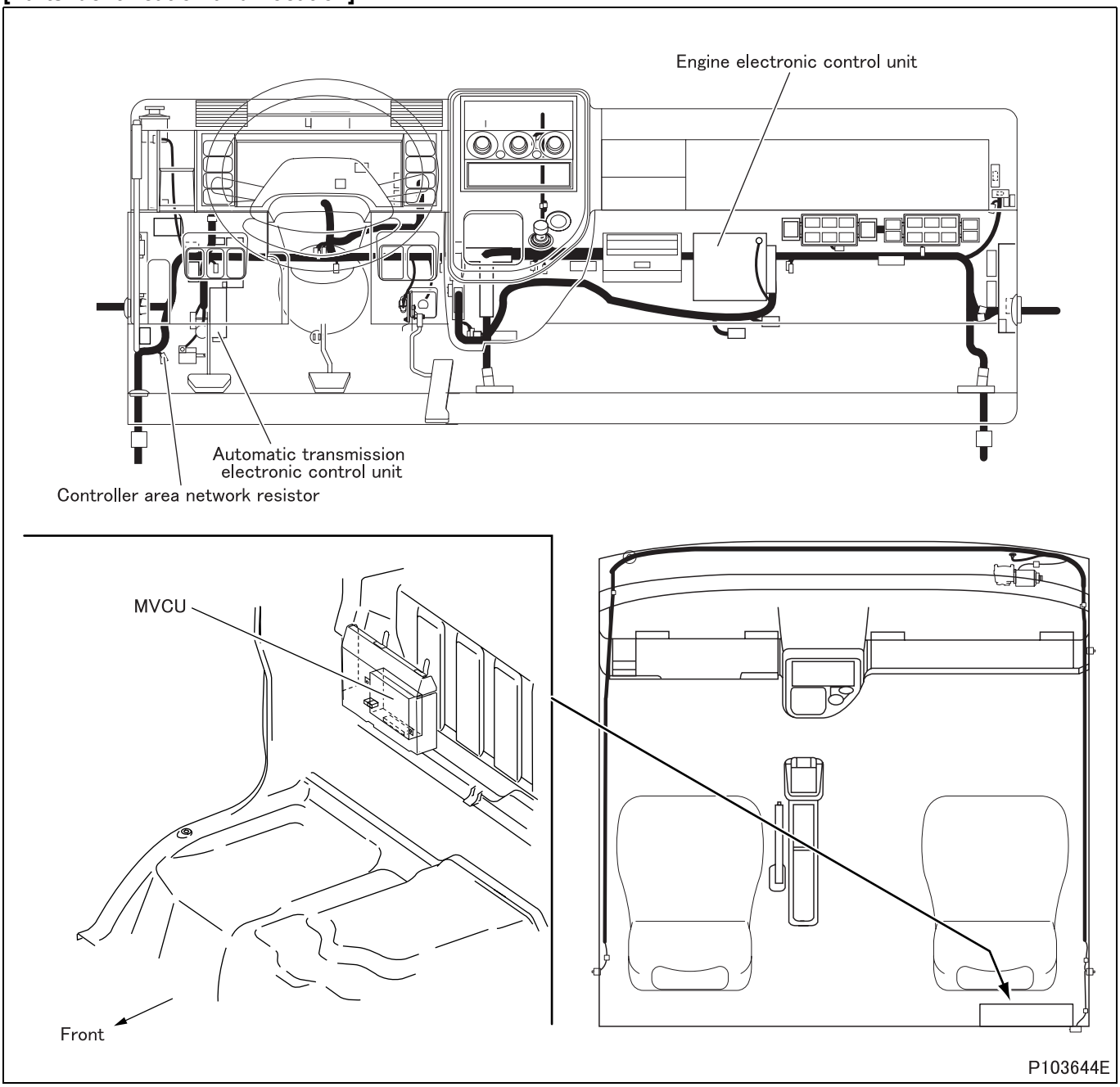
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between engine electronic control unit and each electronic control unit (automatic transmission, multifunction vehicle control unit)
- Malfunction of each connector
- Malfunction of engine electronic control unit
- Malfunction of each electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

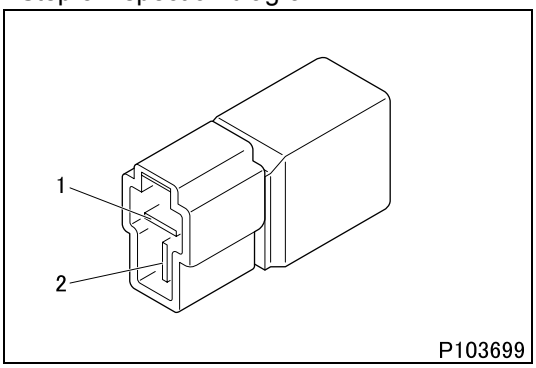
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by engine electronic control unit connector
	Maintenance item		Measure value of resistance between engine electronic control unit connector (GE58A) terminal No. 11 and 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and No. 2.
	Inspection condition		Disconnect connector and measure resistor side.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of controller area network resistor

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and engine electronic control unit connector (GE58A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and engine electronic control unit connector (GE58A) terminal No. 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between multifunction vehicle control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and multifunction vehicle control unit connector (CY17A) terminal No. 8.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between multifunction vehicle control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and multifunction vehicle control unit connector (CY17A) terminal No. 7.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection of multifunction vehicle control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 10	Inspection items		Inspection of harness between automatic transmission electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and automatic transmission electronic control unit connector (CY24A) terminal No. 20.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between throttle electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and automatic transmission electronic control unit connector (CY24A) terminal No. 21.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of automatic transmission electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replace the engine electronic control unit as well if this diagnosis code occurs after the replacement of either multifunction vehicle control unit or automatic transmission electronic control unit.
		NO	Modify connector.

[Fault code]
Diagnosis code: U0029/Flash code: 76
[Monitor]
Abnormality in controller area network 1 communication
[Fault (outline)]
Controller area network A bus off
[Diagnosis check]
- Controller area network communication between engine electronic control unit and each electronic control unit (automatic transmission, multifunction vehicle control unit) is monitored for abnormality.

[Code generation condition]
- No controller area network signal is received from each electronic control unit after engine start (controller area network bus OFF).
  (Warning lamp is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

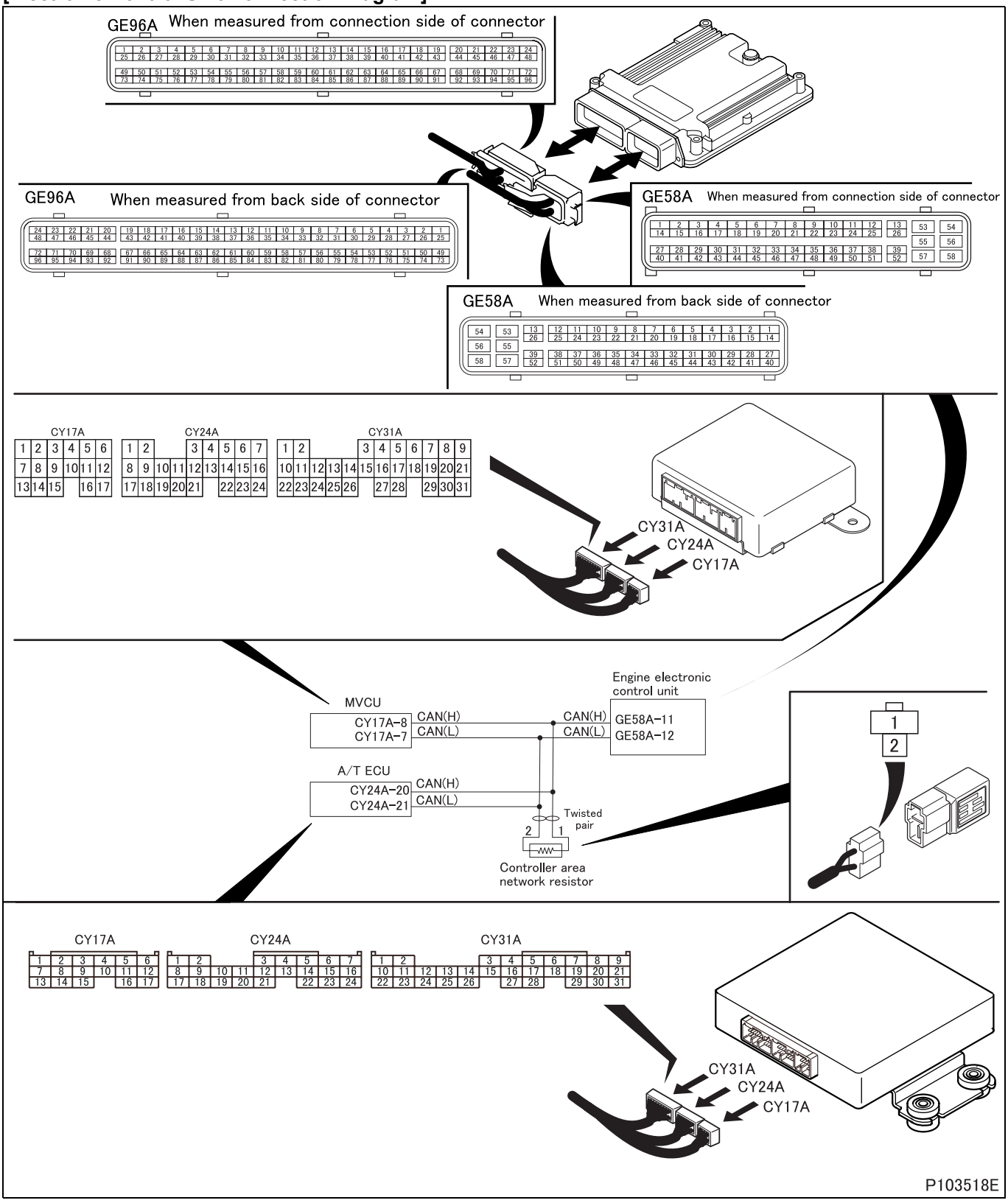
[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
- Auto cruise control stopped
- Speed limitation device control is stopped.
- Traction control is stopped. <Automatic transmission>

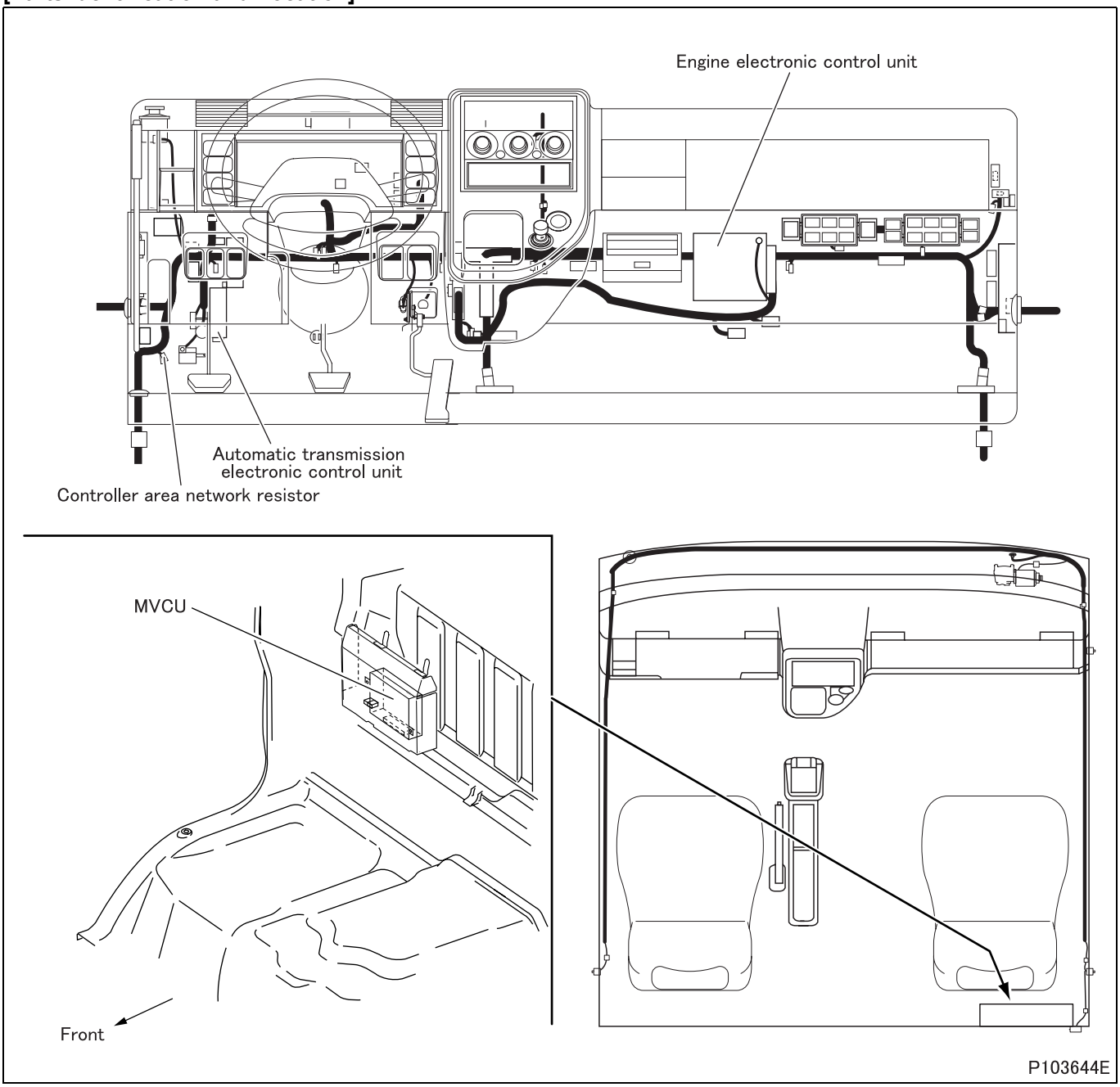
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between engine electronic control unit and each electronic control unit (automatic transmission, multifunction vehicle control unit)
- Malfunction of each connector
- Malfunction of engine electronic control unit
- Malfunction of each electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Warning lamp is extinguished and diagnosis code is cleared at fourth display of diagnosis code after recovery.)

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

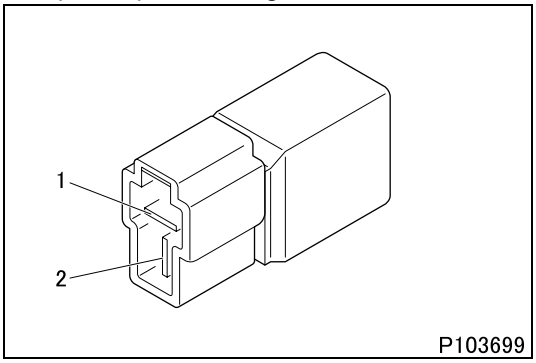
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by engine electronic control unit connector
	Maintenance item		Measure value of resistance between engine electronic control unit connector (GE58A) terminal No. 11 and 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and No. 2.
	Inspection condition		Disconnect connector and measure resistor side.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of controller area network resistor

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and engine electronic control unit connector (GE58A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and engine electronic control unit connector (GE58A) terminal No. 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between multifunction vehicle control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and multifunction vehicle control unit connector (CY17A) terminal No. 8.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between multifunction vehicle control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and multifunction vehicle control unit connector (CY17A) terminal No. 7.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection of multifunction vehicle control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 10	Inspection items		Inspection of harness between automatic transmission electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and automatic transmission electronic control unit connector (CY24A) terminal No. 20.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 11.
		NO	Modify harness.

Step 11	Inspection items		Inspection of harness between throttle electronic drive unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and automatic transmission electronic control unit connector (CY24A) terminal No. 21.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 12.
		NO	Modify harness.

Step 12	Inspection items		Inspection of automatic transmission electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replace the engine electronic control unit as well if this diagnosis code occurs after the replacement of either multifunction vehicle control unit or automatic transmission electronic control unit.
		NO	Modify connector.

[Fault code]
Diagnosis code: U0101/Flash code: 76
[Monitor]
Abnormality in controller area network (automatic transmission) communication
[Fault (outline)]
Engine warning lamp (orange) request message timeout
[Diagnosis check]
- Controller area network communication between engine electronic control unit and automatic transmission electronic control unit is monitored for abnormality.

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
<Condition (1)>
- Engine electronic control unit fails to receive controller area network signal containing automatic transmission warning information from automatic transmission electronic control unit within specified time.
  (Diagnosis code is displayed on first establishment of code generation condition.)

<Condition (2)>
- Abnormality in controller area network communication in other cases than condition (1) above
  (Warning lamp (red) is lit and diagnosis code is displayed on third establishment of code generation condition.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed during the driving cycle.

[Diagnostic requirement]
–

[Control effected by electronic control unit during fault]
Electronic control unit differs in the way of control by the diagnosis check item.
<Transmission gear position>
- Engine torque is limited.

<Engine speed>
- Traction control is stopped. <Automatic transmission>

<Automatic transmission warning lamp>
- Effects no special control.

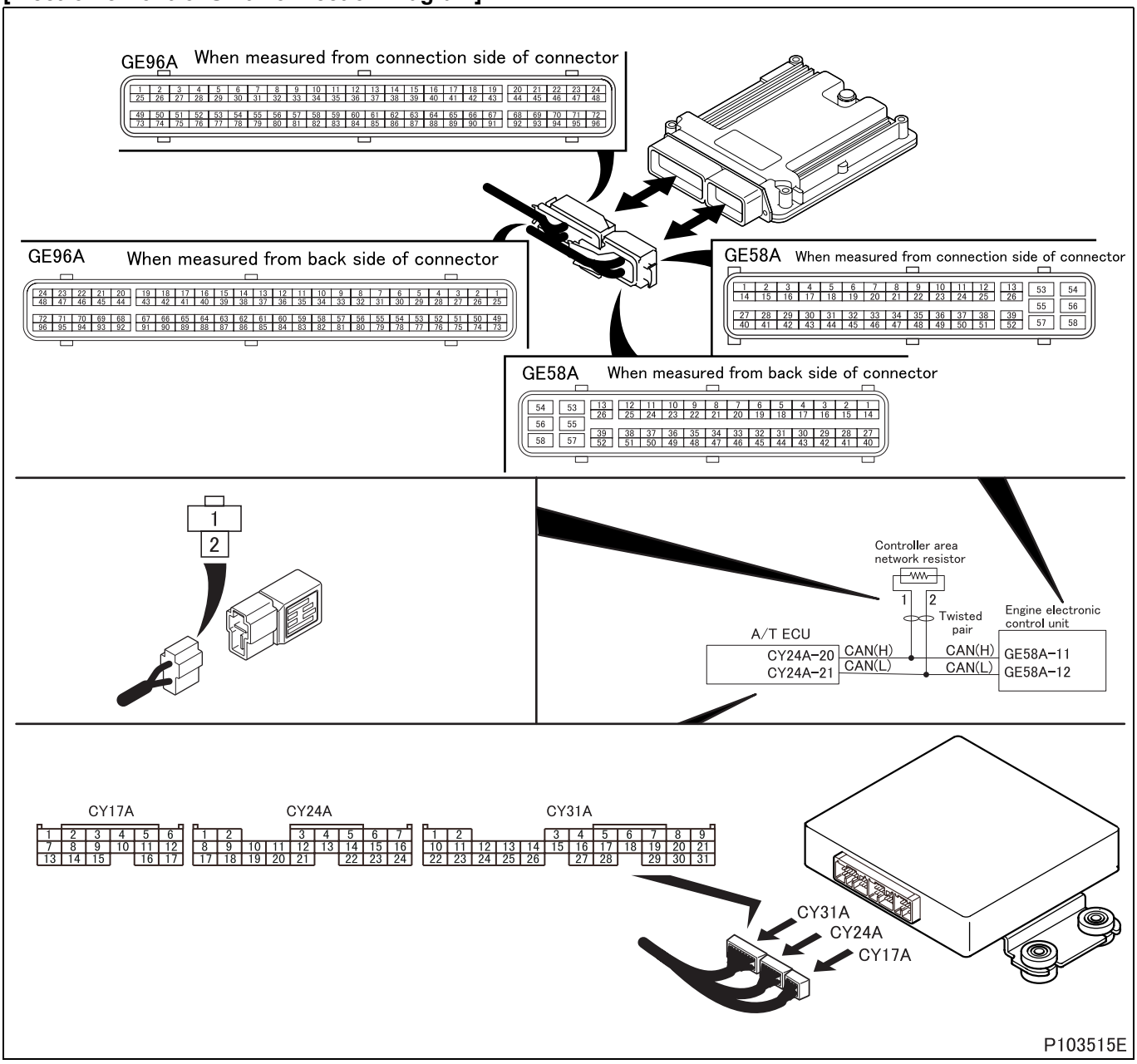
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between engine electronic control unit and automatic transmission electronic control unit
- Malfunction of each connector
- Malfunction of engine electronic control unit
- Malfunction of automatic transmission electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).
  (Timing of warning lamp/diagnosis code OFF depends on condition.)

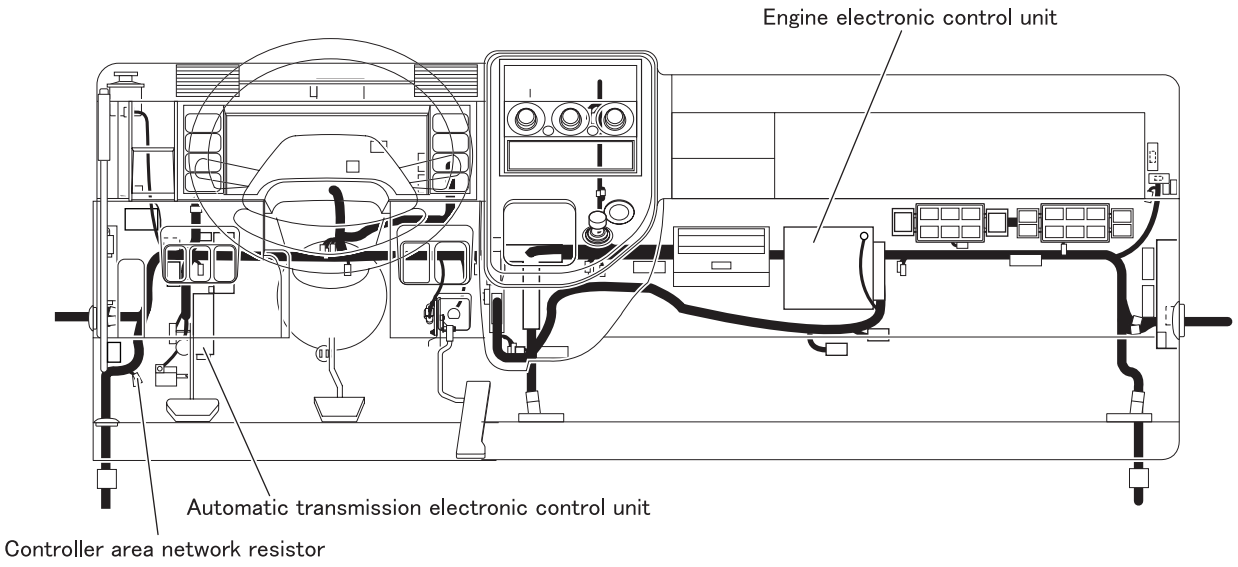
<Condition (1)>
- Code is cleared simultaneously with recovery.

<Condition (2)>
- Lamp is extinguished and code is cleared at fourth diagnosis code display after recovery.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

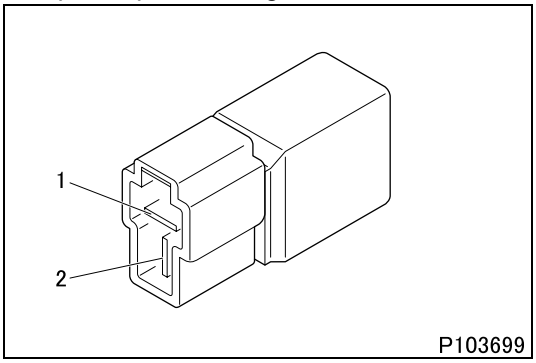
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by engine electronic control unit connector
	Maintenance item		Measure value of resistance between engine electronic control unit connector (GE58A) terminal No. 11 and 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Go to step 2.

Step 2	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 and No. 2.
	Inspection condition		Disconnect connector and measure resistor side.
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Replacement of controller area network resistor

<Step 3 inspection diagram>



Step 4	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and engine electronic control unit connector (GE58A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify harness.

Step 5	Inspection items		Inspection of harness between engine electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and engine electronic control unit connector (GE58A) terminal No. 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 7	Inspection items		Inspection of harness between automatic transmission electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and automatic transmission electronic control unit connector (CY24A) terminal No. 20.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between automatic transmission electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and automatic transmission electronic control unit connector (CY24A) terminal No. 21.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection of automatic transmission electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replace the engine electronic control unit as well if this diagnosis code occurs after the replacement of automatic transmission electronic control unit.
		NO	Modify connector.

4. Multi-Use Tester Service Data

• Both service data and actuator test results are indicated at the same time.

No.	Item	Data	Inspection condition	Criterion for normality
01	Engine Revolution	■■■■.r/min	Racing (engine in operation)	Synchronous with tachometer
02	LOAD Value	■■■■.%	Starter switch ON	0%
0A	Reference Injection Quantity	■■■■.%	Idling	0% or lower
10	Intake Air Temperature (EGR)	■■■. ■°F	Engine cold	Value corresponds to ambient temperature
14	Fuel Temperature (leak)	■■■. ■°F	Engine cold	Value corresponds to ambient temperature
16	PTO Adjustment Resistor No.	1/2/3/4/5/6/7/8/9/10/11/NON	–	–
17	Exhaust Gas Flow	■■■■.m3/h	During warm-up	Gradually increased
19	Reference Common Rail Pressure 2	■■■. ■%	Idling	0% or lower
1B	Actual Common Rail Pressure 2	■■■. ■%	Idling	0% or lower
1C	Difference Common Rail Pressure 2	■■■. ■%	Idling	0% or lower
1F	Auto Cruise Reference Speed	■■■■.mph	Vehicle in auto cruise mode	Same vehicle speed in auto cruise mode
20	Atmospheric Pressure	■■■■.psi	Altitude: 0 m {0 ft.}	14.6 psi
			Altitude: 600 m {1970 ft.}	13.8 psi
21	Boost Pressure	■■■■.psi	Starter switch ON (engine stationary)	Coincides with atmospheric pressure
			After engine has started, press accelerator pedal	Gradually increased
22	Difference pressure across DPF	■■■■.psi	Accelerator pedal pressed	Gradually increased
23	Exhaust gas pressure	■■■■.psi	Accelerator pedal pressed	Gradually increased
24	OXI CAT Temperature	■■■■.°F	During warm-up	Gradually increased
25	DPF Temperature (UpStream)	■■■■.°F	During warm-up	Gradually increased
26	DPF Temperature (DownStream)	■■■■.°F	During warm-up	Gradually increased
27	Downstream OXI CAT Temperature	■■■■.°F	During warm-up	Gradually increased
28	DPF Related Information	Memory/No memory	Before electronic control unit reset	Memory
			After electronic control unit reset	No memory
30	Intake Air Temp. (upstream)	■■■■.°F	Engine cold	Value corresponds to ambient temperature
31	Water Temperature	■■■■.°F	Engine cold	Value corresponds to ambient temperature
			During warm-up	Gradually increased
			When engine is stopped after warm-up	Gradually declines
32	Water Temperature 2	■■■■.°F	Engine cold	Value corresponds to ambient temperature
			During warm-up	Gradually increased
			When engine is stopped after warm-up	Gradually declines

No.	Item	Data	Inspection condition	Criterion for normality
33	Fuel Temperature (inlet)	■■■■.°F	Engine cold	Value corresponds to ambient temperature
			During warm-up	Gradually increased
			When engine is stopped after warm-up	Gradually declines
40	Accelerator sensor voltage 1	■■. ■■V	Accelerator pedal gradually pressed from released position.	0.85 to 4.15 V
41	Accelerator sensor voltage 2	■■. ■■V	Accelerator pedal gradually pressed from released position.	0.85 to 4.15 V
42	Accel Pedal Position (unfiltered)	■■■■.%	Accelerator pedal released	0%
			Gradually press.	Gradually increased
			Accelerator pedal fully pressed	100%
43	Accel Pedal Position (filtered)	■■■■.%	Accelerator pedal released	0%
			Gradually press.	Gradually increased
			Accelerator pedal fully pressed	100%
50	Target EGR Valve Position	■■■■.%	Idling	100%
51	Actual EGR Valve Position	■■■■.%	Idling	100%
			[Actuator test] A0: EGR 1	
52	Target Intake Throttle Position	■■■■.%	Idling	10 to 20%
53	Actual Intake Throttle Position	■■■■.%	Idling	10 to 20%
			[Actuator test] A3: Intake Throttle 1	
54	Target VGT Position	■■■■.%	Starter switch ON	10%
55	Actual VGT Position	■■■■.%	Starter switch ON	10%
			[Actuator test] A4: VGT 1	
56	EGR Temperature	■■■■.°F	During warm-up	Gradually increased
60	Air mass flow	■■■■.g/h	Gradually press accelerator pedal.	Gradually increased
80	Power Supply Voltage	■■■. ■V	Starter switch ON	Value matches battery voltage.
82	Q Adjustment Resistor No.	1/2/3/4/5/6/7/8/9/ 10/11/NON	–	–
83	PTO Accel Position	■■■■.%	Power take-off is operated (MIN-MAX)	0 to 100%
84	PTO Accel Sensor Voltage	■■. ■■V	Power take-off is operated (MIN-MAX)	1.0 to 3.0 V
85	PTO Engine Revolution	■■■■.rpm	PTO in operation	Value matches preset PTO idling speed
90	Vehicle Speed	■■■■.mph	During vehicle operation	Synchronous with speedometer
91	Speed Limiter Reference Speed	■■■■.mph	Vehicle speed being limited	Same vehicle speed as that of speed limit
A0	Starter SW (S)	ON/OFF	Engine cranked by means of starter switch	ON
			Starter switch except START position	OFF
A1	Starter SW (M)	ON/OFF	Starter switch ON position	ON
			Starter switch except ON posi-tion	OFF
A2	Accel SW	ON/OFF	Accelerator pedal released	ON
			Accelerator pedal released	OFF
A3	Break SW	ON/OFF	Combination switch ON	ON
			Combination switch OFF	OFF

No.	Item	Data	Inspection condition	Criterion for normality
A4	DPF SW	ON/OFF	Diesel particulate filter cleaning switch ON	ON
			Diesel particulate filter cleaning switch OFF	OFF
			[Actuator test] A5: DPF Regeneration (Manual)	
A5	Parking Break SW	ON/OFF	Vehicle parked	ON
			Vehicle in motion	OFF
A6	Auxiliary Brake SW 1	ON/OFF	Exhaust brake operating	ON
			Exhaust brake not operating	OFF
A7	Clutch SW	ON/OFF	Clutch pedal pressed	ON
			Clutch pedal released	OFF
A8	Neutral SW	ON/OFF	Transmission neutral position	ON
			Transmission except neutral position	OFF
A9	Idle Up Cancel SW	ON/OFF	Change lever in D position	ON
			<Manual transmission> Normally <Automatic transmission> Change lever in N position	OFF
			[Actuator test] B4: Idle Up Canel SW	
AA	AC SW	ON/OFF	Air conditioner compressor running	ON
			Air conditioner compressor not running	OFF
			[Actuator test] B3: Air Conditioner SW	
AB	Warm up SW	ON/OFF	Warm-up switch ON	ON
			Warm-up switch OFF	OFF
AC	Torque Cut SW	ON/OFF	Transmission in 1st or reverse	ON
			Except above	OFF
AD	PTO SW	ON/OFF	Switch ON	ON
			Switch OFF	OFF
AE	Diagnosis SW	ON/OFF	Diagnosis switch (fuse connected)	ON
			Diagnosis switch (fuse disconnected)	OFF
AF	Auxiliary Brake Cut SW	ON/OFF	Operated under following conditions • Accelerator and clutch pedals are pressed • Transmission in neutral position • Anti-lock brake system in operation	ON
			Except above conditions	OFF
B0	Auxiliary Brake M/V 1	ON/OFF	Exhaust brake operating	ON
			Exhaust brake not operating	OFF
			[Actuator test] AA: Auxiliary Brake M/V 1	
B1	Auxiliary Brake Indicator Lamp	ON/OFF	Exhaust brake operating	ON
			Exhaust brake not operating	OFF
			[Actuator test] AB: Auxiliary Brake Indicator Lamp	

No.	Item	Data	Inspection condition	Criterion for normality
B2	Glow Relay	ON/OFF	Perform actuator test	ON
			Actuator test not performed	OFF
			[Actuator test] AC: Relay for Glow Relay	
B3	Glow Indicator Lamp	ON/OFF	Preheater in operation	ON
			Preheater not in operation	OFF
			[Actuator test] AD: Glow Indicator Lamp	
B4	Starter Safety Relay	ON/OFF	Perform actuator test	ON
			Actuator test not performed	OFF
			[Actuator test] AE: Starter Safety Relay	
B5	EDU Power Relay	ON/OFF	Starter switch ON	ON
			Starter switch OFF	OFF
			[Actuator test] AF: EDU Relay	
B6	MIL	ON/OFF	Starter switch ON (Do not start engine)	ON
			No error after engine startup	OFF
			[Actuator test] B0: MIL	
B7	Diagnosis Lamp	ON/OFF	Starter switch ON (Do not start engine)	ON
			No error after engine startup	OFF
			[Actuator test] B1: Diagnosis Lamp	
B8	DPF Indicator Lamp	ON/OFF	During manual diesel particulate filter regeneration	ON
			Except above	OFF
			[Actuator test] A6: DPF Lamp	

5. Mode 06 Data

5.1 General description

- Mode 06 data are used for checking if the system and its components are in order, using not a Multi-Use Tester but a commercial tester.
- Monitor IDs identify individual system components or entire systems under diagnostic test.
- Test IDs indicate specific diagnostic test items of the system components or systems identified by monitor IDs.

5.2 Mode 06 data conversion factor list

- Shown below is a list of conversion factors for commercial tester data of diagnostic test items.

Monitor ID $21: Catalyst

Test ID	Description of test data	Description of test limit	Conversion factor
$22	Difference temperature between OxiCat inlet and DPF inlet	Malfunction criteria for diesel oxidation catalyst deterioration	0.1°C per bit

Monitor ID $31: EGR

Test ID	Description of test data	Description of test limit	Conversion factor
$21	EGR mass flow	Malfunction criteria for blockage and leaks in pipe work or cooler, or EGR valve stuck shut/open	0.001 kg/h per bit

Monitor ID $81: Fuel system

Test ID	Description of test data	Description of test limit	Conversion factor
$09	Rail pressure voltage in offset test	Malfunction criteria for rail pressure sensor	0.001 mV per bit

Monitor ID $A2: Mis-fire Cylinder 1

Test ID	Description of test data	Description of test limit	Conversion factor
$0B	EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles	Malfunction criteria for misfire of cylinder-1	1 per bit
$0C	Misfire counts for last/current driving cycles		

Monitor ID $A3: Mis-fire Cylinder 2

Test ID	Description of test data	Description of test limit	Conversion factor
$0B	EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles	Malfunction criteria for misfire of cylinder-2	1 per bit
$0C	Misfire counts for last/current driving cycles		

Monitor ID $A4: Mis-fire Cylinder 3

Test ID	Description of test data	Description of test limit	Conversion factor
$0B	EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles	Malfunction criteria for misfire of cylinder-3	1 per bit
$0C	Misfire counts for last/current driving cycles		

Monitor ID $A5: Mis-fire Cylinder 4

Test ID	Description of test data	Description of test limit	Conversion factor
$0B	EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles	Malfunction criteria for misfire of cylinder-4	1 per bit
$0C	Misfire counts for last/current driving cycles		

Monitor ID $E1: Boost

Test ID	Description of test data	Description of test limit	Conversion factor
$23	Boost pressure	Malfunction criteria for turbocharger actuator deviation	0.001 kPa per bit

Monitor ID $E2: DPF

Test ID	Description of test data	Description of test limit	Conversion factor
$24	Filter pressure drop	Malfunction criteria for soot and ash loadings	0.001 kPa per bit

6. Actuator Tests Performed Using Multi-Use Tester

• Both service data and actuator test results are indicated at the same time.

No.	Item	Description	Check method
A0	EGR 1	Exhaust gas recirculation valve opening maintained as commanded by Multi-Use Tester NOTE: Immediately after the starter switch is turned to ON, the exhaust gas recirculation valve is automatically checked for about 5 seconds. An actuator test using the Multi-Use Tester must be performed after waiting this period. [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral or P range • Diagnosis switch: OFF (fuse removed)	Check that exhaust gas recirculation valve opening changes. [Service data] 51: Actual EGR Valve Position
A3	Intake Throttle 1	Intake throttle valve opening maintained as commanded by Multi-Use Tester [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral or P range • Diagnosis switch: OFF (fuse removed)	Check that throttle valve opening changes. [Service data] 53: Actual Intake Throttle Position
A4	VGT 1	Turbocharger opening maintained as commanded by Multi-Use Tester NOTE: • Set turbocharger opening to the range of 20 to 80%. • Immediately after the starter switch is turned to ON, the turbocharger actuator automatically undergoes an initial operational checkup for about 5 seconds. An actuator test using the Multi-Use Tester must be performed after waiting this period. [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral or P range • Diagnosis switch: OFF (fuse removed)	Check that turbine vane opening changes. Used for boost pressure measurement/adjustment (See Gr15.) [Service data] 54: Target VGT Position 55: Actual VGT Position
A5	DPF Regeneration (Manual)	Request is output for manual diesel particulate filter regeneration [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Engine: Idling • Parking brake: Vehicle parked (parking brake switch: ON) • After engine warm-up	• Check that diesel particulate filter indicator lamp flickers • Manual diesel particulate filter regeneration started with diesel particulate filter cleaning switch ON and engine speed increased. [Service data] A4: DPF SW
A6	DPF Lamp	Diesel particulate filter indicator lamp turned ON/OFF [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON • Engine: Idling • Transmission: neutral or P range	Check that indicator lamp is turned on and off [Service data] B8: DPF Indicator Lamp

No.	Item	Description	Check method
A8	EGR, ETV, VGT	Exhaust gas recirculation, intake throttle and turbocharger opening maintained as commanded by Multi-Use Tester NOTE: • Set turbocharger opening to the range of 20 to 80%. • Immediately after the starter switch is turned to ON, the exhaust gas recirculation valve and turbocharger actuator automatically undergo initial operational checkups for about 5 seconds. An actuator test using the Multi-Use Tester must be performed after waiting this period. [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON (engine started) • Transmission: neutral or P range • Diagnosis switch: OFF (fuse removed) • Caution!: When actuator test is executed during engine stop, turn starter switch OFF after engine startup and then ON within 15 seconds (Do not start engine).	Check that exhaust gas recirculation, intake throttle and turbine vane valve openings change. Used for boost pressure measurement/adjustment (See Gr15.) [Service data] 51: Actual EGR Valve Position 53: Actual Intake Throttle Position 55: Actual VGT Position
AA	Auxiliary Brake M/V 1	Exhaust shutter 3-way magnetic valve driving signal [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON • Engine: stopped	Magnetic valve operating sound [Service data] B0: Auxiliary Brake M/V 1
AB	Auxiliary Brake Indicator Lamp	Exhaust brake indicator lamp driving signal [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON • Engine: stopped	Check that indicator lamp is turned on and off [Service data] B1: Auxiliary Brake Indicator Lamp
AC	Relay for Glow Relay	ON/OFF switchover of glow drive relay [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON • Engine: stopped	Relay operating sound [Service data] B2: Glow Relay
AD	Glow Indicator Lamp	Preheating indicator lamp driving signal [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON • Engine: stopped	Check that indicator lamp is turned on and off [Service data] B3: Glow Indicator Lamp
AE	Starter Safety Relay	ON/OFF switchover of starter continuous power-on preventive relay (safety relay) [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON • Engine: stopped	Relay operating sound [Service data] B4: Starter Safety Relay
AF	EDU Relay	ON/OFF switchover of electronic drive unit relay (errors involving exhaust gas recirculation, intake air throttle and turbocharger may be detected during this actuator test). [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON • Engine: stopped	Relay operating sound [Service data] B5: EDU Power Relay
B0	MIL	Engine warning lamp (orange) driving signal [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral or P range • Engine: stopped	Check that warning lamp (orange) is turned on and off [Service data] B6: MIL
B1	Diagnosis Lamp	Engine warning lamp (red) driving signal [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral or P range • Engine: stopped	Check that warning lamp (red) is turned on and off [Service data] B7: Diagnosis Lamp

No.	Item	Description	Check method
B2	Fuel Leak Check	Rail pressure is increased for a certain period of time (6 seconds). [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral or P range • Diagnosis switch: OFF (fuse removed)	Check for leakage from fuel system.
B3	Air Conditioner SW	ON/OFF switchover of air conditioner operation (idle up control) is performed. [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral or P range • Engine: Idling	Check that engine speed increases and decreases. [Service data] AA: AC SW
B4	Idle Up Cancel SW	ON/OFF switchover of idle up inhibited status [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Transmission: neutral or P range	Check that idling speed remains low. [Service data] A9: Idle Up Cancel SW
B5	GCU (GLOW PLUG)	ON/OFF switchover of the glow plugs [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Starter switch: ON • Engine: stopped	Check to see that the glow plugs are energized.
BB	Injector Test 1	Selected injector magnetic valve is forced to stop. [Can be executed under following conditions] • Vehicle: stationary (vehicle speed 0 km/h {0 MPH}) • Engine speed: 1500 rpm or less • Transmission: neutral • The current diagnosis code does not occur.	Check that No. 1 cylinder injector magnetic valve is stopped.
BC	Injector Test 2		Check that No. 4 cylinder injector magnetic valve is stopped.
BD	Injector Test 3		Check that No. 2 cylinder injector magnetic valve is stopped.
BE	Injector Test 4		Check that No. 3 cylinder injector magnetic valve is stopped.

M E M O

REGISTRATION AND ALTERATION OF DATA IN ENGINE ELECTRONIC CONTROL UNIT

1. Operation at Electronic Control Unit Replacement

- Vehicle information and equipment specifications are registered in each engine electronic control unit as coded data (coding data).
- Given in the chart below are the items on which registered data in the engine electronic control unit are necessary to alter or new data are necessary to register with the disposition of equipment.
- If the electronic control unit is left initialized with no necessary data registered, it is not capable of proper engine control.
- For data alteration/registration and data write operation, contact your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.

Engine electronic control unit data / Disposition of equipment		VIN (Vehicle Identification Number)	Injector correction	Injection quantity correction	Air flow sensor characteristics	PTO idling speed	Ash accumulation data transfer	Remarks
Engine electronic control unit	Replaced with new unit	O	O	O	O	O	O	
	Relocated from other vehicle	O	O	O	O	O	O	
	Erasure of diagnosis codes							No action is required.
Replacement of injector			O					Data code (IQA code) differs from injector to injector and is necessary to change.
Replacement of air flow sensor								Data is not necessary to change if the replacement is identical.
Change of PTO idling speed						O		

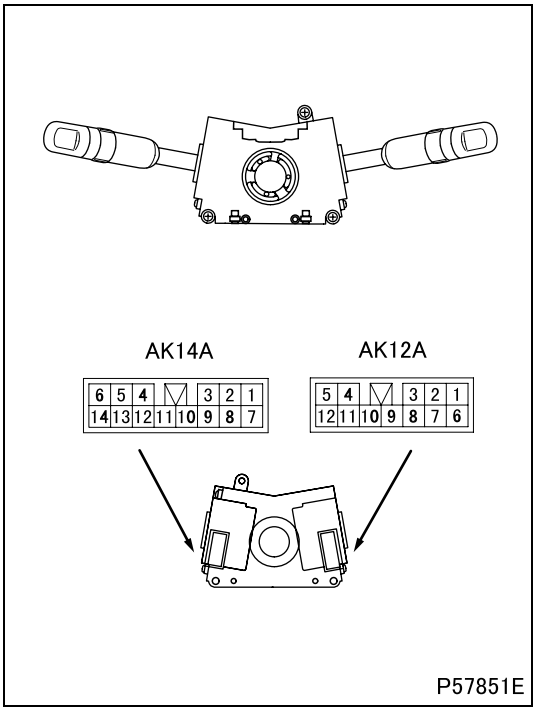
O : Denotes the necessity of data being updated or registered.

IQA: Injection Quantity Adjustment

2. Resetting the Diesel Particulate Filter Related Information (Resetting Electronic Control Unit)

- On the regeneration control type as diesel particulate filter system, the engine electronic control unit stores many diesel particulate filter related information to control the diesel particulate filter regeneration as diesel particulate filter history.
- If the ceramic filter is replaced or cleaned without regeneration, reset the history of diesel particulate filter using Multi-Use Tester. (For reset procedure, see Gr15.)
- In the case of diesel particulate filter regeneration by use of the diesel particulate filter cleaning switch, however, history reset with a Multi-Use Tester is not required because the history is automatically reset by engine electronic control unit.

M E M O

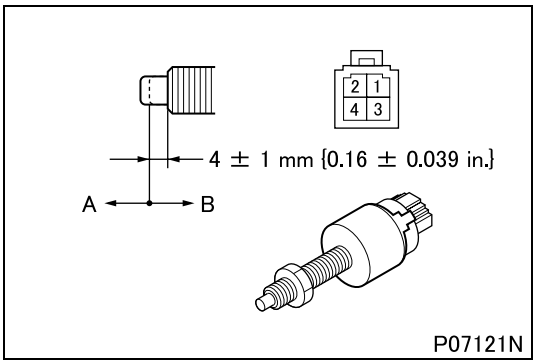


#001 Inspection of combination switch

AK14A connector connection table

Switch position		Terminals with continuity
Exhaust brake switch	OFF	–
	ON	8 - 9

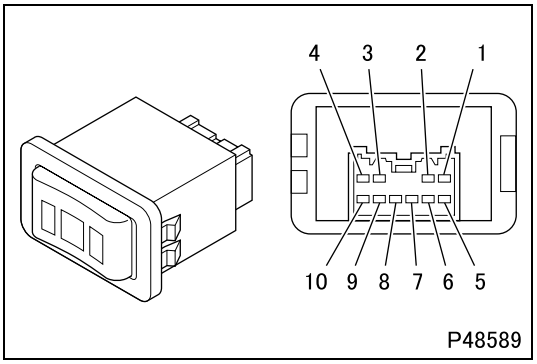
- For other inspections than shown above, see Electrical.
- If there is any abnormality, replace the switch.



#031 Inspection of clutch switch

Switch position	Terminals with continuity
A	1 - 4
B	2 - 3

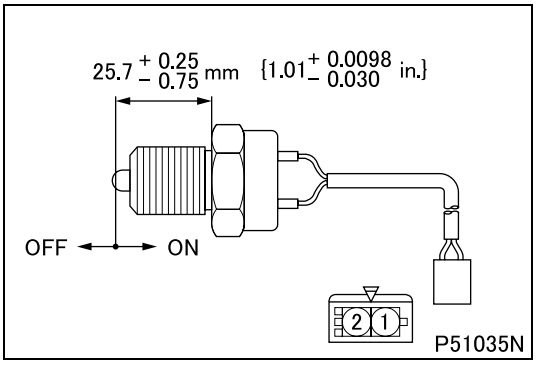
- If there is any abnormality, replace the switch.



#089 Inspection of DPF cleaning switch

Switch position	Terminals with continuity	Night lighting
–	1 - 8	(+) 6 - 2 (–)
ON	1 - 7	

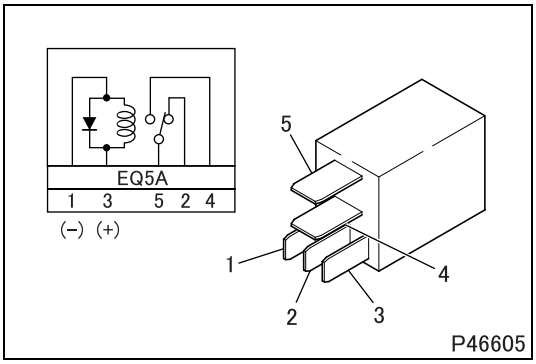
- If there is any abnormality, replace the switch.



#163 Inspection of torque limit switch

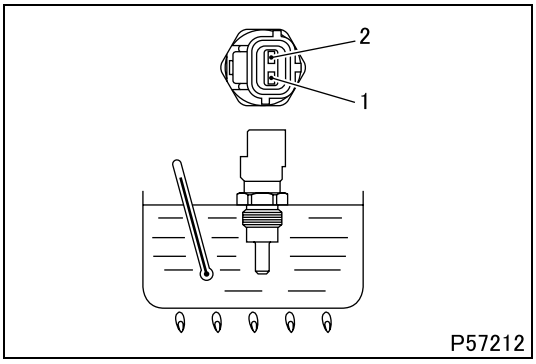
Switch position	Terminals with continuity
OFF	–
ON	1 - 2

- If there is any abnormality, replace the switch.



#201 Inspection of relay (normally open 5-pin)

- Check continuity and operating condition of the relay. Replace the relay if necessary.



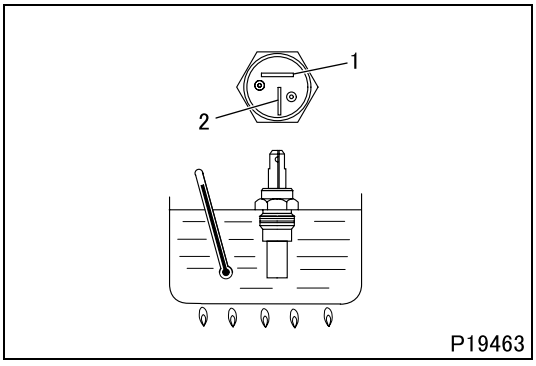
#262 Inspection of water temperature sensor

<Water temperature sensor 1>

- Place the water temperature sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	2.45 ± 0.14 kΩ
	80°C {176°F}	0.32 kΩ (reference value)
	110°C {230°F}	147.1 ± 2 Ω

- If the measurement is out of specification, replace the sensor.

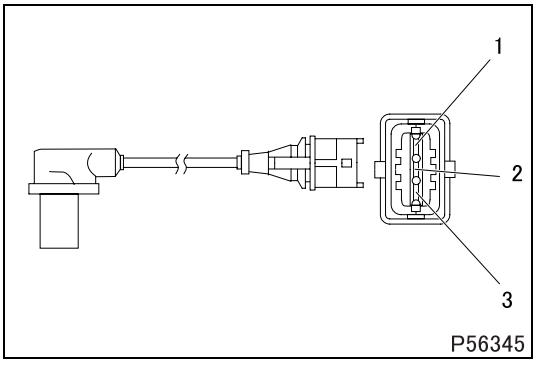


<Water temperature sensor 2>

- Place the water temperature sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 2 and the body.

Standard value	–20°C {–4°F}	24.8 ± 2.5 kΩ
	0°C {32°F}	8.62 kΩ
	20°C {68°F}	3.25 ± 0.33 kΩ
	60°C {140°F}	620 Ω
	80°C {176°F}	300 Ω

- If the measurement is out of specification, replace the sensor.

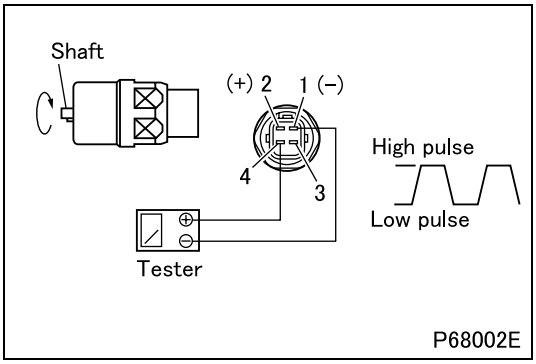


#263 Inspection of engine speed sensor

- Measure the resistance between terminals 1 and 2.

Standard value (at 20°C {68°F})	860 ± 86 Ω

- If the measurement is out of specification, replace the sensor.

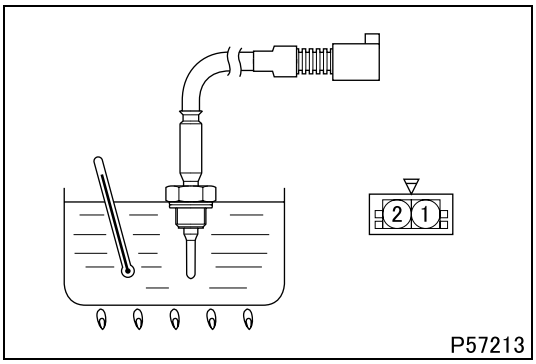


#265 Inspection of vehicle speed sensor

- With the DC 12 V applied to terminals 1 and 2, slowly turn the shaft of the vehicle speed sensor.
- Measure the maximum voltage (high pulse voltage) and minimum voltage (low pulse voltage) occurring at each specified pair of terminals.

Terminals	Inspection condition	Standard value
25-pulse output: terminals 1 and 4	Low pulse voltage	0.5 V or lower
	High pulse voltage	8 ± 1 V

- If any measurement is out of specification, replace the sensor.



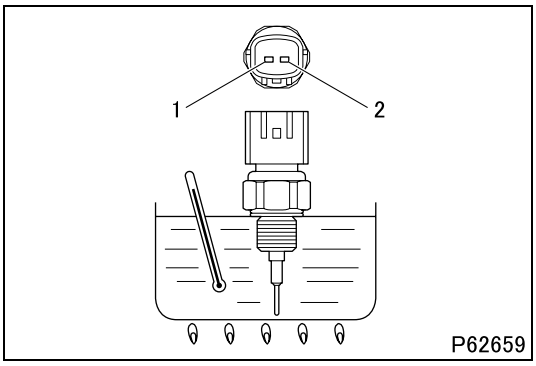
#305 Inspection of air temperature sensor

<Intake air temperature sensor>

- The intake air temperature sensor may output false signals if its tip is contaminated. Clean it if necessary. (See Gr15.)
- Place the sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	50°C {122°F}	$2.202\ ^{+0.233}_{-0.208}$ kΩ
	100°C {212°F}	$508.1\ ^{+41.3}_{-37.7}$ Ω
	150°C {302°F}	$160.4\ ^{+10.3}_{-9.6}$ Ω

- If either measurement is out of specification, replace the sensor.



<Boost air temperature sensor>

- The boost air temperature sensor may output false signals if its tip is contaminated. Clean it if necessary. (See Gr15.)
- Place the sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	0°C {32°F}	$162.3\ ^{+48.8}_{-36.5}$ kΩ
	20°C {68°F}	$61.47\ ^{+15.99}_{-12.35}$ kΩ
	80°C {176°F}	$6.120\ ^{+1.095}_{-0.907}$ kΩ

- If the measurement is out of specification, replace the sensor.

#306 Inspection of air flow sensor

- The sensor cannot be checked as a single unit. Instead, measure and compare the intake air flow rates of the existing sensor mounted on the vehicle and a new sensor installed in the place of the existing sensor for inspection using corresponding Multi-Use Tester Service Data items to determine characteristics deterioration in the existing sensor mounted on the vehicle.

(1) Preparation for inspection

- Clean or replace the air cleaner element.
- Make a new air flow sensor ready for use.
- Warm up the engine enough.
- Connect a Multi-Use Tester. (See Gr00.)

(2) Measurement of existing sensor intake air flow rate

- Press the accelerator pedal from the idling position all the way down to the stopper bolt. (The engine is running at maximum speed under no load.)
- Measure the following items from “Service Data”.
  <General Scanning Tool used>
  Engine speed: “Ne” (rpm)
  Intake air flow rate: “Air Flow Rate from MAFS” (g/s)
  <Multi-Use Tester used>
  Engine speed: 01 “Engine Revolution” (rpm)
  Intake air flow rate: 60 “Air mass flow” (g/s)

(3) Measurement of new sensor intake air flow rate

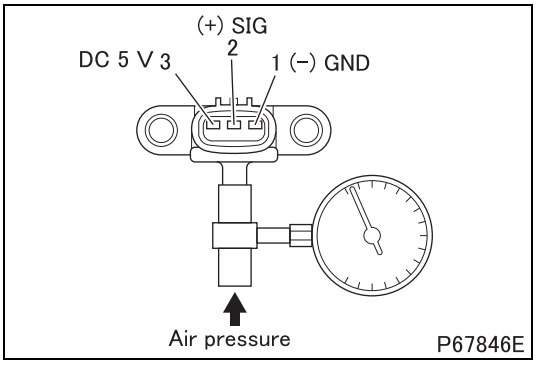
- Remove the existing sensor mounted on the vehicle and install a new sensor in its place.
- Press the accelerator pedal from the idling position all the way down to the stopper bolt. (The engine is running at maximum speed under no load.)
- From “Service Data”, measure intake air flow rate at the same speed as the engine speed under (2) above.

(4) Comparison for characteristics deterioration

- Calculate the characteristics deterioration rate (%) as follows.

$$\text{Characteristics deterioration rate} = \frac{\text{New sensor intake air flow rate} - \text{Existing sensor intake air flow rate}}{\text{New sensor intake air flow rate}} \times 100\ (\%)$$

- If the calculated value is 10% or more, the characteristics of the existing sensor can be judged as deteriorated. In this case, replace it with the new sensor.



#318 Inspection of boost pressure sensor

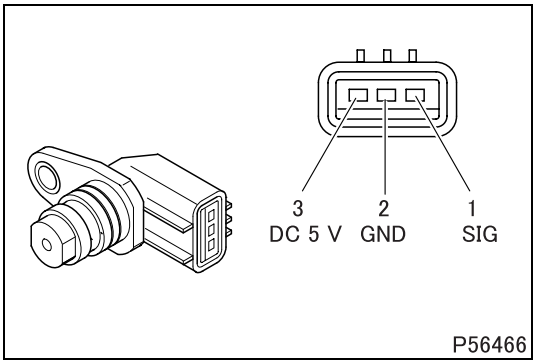
- Apply DC 5 V to terminals 3 and 1.
- Apply air pressure. Gradually increase it and, while doing so, measure the output voltage occurring at terminals 2 and 1.

	Air pressure (gauge reading)	Voltage
Standard value	232.2 kPa {34 psi, 2.3 kg/cm^2}	Approx. 3.2 V
	99 kPa {14 psi, 1.0 kg/cm^2}	Approx. 4.5 V

- If any measurement is out of specification, replace the sensor.

#319 Inspection of common rail pressure sensor

- The sensor cannot easily be inspected in isolation, so you must evaluate it indirectly by inspection of system harnesses and related parts.
- If there is no abnormality in any related part but the system is abnormal, replace the common rail.

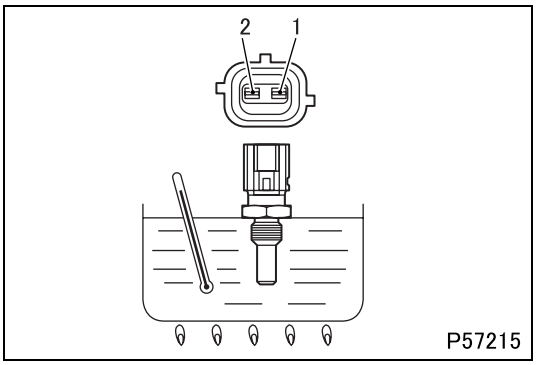


#320 Inspection of cylinder recognition sensor

- Measure the resistance between terminals 2 and 3.

Standard value	200 to 1800 Ω

- If the measurement is out of specification, replace the sensor.

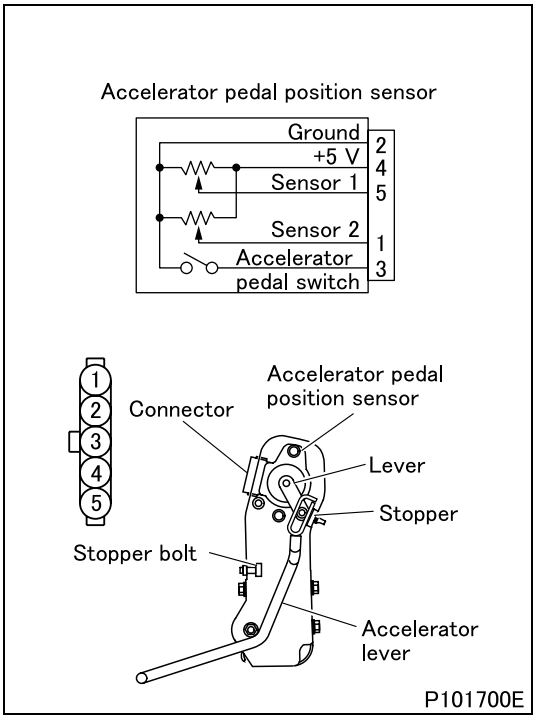


#323 Inspection of fuel temperature sensor

- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	2.45 $^{+0.14}_{-0.13}$ kΩ
	80°C {176°F}	0.318 ± 0.01 kΩ
	110°C {230°F}	0.1417 ± 0.0018 kΩ

- If any measurement is out of specification, replace the sensor.



#324 Inspection of accelerator pedal position sensor

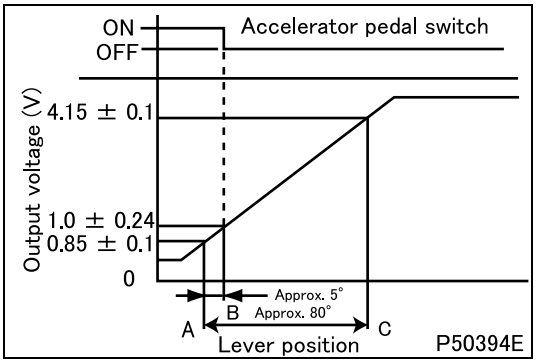
[Inspection]

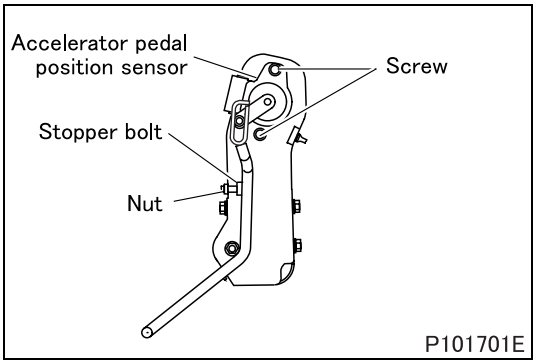
- Apply DC 5 V to terminals 4 and 2 of the accelerator pedal position sensor.
- Measure the output voltage at terminals 2 and 5 (sensor 1) and the output voltage at terminals 1 and 2 (sensor 2) with the accelerator lever in each specified position.

	Accelerator lever position	Output voltage
Standard value	Idling position A	0.85 ± 0.1 V
	Accelerator pedal switch operating position B	1.0 ± 0.24 V
	Full load position C	4.15 ± 0.1 V

A: Position in which accelerator lever is touching stopper
B: Position at which continuity between terminals 2 and 3 disappears as accelerator pedal is pushed downward
C: Position in which accelerator lever is touching stopper bolt

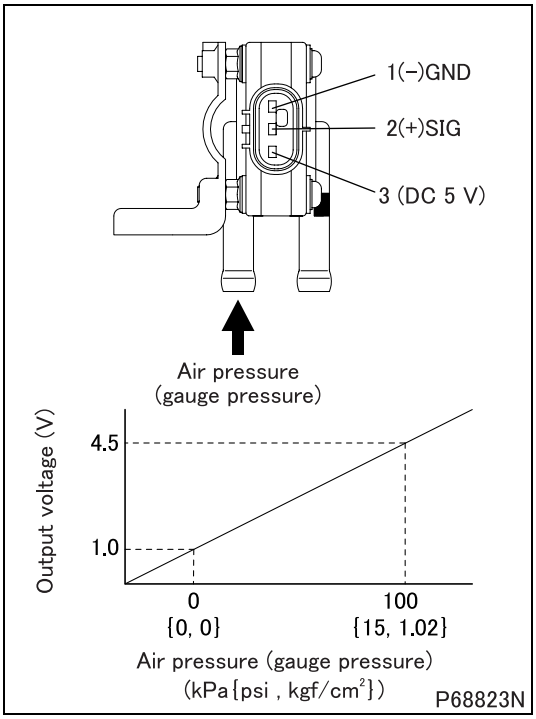
- If any output voltage is out of specification, make an adjustment.
- If any output voltage is still out of specification when you have made an adjustment, replace the sensor.





[Adjustment]

- To adjust the output voltage for the idling position A, loosen the screws and move the accelerator pedal position sensor. Tighten the screws after making the adjustment.
- To adjust the output voltage for the full load position C, loosen the nut and make the adjustment using the stopper bolt. After making the adjustment, lock the stopper bolt in position with the nut.



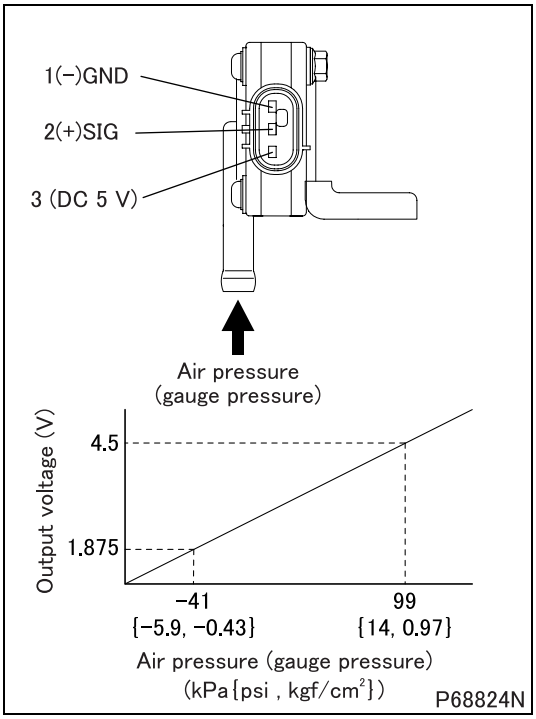
#334 Inspection of DPF pressure sensor

<DPF pressure sensor (DIFF)>

- Apply DC 5 V to terminals 3 and 1.
- Apply air pressure (gauge pressure) and measure the output voltage occurring at terminals 2 and 1 (left figure).

Standard value	0 ± 3.5 kPa {0 ± 0.5 psi, 0 ± 0.04 kgf/cm^2}	1 V
	100 ± 3.5 kPa {15 ± 0.5 psi, 1.02 ± 0.04 kgf/cm^2}	4.5 V

- If the measurement is out of specification, replace the sensor.

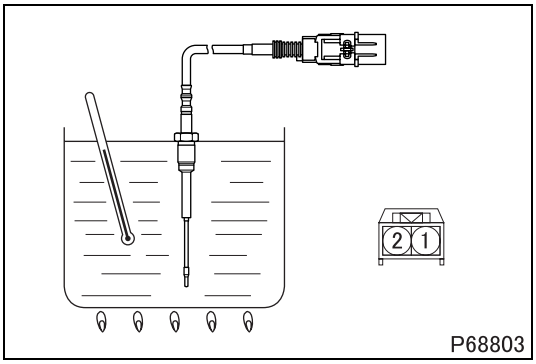


<DPF absolute pressure sensor>

- Apply DC 5 V to terminals 3 and 1.
- Apply air pressure (gauge pressure) and measure the output voltage occurring at terminals 2 and 1 (left figure).

Standard value	−41 ± 3.2 kPa {−5.9 ± 0.5 psi, −0.43 ± 0.03 kgf/cm^2}	1.875 V
	99 ± 3.2 kPa {14 ± 0.5 psi, 1.0 ± 0.03 kgf/cm^2}	4.5 V

- If the measurement is out of specification, replace the sensor.



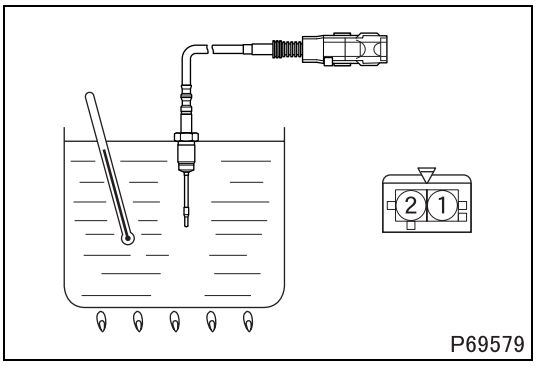
#336 DPF temperature sensor

<DPF temperature sensor 1>

- The DPF temperature sensor 1 may output false signals if its tip is contaminated. Clean it if necessary. (See Gr15.)
- Place the sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	241.8 kΩ
	50°C {122°F}	$106.2^{+74.3}_{-41.8}$ kΩ
	100°C {212°F}	$33.56^{+17.60}_{-10.60}$ kΩ
	150°C {302°F}	$13.90^{+5.36}_{-3.60}$ kΩ
	200°C {392°F}	$6.896^{+2.064}_{-1.252}$ kΩ

- If the measurement is out of specification, replace the sensor.

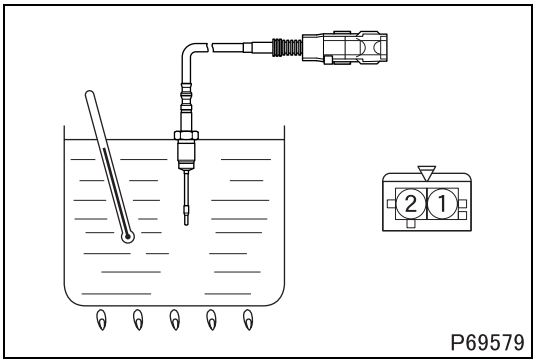


<DPF temperature sensor 2>

- The DPF temperature sensor 2 may output false signals if its tip is contaminated. Clean it if necessary. (See Gr15.)
- Place the sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	241.8 kΩ
	50°C {122°F}	$106.2^{+74.3}_{-41.8}$ kΩ
	100°C {212°F}	$33.56^{+17.60}_{-10.60}$ kΩ
	150°C {302°F}	$13.90^{+5.36}_{-3.60}$ kΩ
	200°C {392°F}	$6.896^{+2.064}_{-1.252}$ kΩ

- If the measurement is out of specification, replace the sensor.

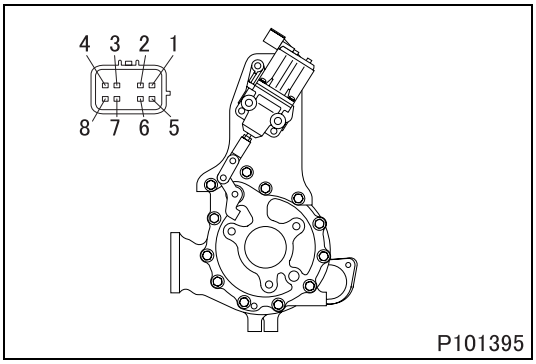


#338 Inspection of catalytic temperature sensor

- The catalytic temperature sensor may output false signals if its tip is contaminated. Clean it if necessary. (See Gr15.)
- Place the sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	241.8 kΩ
	50°C {122°F}	$106.2^{+74.3}_{-41.8}$ kΩ
	100°C {212°F}	$33.56^{+17.60}_{-10.60}$ kΩ
	150°C {302°F}	$13.90^{+5.36}_{-3.60}$ kΩ
	200°C {392°F}	$6.896^{+2.064}_{-1.252}$ kΩ

- If the measurement is out of specification, replace the sensor.



#514 Inspection of turbocharger actuator

- Perform the following checks. If there is any abnormality, replace the turbocharger actuator.

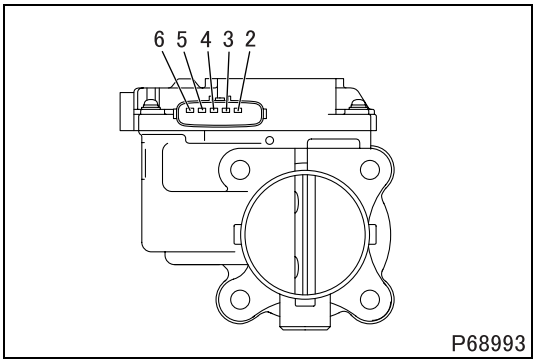
(1) Coil resistance of motor

- Measure the resistance between terminals 8 and 7, 8 and 6, and 7 and 6.

Standard value	2.1 ± 0.3 Ω

(2) Position sensor

- The sensor cannot easily be inspected, so you must evaluate it indirectly by inspection of system harnesses and related parts.
- If there is no abnormality in any related part but the system is abnormal, replace the turbocharger actuator.



#529 Inspection of intake throttle

- Perform the following checks. If there is any abnormality, replace the intake throttle.

(1) Coil resistance of motor

- Measure the resistance between terminals 5 and 6.

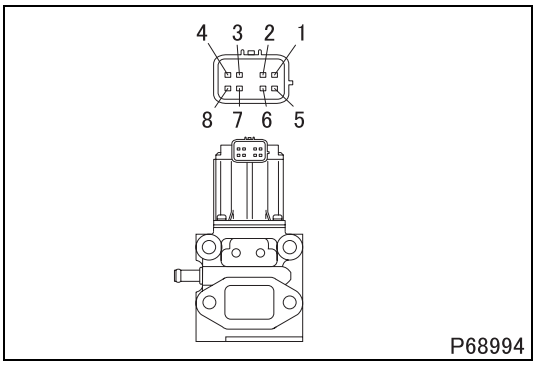
Standard value	0.3 to 80 Ω

CAUTION ⚠

- **If the measurement is out of specification, manually open and close the butterfly valve and measure the resistance again.**

(2) Position sensor

- The sensor cannot easily be inspected, so you must evaluate it indirectly by inspection of system harnesses and related parts.
- If there is no abnormality in any related part but the system is abnormal, replace the intake throttle.



#530 Inspection of EGR valve

- Perform the following checks. If there is any abnormality, replace the EGR valve.

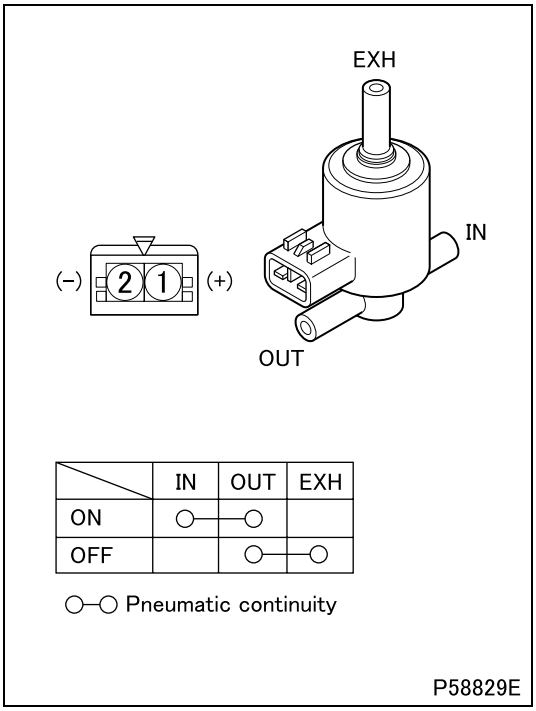
(1) Coil resistance of motor

- Measure the resistance between terminals 8 and 7, 8 and 6, and 7 and 6.

Standard value	2.1 ± 0.3 Ω

(2) Position sensor

- The sensor cannot easily be inspected, so you must evaluate it indirectly by inspection of system harnesses and related parts.
- If there is no abnormality in any related part but the system is abnormal, replace the EGR valve.



#565 Inspection of exhaust shutter 3-way magnetic valve

- Perform the following checks. If there is any abnormality, replace the exhaust shutter 3-way magnetic valve.

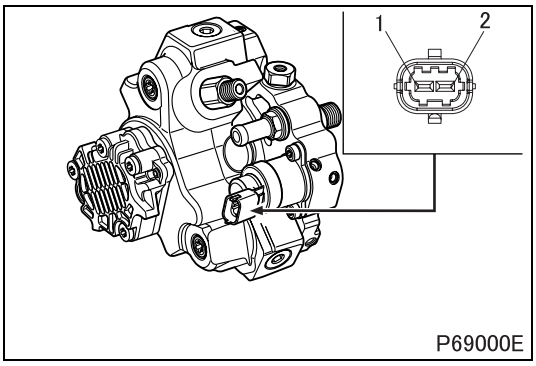
(1) Check of operation

- Gradually increase from zero the voltage applied to terminals 1 and 2.
- Observe the voltage when the exhaust shutter 3-way magenetic valve operates.
  (Determine the magnet valve's OFF-ON operation from the operating sound.)

Standard value (min. operating voltage)	11 V or lower

(2) Check of continuity and airtightness

- Vacuum pressure applied during check:
  –100 kPa {–15 psi, –10 kgf/cm^2}

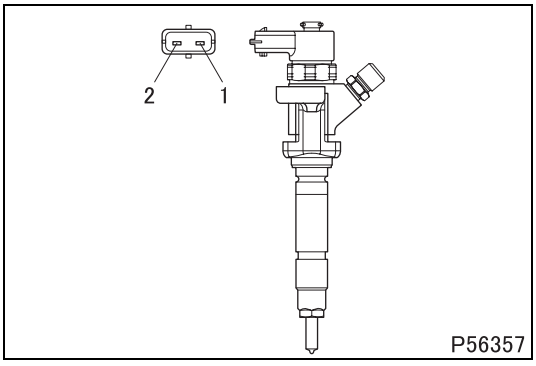


#574 Inspection of MPROP
(rail pressure control valve)

- Measure the resistance between terminals 1 and 2.

Standard value	2.6 to 3.15 Ω

- If the measurement is out of specification, replace the supply pump.



#582 Inspection of injector magnetic valve

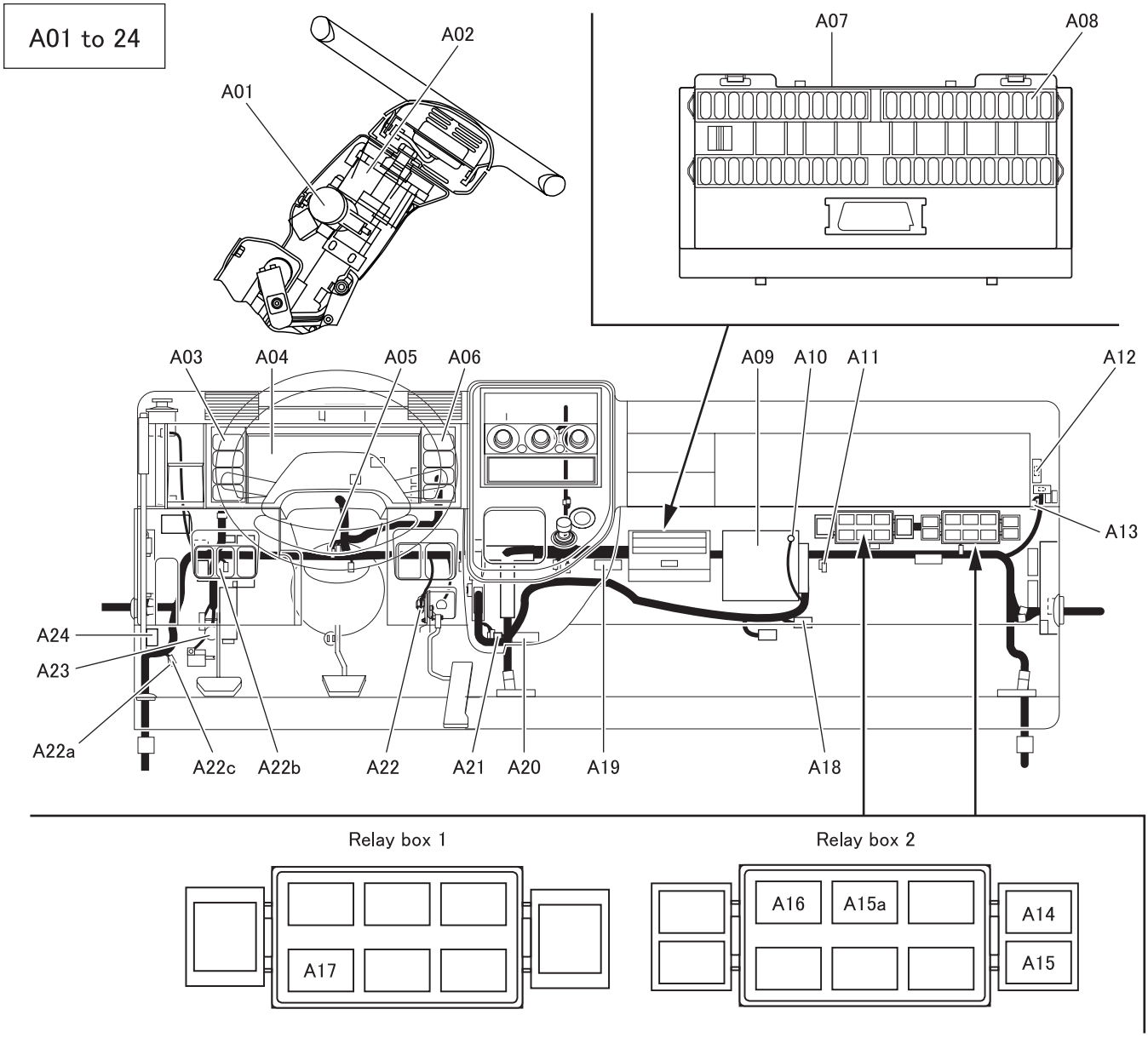
- Measure the resistance between terminals 1 and 2.

Standard value (at 20°C {68°F})	0.255 ± 0.04 Ω

- If the measurement is out of specification, replace the injector.
- If an injector is replaced with a new one, the injector correction data must be written in the engine electronic control unit.
- For storing of data in the engine electronic control unit, contact your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.

M E M O

INSTALLED LOCATIONS OF PARTS

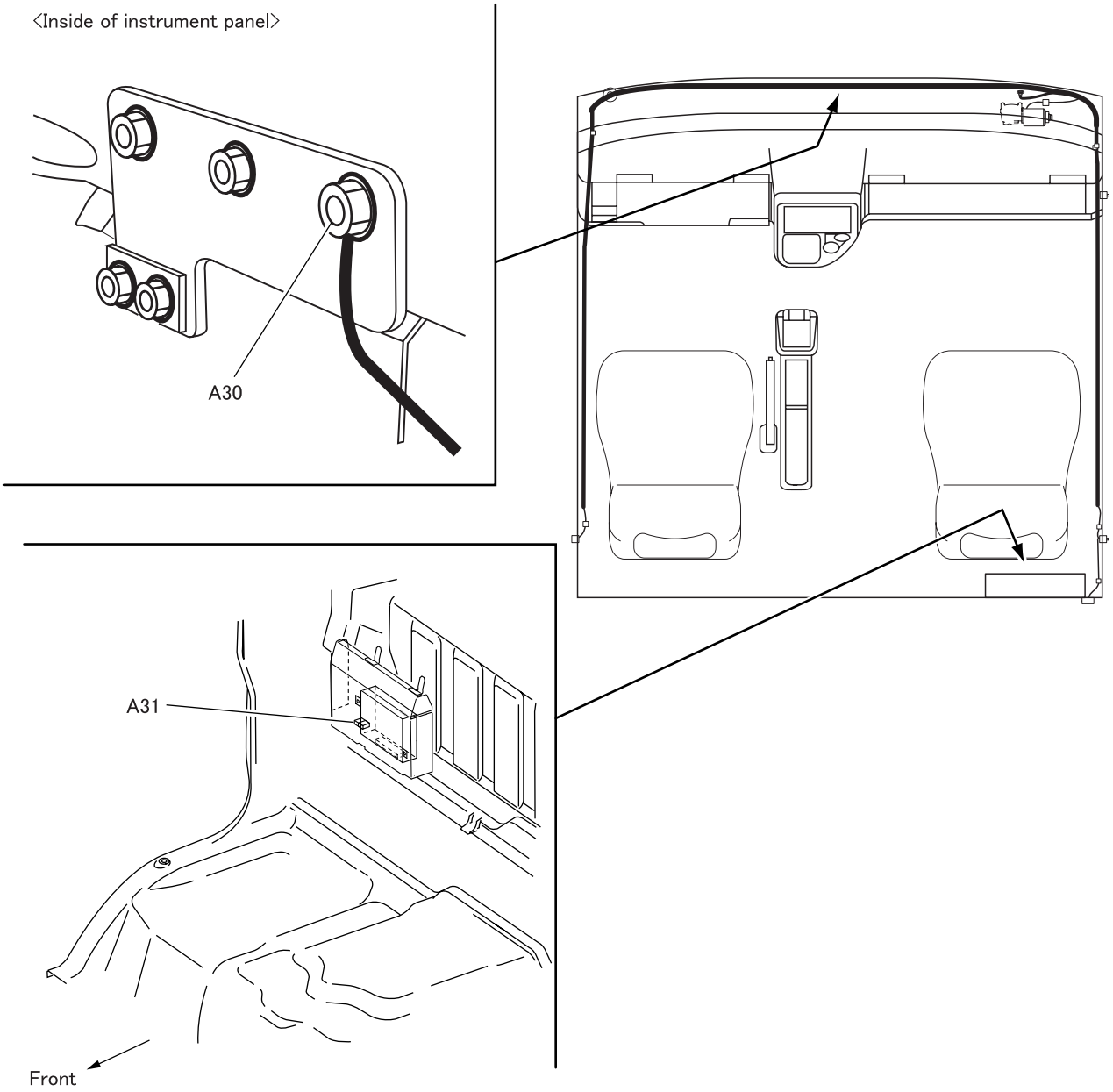


A01 Starter switch
A02 Combination switch
A03 DPF cleaning switch
A04 Meter cluster
A05 Diode
A06 Warm-up switch
A07 Fuse box
A08 Diagnosis switch
A09 Engine ECU
A10 Ground
A11 Diode
A12 Turbocharger EDU
A13 Controller area network resistor
A14 Engine start relay <M/T>
Neutral start relay <A/T>
A15 T/M neutral relay <M/T>
Exhaust brake cut relay <A/T>
A15a Glow drive relay <Except FE83>
A16 ABS exhaust brake cut relay
A17 Safety relay
A18 Joint connector (J/C-2)
A19 Joint connector (J/C-1)
A20 Joint connector (J/C-M1)
A21 Diode
A22 Accelerator pedal position sensor
A22a Joint connector (J/C-040)
A22b Joint connector (J/C-040) <A/T>
A22c Controller area network resistor
A23 Clutch switch
A24 Multi-Use Tester connector

ABS : Anti-lock brake system
ECU : Electronic control unit
DPF : Diesel particulate filter
J/C : Joint connector
EDU : Electronic drive unit
M/T : Manual transmission
A/T : Automatic transmission
T/M : Transmission

L02381

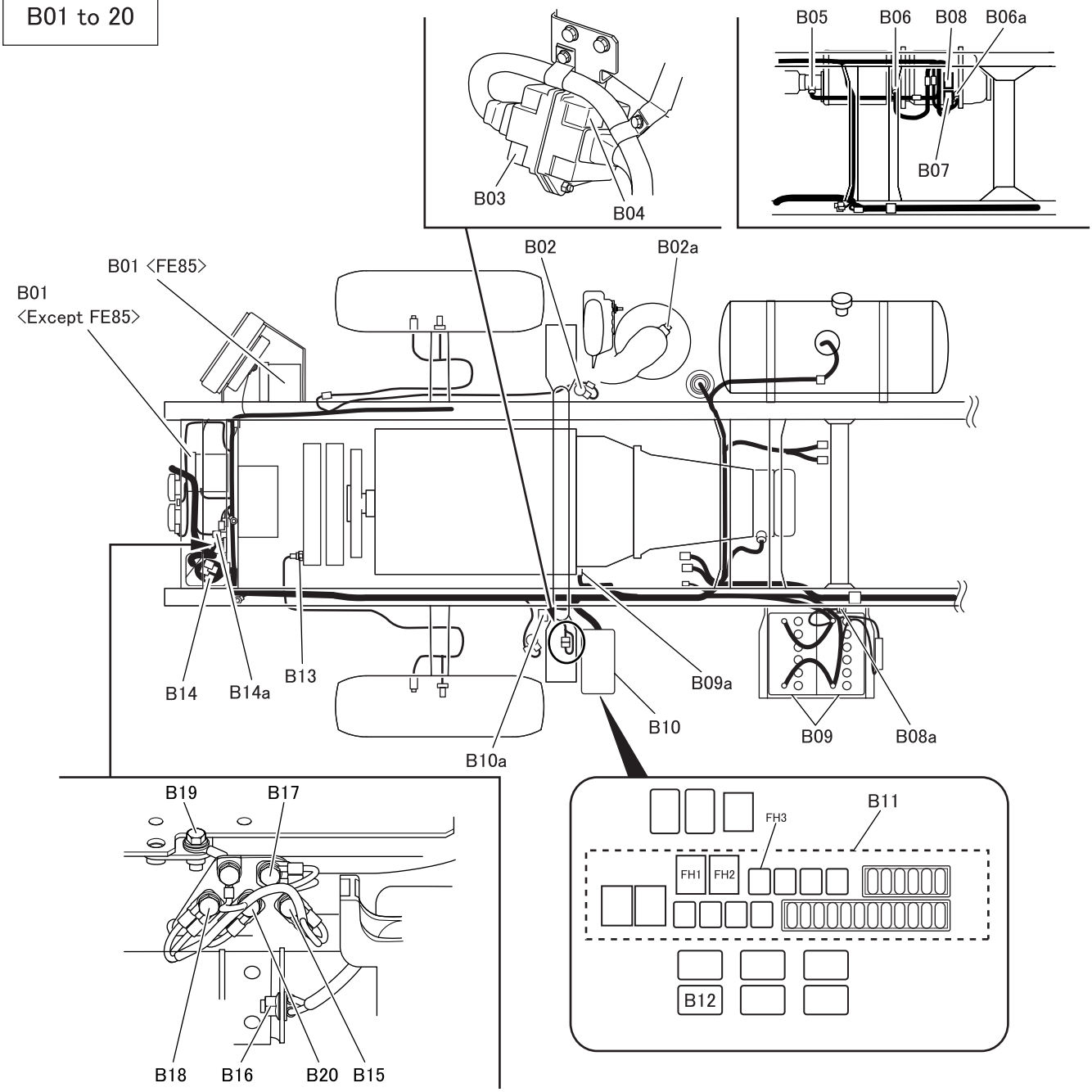
A30–31



A30 Ground
A31 Controller area network resistor

INSTALLED LOCATIONS OF PARTS

B01 to 20



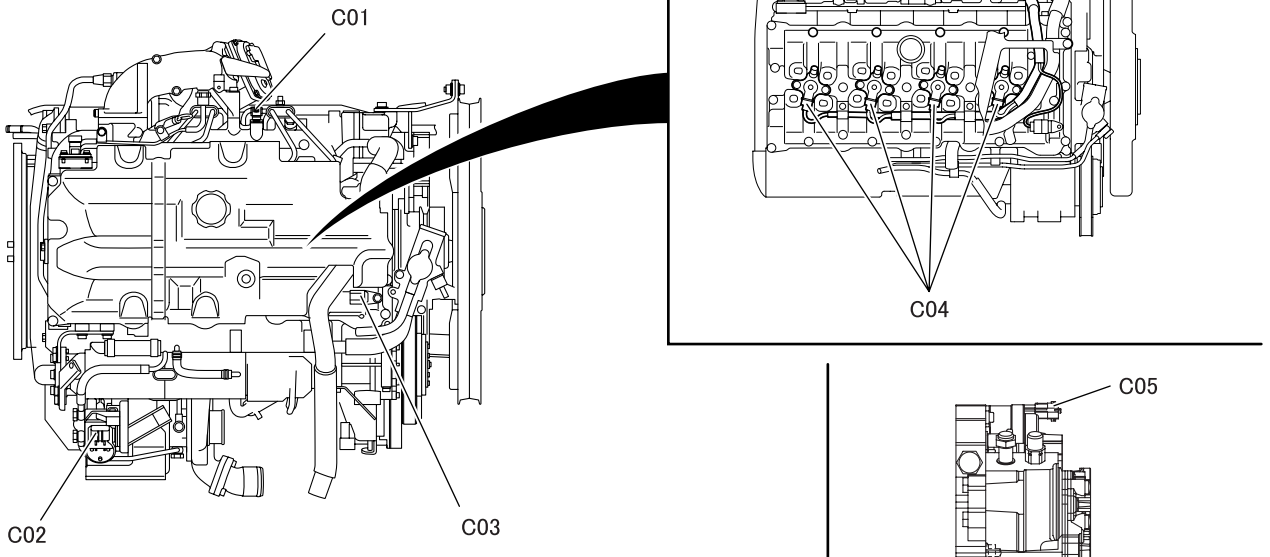
B01 Hydraulic unit
B02 Exhaust shutter 3-way magnetic valve
B02a Air flow sensor
B03 Throttle EDU
B04 EGR EDU
B05 Catalytic temperature sensor
B06 DPF temperature sensor 1
B06a DPF temperature sensor 2
B07 DPF pressure sensor (DIFF)
B08 DPF absolute pressure sensor
B08a Ground
B09 Battery
B09a Ground
B10 High-current fuse box
B10a Glow ECU <FE83>
B11 High-current fuse, fuse
B12 EDU relay
B13 Intake air temperature sensor
B14 Connection of chassis harness and cab harness or engine harness
B14a Connection of cab harness and engine harness
B15 Ground
B16 Ground
B17 Ground
B18 Ground
B19 Ground
B20 Ground

ECU : Electronic control unit
EDU : Electronic drive unit
EGR : Exhaust gas recirculation
DPF : Diesel particulate filter

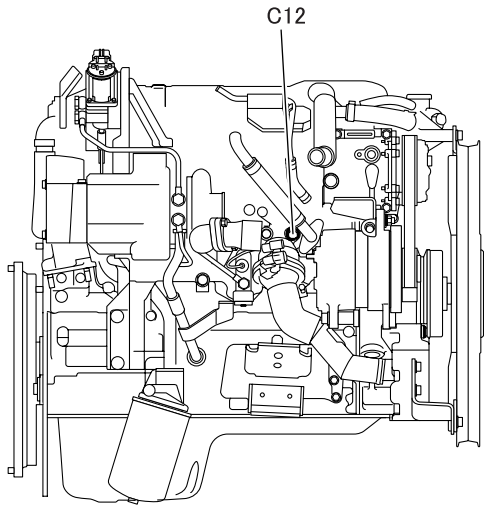
L02383

C01 to 12

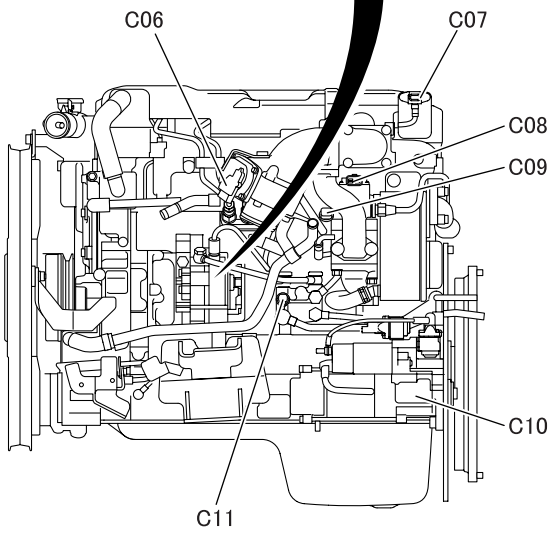
Upper view



Right side view



Left side view



C01	Boost air temperature sensor
C02	Turbocharger actuator
C03	Cylinder recognition sensor
C04	Injector magnetic valve
C05	MPROP (rail pressure control valve)
C06	Throttle actuator (building into motor, position sensor)
C07	Boost pressure sensor
C08	EGR valve
C09	Common rail pressure sensor
C10	Starter
C11	Fuel temperature sensor
C12	Water temperature sensor (connects to engine ECU)

ECU : Electronic control unit
EGR : Exhaust gas recirculation

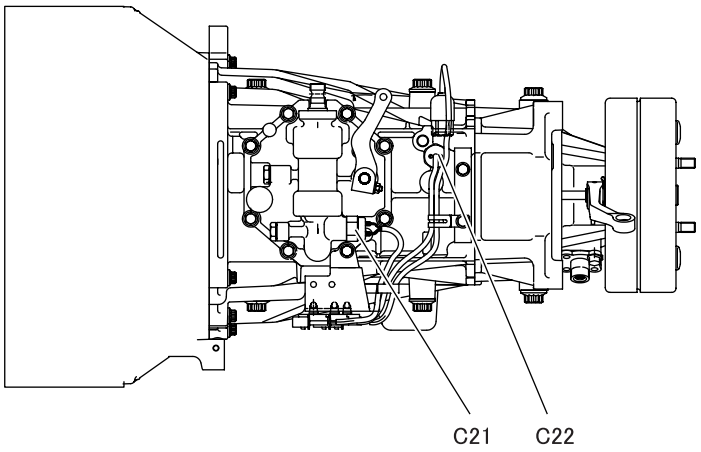
L02384

INSTALLED LOCATIONS OF PARTS

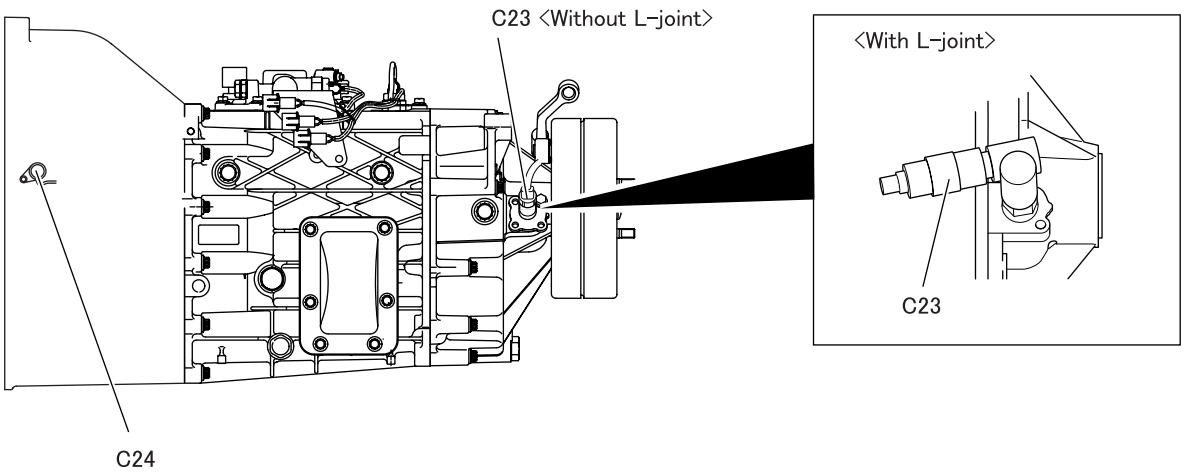
C21 to 24

<Manual transmission>

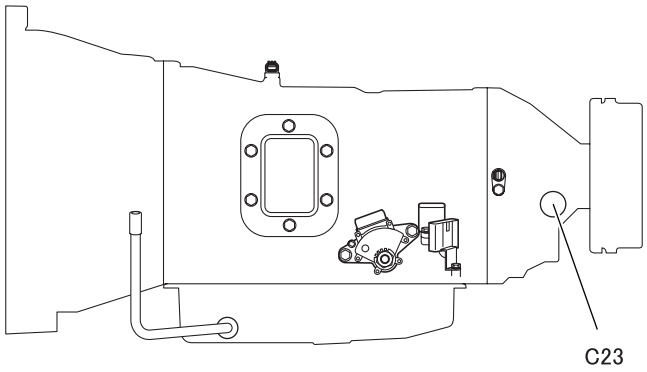
Upper view



Left side view



<Automatic transmission>

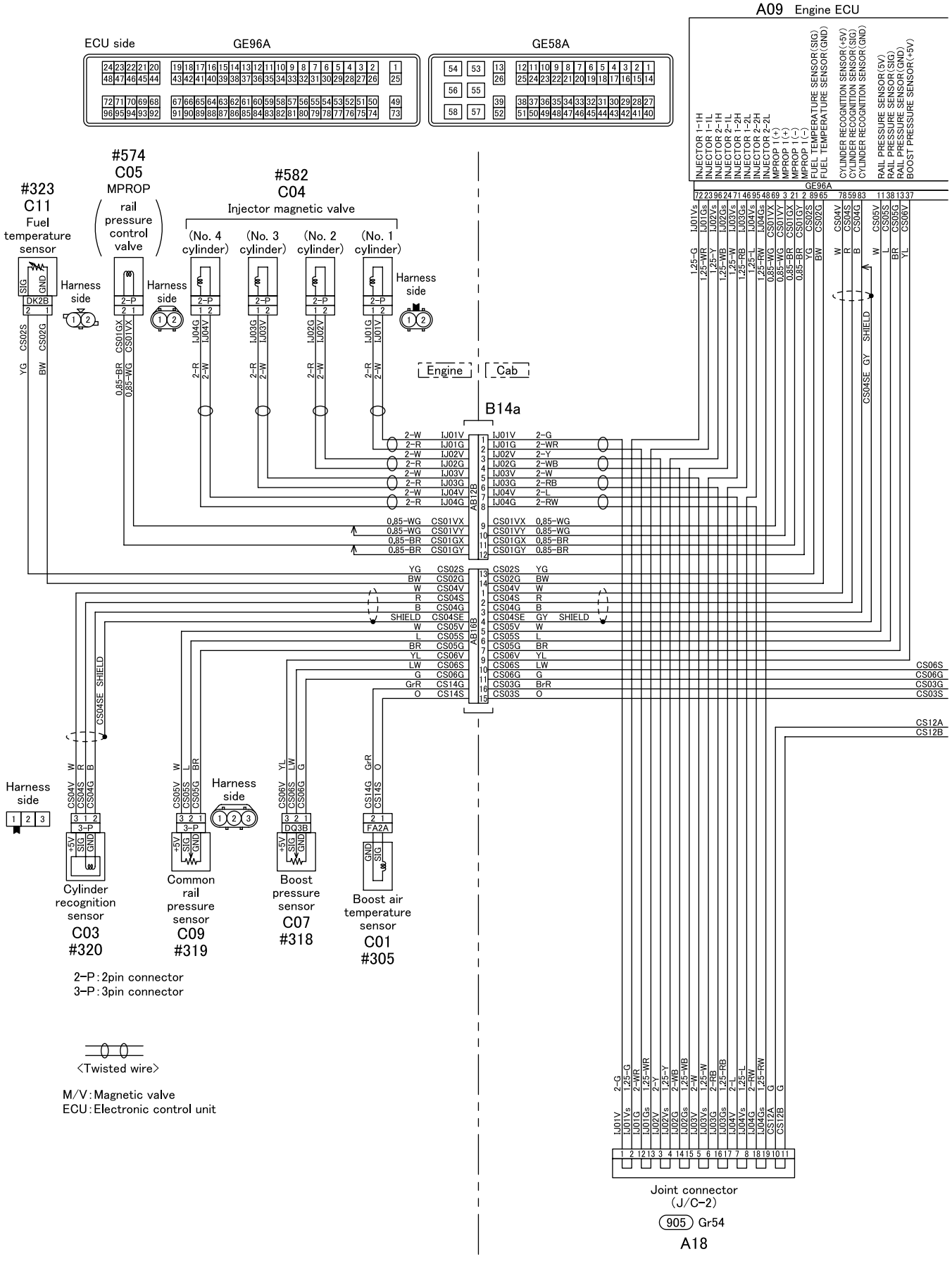


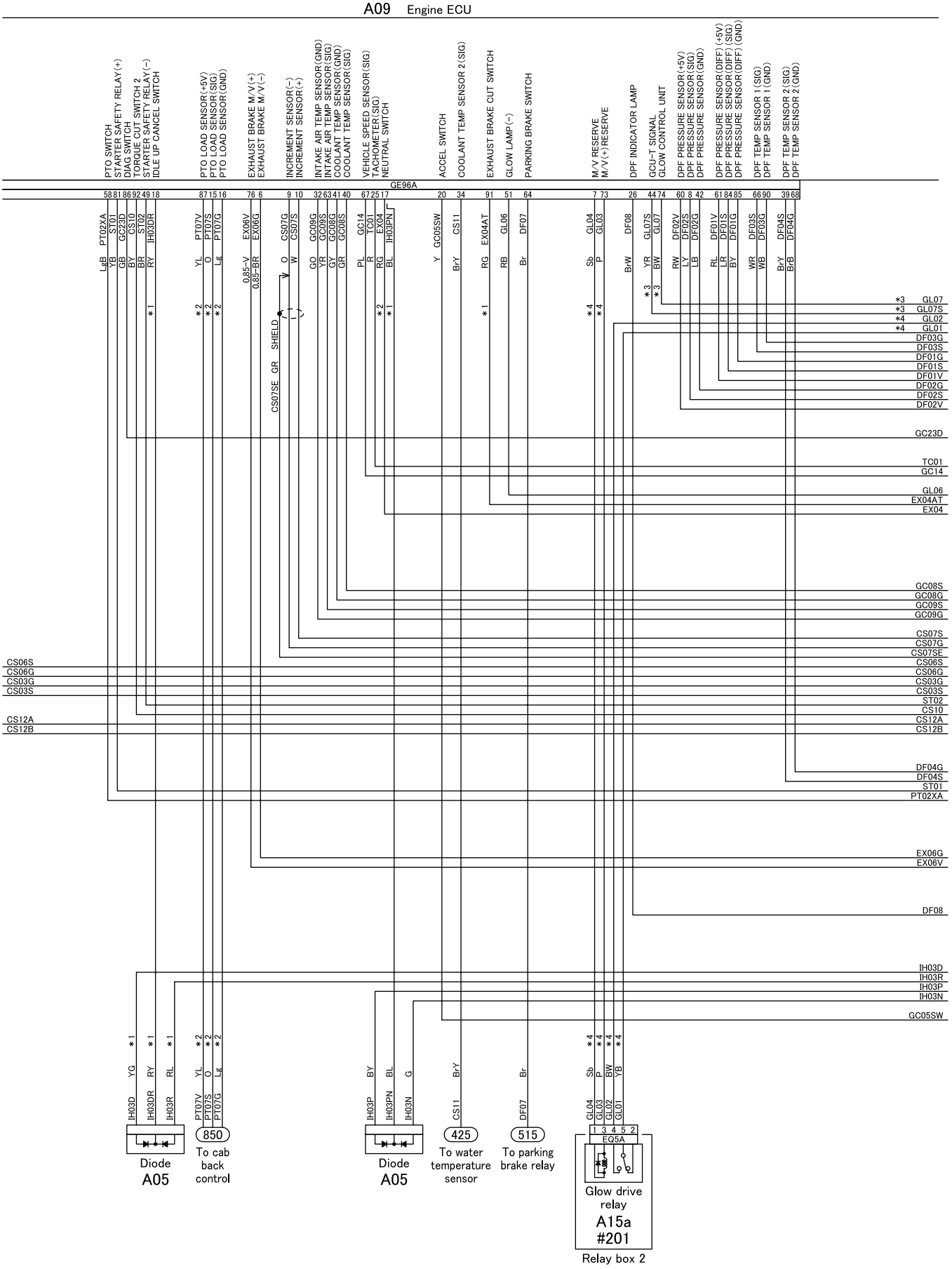
C21 Transmission neutral switch
C22 Torque limit switch
C23 Vehicle speed sensor
C24 Engine speed sensor

L02385

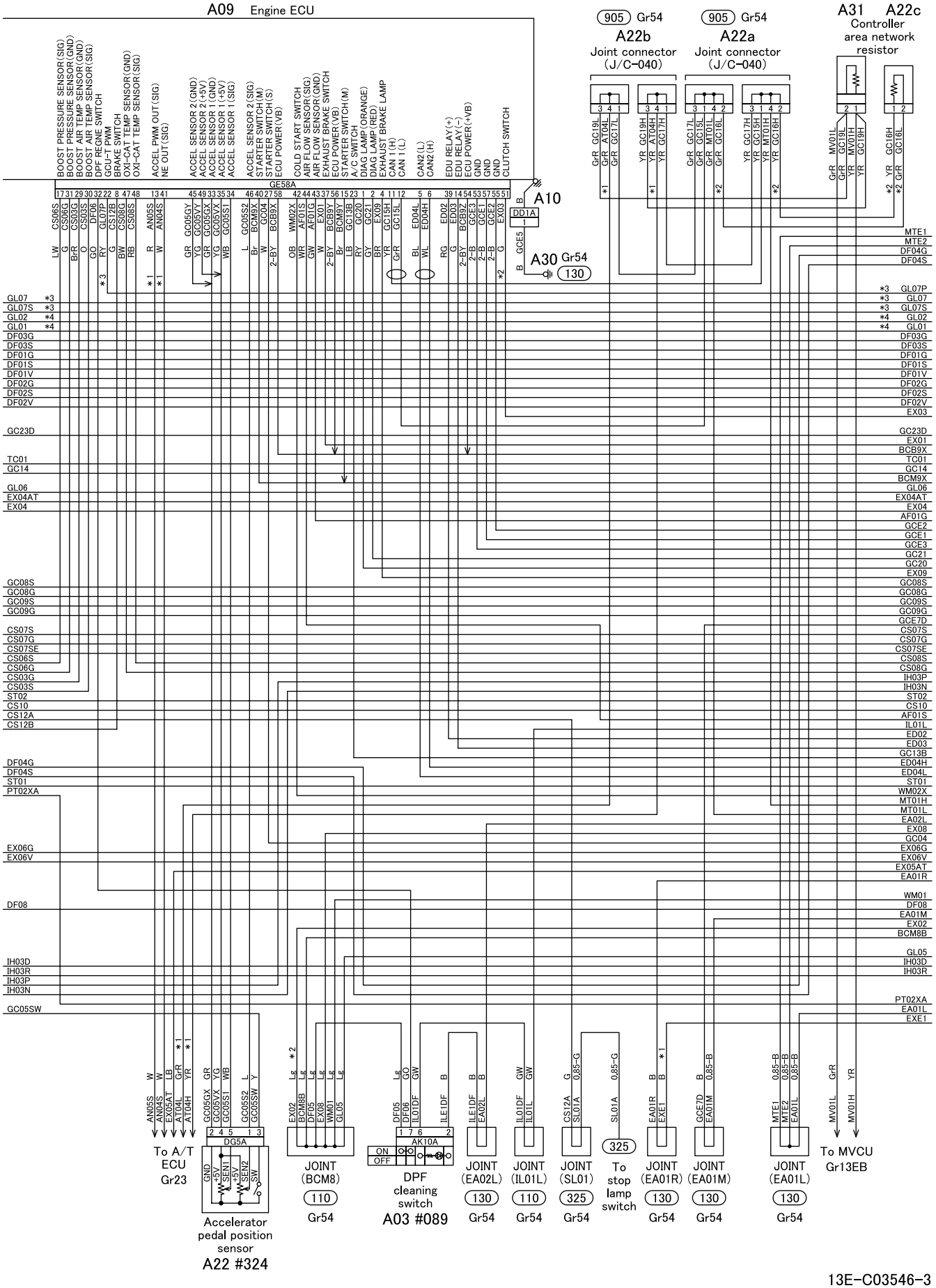
M E M O

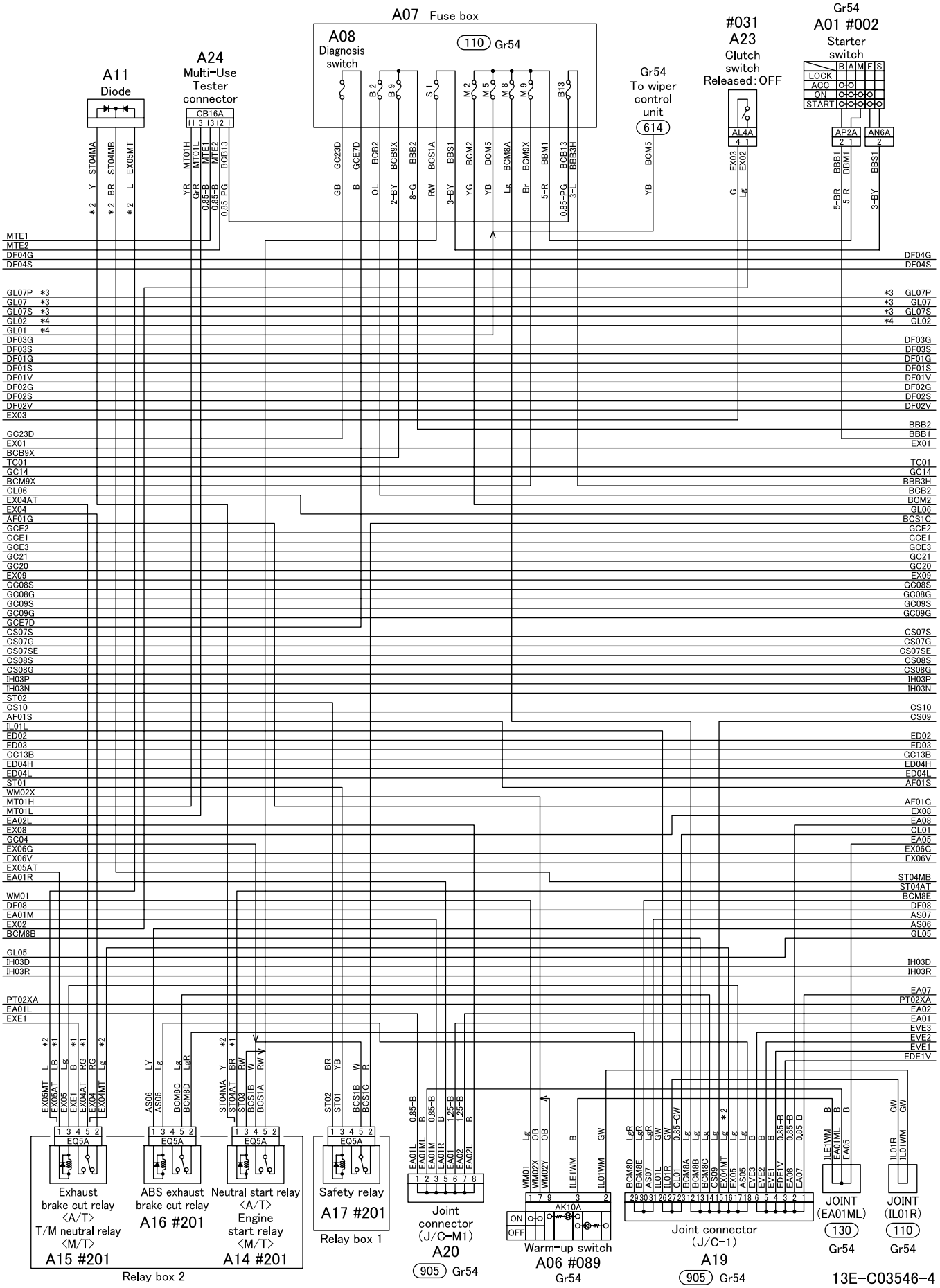
ELECTRIC CIRCUIT DIAGRAM



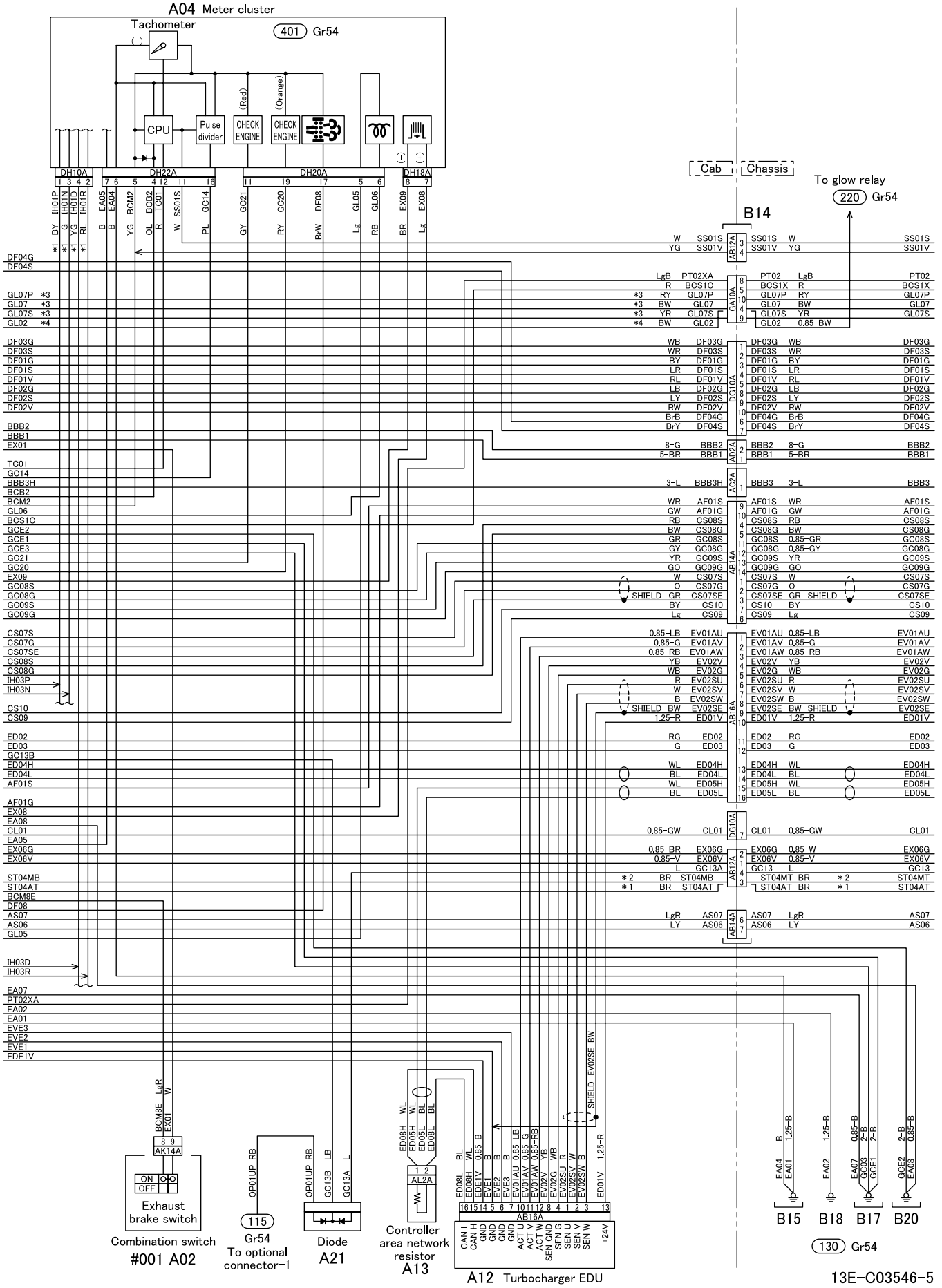

A09 Engine ECU
GE96A
PTO SWITCH
STARTER SAFETY RELAY(+)
DIAG SWITCH
TORQUE CUT SWITCH 2
STARTER SAFETY RELAY(-)
IDLE UP CANCEL SWITCH
PTO LOAD SENSOR(+5V)
PTO LOAD SENSOR(SIG)
PTO LOAD SENSOR(GND)
EXHAUST BRAKE M/V(+)
EXHAUST BRAKE M/V(-)
INCREMENT SENSOR(-)
INCREMENT SENSOR(+)
INTAKE AIR TEMP SENSOR(GND)
INTAKE AIR TEMP SENSOR(SIG)
COOLANT TEMP SENSOR(GND)
COOLANT TEMP SENSOR(SIG)
VEHICLE SPEED SENSOR(SIG)
TACHOMETER(SIG)
NEUTRAL SWITCH
ACCEL SWITCH
COOLANT TEMP SENSOR 2(SIG)
EXHAUST BRAKE CUT SWITCH
GLOW LAMP(-)
PARKING BRAKE SWITCH
M/V RESERVE
M/V(+)RESERVE
DPF INDICATOR LAMP
GCU-T SIGNAL
GLOW CONTROL UNIT
DPF PRESSURE SENSOR(+5V)
DPF PRESSURE SENSOR(SIG)
DPF PRESSURE SENSOR(GND)
DPF PRESSURE SENSOR(DIFF)(+5V)
DPF PRESSURE SENSOR(DIFF)(SIG)
DPF PRESSURE SENSOR(DIFF)(GND)
DPF TEMP SENSOR 1(SIG)
DPF TEMP SENSOR 1(GND)
DPF TEMP SENSOR 2(SIG)
DPF TEMP SENSOR 2(GND)
Diode A05
To cab back control
Diode A05
To water temperature sensor
To parking brake relay
Glow drive relay A15a #201
Relay box 2
EQ5A

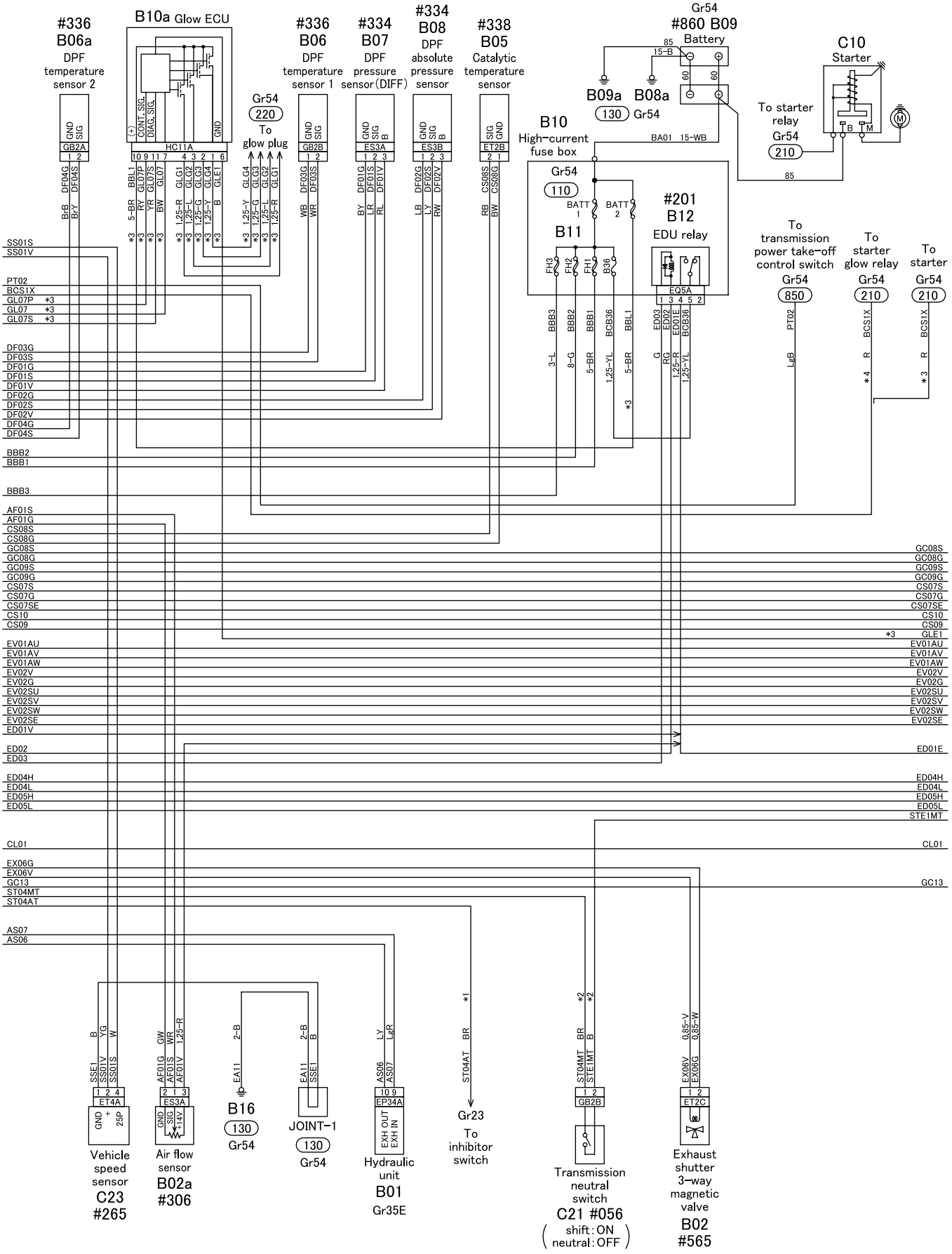
ELECTRIC CIRCUIT DIAGRAM



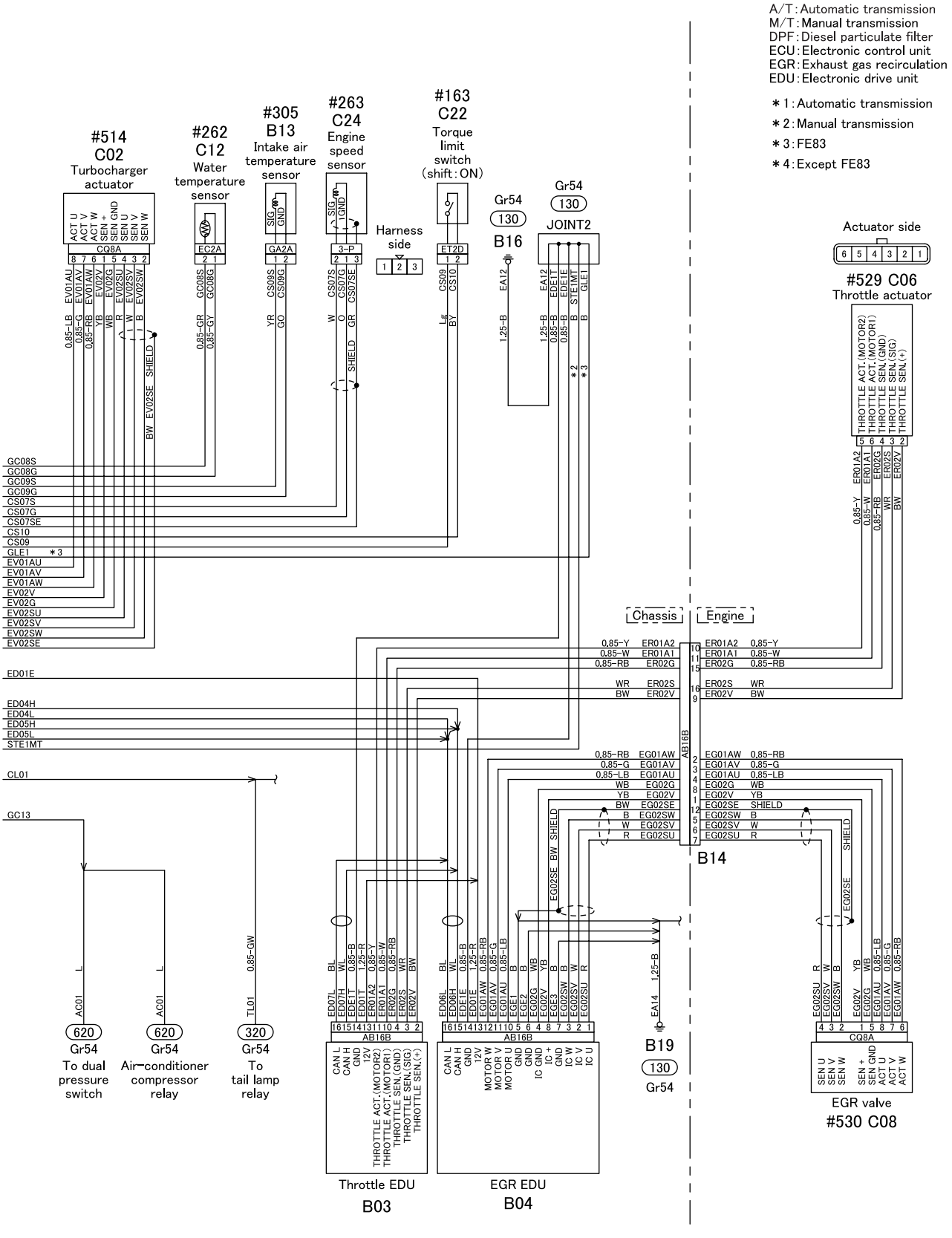

A07 Fuse box
A08 Diagnosis switch
110 Gr54
A11 Diode
A24 Multi-Use Tester connector
CB16A
Gr54 To wiper control unit
614
#031 A23 Clutch switch Released : OFF
AL4A
Gr54 A01 #002 Starter switch
LOCK ACC ON START
AP2A
AN6A
A15 #201 Exhaust brake cut relay <A/T> T/M neutral relay <M/T>
A16 #201 ABS exhaust brake cut relay
A14 #201 Neutral start relay <A/T> Engine start relay <M/T>
Relay box 2
A17 #201 Safety relay
Relay box 1
Joint connector (J/C-M1) A20 905 Gr54
AK10A Warm-up switch A06 #089 Gr54
Joint connector (J/C-1) A19 905 Gr54
JOINT (EA01ML) 130 Gr54
JOINT (IL01R) 110 Gr54
13E-C03546-4

ELECTRIC CIRCUIT DIAGRAM




#336
B06a
DPF
temperature
sensor 2
B10a Glow ECU
#336
B06
DPF
temperature
sensor 1
#334
B07
DPF
pressure
sensor(DIFF)
#334
B08
DPF
absolute
pressure
sensor
#338
B05
Catalytic
temperature
sensor
Gr54
#860 B09
Battery
C10
Starter
B09a
B08a
Gr54
220
To
glow plug
B10
High-current
fuse box
Gr54
110
B11
#201
B12
EDU relay
To starter
relay
Gr54
210
To
transmission
power take-off
control switch
Gr54
850
To
starter glow relay
Gr54
210
To
starter
Gr54
210
Vehicle
speed
sensor
C23
#265
Air flow
sensor
B02a
#306
B16
Gr54
130
JOINT-1
Gr54
130
Hydraulic
unit
B01
Gr35E
Gr23
To
inhibitor
switch
Transmission
neutral
switch
C21 #056
shift : ON
neutral : OFF
Exhaust
shutter
3-way
magnetic
valve
B02
#565

ELECTRIC CIRCUIT DIAGRAM



INDEX

STRUCTURE AND OPERATION

1. General Description 13EB-2
2. Electronic Control System 13EB-2
3. Electronic Control Unit Connection Diagram 13EB-6

TROUBLESHOOTING

1. Diagnosis Procedure 13EB-8
2. Diagnostic Precautions 13EB-8
3. Inspection Based on Diagnosis Codes 13EB-9
4. Multi-Use Tester Service Data 13EB-13
5. Actuator Tests Performed Using Multi-Use Tester 13EB-14
6. Works Required When Replacing the Multifunction Vehicle Control Unit (MVCU) 13EB-14
7. Inspections Performed at Electronic Control Unit Connectors 13EB-15

INSPECTION OF ELECTRICAL EQUIPMENT 13EB-16

INSTALLED LOCATIONS OF PARTS 13EB-18

ELECTRIC CIRCUIT DIAGRAM 13EB-22

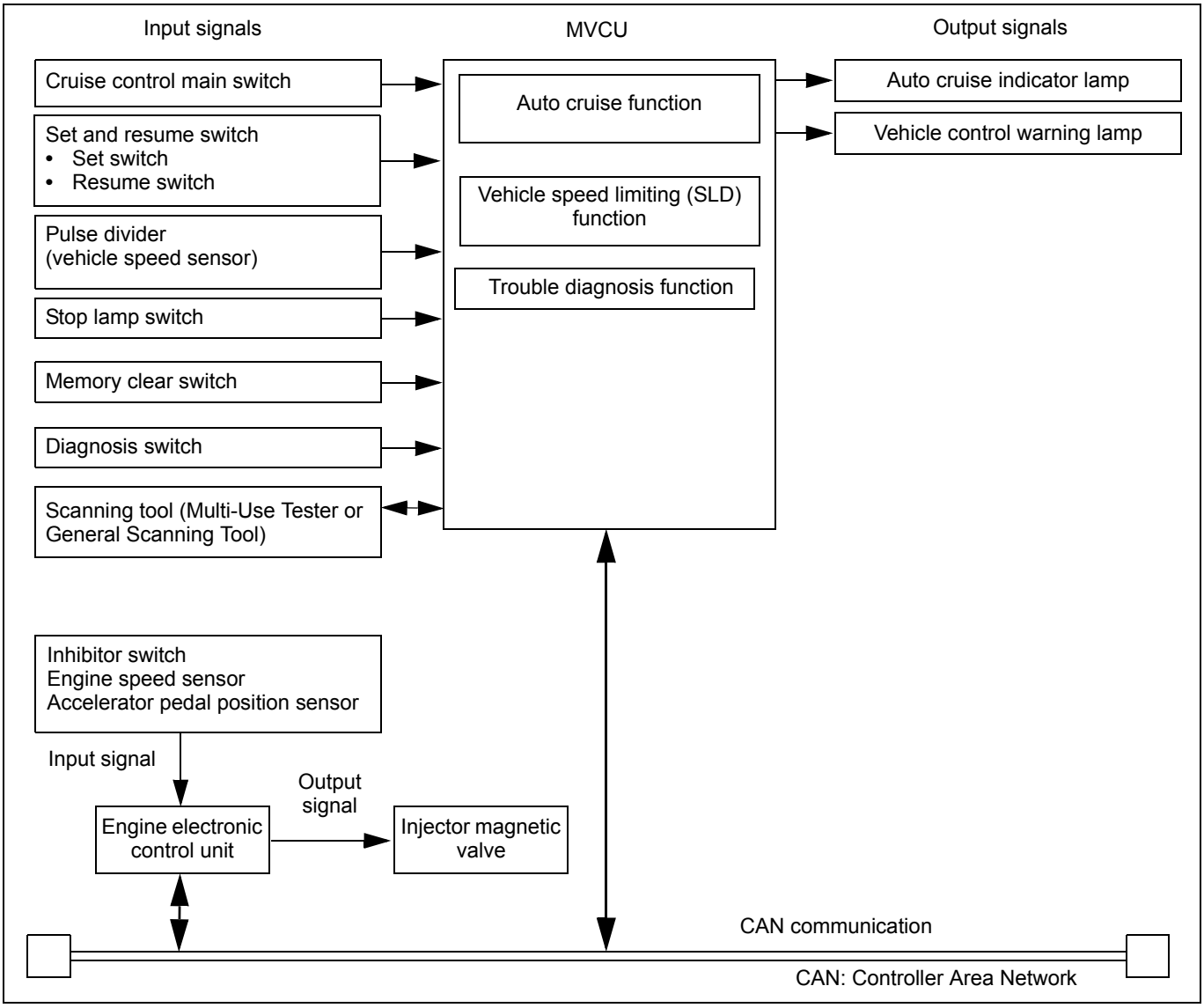
STRUCTURE AND OPERATION

1. General Description

- The MVCU (Multi function Vehicle Control Unit) is an integrated electronic control unit which has the following functions:
  - Auto cruise function
  - Vehicle speed limiting (SLD) function <Configurable for vehicles with automatic transmission (except Crew-cab models)>
- For these functions, MVCU receives the sensor and switch information from other ECUs via CAN communication system.
- In the auto cruise function, the target vehicle speed is set using the main switch, set switch and resume switch, and the MVCU maintains the set speed by controlling the engine.
- The vehicle speed limiting (SLD) function is designed to send output signals to the engine ECU to restrict the maximum vehicle speed to a preset speed limit regardless of the accelerator pedal operation when the vehicle speed reaches the speed limit on flat or uphill road.
  This vehicle speed limiting (SLD) function is inactive in the initial setting of MVCU. To activate this, consult your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.
- The MVCU also has the self-diagnosis function to diagnose major components and warns the driver if any abnormality is found.

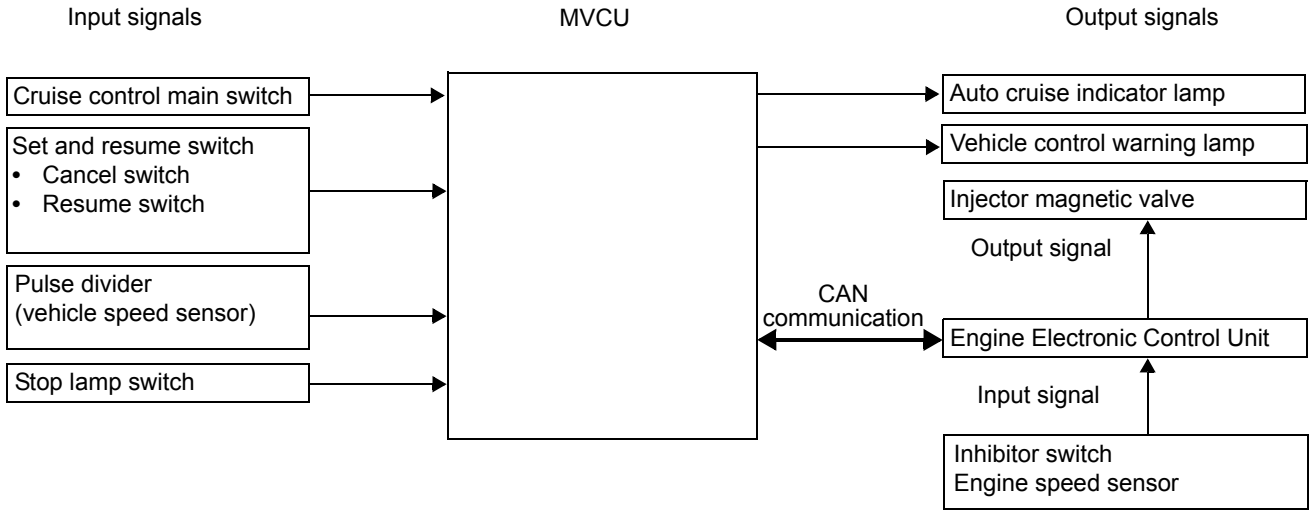
2. Electronic Control System

2.1 System block diagram



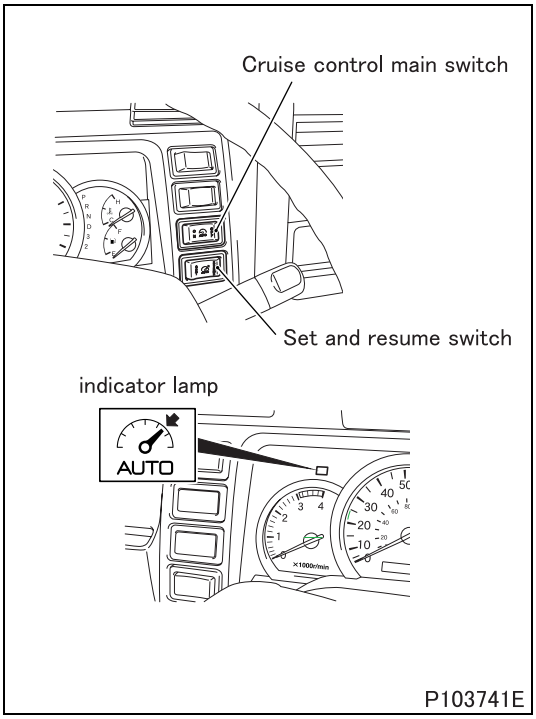
Part name	Function/operation
Cruise control main switch	ON-OFF control of auto cruise system
Set switch	Selection and change of desired cruising speed
Resume switch	Resumption and change of canceled cruising speed
Pulse divider (vehicle speed sensor)	Detection of vehicle speed
Stop lamp switch	Detection of brake pedal depression (lamp lit on pedal being pressed)
Memory clear switch	Clearing of existing diagnosis code, output of earlier diagnosis codes
Diagnosis switch	Output of diagnosis codes
Scanning tool (Multi-Use Tester or General Scanning Tool)	Communication between scanning tool (Multi-Use Tester or General Scanning Tool) and MVCU
Auto cruise indicator lamp	Indication of system in operation
Vehicle control warning lamp	Indication of system failure
CAN communication (engine electronic control unit)	MVCU outputs recognized vehicle data on CAN so that engine electronic control unit receives necessary data for control. Engine electronic control unit outputs necessary signals to MVCU for appropriate control of individual systems.

2.2 Auto cruise function



- In the auto cruise function, the target vehicle speed is set using the main switch, set switch and resume switch, and the MVCU maintains the set speed by controlling the engine.

(1) Setting the auto cruise function



- The operation of the auto cruise function using the set and resume switch is as follows:

(1.1) Setting condition

- To activate the auto cruise function, the following condisitons should be met:
  - Shift lever is in 4th or higher gear position.
  - Vehicle speed is increased to approx. 40 km/h {25 MPH} or higher.
  - The cruise control main switch is in ON position.
  - The brake pedals are released.

(1.2) Set switch ("SET" side of the set and resume switch)

- This switch is used to set or change the target vehicle speed.

Setting the vehicle speed

- Accelerate to a desired speed using the accelerator pedal.
- In this condition, press and release the set switch. The target vehicle speed is set when the switch is released and the auto cruise indicator lamp illuminates.

Lowering the set speed

- During auto cruise driving, pressing the set switch decelerates the vehicle speed. Press the set switch to lower the vehicle speed and, when the speed lowers to a desired speed, release the set switch. A new target vehicle speed is set at that moment.

Raising the set speed

- Press the accelerator pedal and raise the vehicle speed. When the desired speed is reached, press and release the set switch. A new target vehicle speed is set at that moment.

(1.3) Resume switch ("RESUME" side of the set and resume switch)

- This switch is used to resume the auto cruise control when the control is temporarily disengaged or to change the target vehicle speed.

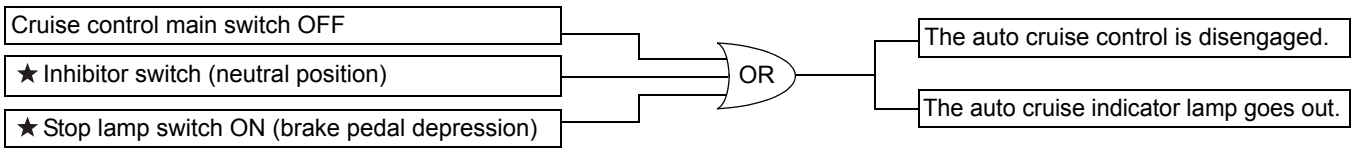
Resuming the auto cruise control (target speed)

- During auto cruise driving when the control has temporarily disengaged due to braking or other reason, press and release the resume switch. The auto cruise control is reengaged and it regulates the vehicle speed to a former target speed.

Raising the set speed

- During auto cruise driving, pressing the resume switch accelerates the vehicle speed. Press the resume switch to raise the vehicle speed and, when the speed rises to a desired speed, release the resume switch. A new target vehicle speed is set at that moment.

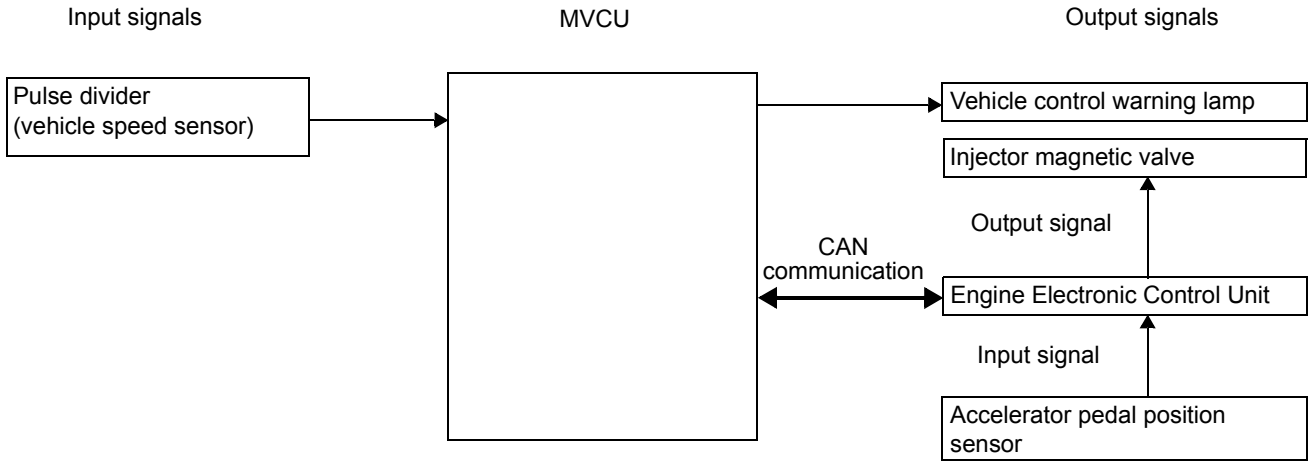
(2) Disengaging the auto cruise control



The condition marked ★ disengages the auto cruise control temporarily.

2.3 Vehicle speed limiting (SLD) function

- This vehicle speed limiting (SLD) function is inactive in the initial setting of MVCU.
- To activate this function, ask your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.

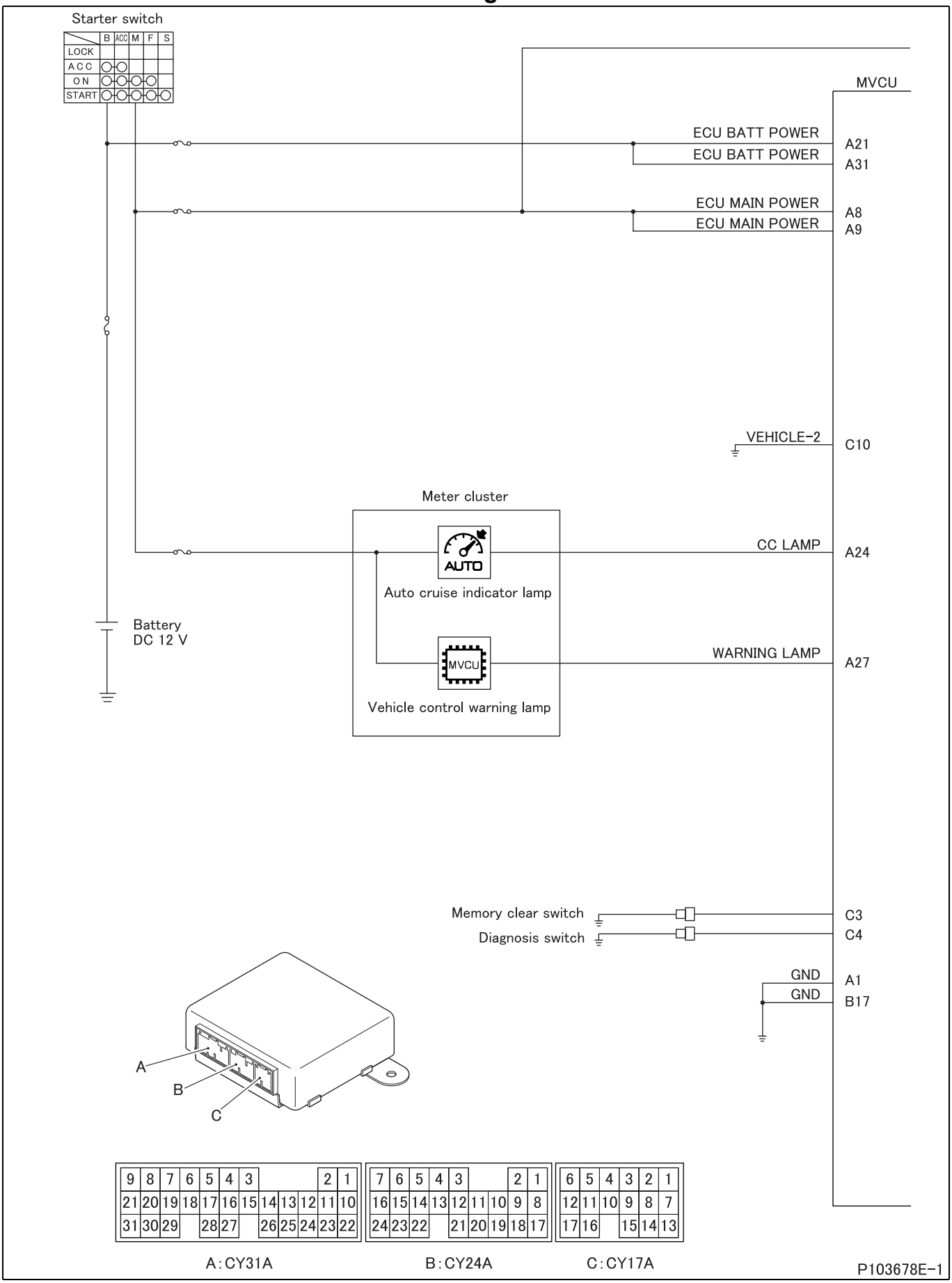


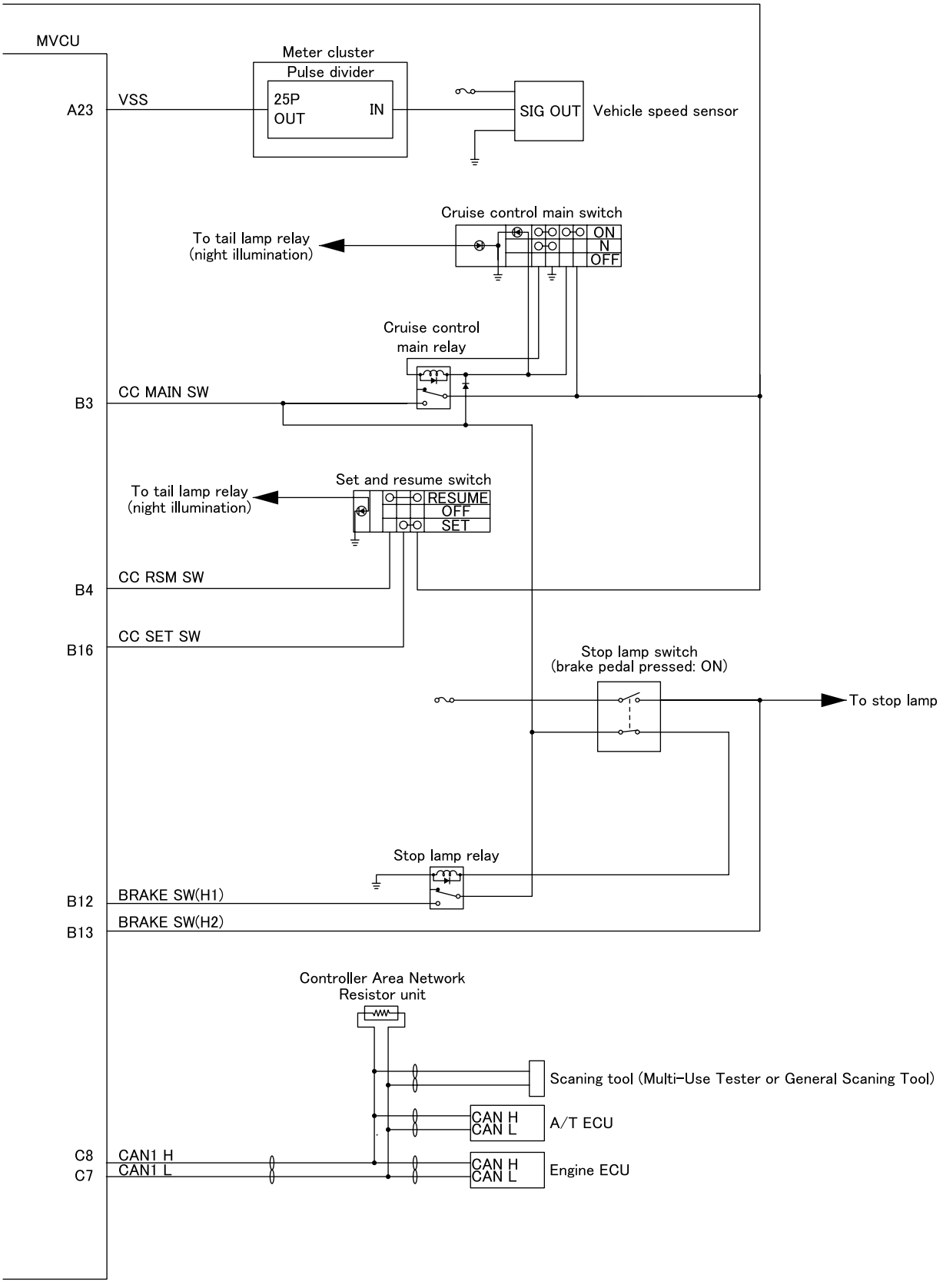
- The vehicle speed limiting (SLD) function is designed to send output signals to the engine ECU to restrict the maximum vehicle speed to a preset speed limit regardless of the accelerator pedal operation when the vehicle speed reaches the speed limit on flat or uphill road.

2.4 Trouble diagnosis function

- The system constantly performs trouble diagnosis to determine if various sensors, etc. malfunction when the starter switch is ON. When a failure is detected, trouble information is indicated on the meter cluster to inform the driver to that effect. At the same time, the location of the trouble is stored in memory as a diagnosis code to start restricted in-trouble control.
- While in trouble, the system's control functions are restricted to ensure safety of the vehicle and its driver. Diagnosis codes stored in memory can be retrieved on the Multi-Use Tester or through blinking warning lamp.
- Diagnosis codes are different in kind between the Multi-Use Tester and blinking warning lamp.

3. Electronic Control Unit Connection Diagram



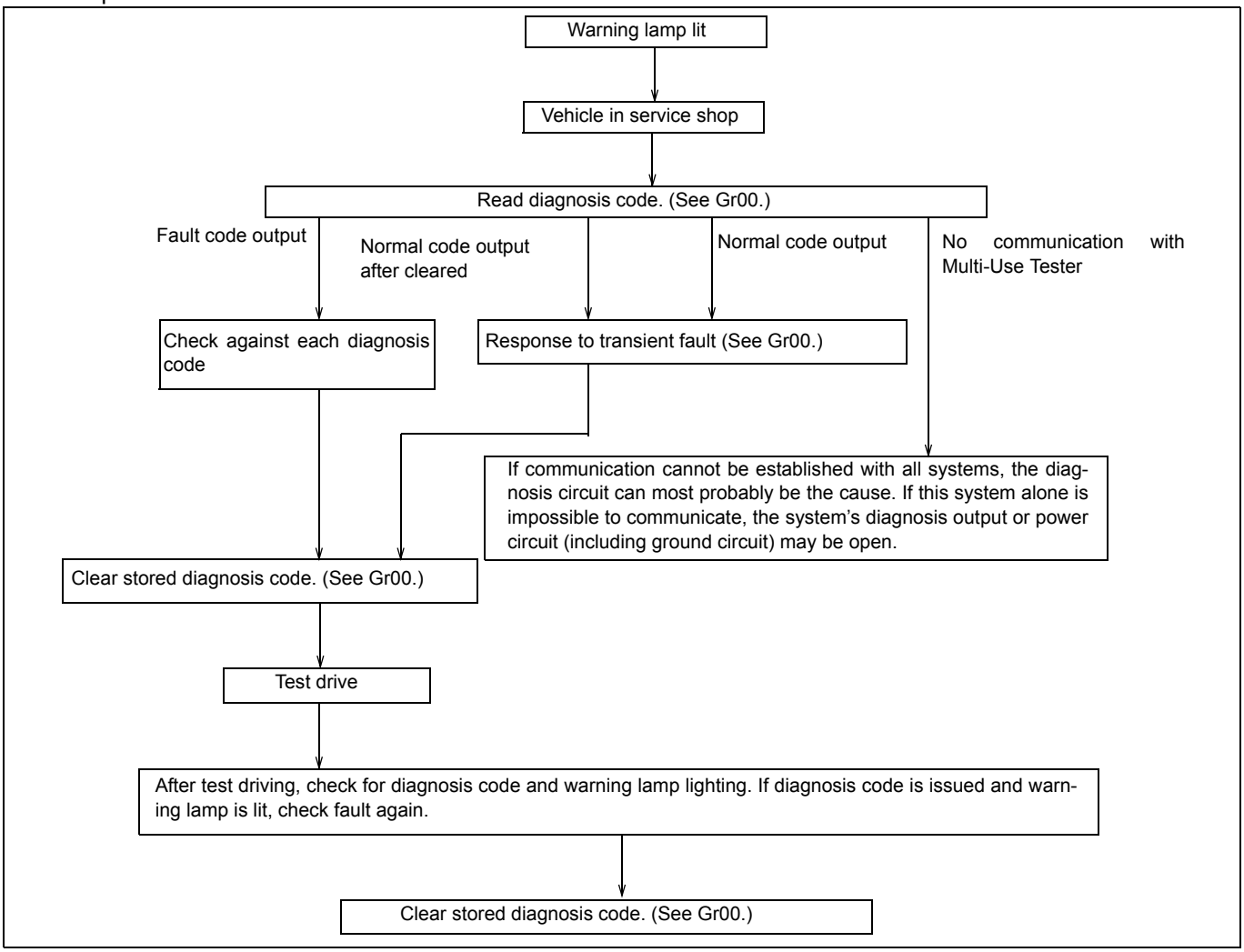

MVCU
Meter cluster
Pulse divider
A23
VSS
25P
OUT
IN
SIG OUT
Vehicle speed sensor
Cruise control main switch
To tail lamp relay
(night illumination)
ON
N
OFF
Cruise control
main relay
B3
CC MAIN SW
Set and resume switch
To tail lamp relay
(night illumination)
RESUME
OFF
SET
B4
CC RSM SW
B16
CC SET SW
Stop lamp switch
(brake pedal pressed: ON)
To stop lamp
Stop lamp relay
B12
BRAKE SW(H1)
B13
BRAKE SW(H2)
Controller Area Network
Resistor unit
Scaning tool (Multi-Use Tester or General Scaning Tool)
CAN H
CAN L
A/T ECU
C8
CAN1 H
C7
CAN1 L
CAN H
CAN L
Engine ECU

P103678E-2

TROUBLESHOOTING

1. Diagnosis Procedure

- The system can be efficiently inspected for faults using a Multi-Use Tester.
  System inspection can be accomplished basically in two ways according to trouble symptom and diagnosis code as shown below.
  - Check against each diagnosis code stored in memory by the electronic control unit
  - Response to transient fault



2. Diagnostic Precautions

- Before measuring voltage, check the battery for charged condition and specific gravity. If system inspection is performed with the battery uncharged or reduced in specific gravity, accurate measurements cannot be achieved.
- To avoid having electrical parts damaged, set the starter switch and lighting switch to LOCK or OFF before disconnecting and reconnecting battery cables.
- Before disconnecting connectors, set the starter switch to LOCK or OFF, then allow at least 20 seconds. Voltage may remain in electric parts or connected circuit.
- When performing measurement with the tester, handle the test bar carefully so that it does not damage internal circuit and other electrical parts of the electronic control unit to result in a short-circuit failure between terminals in connector or between connector and car body.
- Resistance is affected by temperature. Determine the necessity of resistance measurement following given temperature specification as a guide. Otherwise, use normal temperature (10 to 35°C {50 to 95°F}) as the measuring condition.

CAUTION ⚠

- **When replacing the MVCU with a new one, writing of data in the new MVCU is required. (See "Works Required When Replacing the Multifunction Vehicle Control Unit (MVCU)".)**

3. Inspection Based on Diagnosis Codes

3.1 List of diagnosis codes

NOTE

- **Diagnosis codes are different in kind between the Multi-Use Tester and blinking warning lamp.**
- **The Multi-Use Tester issues diagnosis codes that tell more in detail.**

Code	Message	Warning lamp blinking
–	OK	01
P0500	Vehicle Speed Sensor	06
P0504	Brake SW	11
P1002	Battery Voltage	02
P1003	Battery Terminal	03
P1004	Main Voltage	04
P1007	MVCU	07
P1008	Vehicle Identification	08
P1009	Non Coding	09
P1016	Cruise Variation Identify	16
U0100	CAN Communication	05
U1013	Engine ECU Cruise Control	13
U1031	Engine ECU Speed Limiting	31

3.2 Diagnosis code generation conditions and inspection items

P0500: Vehicle Speed Sensor (Warning lamp: 06)

Generation condition		Engine speed at 1000 rpm or higher, clutch pedal released, transmission neutral switch in ON position and the vehicle speed at 0.75 km/h {0.47 MPH} or lower.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Auto cruise control and vehicle speed limiting (SLD) control is suspended. • Occurrence of trouble with vehicle speed limiting function sent through CAN bus.
Inspection	Service data	03: Vehicle Speed
	Electronic control unit connector	01: Vehicle speed sensor
	Electrical equipment	#265: Vehicle speed sensor
	Electric circuit diagram	Vehicle sensor system

P0504: Brake SW (warning lamp: 11)

Generation condition		Stop lamp switch (H1, H2) signals are not identical.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Auto cruise control is suspended. • Vehicle speed limiting (SLD) control is continued.
Inspection	Service data	24: Brake SW 1, 25: Brake SW 2
	Electronic control unit connector	02: Stop lamp switch
	Electrical equipment	#042: Stop lamp switch
	Electric circuit diagram	Stop lamp system

P1002: Battery Voltage (Warning lamp: 02)

Generation condition		MVCU power terminal (direct from battery) voltage is lower than 10 V for approx. 10 seconds.
Control effected by electronic control unit		Auto cruise control and vehicle speed limiting (SLD) control is continued.
Inspection	Service data	01: Power Supply Voltage (BATTERY)
	Electric circuit diagram	Power supply system
	Other	• Battery (See Gr54.) • Alternator (See Gr54.)

P1003: Battery Terminal (Warning lamp: 03)

Generation condition		MVCU power terminal (direct from battery) voltage is lower than 4 V for approx. 5 seconds.
Control effected by electronic control unit		Auto cruise control and vehicle speed limiting (SLD) control is continued.
Inspection	Service data	01: Power Supply Voltage (BATTERY)
	Electric circuit diagram	MVCU connector (CY31A) terminal No. 21 and No. 31 system
	Other	Battery (See Gr54.)

P1004: Main Voltage (Warning lamp: 04)

Generation condition		MVCU power terminal (starter switch ON) voltage is lower than 10 V for approx. 10 seconds.
Control effected by electronic control unit		Auto cruise control and vehicle speed limiting (SLD) control is continued.
Inspection	Service data	02: Power Supply Voltage (MAIN)
	Electric circuit diagram	Starter switch (M terminal) system
	Other	• Battery (See Gr54.) • Alternator (See Gr54.)

P1007: MVCU (Warning lamp: 07)

Generation condition		Faulty CPU (processor) in MVCU
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Auto cruise control and vehicle speed limiting (SLD) control is suspended. • Occurrence of trouble with vehicle speed limiting function sent through CAN bus.
Inspection	Other	Malfunction vehicle control unit proper

P1008: Vehicle Identification (Warning lamp: 08)

Generation condition		Identification start condition continued for predetermined time after starting the vehicle identification but the vehicle identification remained unidentified.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Auto cruise control and vehicle speed limiting (SLD) control is suspended. • Occurrence of trouble with vehicle speed limiting function sent through CAN bus.
Inspection	Service data	13: Cruise Variation Number
	Electric circuit diagram	Write data in MVCU. (Refer to “Works Required When Replacing the Multifunction Vehicle Control Unit (MVCU)”.)

P1009: Non Coding (Warning lamp: 09)

Generation condition		Data has not written in MVCU.
Recoverability		System recovers after writing data in MVCU.
Control effected by electronic control unit		• Auto cruise control and vehicle speed limiting (SLD) control is suspended. • Occurrence of trouble with vehicle speed limiting function sent through CAN bus.
Inspection	Other	Write data in MVCU. (Refer to “Works Required When Replacing the Multifunction Vehicle Control Unit (MVCU)”.)

P1016: Cruise Variation Identify (Warning lamp: 16)

Generation condition		The vehicle identification and auto cruise control do not match.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Auto cruise control is suspended. • Vehicle speed limitting (SLD) control is continued.
Inspection	Service data	13: Cruise Variation Number
	Other	Write data in MVCU. (Refer to “Works Required When Replacing the Multifunction Vehicle Control Unit (MVCU)”.)

U0100: CAN Communication (Warning lamp: 05)

Generation condition		No CAN data is received from the engine electronic control unit for approx. 2 seconds.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Auto cruise control and vehicle speed limiting (SLD) control is suspended. • Occurrence of trouble with vehicle speed limiting function sent through CAN bus.
Inspection	Electrical equipment	CAN communication system

U1013: Engine ECU Cruise Control (Warning lamp: 13)

Generation condition		When either condition is met. ① : The vehicle speeds recognized by Multifunction Vehicle Control Unit (MVCU) and by engine electronic control unit do not match for 2 seconds. ② : Faulty auto cruise control function under the engine electronic control unit is noticed through CAN communication.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Auto cruise control is suspended. • Vehicle speed limitting (SLD) control is continued.
Inspection	Electronic control unit connector	01: Vehicle speed sensor
	Electrical equipment	#265: Vehicle speed sensor
	Electric circuit diagram	Engine electronic control unit and Multifunction Vehicle Control Unit (MVCU) CAN communication system
	Other	Engine electronic control unit

U1031: Engine ECU SPEED Limiting (Warning lamp: 31)

Generation condition		When either condition is met. ① : The vehicle speeds recognized by Multifunction Vehicle Control Unit (MVCU) and by engine electronic control unit do not match for 2 seconds. ② : Faulty vehicle speed limiting function under the engine electronic control unit is noticed through CAN communication.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Auto cruise control is continued. • Vehicle speed limiting (SLD) control is suspended. • Occurrence of trouble with vehicle speed limiting function sent through CAN bus.
Inspection	Electronic control unit connector	01: Vehicle speed sensor
	Electrical equipment	#265: Vehicle speed sensor
	Electric circuit diagram	Engine electronic control unit and Multifunction Vehicle Control Unit (MVCU) CAN communication system
	Other	Engine electronic control unit

4. Multi-Use Tester Service Data

NOTE

- **Both service data and actuator test results are indicated at the same time.**

No.	Item	Data	Inspection condition	Criterion for normality
01	Power Supply Voltage (BATTERY)	■■.■■ V	Starter switch in ON position	8 to 16 V
02	Power Supply Voltage (MAIN)	■■.■■ V	Starter switch in ON position	8 to 16 V
03	Vehicle Speed	■■■■.MPH	When driving	Synchronous with speedometer
04	Vehicle Speed (Engine Electronic Control Unit)	■■■■.MPH	When driving	Synchronous with speedometer
05	Accel Pedal Position	■■■.■ %	Released	0%
			Gradually pressed	Gradually rising
			Fully pressed	100%
06	Engine Speed	■■■■.rpm	Racing (with engine running)	Synchronous with tachometer
07	Engine Variation ID	■■■■.	Starter switch in ON position	200: 4M50T7 205: 4M50T8
08	Cruise Control Set Speed	■■■■.MPH	During auto cruise driving on a flat road	Equal to vehicle speed in auto cruise mode
12	Limit Vehicle Speed	■■■■.MPH	Vehicle speed limiting function activates with the accelerator pedal pressed	Around limit speed
13	Cruise Variation Number	1/2/3/4/5/6/7/8/9/10/11/12/NON	Starter switch in ON position	Recongnized as “2” (with auxiliary brake non-linked cruise function) through the information record feature of MVCU
21	Neutral SW	Neutral/shift	Transmission in neutral	Neutral
			Transmission in other gear than neutral	Shift
24	Brake SW 1	ON/OFF	Brake pedal pressed	ON
			Brake pedal released	OFF
25	Brake SW 2	ON/OFF	Brake pedal pressed	ON
			Brake pedal released	OFF
29	Cruise Main SW	ON/OFF	Cruise control main switch ON	ON
			Cruise control main switch OFF	OFF
30	Cruise Set SW	ON/OFF	Set and resume switch SET	ON
			Set and resume switch OFF	OFF
31	Cruise Resume SW	ON/OFF	Set and resume switch RESUME	ON
			Set and resume switch OFF	OFF
34	Diagnosis SW	ON/OFF	Diagnosis switch ON (fuse connected)	ON
			Diagnosis switch OFF (fuse disconnected)	OFF
35	Memory Clear SW	ON/OFF	Memory clear switch ON (fuse connected)	ON
			Memory clear switch OFF (fuse disconnected)	OFF

No.	Item	Data	Inspection condition	Criterion for normality
41	Cruise Lamp	ON/OFF	Auto cruise mode	ON
			Normal driving	OFF
			[Actuator test] 51: Cruise Lamp ON 52: Cruise Lamp OFF	
43	System Warning Lamp	ON/OFF	Starter switch in ON position (engine not started)	ON for some seconds
			[Actuator test] 55: System Warning Lamp ON 56: System Warning Lamp OFF	

5. Actuator Tests Performed Using Multi-Use Tester

NOTE

- **Both service data and actuator test results are indicated at the same time.**

No.	Item	Description	Check method
51	Cruise Lamp ON	Auto cruise indicator lamp drive signal	Lighting status of auto cruise indicator lamp [Service data] 41: Cruise Lamp
52	Cruise Lamp OFF		
55	System Warning Lamp ON	Vehicle control warning lamp drive signal	Lighting status of vehicle control warning lamp [Service data] 43: System Warning Lamp
56	System Warning Lamp OFF		

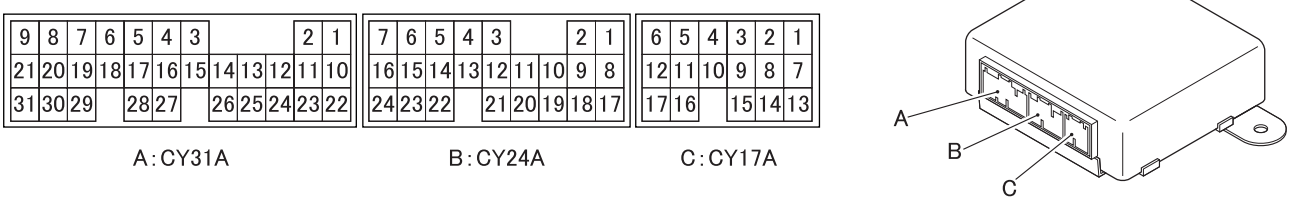
6. Works Required When Replacing the Multifunction Vehicle Control Unit (MVCU)

- When replacing the MVCU with a new one, it is necessary to write the vehicle specification identification data and necessary control parameters for softwares in the new MVCU. Otherwise the system cannot operate correctly, resulting in faulty system.
- For data writing operation, ask your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.

7. Inspections Performed at Electronic Control Unit Connectors

- These inspections aid troubleshooting by enabling you to check whether electronic control unit signals are being correctly transmitted via the vehicle harness and connectors.
  The white-on-black numbers (01, 02 and so on) correspond to the similarly printed reference numbers in section "**3. Inspection Based on Diagnosis Codes**".

7.1 Electronic control unit connector terminal arrangement



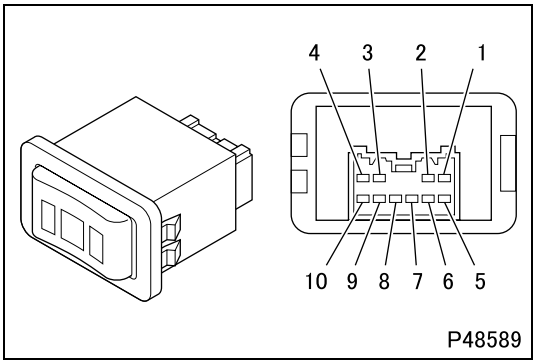
P101774

7.2 Inspection procedure

CAUTION ⚠

- **Depending on check items, checking is performed with connector disconnected or left connected.**
- **Be sure to not touch any other connector terminal than involved in the check. Use extra care so that connector terminals are not shorted by the tester.**

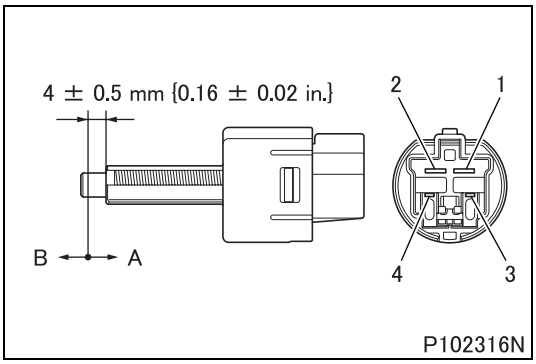
Check item	Check method
01 Vehicle speed sensor signal voltage	[Conditions] • Starter switch is in ON position. • Vehicle-side harness is left connected (checked from behind the connector.) • Wheels are slowly rotated using chassis dynamo or the like. [Criteria] Between terminals (+) - (–): A23-chassis grounding • High pulse voltage: Approx. 8 ± 1 V • Low pulse voltage: 0.5 V or less
02 Stop lamp switch continuity	<Switch (H1)> [Conditions] • Starter switch in ON position. • Cruise control main switch in ON position. • Connector disconnected; check at vehicle-side connector [Criteria] Between terminals: B12-chassis grounding • When brake pedal pressed: Continuity established • When brake pedal released: No continuity <Switch (H2)> [Conditions] • Starter switch in OFF position. • Connector disconnected; check at vehicle-side connector [Criteria] Between terminals: B13-chassis grounding • When brake pedal pressed: Continuity established • When brake pedal released: No continuity



#007 Cruise control main switch inspection

Switch position	Terminal continuity	Operational illumination	Night illumination
ON	1 - 7, 5 - 6	(+) 9 - 3 (–)	(+) 2 - 3 (–)
N (Neutral)	5 - 6	–	
OFF	–	–	

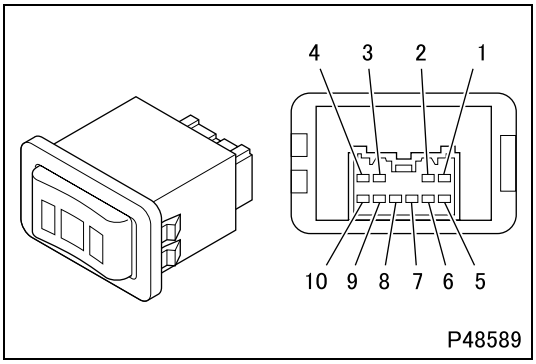
- Replace the switch if found abnormality.



#042 Stop lamp switch

Switch position	Terminal continuity
A	3 - 4
B	1 - 2

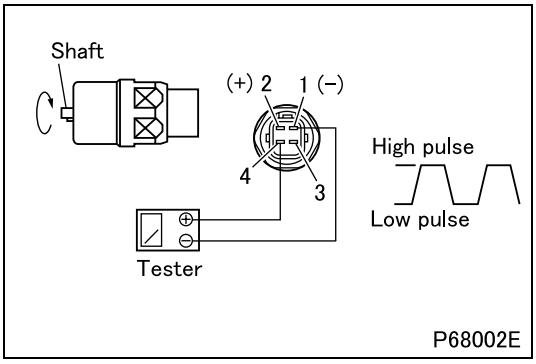
- Replace the switch if found abnormality.



#099 Set and resume switch inspection

Switch position	Terminal continuity	Night illumination
SET	1 - 7	(+) 2 - 3 (–)
N (Neutral)	1 - 8	
RESUME	–	

- Replace the switch if found abnormality.



#265 Vehicle speed sensor inspection

- Slowly rotate the shaft of the vehicle speed sensor with battery voltage applied between terminals 1 and 2 of the sensor.
- Measure maximum voltage (high pulse voltage) and minimum voltage (low pulse voltage) appearing between terminals 1 and 4 of the sensor.

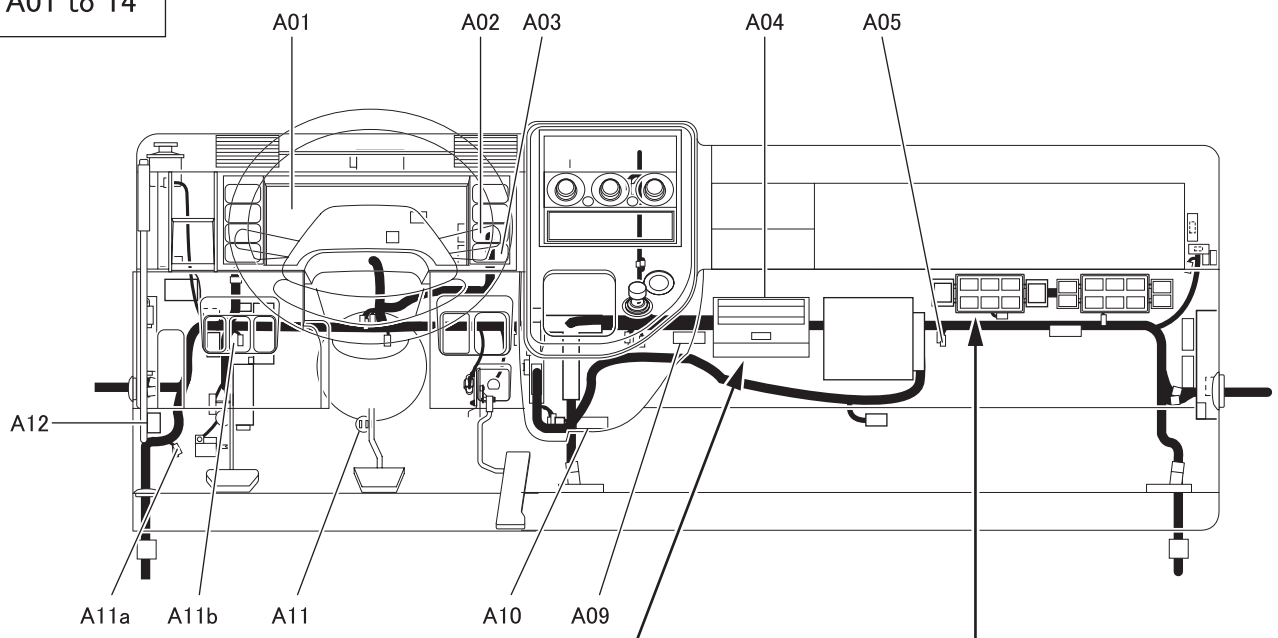
Standard value	Low pulse voltage	0.5 V or less
	High pulse voltage	8 ± 1 V

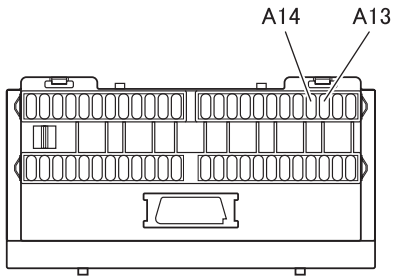
- If the measurements deviate from the specified standard values, replace the sensor.

M E M O

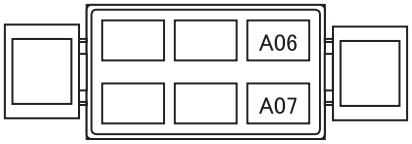
INSTALLED LOCATIONS OF PARTS

A01 to 14

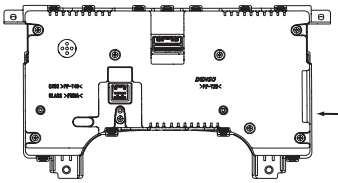


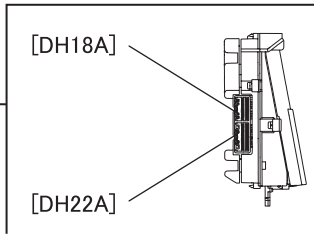


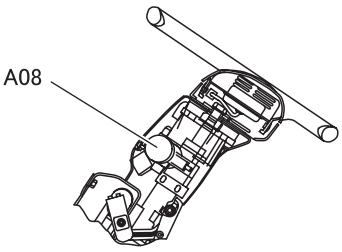
Relay box 1



Meter cluster backward view





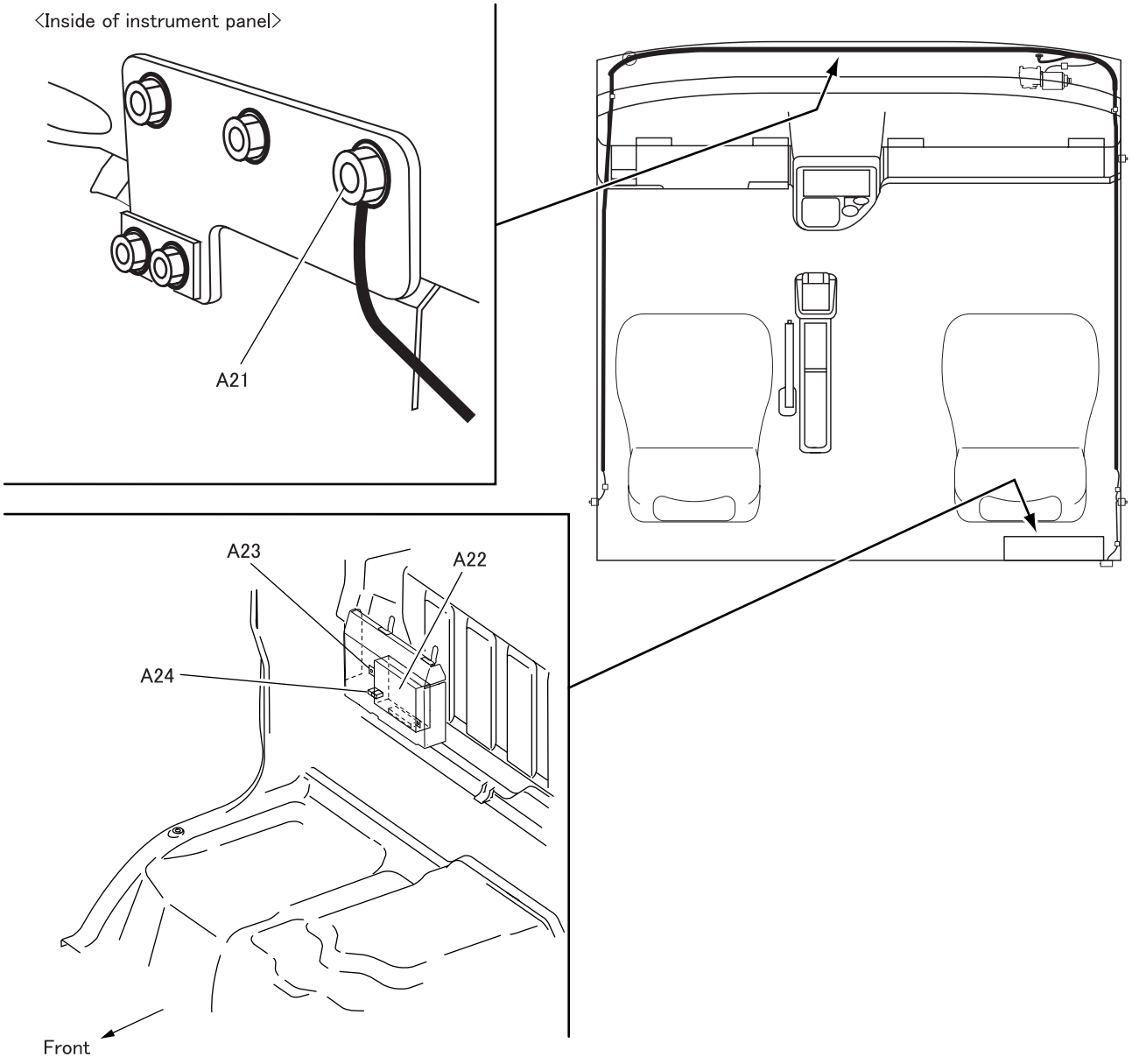


A01 Meter cluster
A02 Cruise control main switch
A03 Set and resume switch
A04 Fuse box
A05 Diode
A06 Stop lamp relay
A07 Cruise control main relay
A08 Starter switch
A09 Joint connector (J/C-1)
A10 Joint connector (J/C-M1)
A11 Stop lamp switch
A11a Joint connector(J/C-040)
A11b Joint connector(J/C-040)<A/T>
A12 Multi-Use Tester connector
A13 Memory clear switch
A14 Diagnosis switch

A/T : Automatic transmission
J/C : Joint connector
Indicate by connector type [ ].

L02377

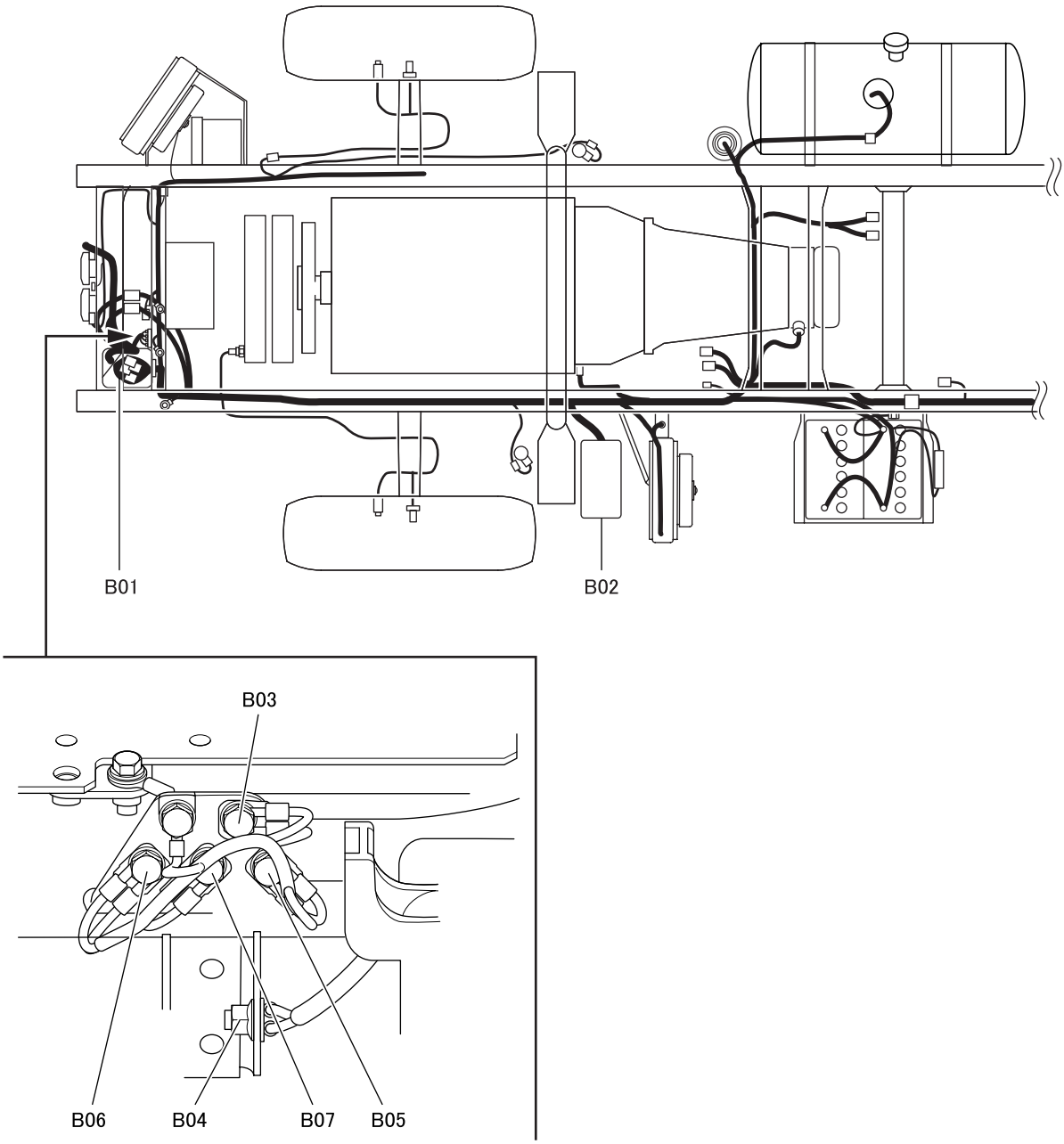
A21 to 24



A21 Ground
A22 MVCU
A23 Ground
A24 Resistor unit

MVCU : Multifunction vehicle control unit

B01 to 07

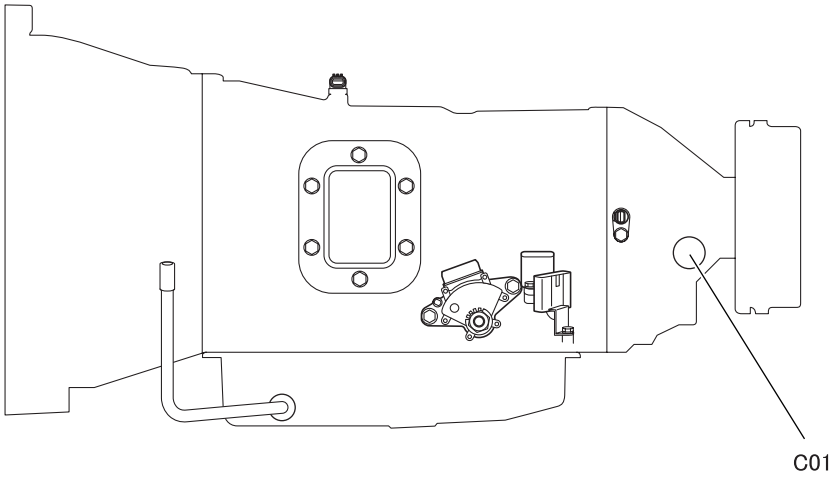


B01 Connection of chassis harness and cab harness
B02 High-current fuse box
B03 Ground
B04 Ground
B05 Ground
B06 Ground
B07 Ground

L02379

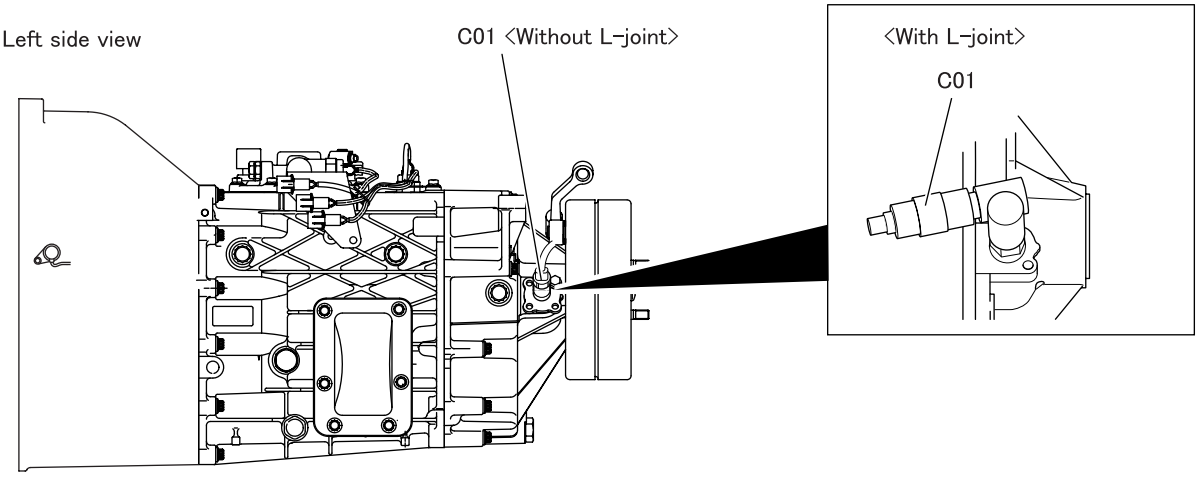
C01 <Automatic transmission>

Left side view



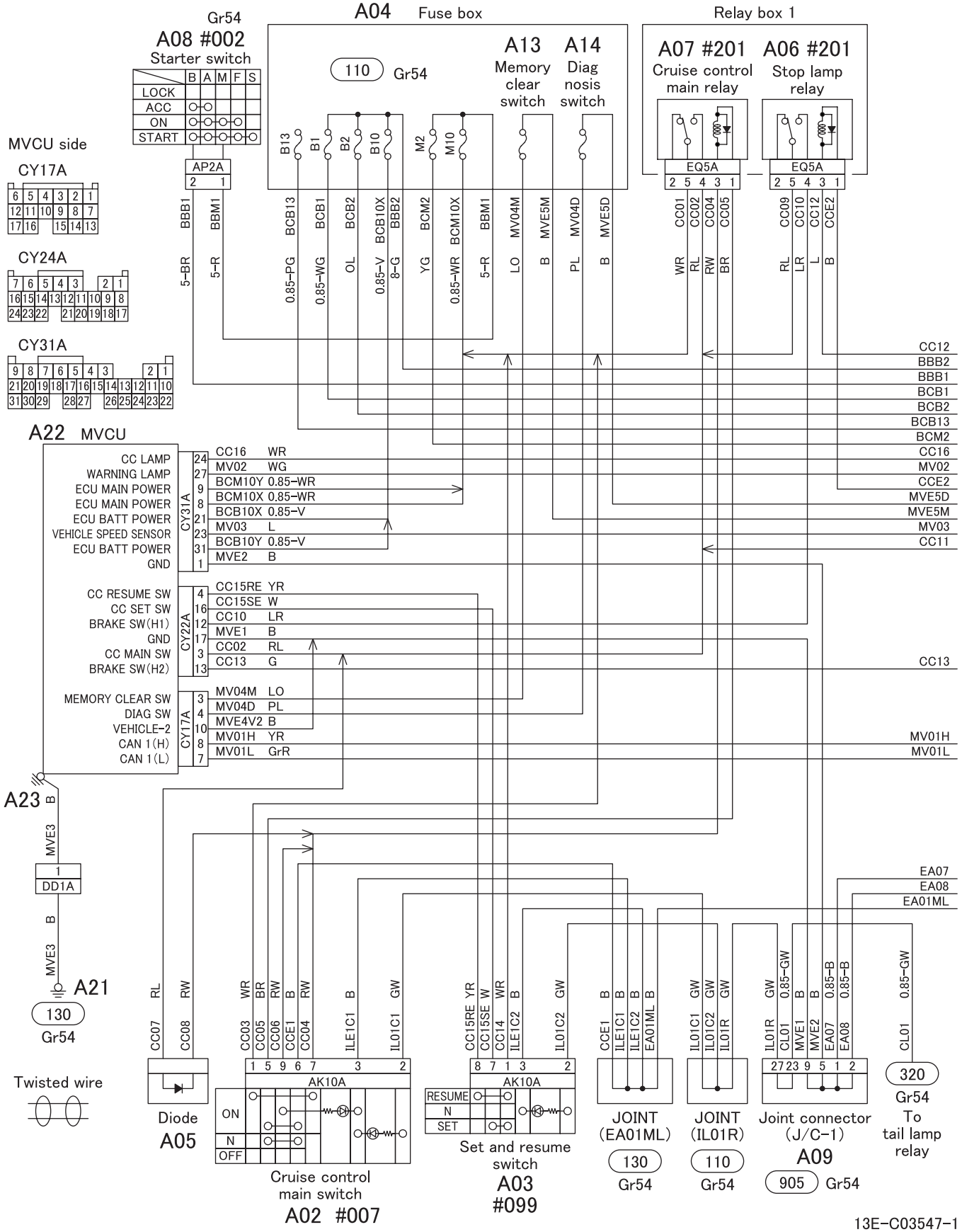
<Manual transmission>

Left side view

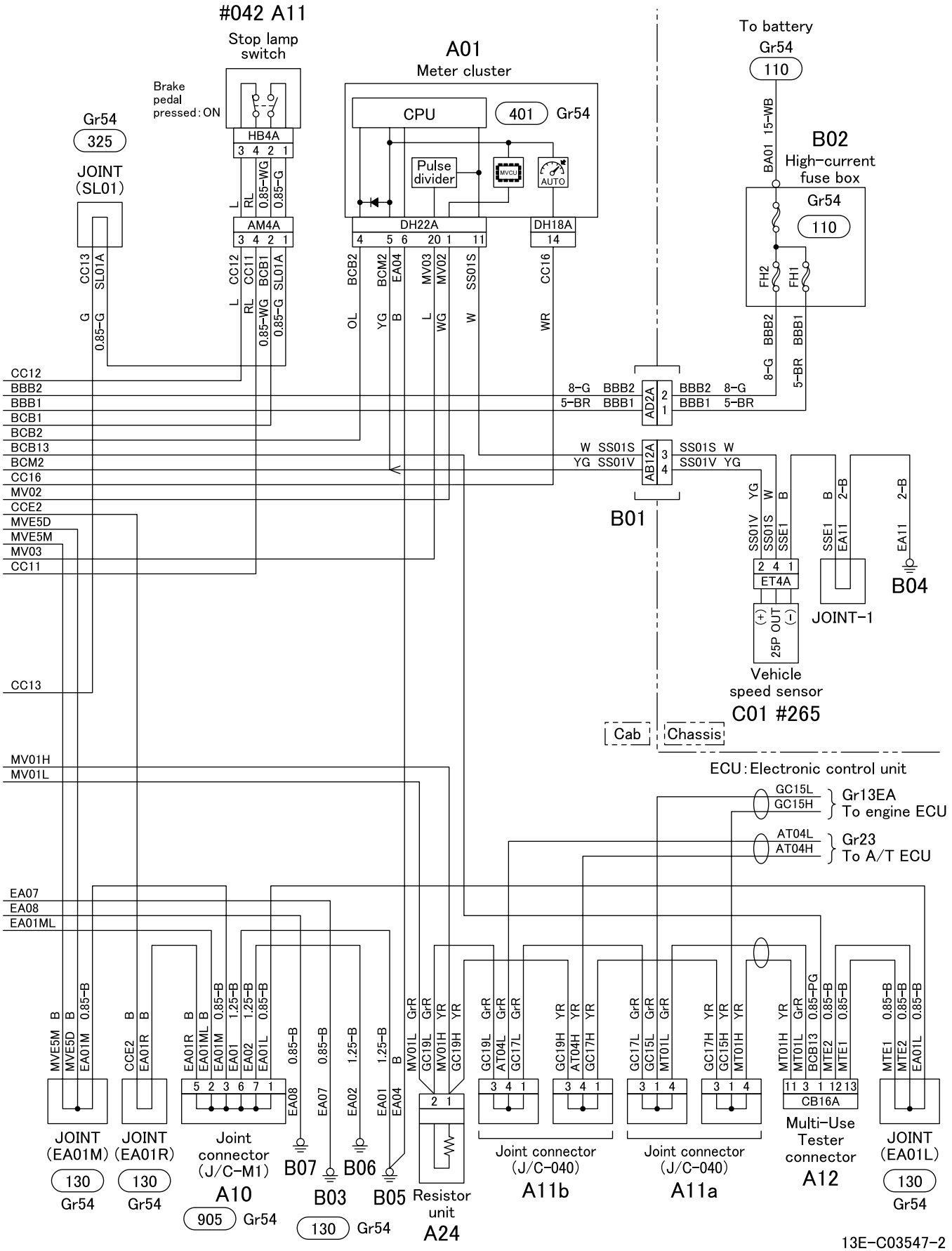


C01 Vehicle speed sensor

ELECTRIC CIRCUIT DIAGRAM



13E-C03547-1


#042 A11
Stop lamp switch
Brake pedal pressed: ON
HB4A
3 4 2 1
Gr54
325
JOINT (SL01)
AM4A
3 4 2 1
A01
Meter cluster
CPU
401
Gr54
Pulse divider
MVCU
AUTO
DH22A
4 5 6 20 1 11
DH18A
14
To battery
Gr54
110
B02
High-current fuse box
Gr54
110
FH2
FH1
BA01 15-WB
BBB2
BBB1
8-G
5-BR
AD2A
AB12A
B01
ET4A
JOINT-1
B04
Vehicle speed sensor
C01 #265
Cab
Chassis
ECU: Electronic control unit
GC15L
GC15H
Gr13EA
To engine ECU
AT04L
AT04H
Gr23
To A/T ECU
CC12
BBB2
BBB1
BCB1
BCB2
BCB13
BCM2
CC16
MV02
CCE2
MVE5D
MVE5M
MV03
CC11
CC13
MV01H
MV01L
EA07
EA08
EA01ML
JOINT (EA01M)
JOINT (EA01R)
Joint connector (J/C-M1)
A10
905
Gr54
B07
B03
B06
B05
130
Gr54
Resistor unit
A24
Joint connector (J/C-040)
A11b
Joint connector (J/C-040)
A11a
CB16A
Multi-Use Tester connector
A12
JOINT (EA01L)
130
Gr54

13E-C03547-2

Operation Manual

Pub. No. TMAE0703R (Revised), OCTOBER 2007

ECU Field Rewriting

FUSO

ECU Field Rewriting Operation Manual

FORWARD

This operation manual is published for the information and guidance for ECU's field rewriting.
We earnestly look forward to seeing that this manual is made full use of in order to perform correct ECU's field rewriting.

OCTOBER 2007

INDEX

1. APPLICABLE ECU AND SERVICE WORKS
2. GENERAL DESCRIPTION OF WORK
3. PREPARATION
4. DATA SERVER OPERATION
5. MUT-III OPERATION

©2007 Mitsubishi Fuso Truck & Bus Corporation

1. APPLICABLE ECU AND SERVICE WORKS

◆ Applicable ECUs and Service Works ····· 1-1

APPLICABLE ECU AND SERVICE WORKS

Some pieces of information such as vehicle ID and equipment specifications are stored in an onboard ECU after being converted into encrypted coding data. In the earlier models, those sets of coding data have been loaded into the spare ECUs. In the later models, you should load those sets of coding data into ECUs in the field. Loading the coding data is referred to as “ECU Field Rewriting”.
The applicable ECUs for which data should be rewritten and each service work for that operation are shown below:

1. Applicable ECUs and Service Works

ECUs that require “ECU Field Rewriting” and their coding are summarized in the following tables for each country.

● For U.S.A.

Models marked with a circle indicate applicable ECUs.

ECU / Vehicle model	Engine ECU (engine control)	MVCU (vehicle combined control unit)
EPA07 CANTER	○	○
EPA07 FK/FM	○	○

Works marked with a circle indicate that the applicable data rewriting is required during the works.

ECU / Coding data / Work item	Engine ECU						MVCU
	VIN code	Injector correction data	Injection quantity correction data	Air flow sensor characteristics data	PTO idle rpm data	Ash accumulation volume data	SLD limited speed data
Replacement of ECU	○	○	○	○	○	○	
Replacement of injector		○					
Change of PTO idle rpm					○		
Replacement of MVCU							○
Change of SLD setting							○

APPLICABLE ECU AND SERVICE WORKS

● For Singapore

Model	ECU	Field rewriting Required: ○ Not required: ×	Coding data		Remarks
			When ECU replacement	When Injector replacement	
FP.FV.FS (Euro4)	6M7	○	(1), (2)	—	(1) Air flow sensor code (2) Air M/V control code (3) SLD code (4) Powertard control code (5) Injector correction code (6) Q-Adjustment (7) Cruise control code
	MVCU	○	(3), (4)	—	
CANTER (Euro4)	4M4	×	—	—	
FK.FM (Euro4)	6M6	○	(1), (5), (6)	(5)	
	MVCU	○	(3)	—	

● For Hong Kong

Model	ECU	Field rewriting Required: ○ Not required: ×	Coding data		Remarks
			When ECU replacement	When Injector replacement	
FP.FV.FS (JP05)	6M7	○	(1), (2)	—	(1) Air flow sensor code (2) Air M/V control code (3) SLD code (4) Powertard control code (5) Injector correction code (6) Q-Adjustment (7) Cruise control code
	MVCU	○	(4), (7)	—	
CANTER (Euro4)	4M5	×	*1	—	
ROSA (JP05)	4M5	×	—	—	
FK.FM (JP05)	6M6	○	(1), (5), (6)	(5)	
	MVCU	○	(7)	—	

Remarks (*1) :
As for CANTER EURO-4 for Hong Kong, “VIN writing” only is required when Engine ECU is replaced with new one.
Therefore, downloading/uploading is not required.
Please see the Shop Manual for the details.

● For Australia / New Zealand

Model	ECU	Field rewriting Required: ○ Not required: ×	Coding data		Remarks
			When ECU replacement	When Injector replacement	
FP.FV.FS (EPA04)	6M7	×	—	—	(1) Air flow sensor code (2) Air M/V control code (3) SLD code (4) Powertard control code (5) Injector correction code (6) Q-Adjustment (7) Cruise control code
	MVCU	○	(3), (4), (7)	—	
CANTER (EPA04)	4M5	×	—	—	
ROSA (EPA04)	4M5	×	—	—	
FK.FM.FN (EPA04)	6M6	×	—	—	
	MVCU	○	(3), (7)	—	

For details of the rewriting procedure, see Section 5 “MUT-III OPERATION”.

2. GENERAL DESCRIPTION OF WORK

◆ **General Description of Work** ····· **2-1**

General Description of Work

This section describes the procedure for ECU field rewriting. First you need to obtain the required ECU data, password, and reference number from the Data Server. This operation is referred to as downloading. The downloaded data should be stored on a removal disk such as USB memory and then loaded into ECU via MUT-III. This operation is referred to as ECU field rewriting. Finally, you should load the data in ECU onto the Data Server. This operation is referred to as uploading. ECU field rewriting ends with uploading. Note that you may not perform the next ECU field rewriting if you fail to perform uploading the data.

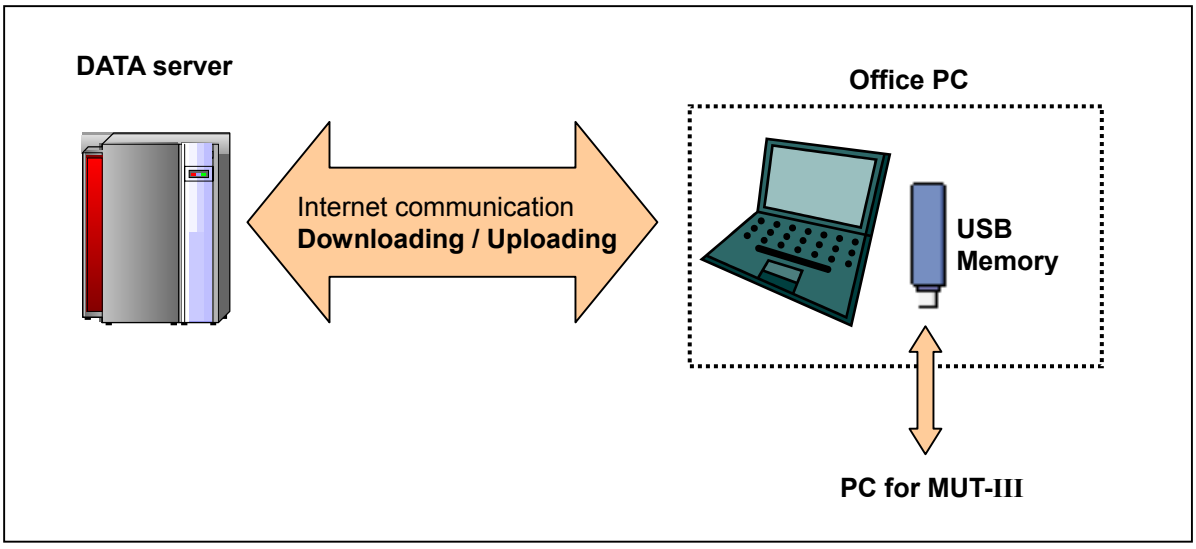
At Office (See Section 4 “DATA SERVER OPERATION”.)

●Downloading

Internet-connected PC
(1) Insert a USB memory stick into a slot of the PC.
(2) Run Internet Explorer and access the Data Server login window.
(3) Log into the Data Server.
(4) Select the chassis number, ECU type, and item for ECU to be rewritten.
(5) Download ECU data and store it in the USB memory.
(6) Make the note of “Reference number” and “Password” or print the window as it is for the ECU rewriting.
(7) Remove the USB memory from the slot of PC.

●Uploading

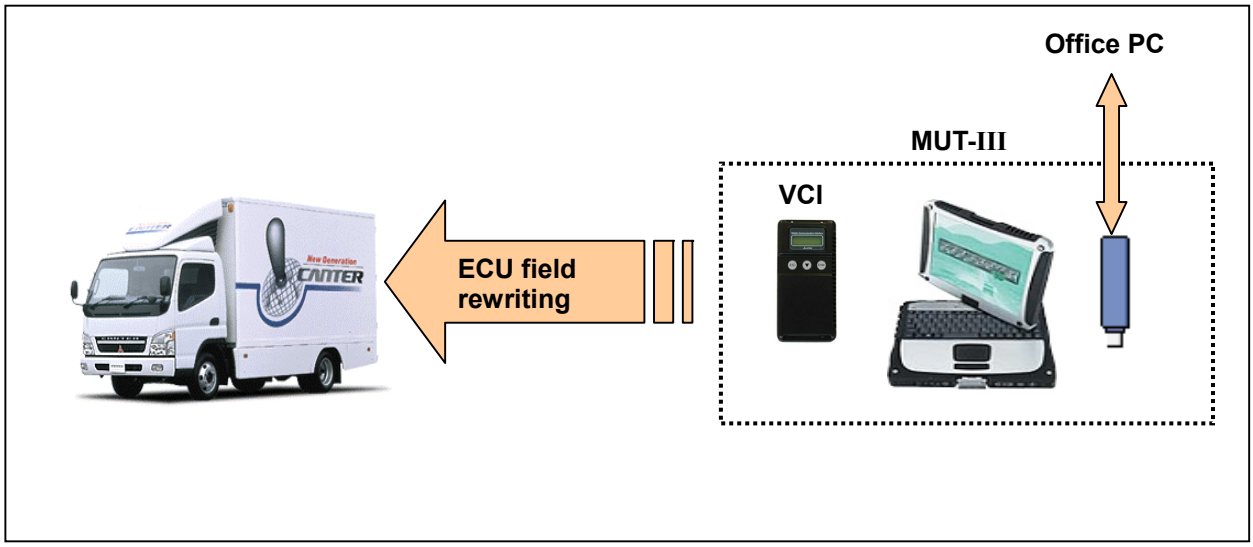
Internet-connected PC
(1) Insert a USB memory stick into a slot of the PC.
(2) Run Internet Explorer and access the Data Server login window.
(3) Log into the Data Server.
(4) Select “History upload” option and then select the required file in the USB memory.
(5) Wait a few seconds until the transmission to the Data Server ends.
(6) The data uploaded to the Data Server is shown on the PC screen. Check the data and select the OK button to complete “History upload”.
(7) Log out the Data Server.
(8) Remove the USB memory from the PC slot.



At Workshop (See Section 5 “MUT-III OPERATION”.)

●ECU rewriting

Use the MUT-III.
(1) Insert a USB memory stick into a slot of the PC for MUT-III and boot up the PC.
(2) Copy data in the USB memory to the PC.
(3) Select “Coding Menu” for rewriting.
(4) Enter the “Password” and “Reference number” transferred from the Data Server window.
(5) Select the rewrite mode (Manual or Automatic).
(6) Enter a work note in the “Memo” field as required.
(7) Check the rewrite data and start rewriting if it is acknowledged, and wait until the rewriting is complete.
(8) Check the “Writing Result” and select the OK button if it is acceptable to end the rewriting.
(9) Shut down the PC for the MUT-III and remove the USB memory from the slot.



3. PREPARATION

◆ **Devices** ····· **3-1**

◆ **License** ····· **3-1**

PREPARATION

To perform ECU rewriting, you need to prepare devices and obtain the right to access the Data Server.

1. Devices

No.	Item	Explanation
1	MUT-III hardware	The following hardware devices are required. These hardware devices are the same as those required for the MUT-III diagnostic tester. • PC for MUT-III • VCI (MH062927) • USB cable (MH063668) • Harness E (MH063661)
2	MUT-III software	The software version FMS-E07-1 or above is required.
3	Removable disc (USB memory etc)	It's required for transmitting the ECU data between PC for MUT-III and PC accessible to the Internet. The folder "CodingData_EOL" should be created in USB memory before loading data.
4	PC accessible to the Internet	It's required for download and upload to Data server. The Internet Explorer, version 5.5 or above, is required. The Antivirus software is recommended.

2. License

To "prevent unauthorized modification" and "secure correct operation", users need to be registered and obtain user IDs and initial passwords in advance to access the Data Server.

(1) Registering a user ID

Each user needs to notify the following information to MFTBC via the distributor. In a few days, the user will be registered and the user ID and initial password will be informed to the user via the distributor.

1) User name
2) Email address
3) Company name
4) VCI serial number used

(2) Password management

a) At initial logon

At initial logon, the user needs to change the password. The user cannot access the Data Server until he/she changes the initial password.

b) Changing the password

The following rules should be observed to change the password:

- Use alphanumeric characters (case sensitive) and/or symbols.
- Use at least six characters.
- Use at least one uppercase letter, at least one lowercase letter, and at least one digit.

c) Password expiration date
A password is expired 30 days after the change of the password. You should change the current password after the expiration date of 30 days.

d) If you forget your password
You have to notify MFTBC via the distributor to reset your password.

(3) Management of user ID

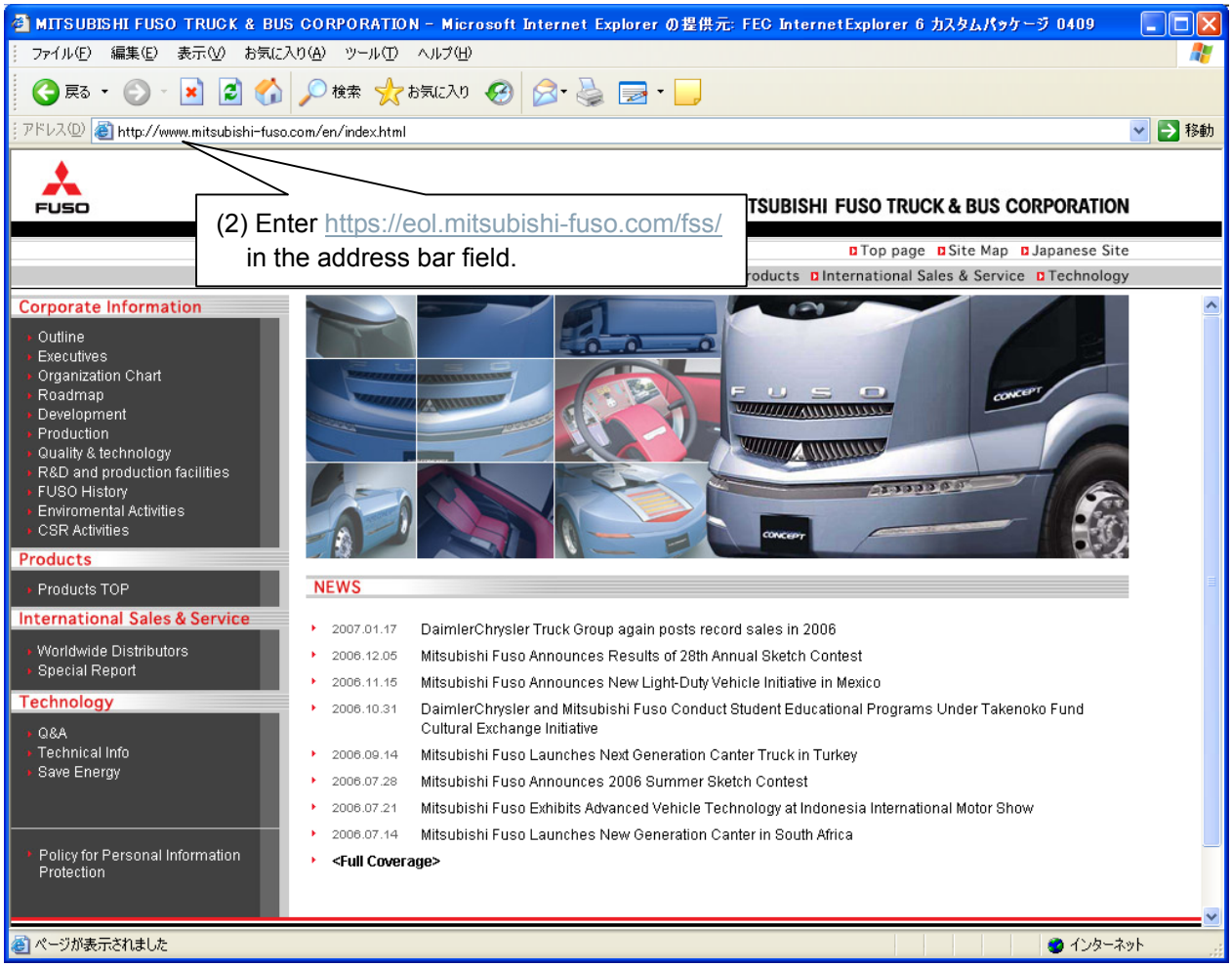
Please notify unnecessary user ID (which is no longer used) to MFTBC via the distributor without delay.

4. DATA SERVER OPERATION

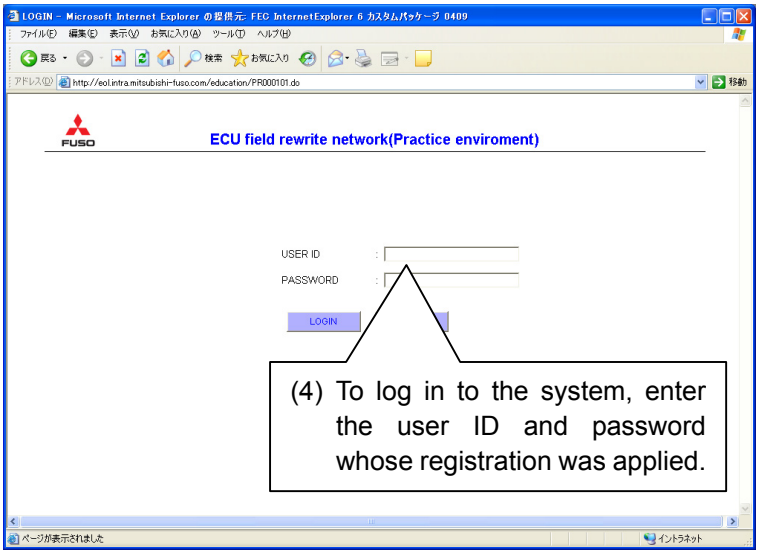
- Access to Data Server ····· 4-1
- Rewriting Data Request (Download) ····· 4-5
- Registering ECU Data (Upload) ····· 4-10
- Quitting Rewriting ····· 4-14
- Rewriting History Search ····· 4-18
- Preparatory Works for Engine Replacement ····· 4-22

Access to Data Server

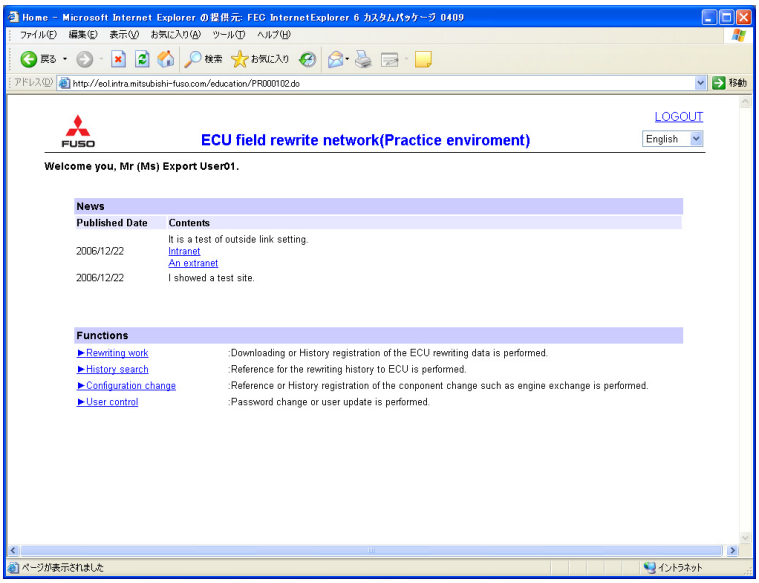
(1) Run the Web browser.



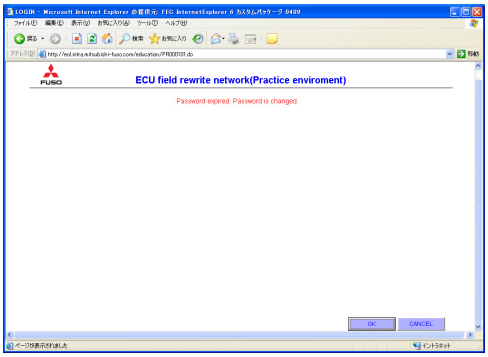
(3) The login page to the system is displayed.

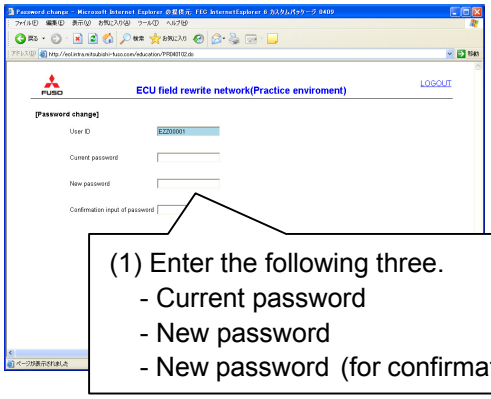


(5) The system top page is displayed, the preparation for the work completed.

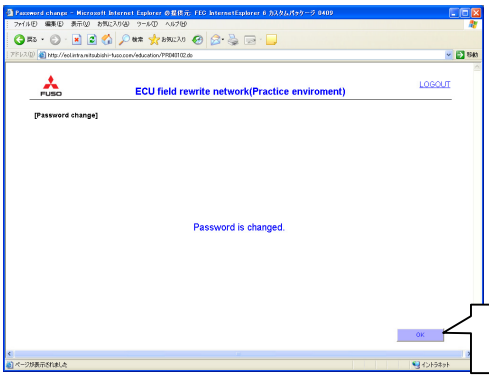


- At the time of the first login or when 30 or more days have passed after password change



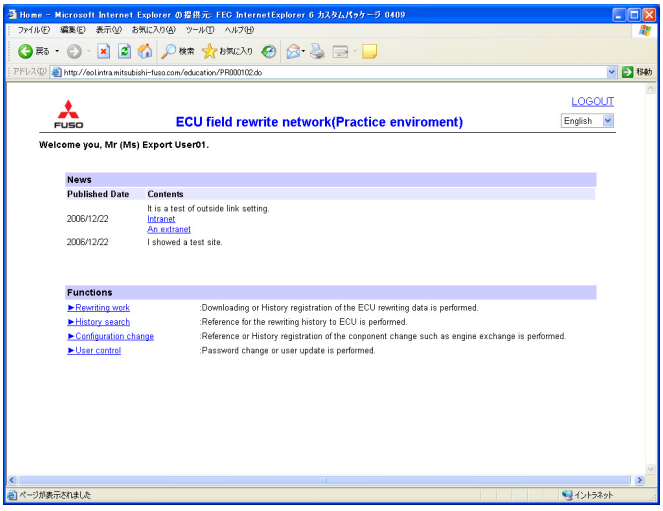


(1) Enter the following three.
- Current password
- New password
- New password (for confirmation)



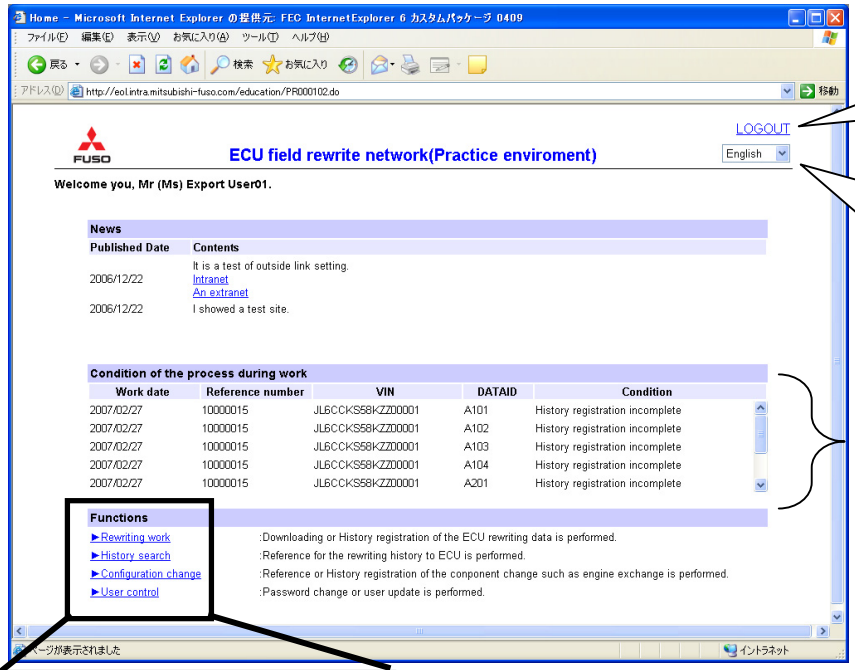
(2) Select OK.

(3) The system top page is displayed.



Important: Notes on password change
When a password is to be changed, set it following the following rules.
- Half-size alphanumeric characters (case-sensitive) can be used.
- Set at least six characters.
- Use one or more upper-case alphabets, one or more lower-case alphabets, and one or more numbers.
- Change to the same password as the current one is invalid.

Window: Top page



Delete login information and display login page.

Japanese-language and English-language window displays can be selected. (The functions are the same.)

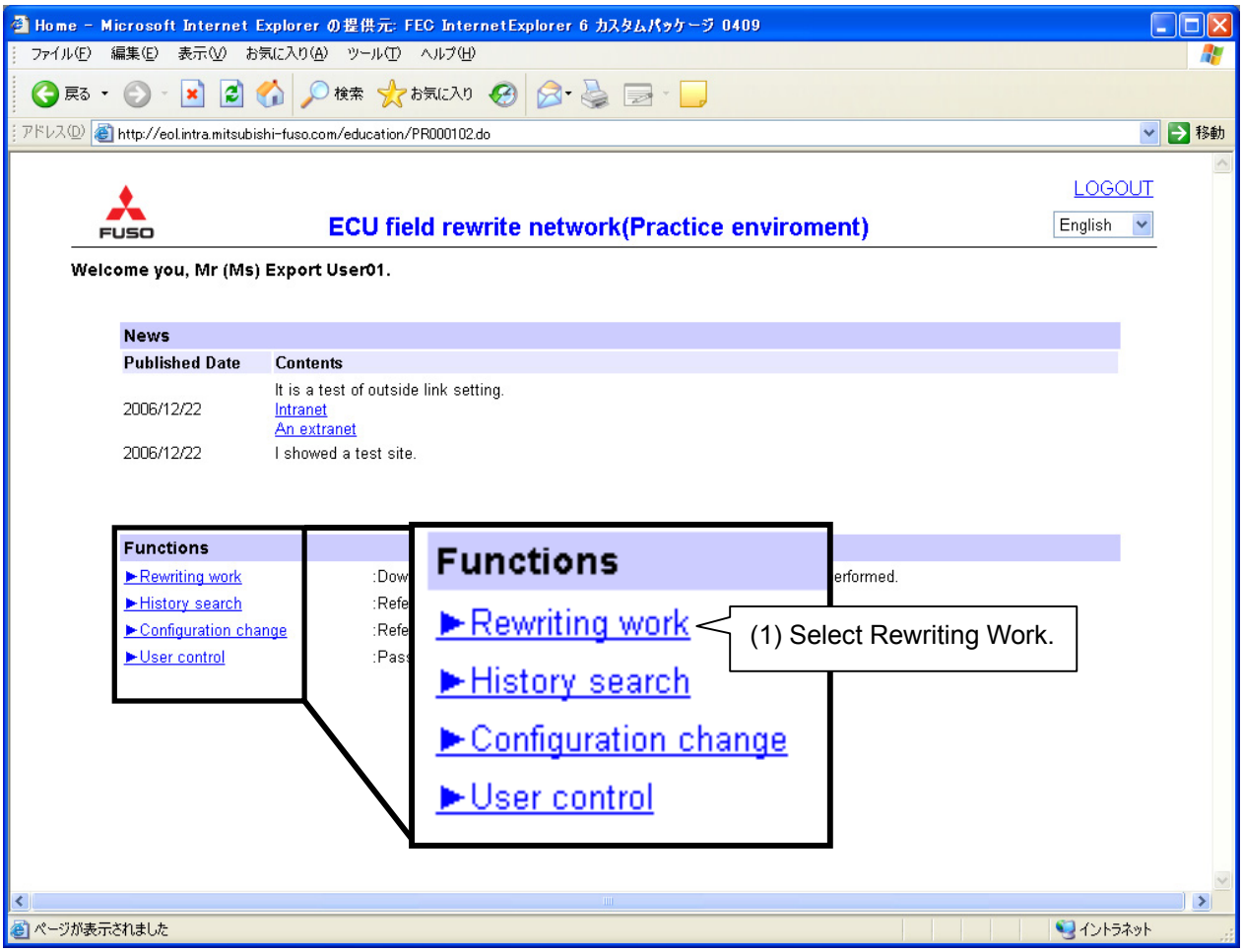
List of works in progress is displayed.
(Items whose history registration is completed are no longer displayed.)

Functions

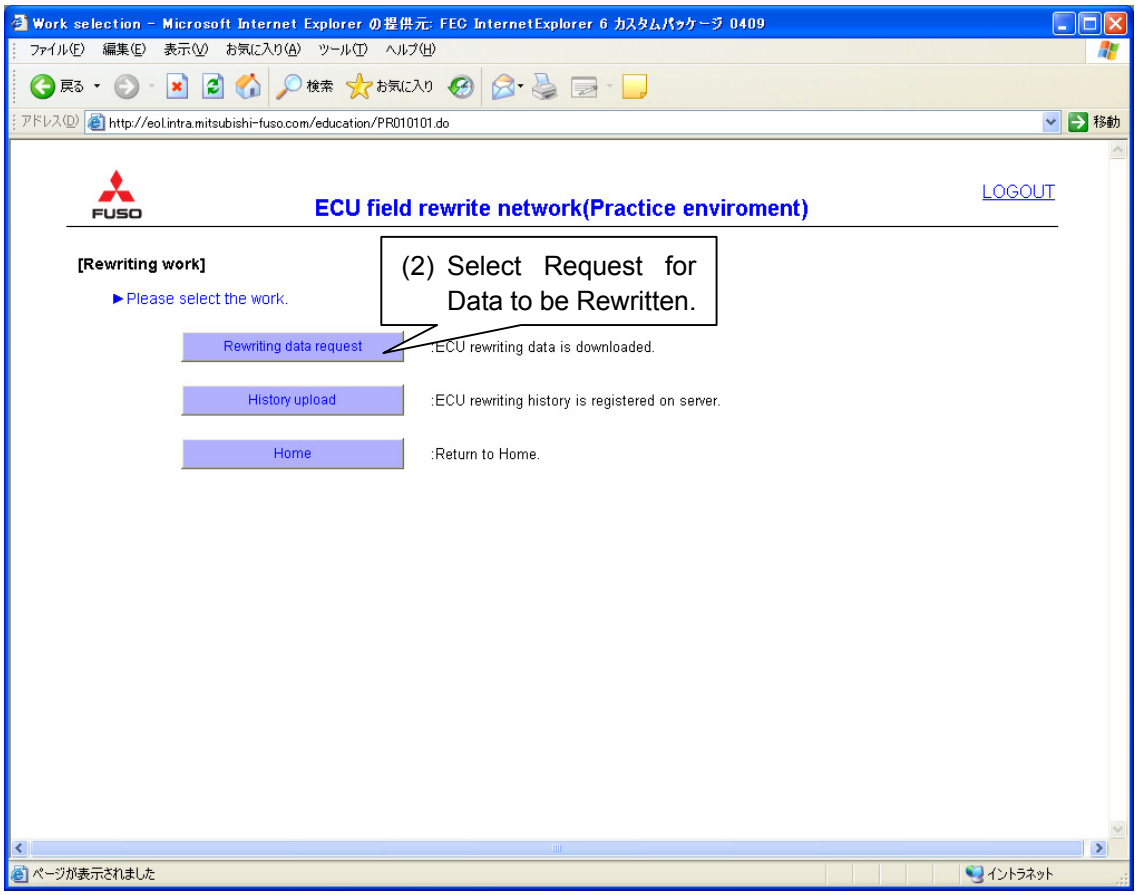
►Rewriting work	Makes it possible to download and history-register written data.
►History search	Makes it possible to view the history of vehicle rewriting.
►Configuration change	Makes it possible to change engines during engine modification and to register link engine data.
►User control	Makes it possible to change passwords.

Rewriting Data Request (Download)

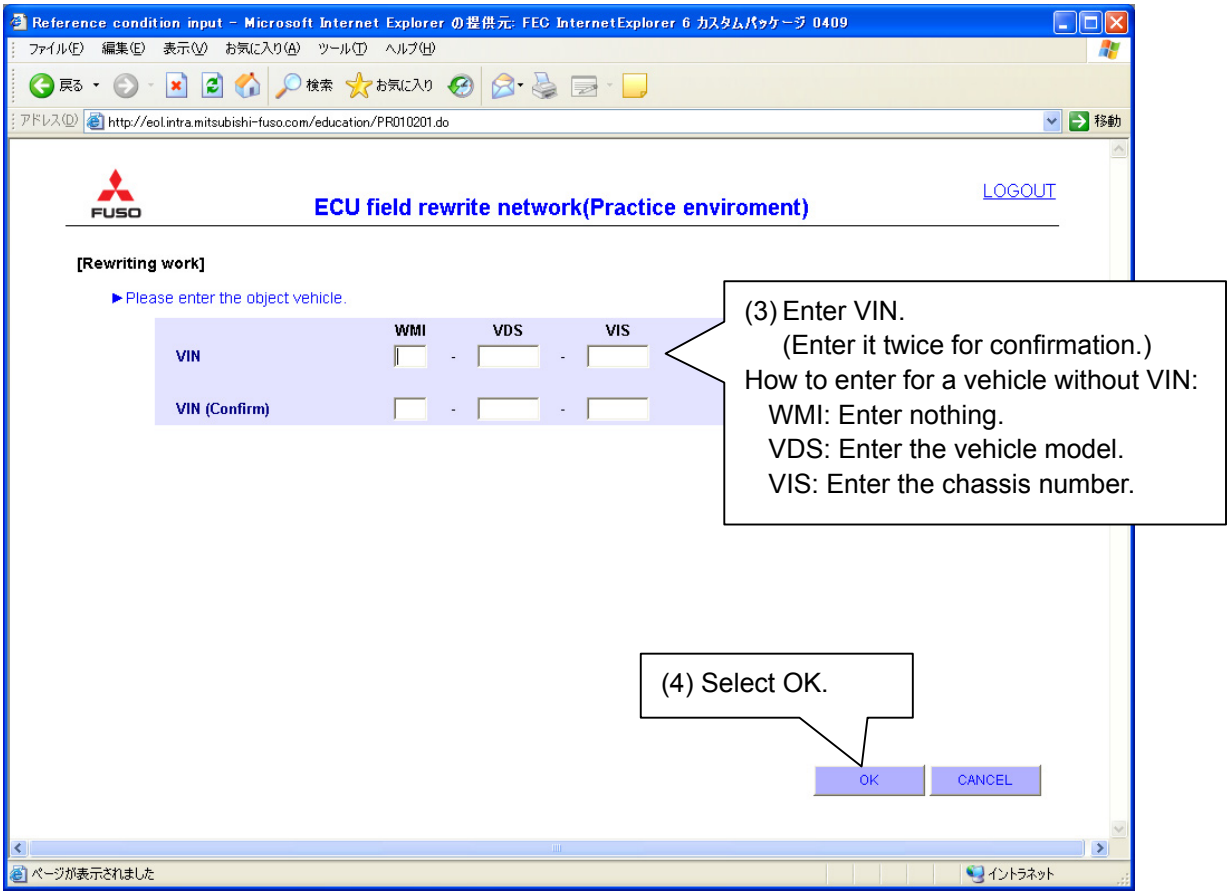
Window: Top page



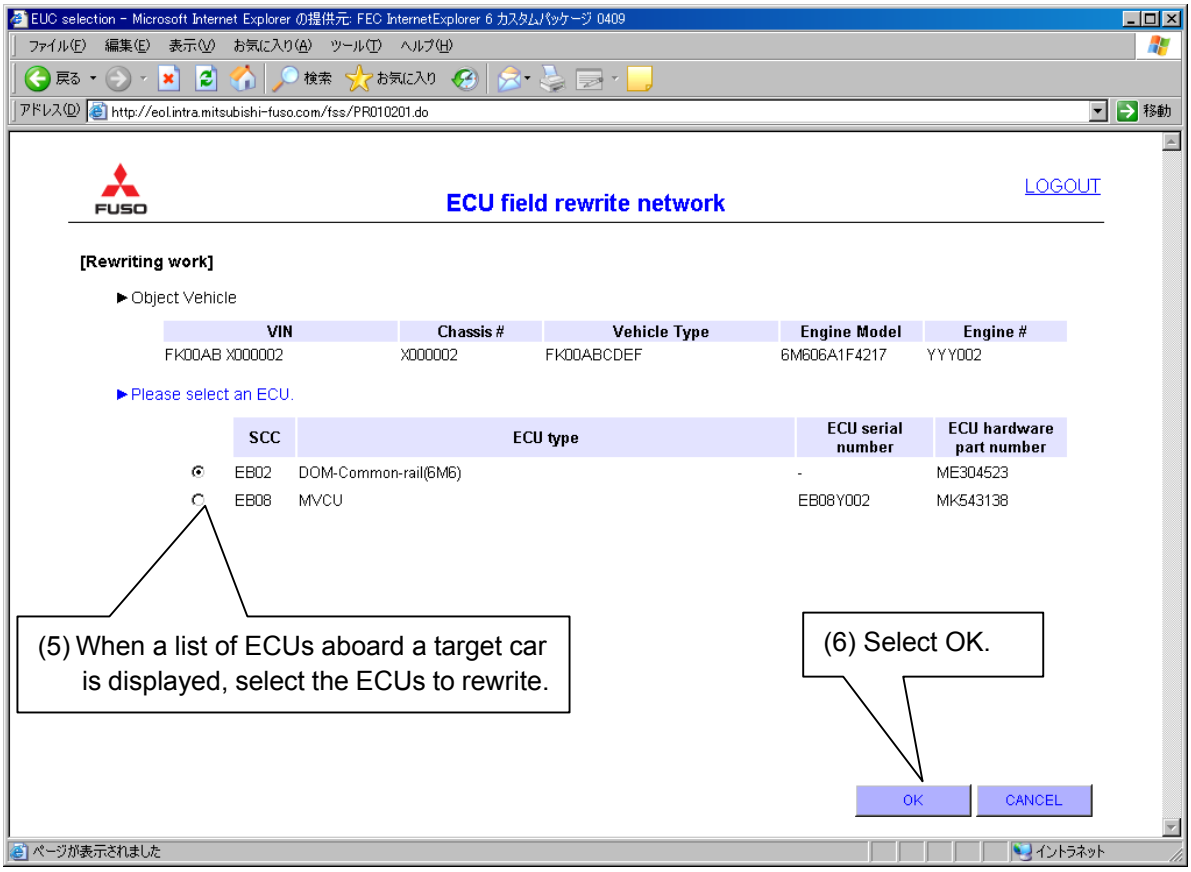
Window: Selecting rewriting work



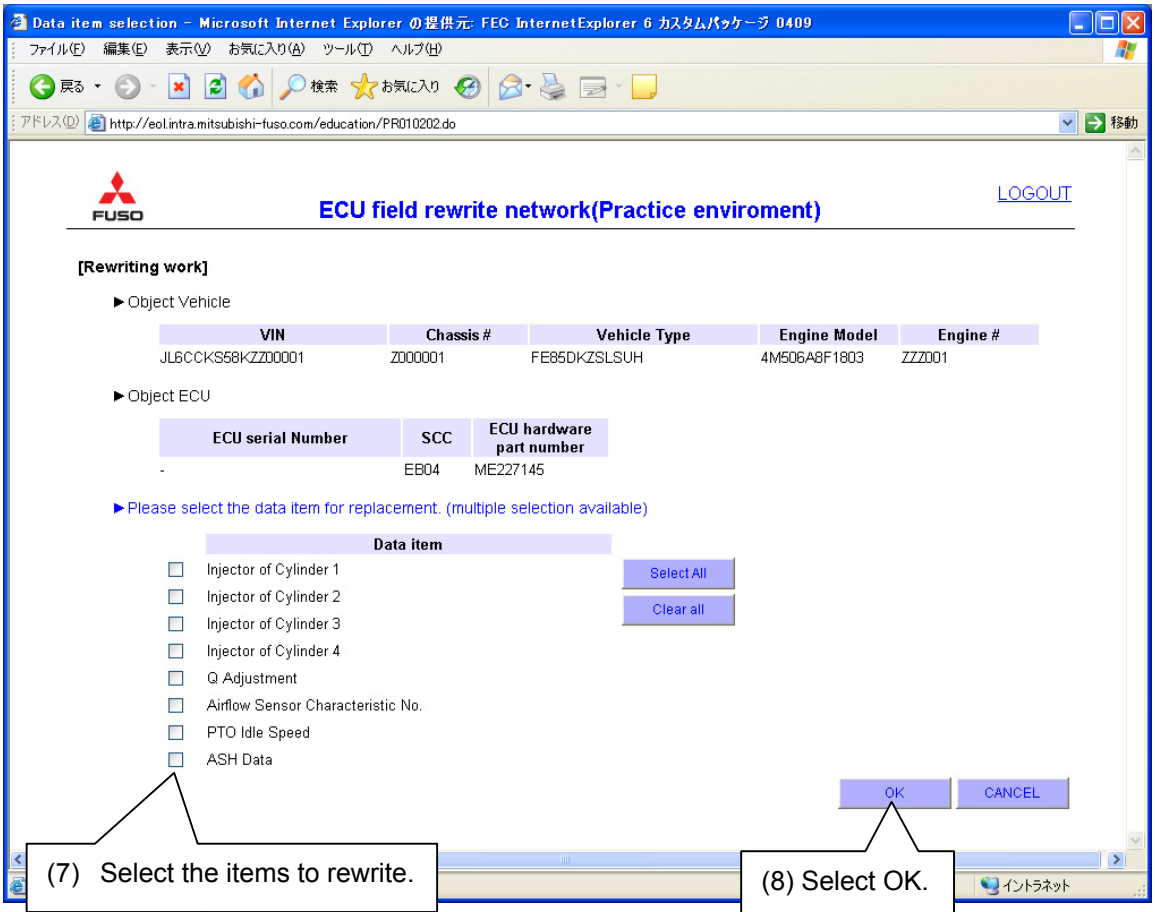
Window: Vehicle selection



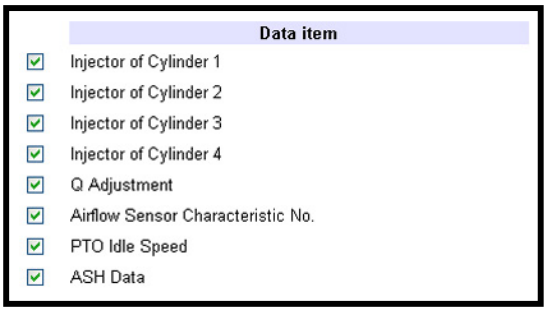
Window: ECU selection



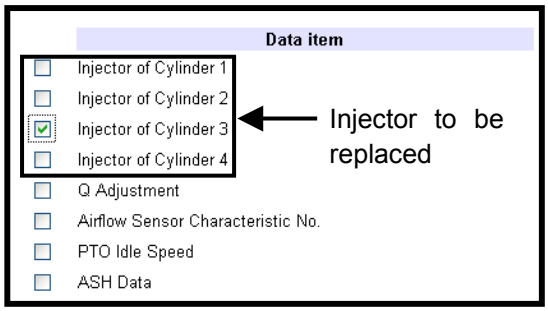
Window: Selecting items to be rewritten



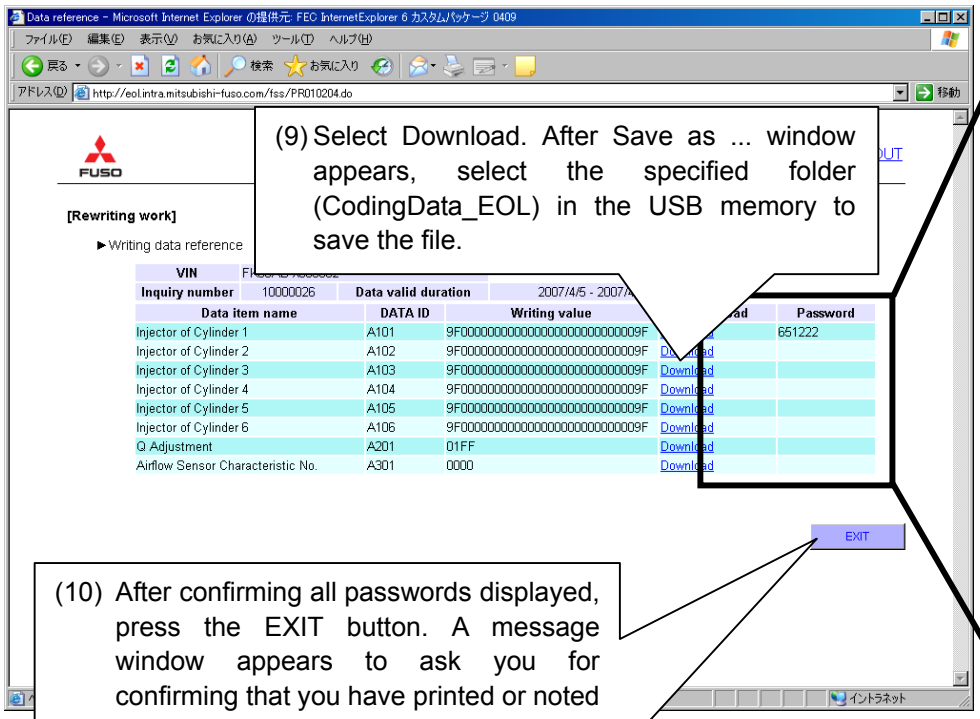
When ECU is replaced (Select all items.)



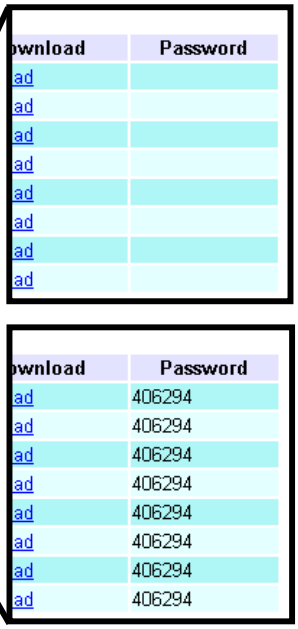
When injector is replaced (Select the injector to be replaced.)



Window: Download

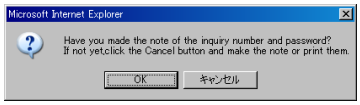


(9) Select Download. After Save as ... window appears, select the specified folder (CodingData_EOL) in the USB memory to save the file.

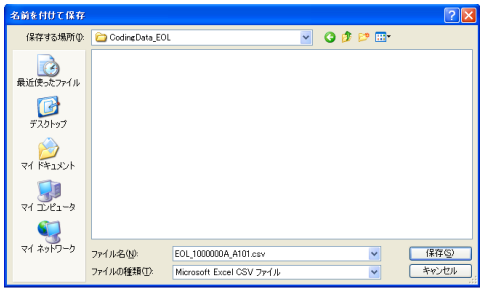


(10) After confirming all passwords displayed, press the EXIT button. A message window appears to ask you for confirming that you have printed or noted down them.

* Be sure to note down the reference number (Inquiry number) and password or output the screen in hardcopy before pressing the EXIT button.



Save as .... window (specify CodingData_EOL) displayed when “Download” is selected in step (9).

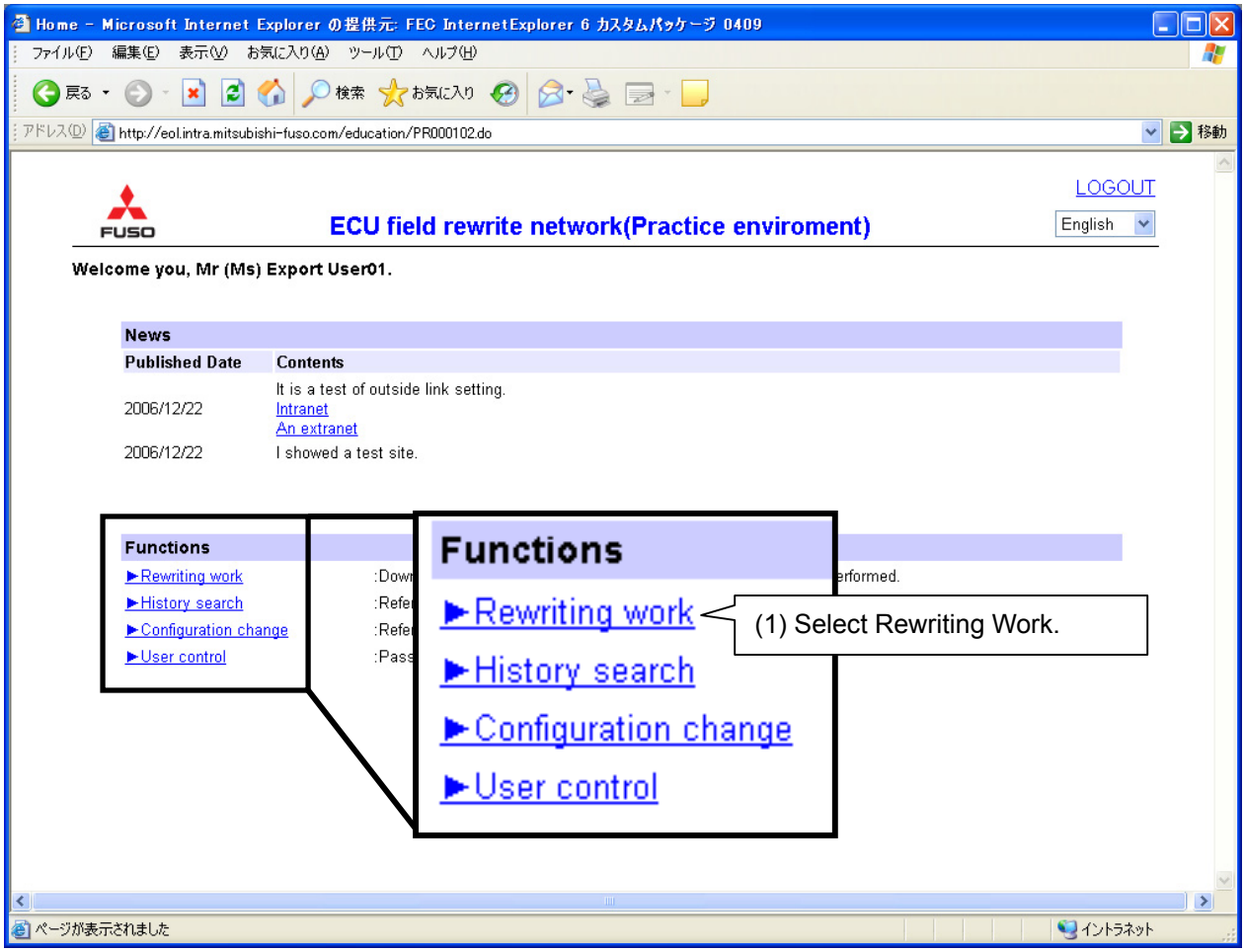


Important: Notes on downloading

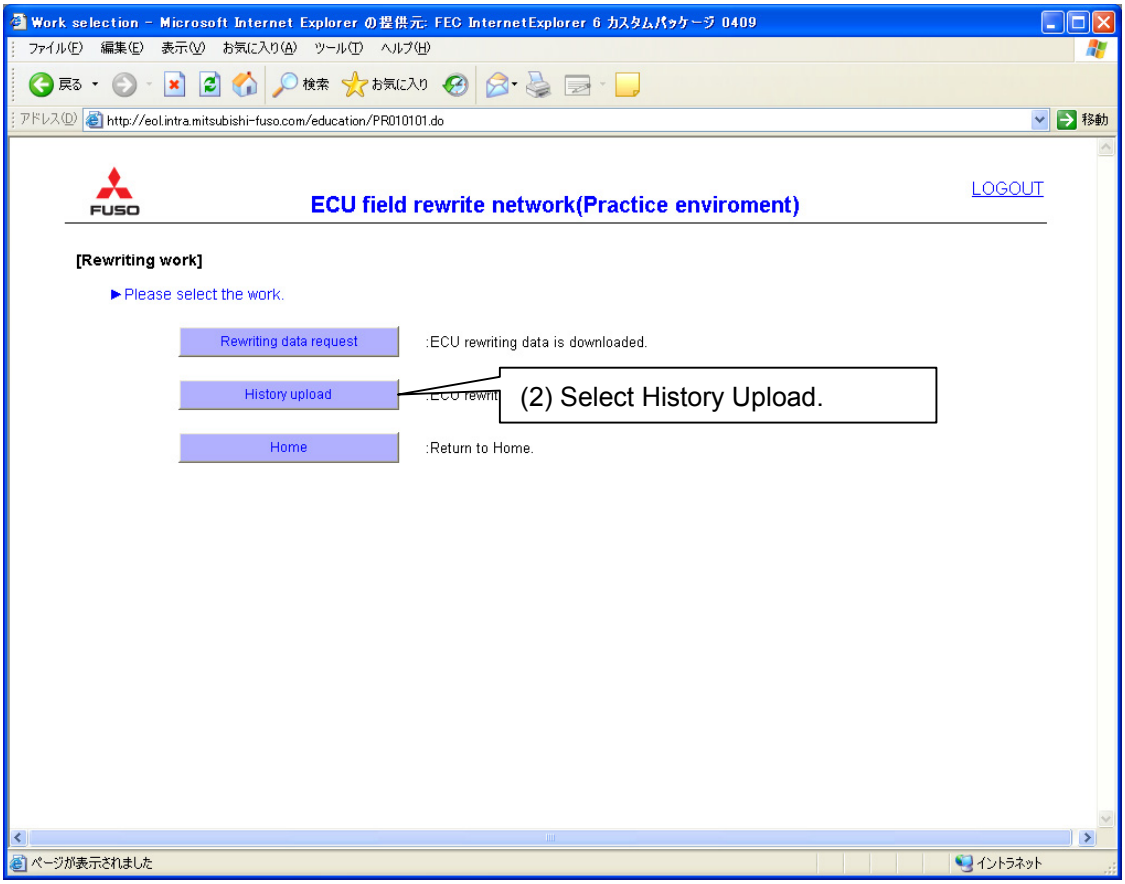
- The Save as ... window appears with the default file name specified. Save the file without changing the file name. (MUT cannot recognize any other file name.)
- When downloading files, confirm that a password is displayed next to the “Download” selected.
- After downloading is complete, be sure to make the note of the reference number (Inquiry number) and password or select the menu option “File” and then “Print” to print the screen.

Registering ECU Data (Upload)

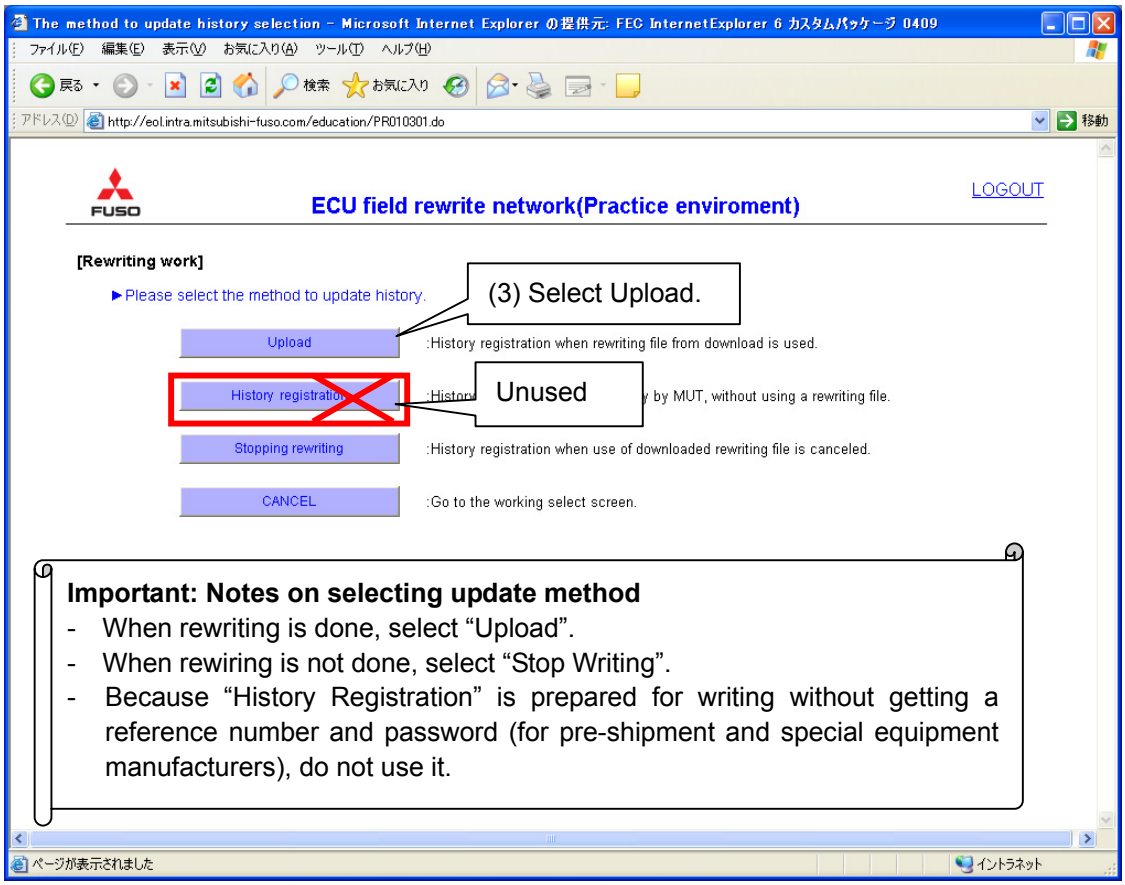
Window: Top page



Window: Selecting rewriting work



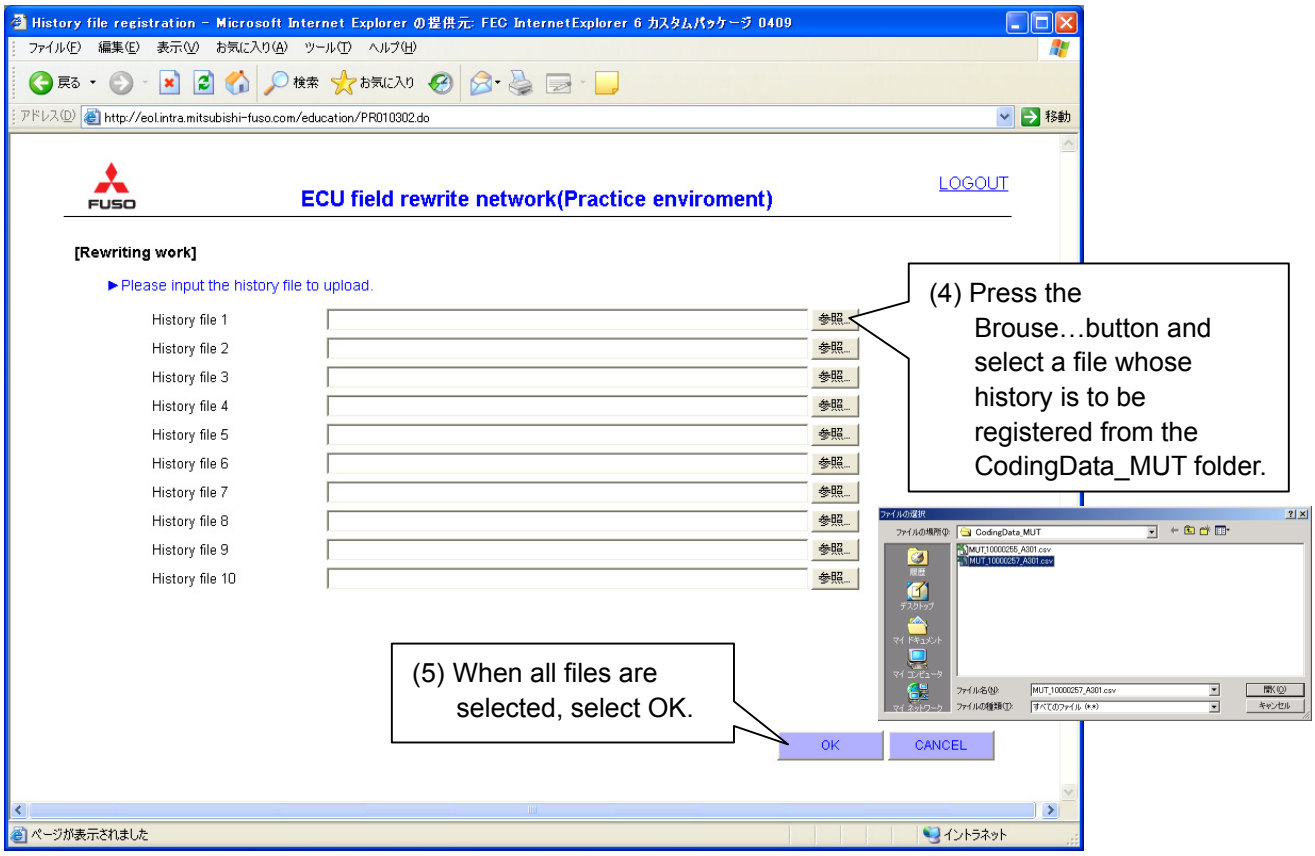
Window: Selecting history registration method



Important: Notes on selecting update method

- When rewriting is done, select “Upload”.
- When rewiring is not done, select “Stop Writing”.
- Because “History Registration” is prepared for writing without getting a reference number and password (for pre-shipment and special equipment manufacturers), do not use it.

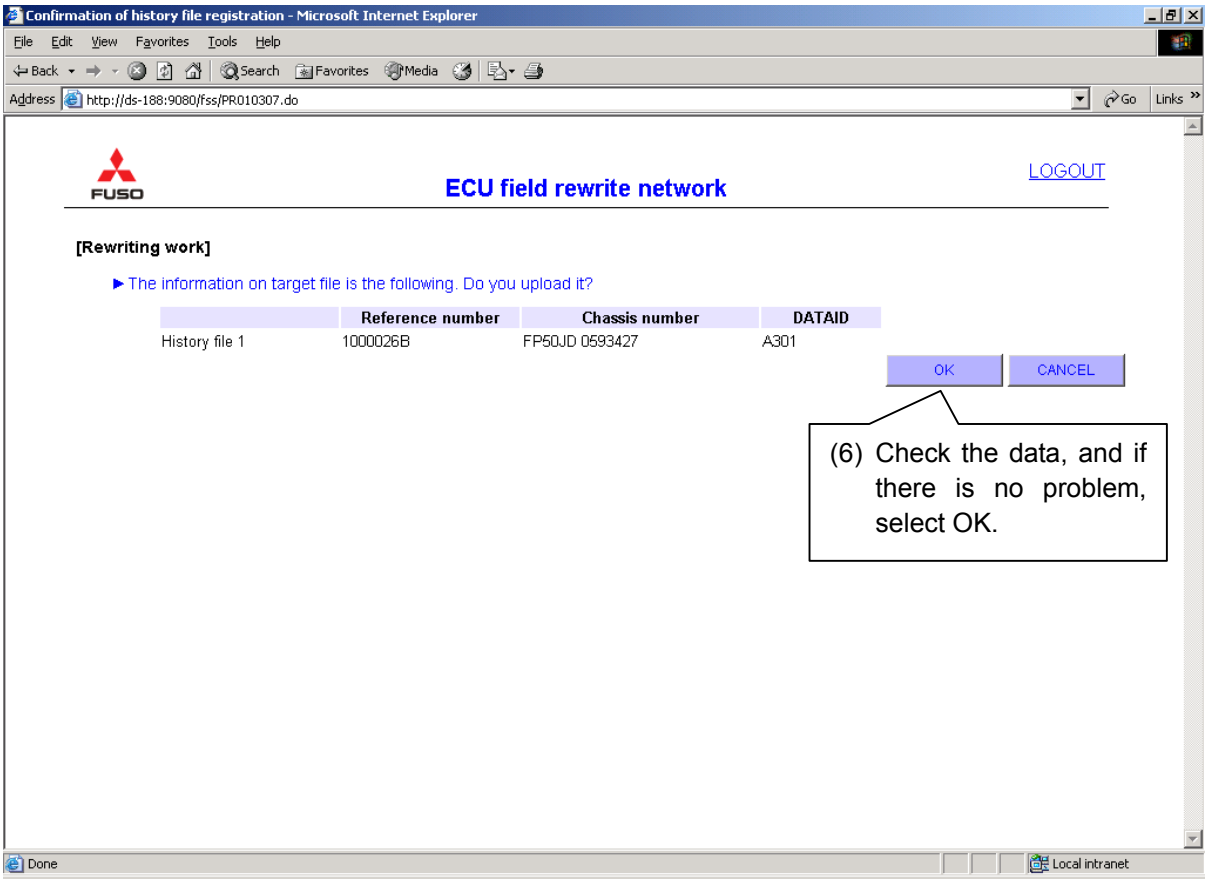
Window: Selecting history file



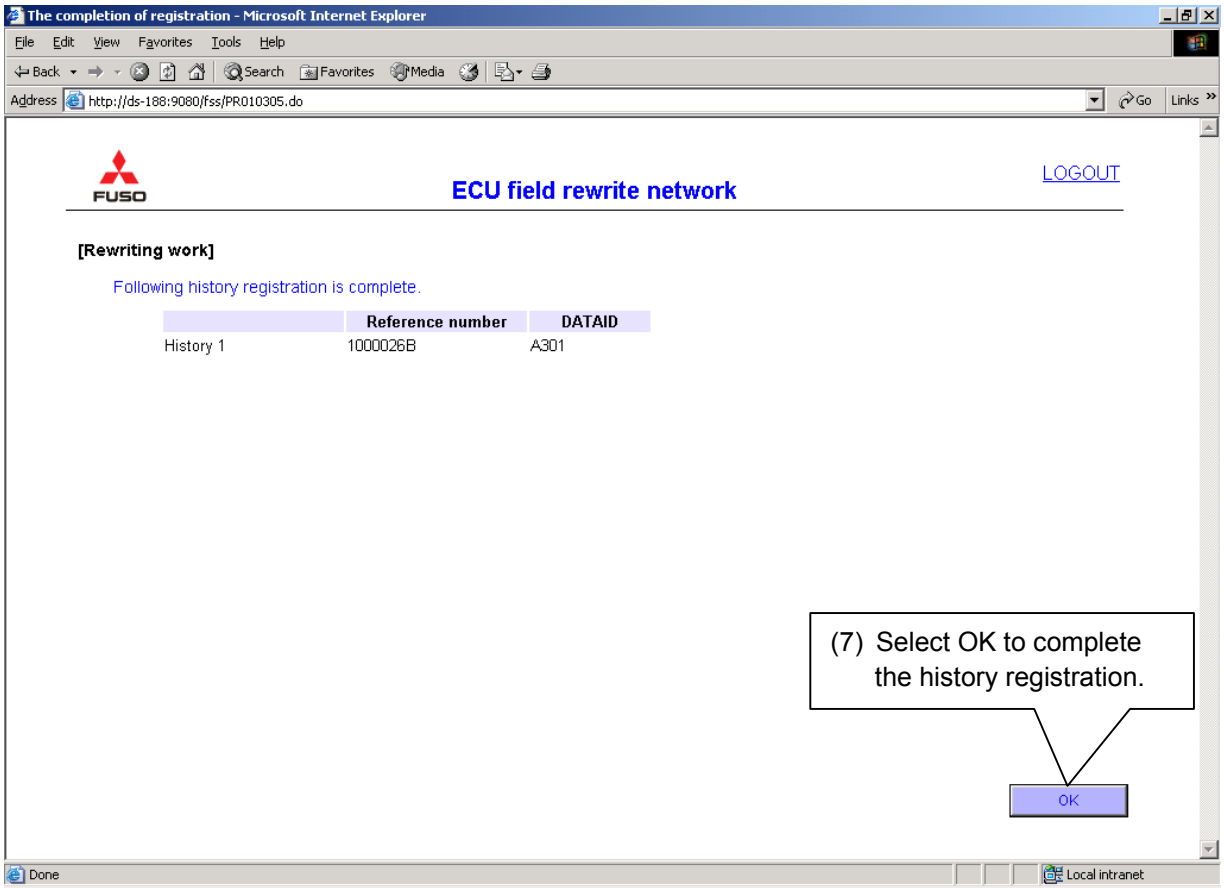
Important: Notes on upload

- Data with the same reference numbers can be collectively uploaded.
- If files with different reference numbers are registered at the same time, or an attempt is made to register data that has already been registered, an error occurs. Select another history file or cancel the registration and then re-select OK.

Window: Checking registered data

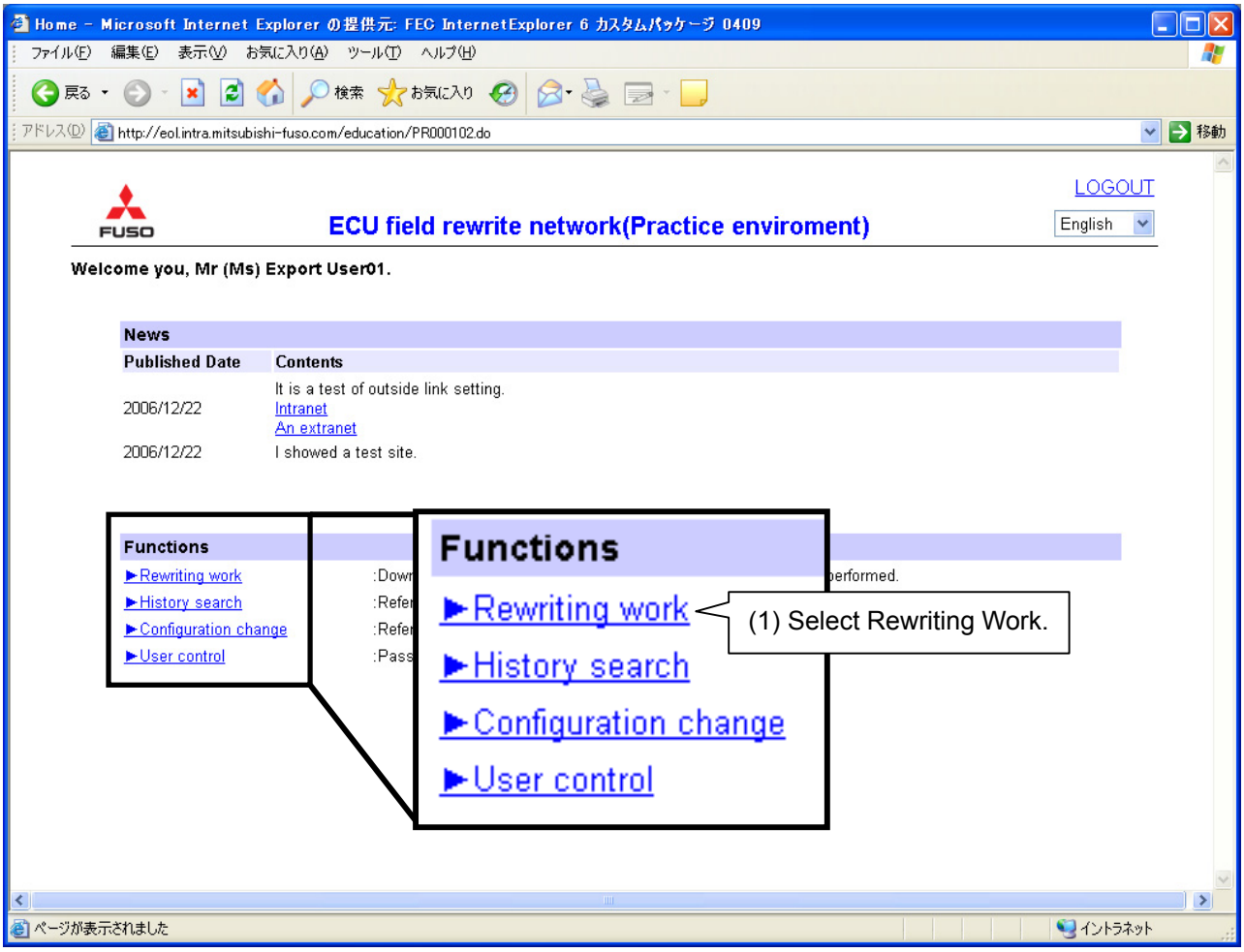


Window: Registration end

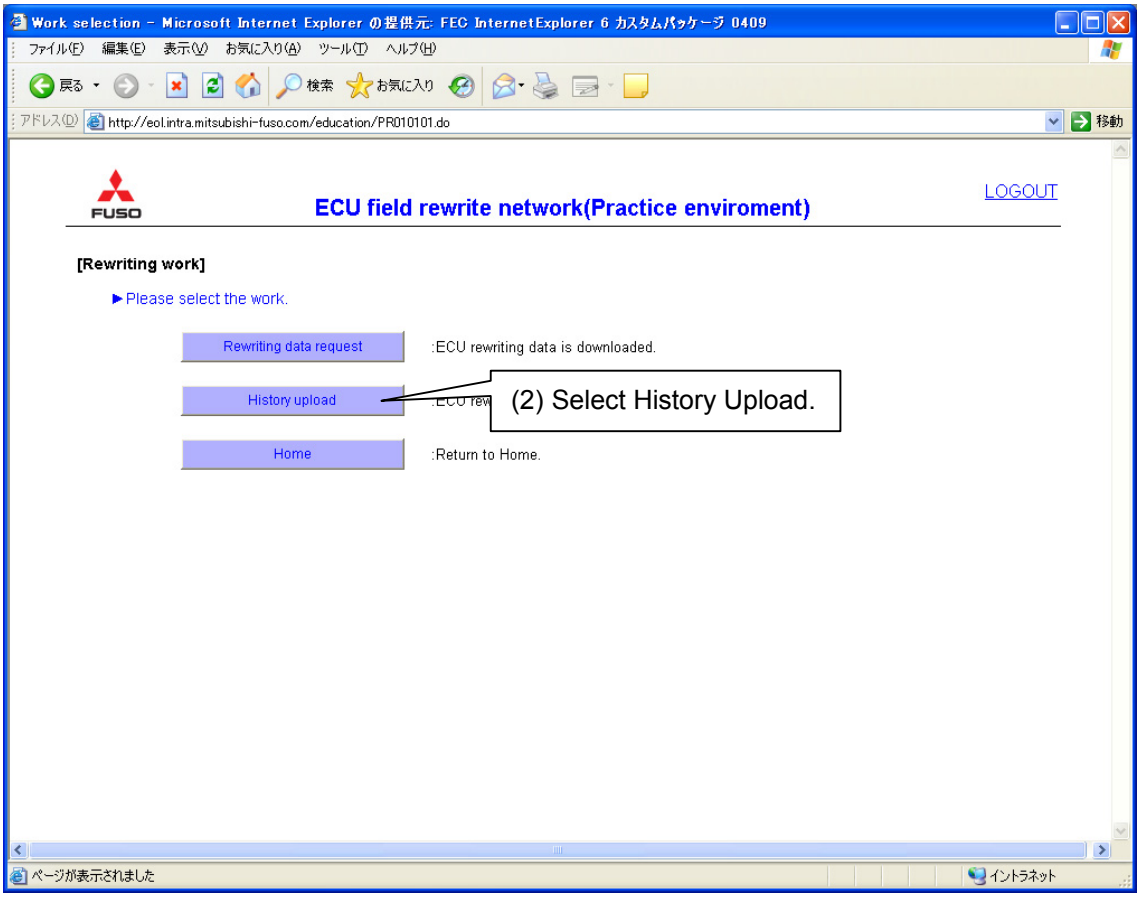


Quitting Rewriting

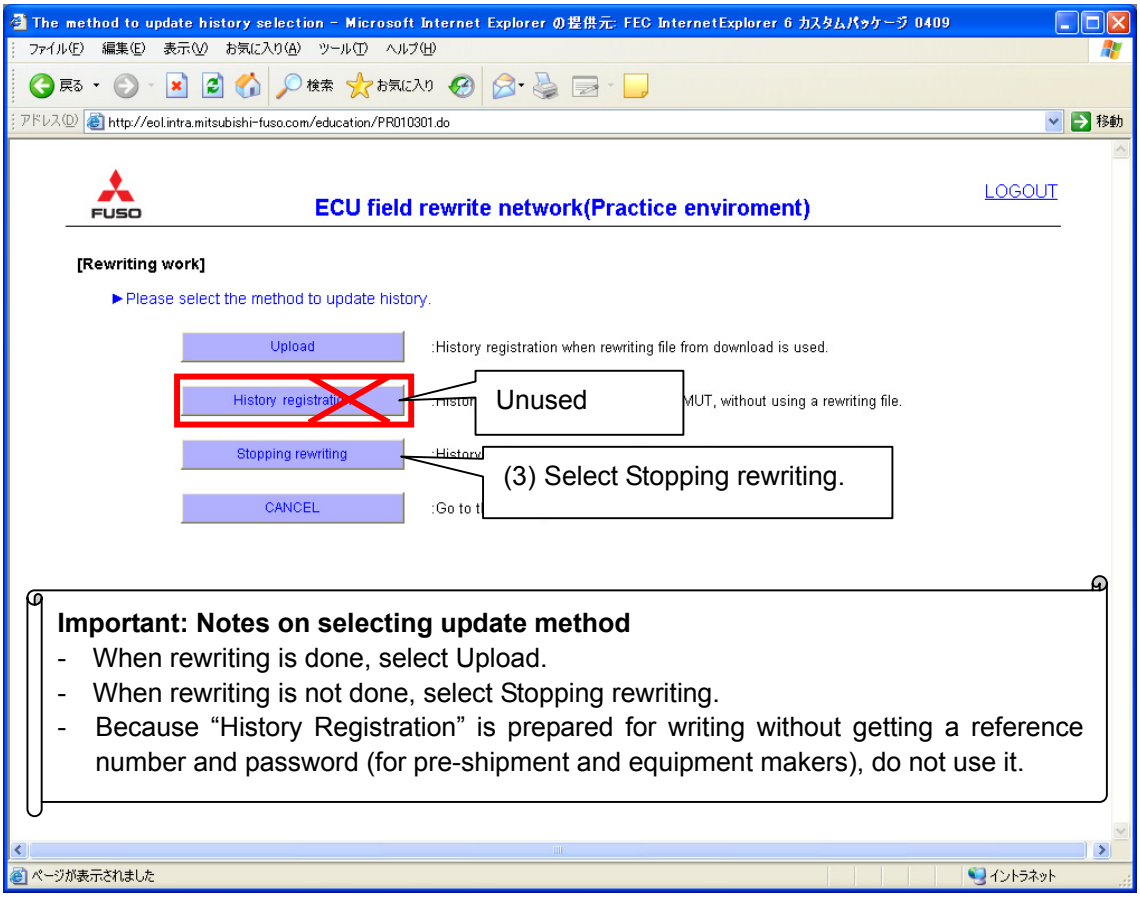
Window: Top page



Window: Selecting rewriting work



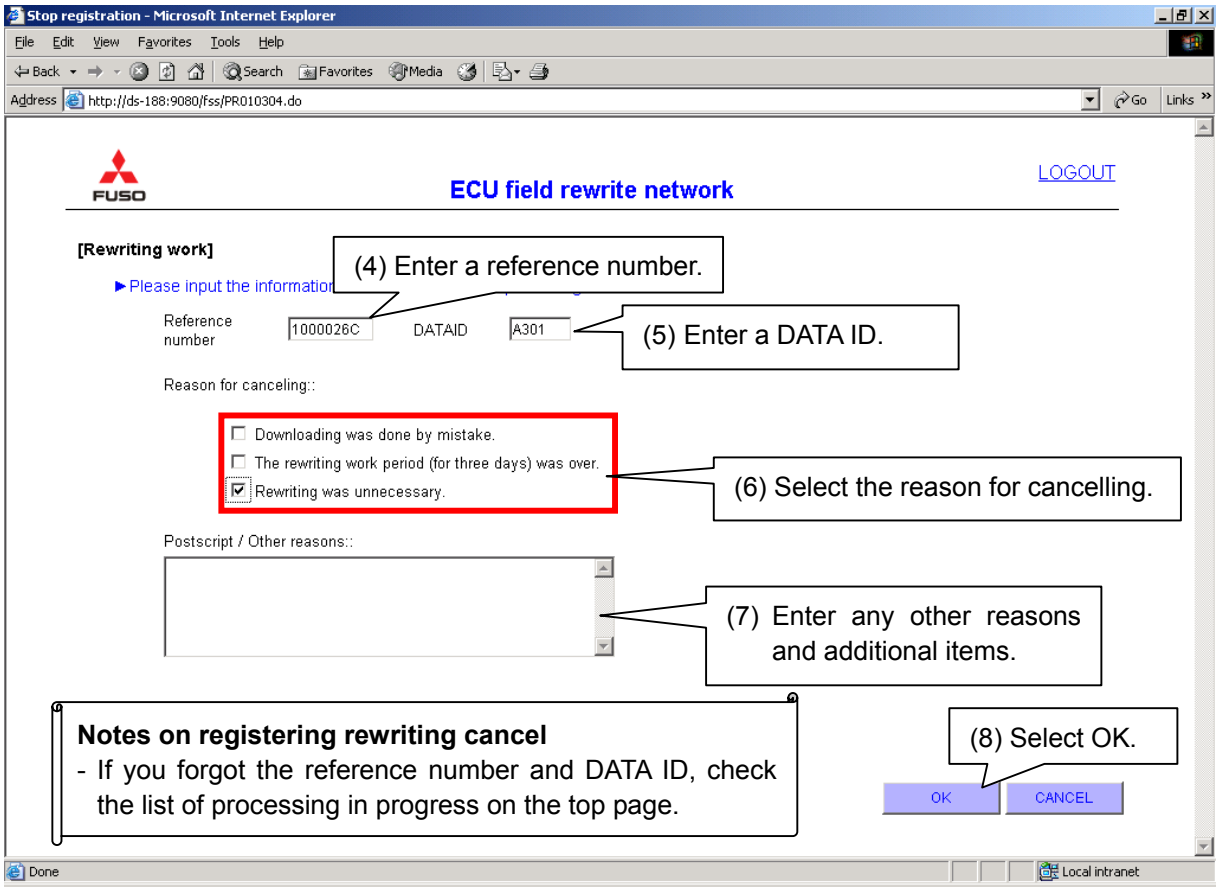
Window: Selecting history registration method



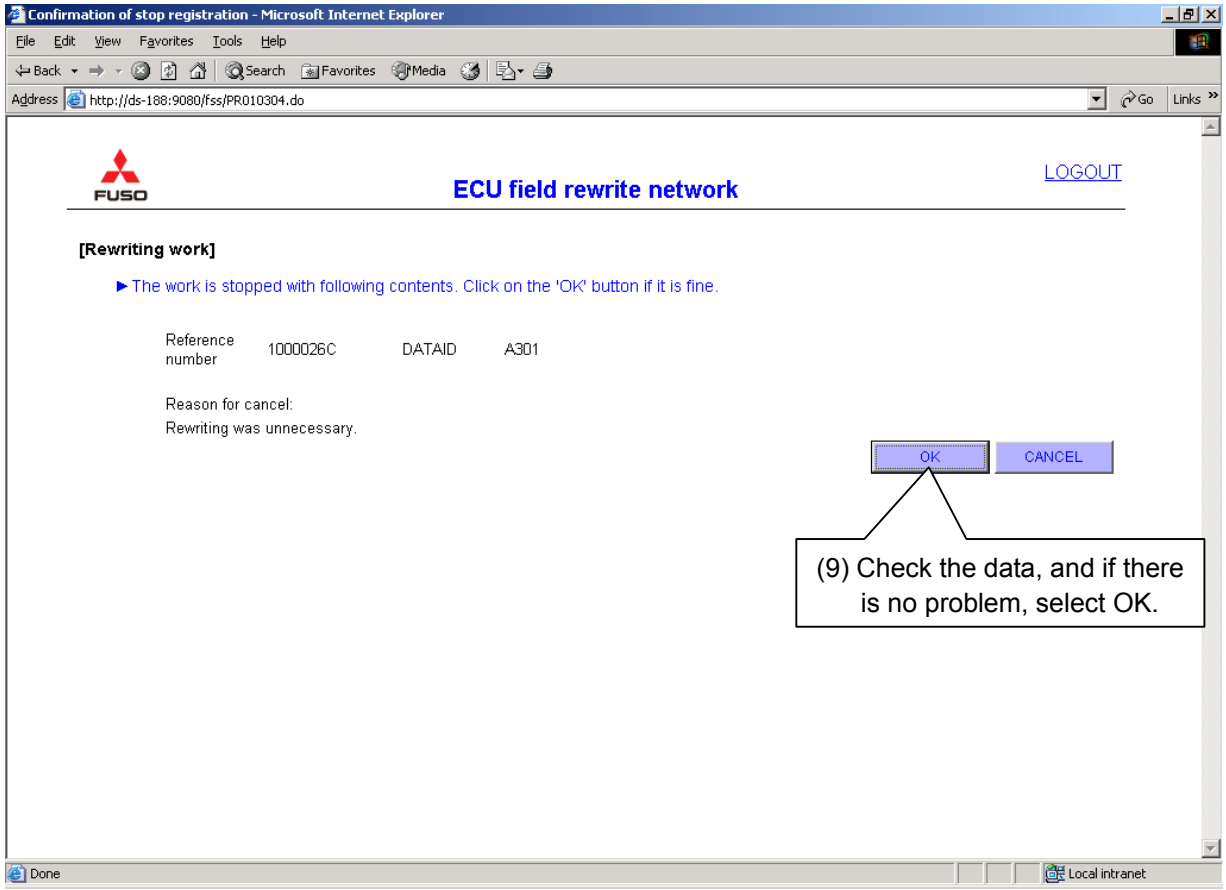
Important: Notes on selecting update method

- When rewriting is done, select Upload.
- When rewriting is not done, select Stopping rewriting.
- Because “History Registration” is prepared for writing without getting a reference number and password (for pre-shipment and equipment makers), do not use it.

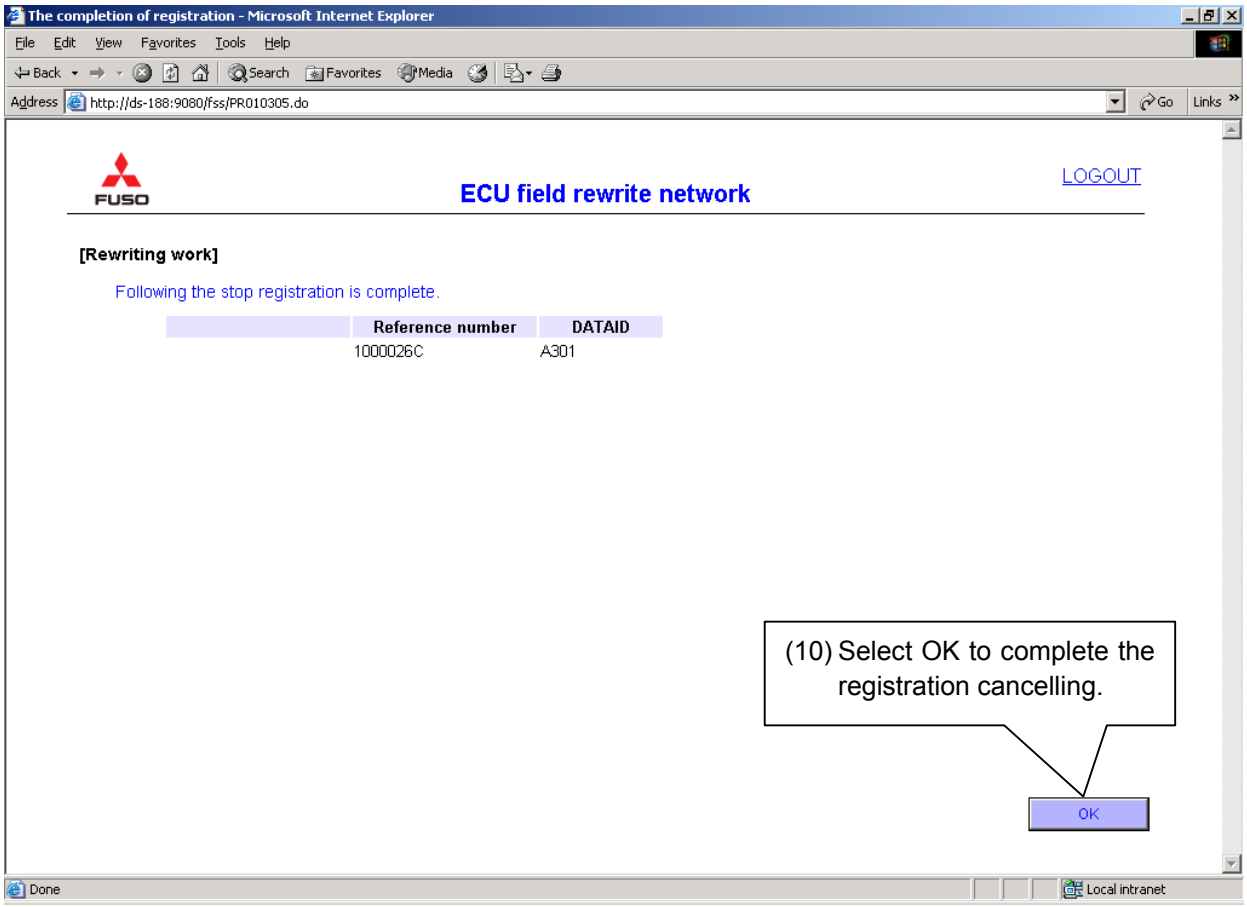
Window: Entering reason for quit



Window: Checking registered data

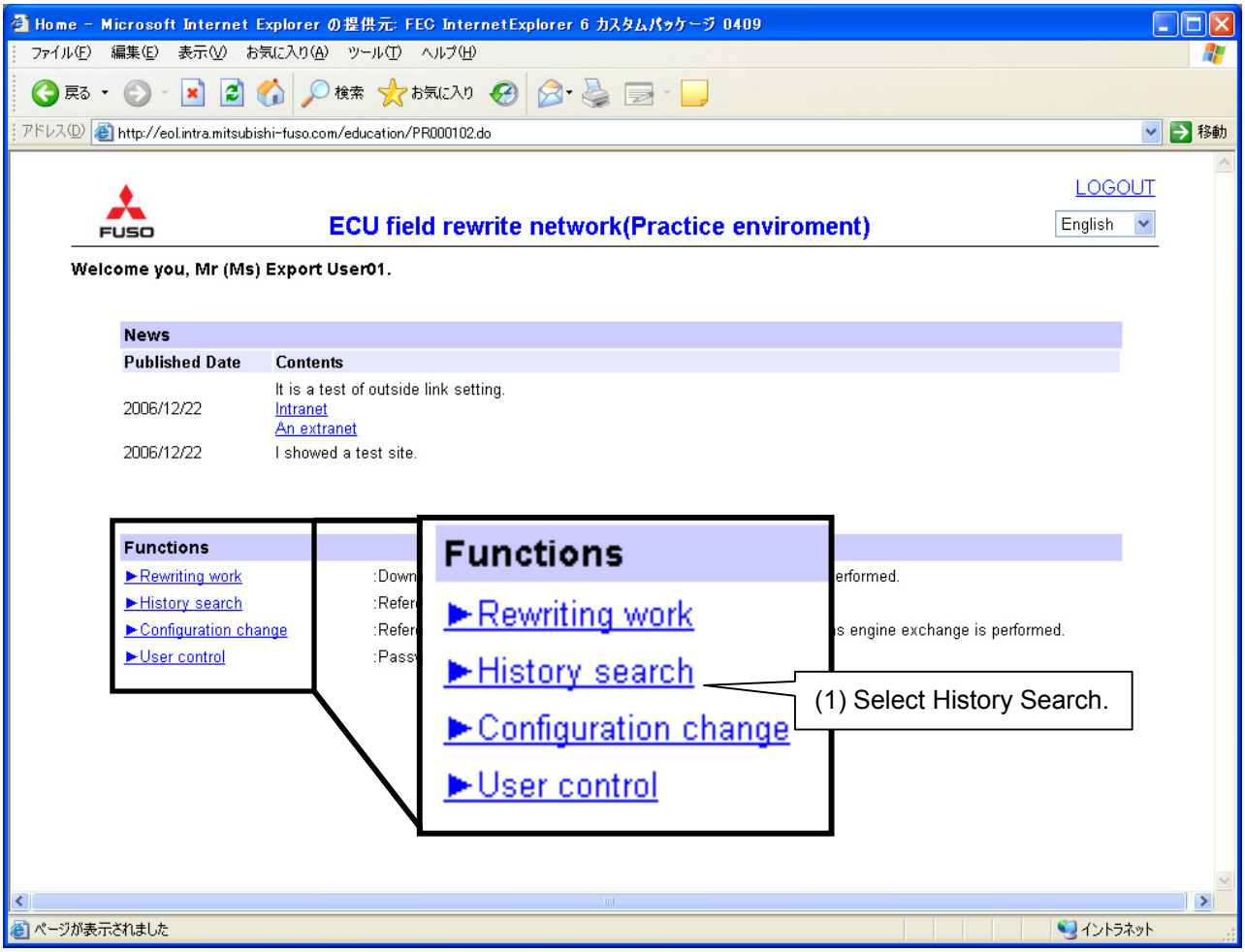


Window: Registration completion

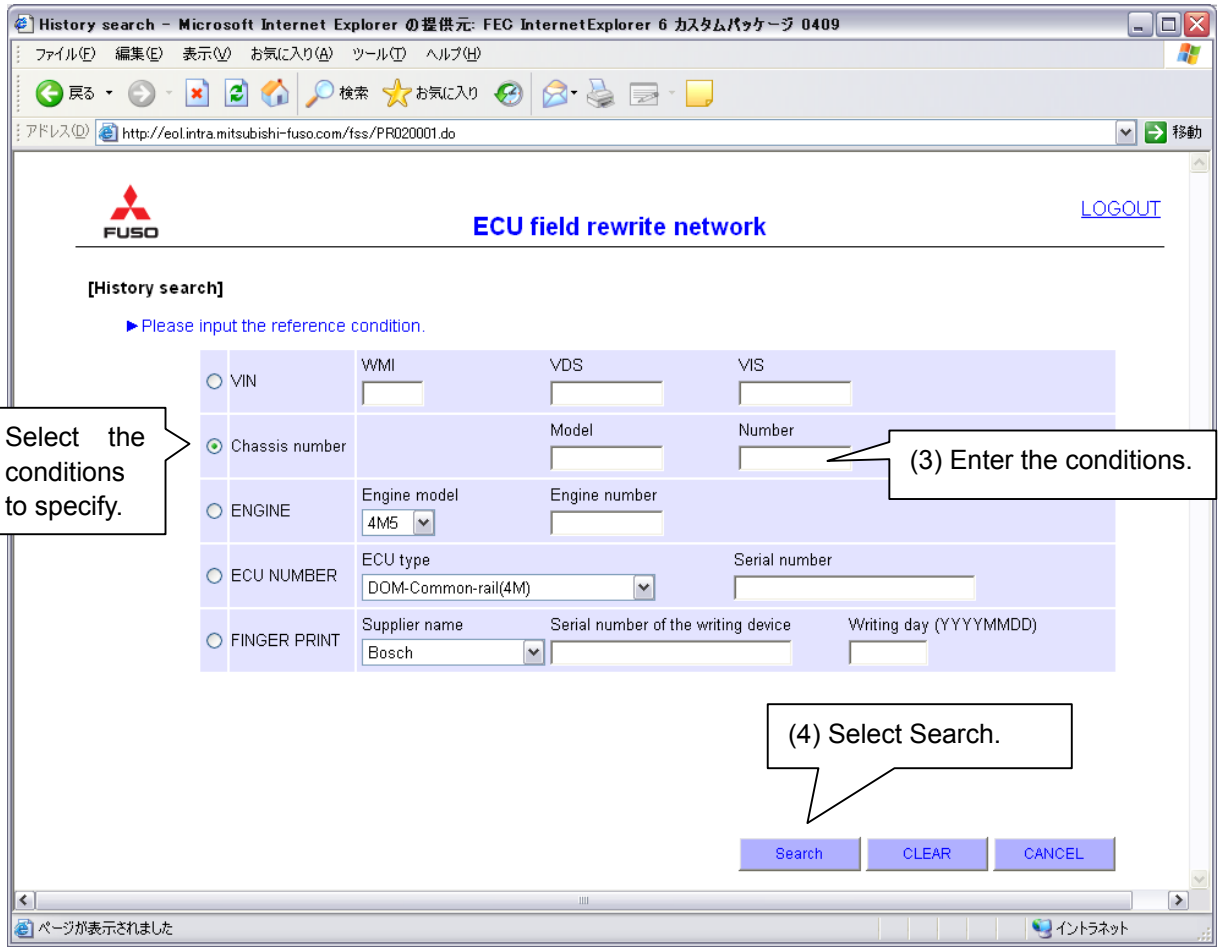


Rewriting History Search

Window: Top page

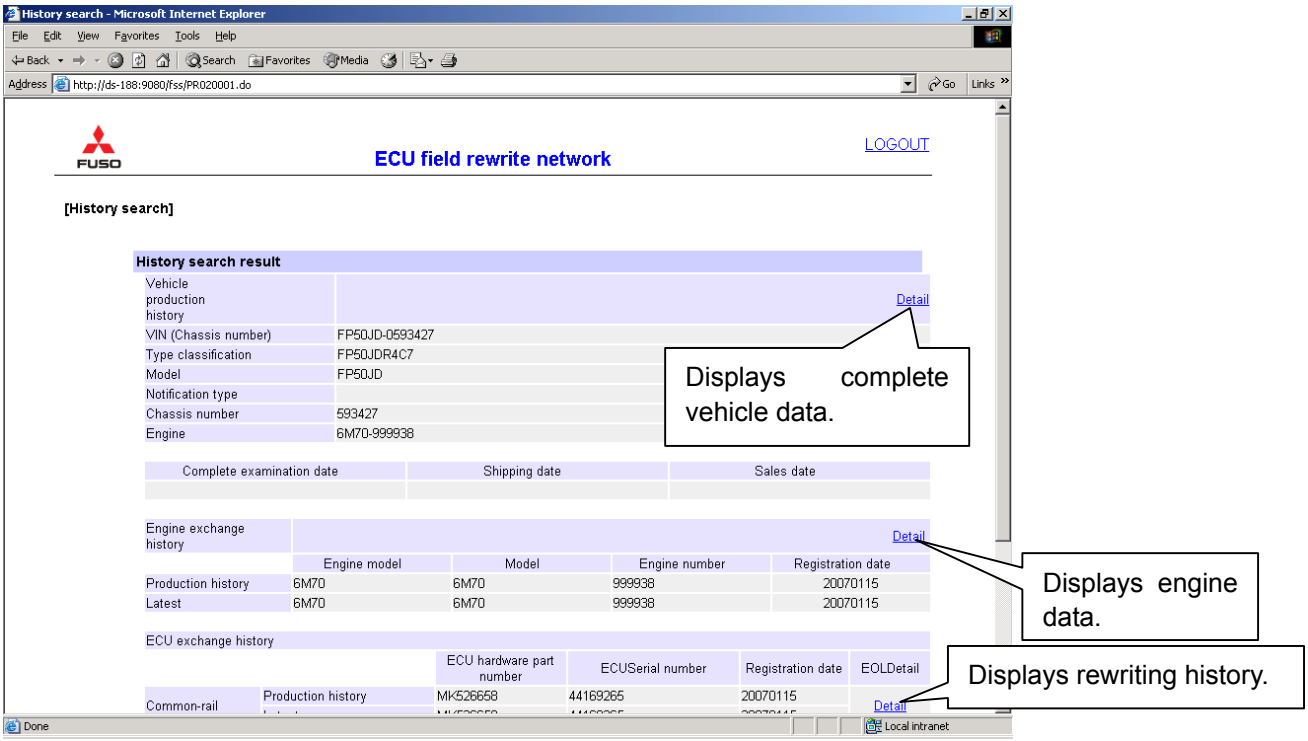


Window: Entering reference conditions

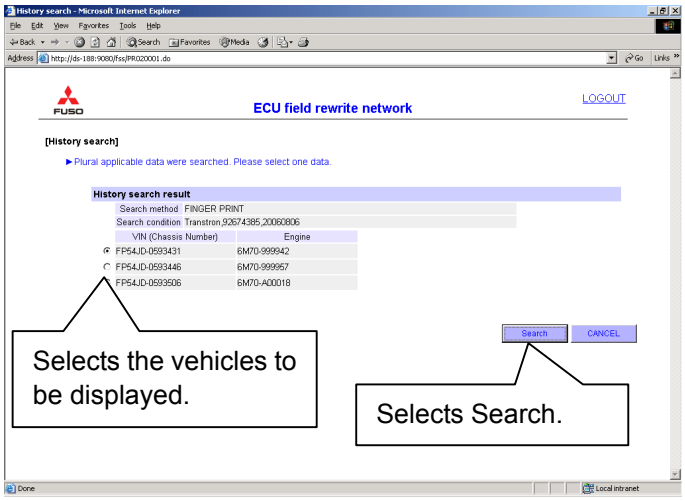


When searching a vehicle without VIN, enter the conditions in Chassis number.

Window: Displaying search results



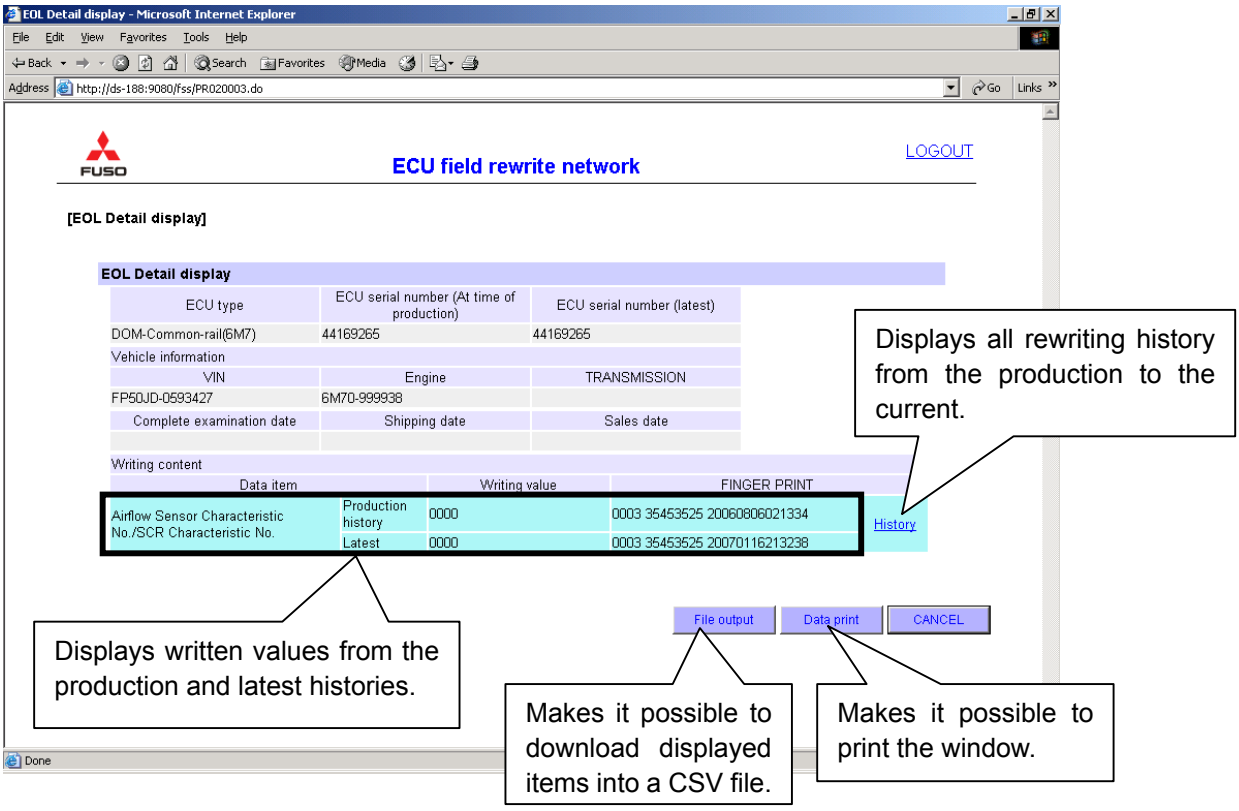
When two or more vehicles meet the conditions



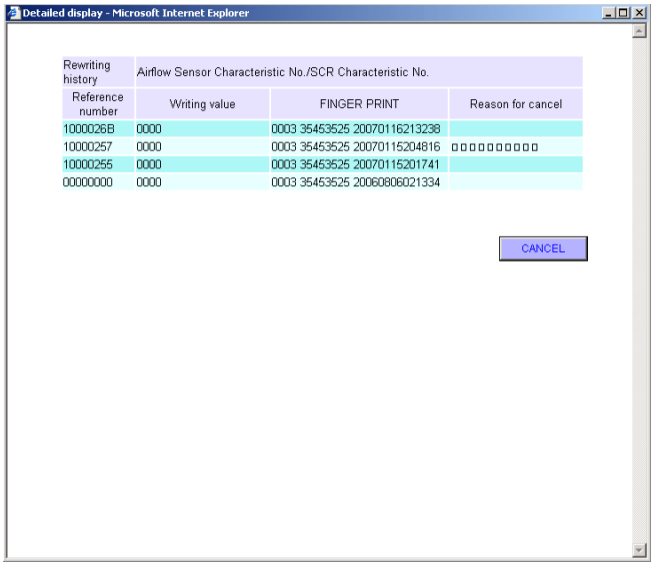
Notes on each data display

- Only the display of rewritten histories is supported.
- Detailed display is to be supported by obtaining complete vehicle, engine and transmission data or by link.

Window: Displaying ECU details



The rewriting history from the production to the current is displayed.

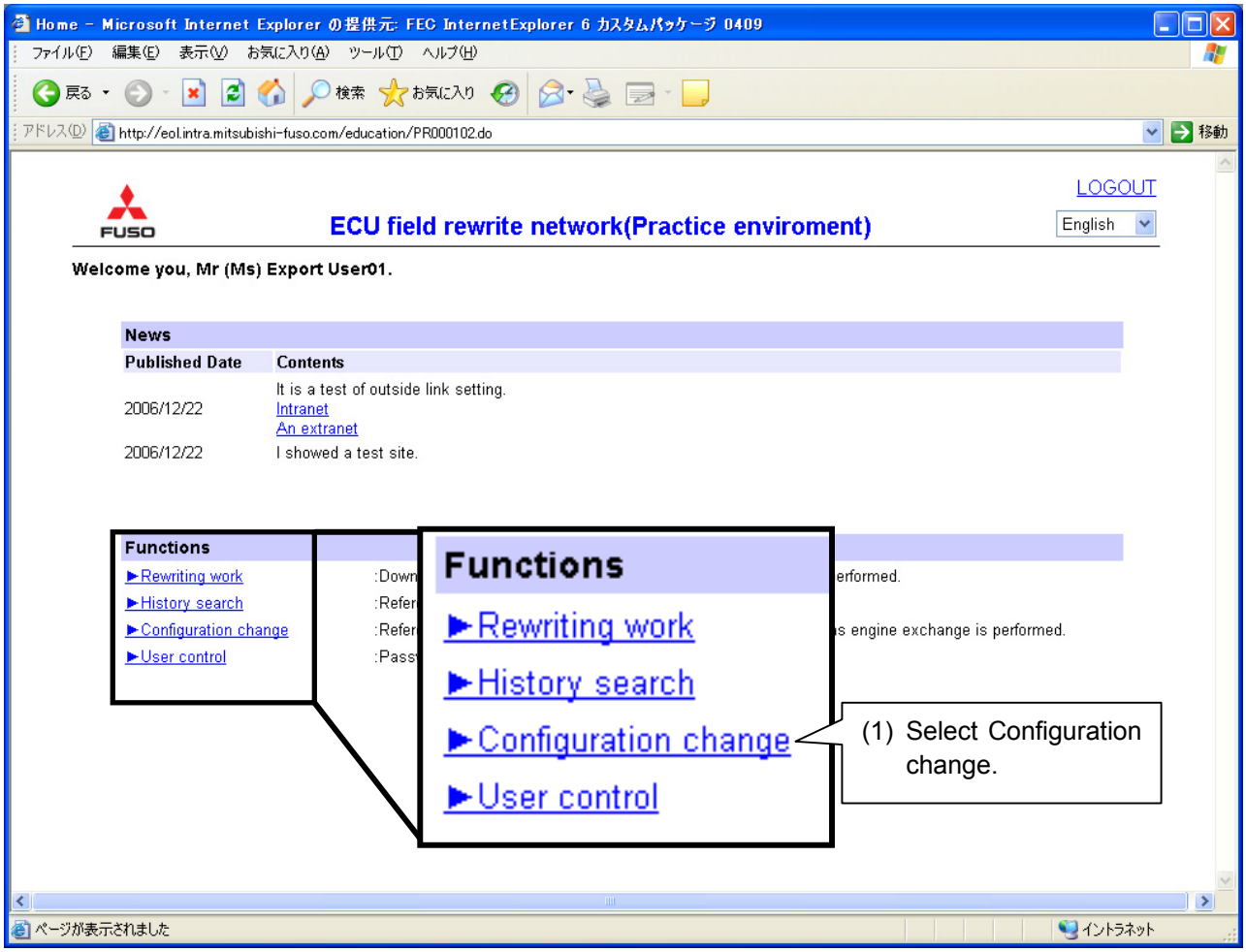


Preparatory Works for Engine Replacement

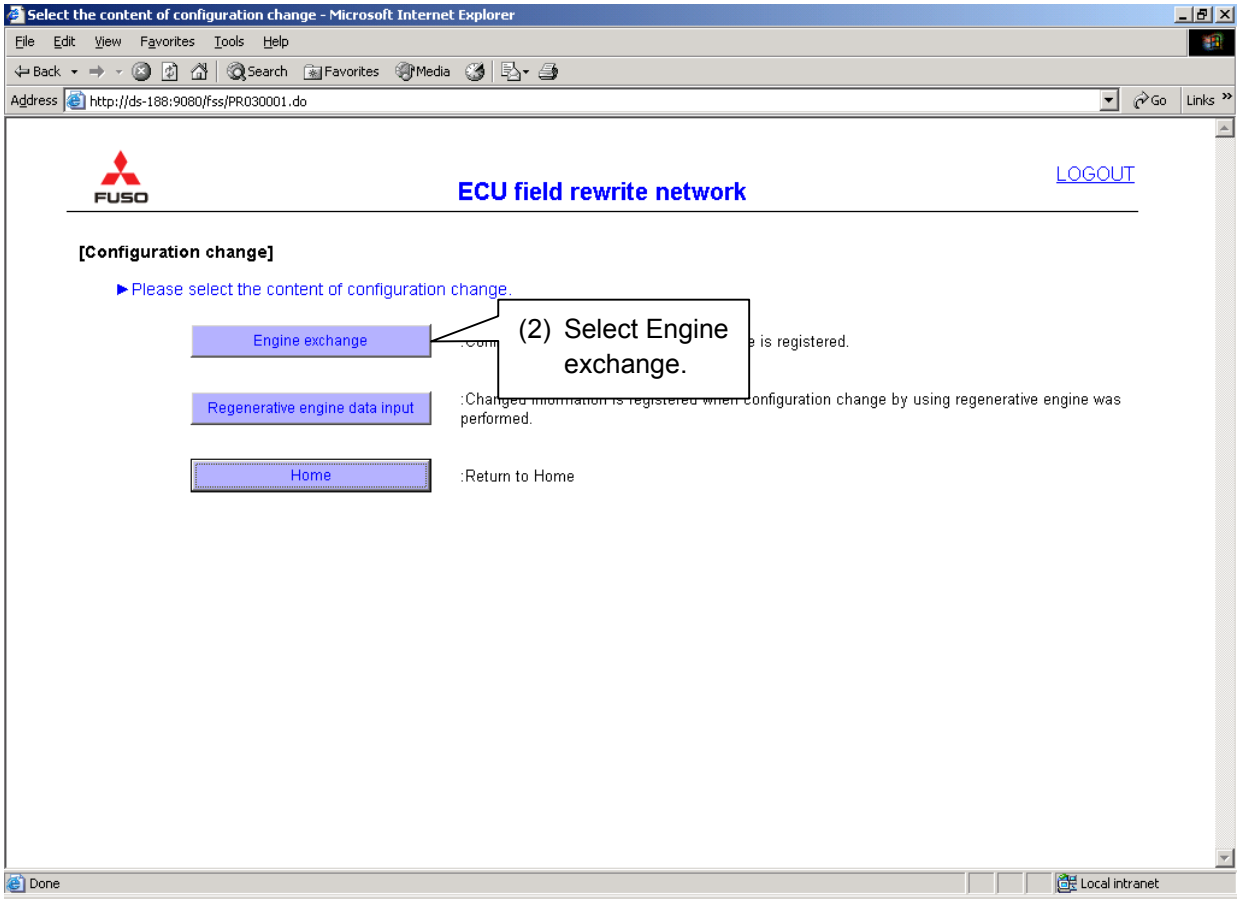
When replacing an engine in a given vehicle, you need to load new data particular to each engine such as injector type into the engine. After one of the following operations has been performed, do the works as indicated in the following pages before downloading the ECU data.

Major operations:
- Replacing an engine with new
- Transferring an engine from another vehicle

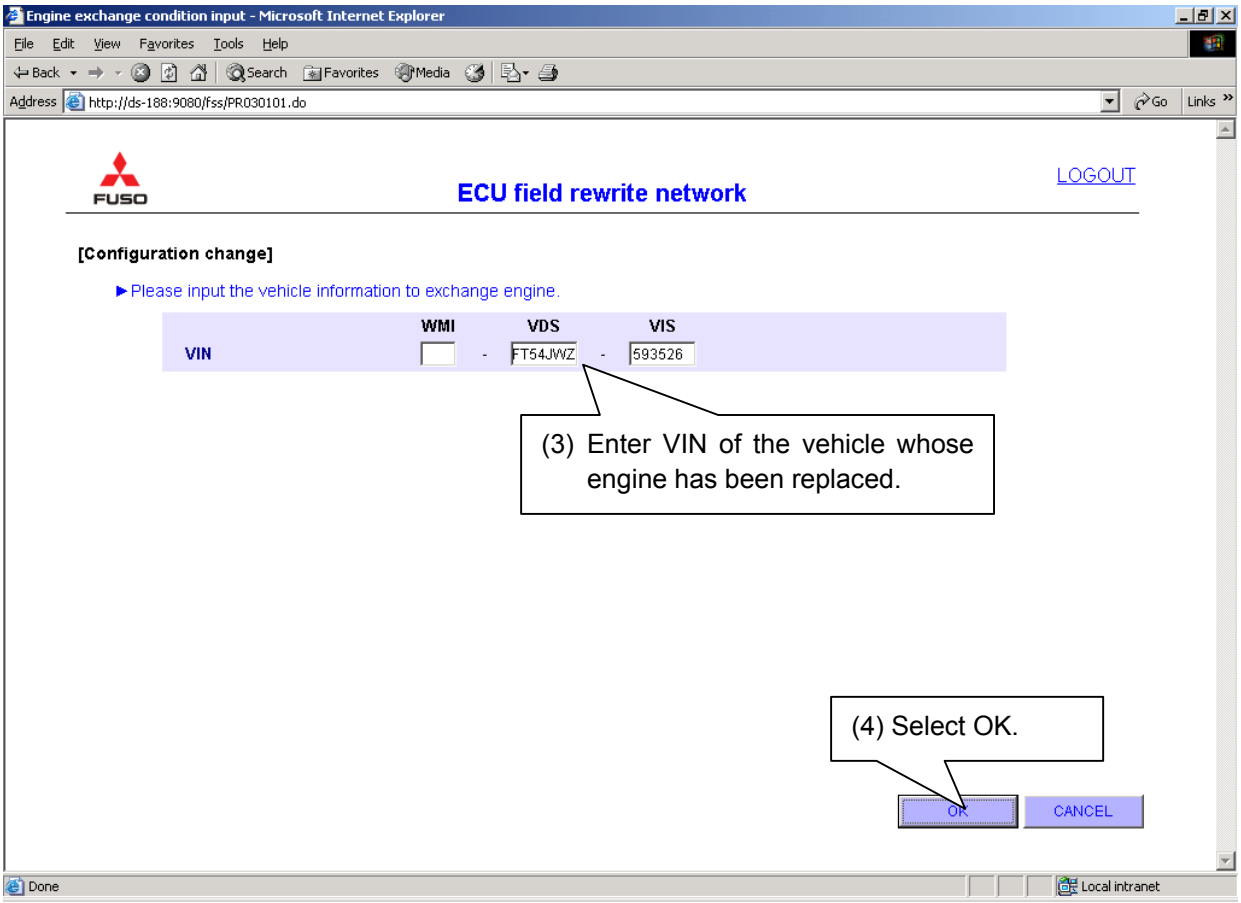
Window: Top page



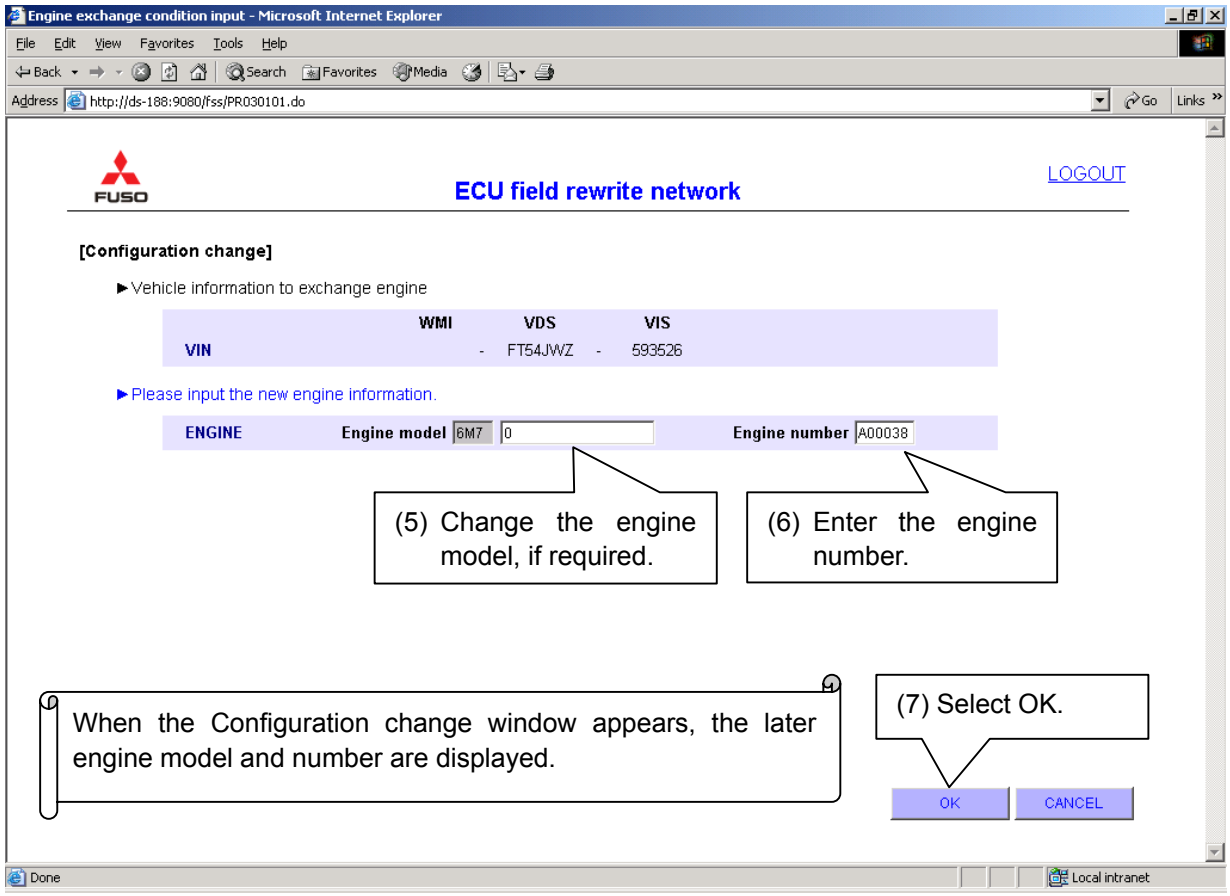
Window: ECU detail display



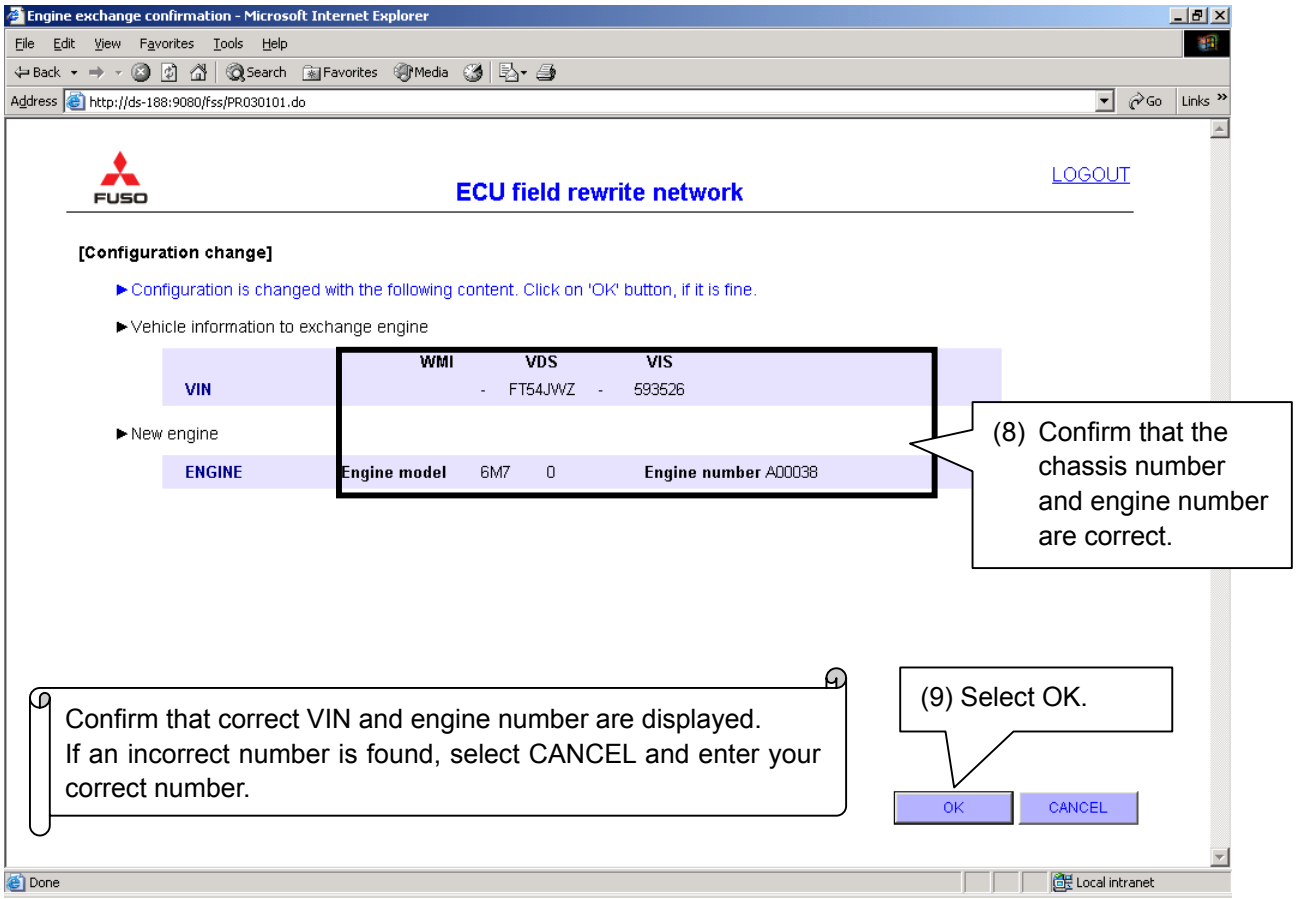
Window: Entering vehicle information



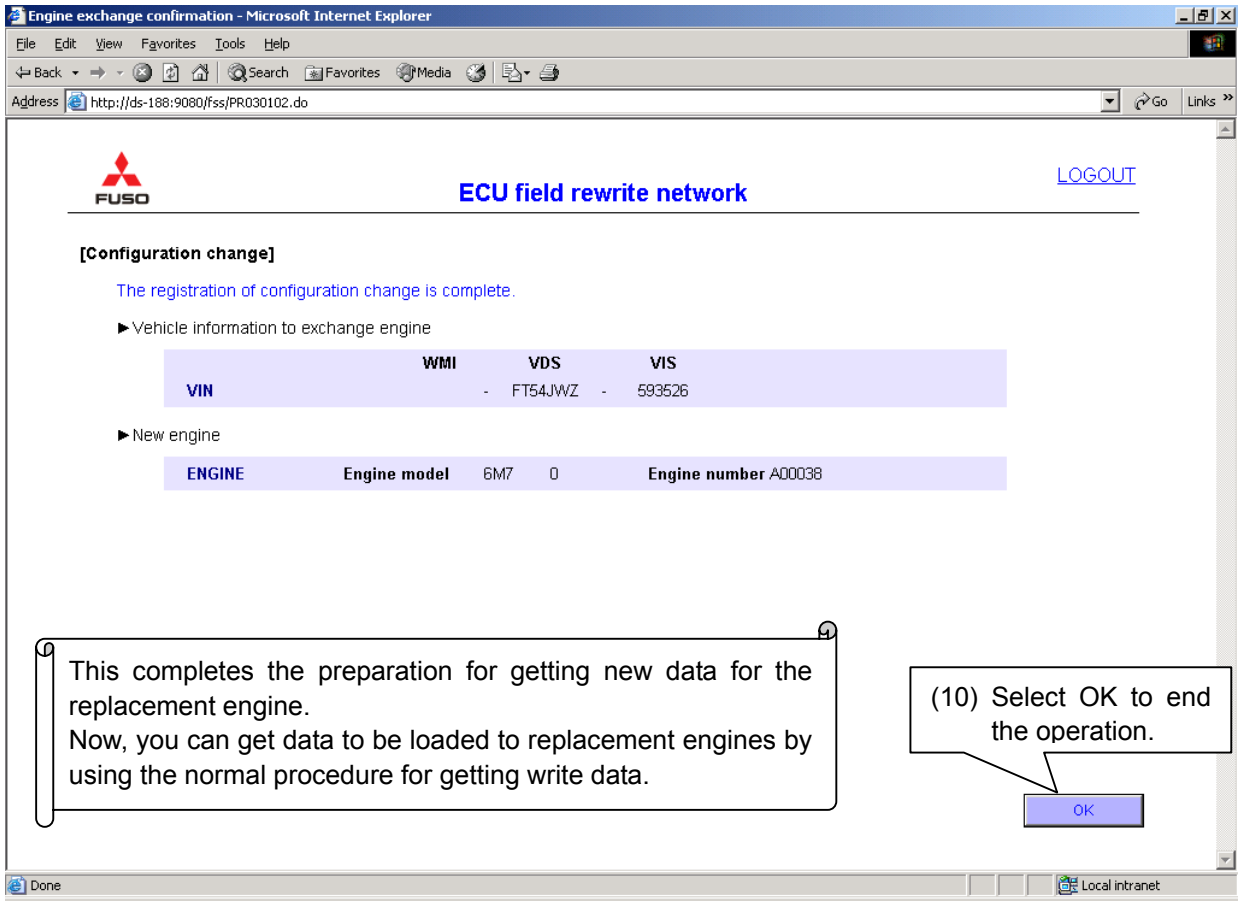
Window: Entering engine information



Window: Entering engine information



Window: Completion of registration



5. MUT-III OPERATION

◆ **Notes** ····· **5-1**

◆ **List of Service Works** ····· **5-2**

◆ **File Transfer (MUT-III⇔Removable Disk)** ····· **5-4**

◆ **All Data Writing** ····· **5-8**

◆ **Injector Data Writing** ····· **5-14**

◆ **PTO Idle speed Writing** ····· **5-21**

◆ **SLD Limited Speed Writing** ····· **5-27**

◆ **Ash Data Writing** ····· **5-33**

Remarks:

This document is quoted from the MUT-III Instruction Manual which comes with the MUT-III Software. Refer to the MUT-III Instruction Manual if you have any questions.

Notes

1. Common check items

The following conditions are not prerequisite for rewriting ECU data. But it is recommended to meet the following requirements when ECU data rewriting is performed for the sake of safety:

- Engine stopped
- Vehicle stopped
- Gear placed in the neutral position and parking brake applied
- Normal battery voltage (24 V-vehicle: terminal voltage 20 V or higher desirable)
  (12 V-vehicle: terminal voltage 10 V or higher desirable)

2. Requirements for ECU data rewriting

The following requirements must be satisfied to perform ECU data rewriting.

ECU	Requirements for rewriting (all must be satisfied)	Error code (*1)
Bosch 4M5 ECU 6M7 ECU	(1) Key switch ON (2) Engine speed = 0 rpm (3) Vehicle speed = 0 km/h (4) Gear position: neutral or parking	Communication error (22)
DENSO 6M6 ECU	(1) Key switch ON (2) Engine speed = 0 rpm (3) Vehicle speed ≤ 1 km/h (4) Data writing not in progress	Communication error (22)
MVCU	(1) On the MUT-III, select the write target system and press the write execution key. (2) Ignition switch: ON (main power supply: higher than 4 V) (3) Auto cruise inoperative (4) SLD inoperative (5) Vehicle speed: Less than 3 km/h (6) Engine speed: Less than 400 rpm (7) ECU power supply: Higher than 8 V (both battery power and main power)	Communication error (22) Diagnostic code P1007 (ECU error) P1009 (writing not complete)

(*1): Error code that is displayed on the MUT-III if an error occurs in the ECU during data rewriting. As communication error is automatically displayed, the ordinary MUT-III diagnostic procedure is necessary for the diagnostic codes.

3. Work to be done after rewriting

After engine ECU data is rewritten, the diagnostic codes stored in the ECU and MVCU should be cleared. Failure to clear the diagnostic codes will cause an ECU communication error.

List of Service Works

The MUT-III operation is described separately for individual service works. Each number in parentheses indicates the applicable document in the following pages.

● For U.S.A.

Works	EPA07 CANTER		EPA07 FK/FM		Reference Manual
	4M5 ECU	MVCU	6M6 ECU	MVCU	
Common works	(1)	(1)	(1)	(1)	(1) File Transfer (MUT- III to/from Removable Disk) (2) All Data Writing (3) Injector Data Writing (4) PTO Idle speed Writing (5) SLD Limited Speed Writing (6) Ash Data Writing
Replacement of ECU (*1)	(2), (6)	(2)	(2)	(2)	
Replacement of Injector	(3)	—	(3)	—	
Change of PTO idle rpm	(4)	—	(4)	—	
Change of SLD Limited speed	—	(5)	—	(5)	

● For Singapore

Works	FP.FV.FS (EURO-4)		FK.FM (EURO-4)		Reference Manual
	6M7 ECU	MVCU	6M6 ECU	MVCU	
Common works	(1)	(1)	(1)	(1)	(1) File Transfer (MUT-III to/from Removable Disk) (2) All Data Writing (3) Injector Data Writing
Replacement of ECU	(2)	(2)	(2)	(2)	
Replacement of Injector	—	—	(3)	—	

● For Hong Kong

Works	FP.FV.FS (JP05)		FK.FM (JP05)		Reference Manual
	6M7 ECU	MVCU	6M6 ECU	MVCU	
Common works	(1)	(1)	(1)	(1)	(1) File Transfer (MUT-III to/from Removable Disk) (2) All Data Writing (3) Injector Data Writing
Replacement of ECU	(2)	(2)	(2)	(2)	
Replacement of Injector	—	—	(3)	—	

● For Australia / New Zealand

Works	FP.FV.FS (EPA04)		FK.FM.FN (EPA04)		Reference Manual
	6M7 ECU	MVCU	6M6 ECU	MVCU	
Common works	—	(1)	—	(1)	(1) File Transfer (MUT-III to/from Removable Disk) (2) All Data Writing
Replacement of ECU	—	(2)	—	(2)	
Replacement of Injector	—	—	—	—	

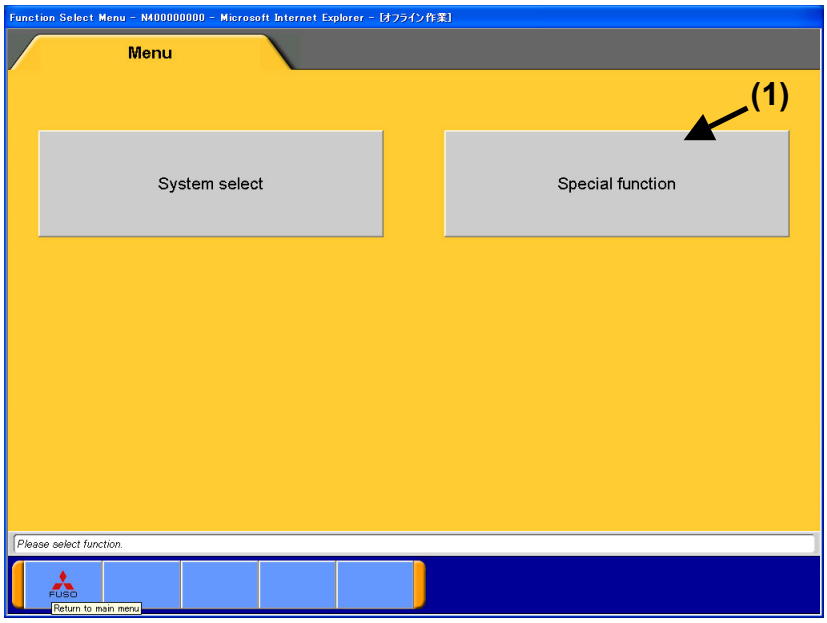
Remarks (*1):
As the following two cases are assumed when EPA07 CANTER ECU for U.S.A. is replaced, determine the case considering the work characteristic.

<Case 1>
(1) Select manual input of coding function Ash of MUT.
(2) Read Ash data from the old ECU (before replacement).
(3) Replace ECU.
(4) Write Ash data to a new ECU (after replacement).
(5) Select automatic input of coding function All of MUT.
(6) Remove check of Ash in coding Item and write data.
Demerits
- If you fail to un-check in Ash, you need to read Ash from old ECU.
- You must replace ECU during rewriting work.

<Case 2>
(1) Select information of coding function Ash of MUT and memo Ash data (6 digits).
(2) Replace ECU.
(3) Select automatic input of coding function All of MUT and write all data.
(4) Select manual input of coding function Ash of MUT and write the memo Ash.
Demerits
- It takes time to write a memo.
- Manual input is required.

(1) File Transfer (MUT-III⇔Removable Disk)

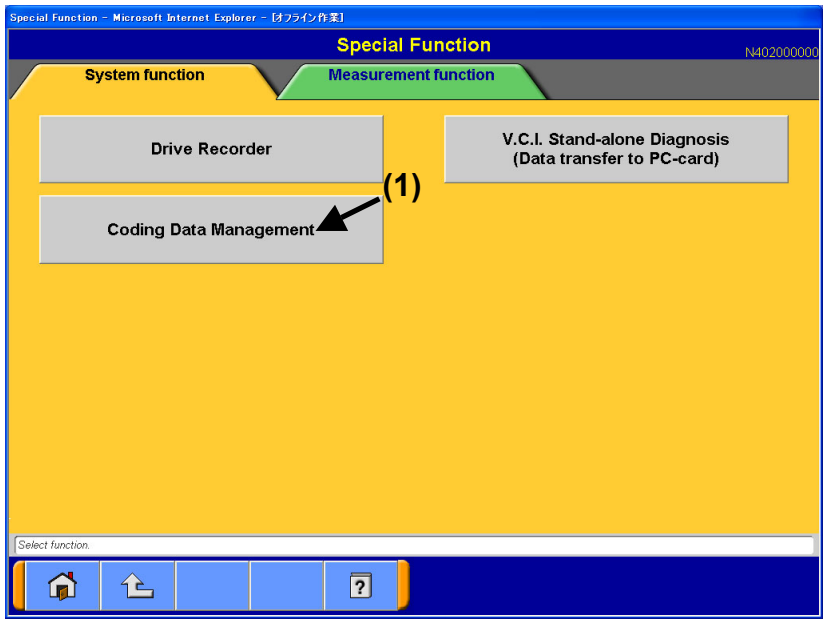
<Menu Window>



Window 1

- Press “Special Function” button (Window 1: (1)) to proceed to the System Function Window (Window 2).

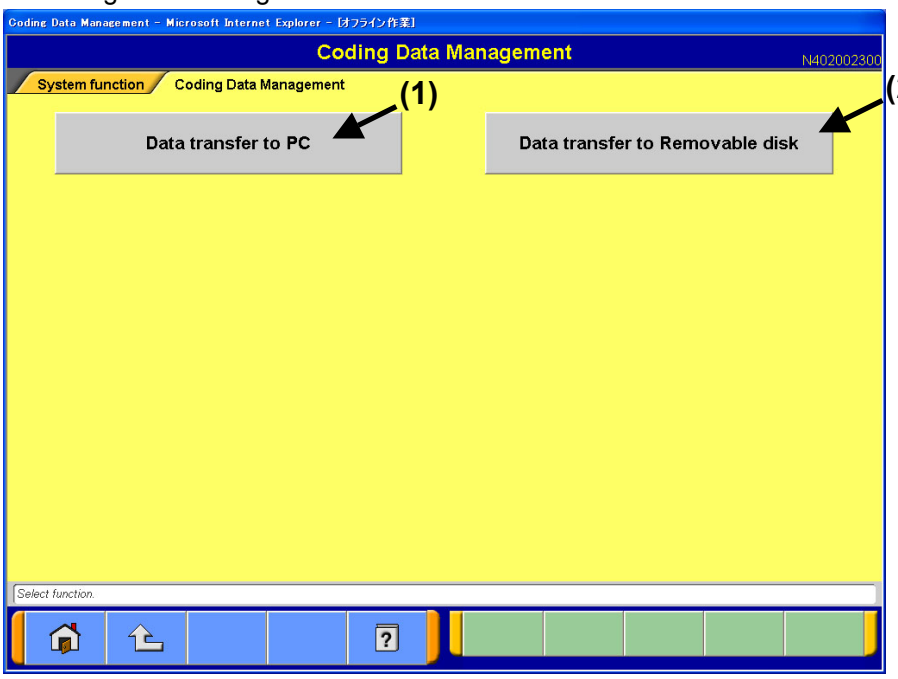
<System Function Window>



Window 2

- Press “Coding Data Management” button (Window 2: (1)) to proceed to the Coding Data Management Window (Window 3).

<Coding Data Management Window>

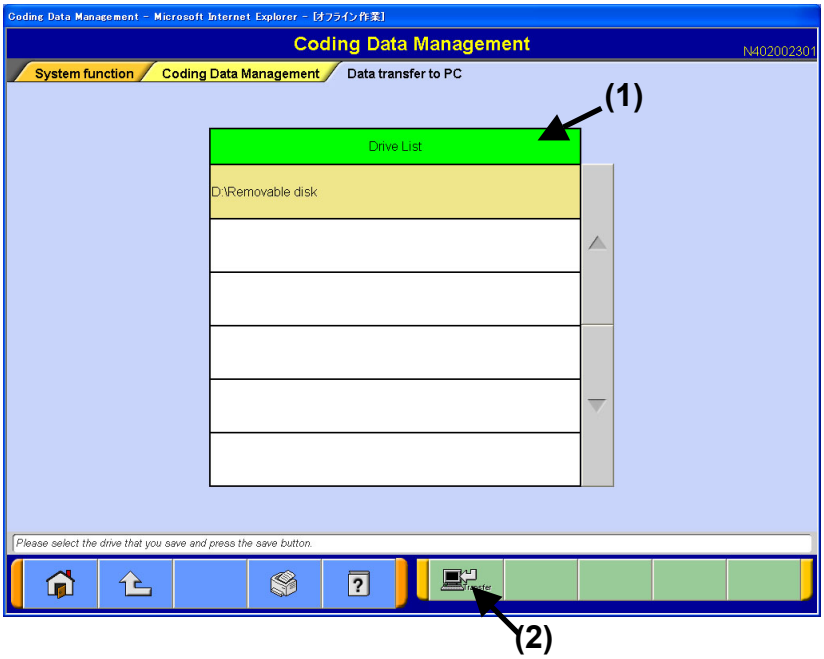


Window 3

- Press Function button to proceed to the following windows.

Function button name	Next window	Remarks
Data transfer to PC (Window 3: (1))	Drive Select Window (Window 4)	Transfer data from removable disk (USB memory, etc.) to MUT PC.
Data transfer to removable disk (Window 3: (2))	Stored File List Window (Window 6)	Transfer data from MUT PC to removable disk (USB memory, etc.).

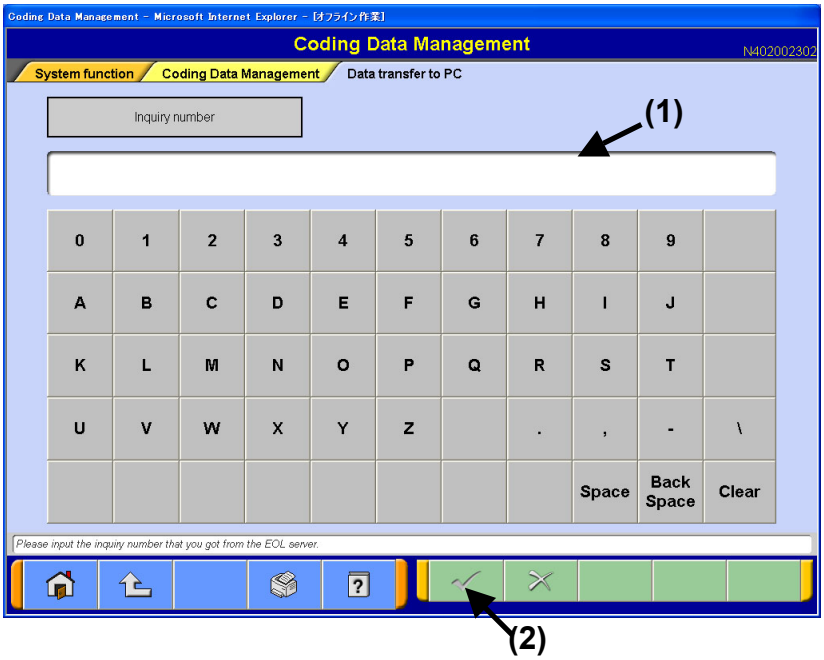
<Drive Select Window>



Window 4

- Select removable disk (Window 4: (1)) which contains data from Drive List.
- Press “Transfer” button (Window 4: (2)) to proceed to the Inquiry Number Input Window (Window 5).

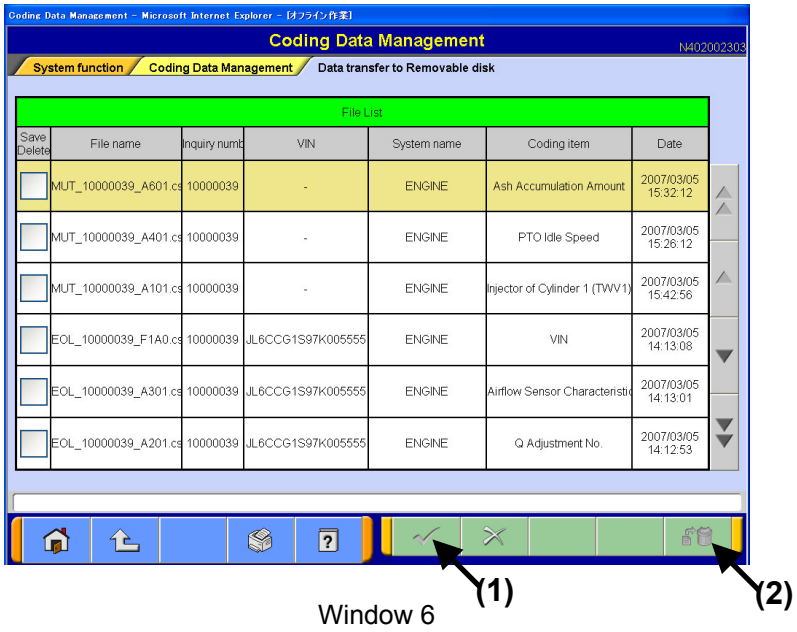
<Inquiry Number Input Window>



Window 5

- Enter inquiry number of transferred data in Inquiry Number Input Field (Window 5: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 5: (2)) to transfer all files that match the entered inquiry number to MUT PC.

<Stored File List Window>



Window 6

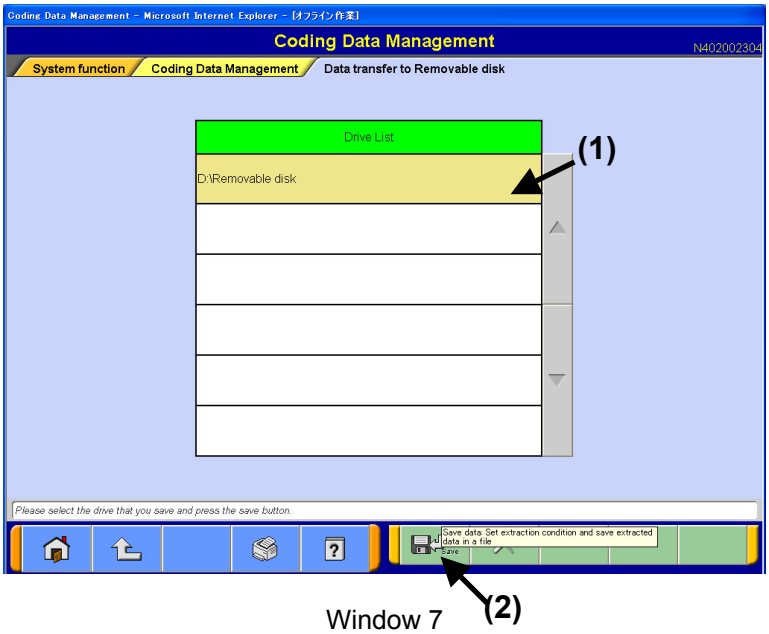
- All files stored in MUT PC are displayed.

File name	Display contents
EOL_~~~.csv	Writing file to download from EOL server.
MUT_~~~.csv	History management file to upload to EOL server. (Automatically created when writing is performed in MUT)

<To transfer a file to removable disk>
- Select a file to transfer. (Check the checkbox on the left.)
- Press OK button (Window 6: (1)) to proceed to the Drive Select Window (Window 7).

<To delete a file>
- Select a file to delete. (Check the checkbox on the left.)
- Press “Delete” button (Window 6: (2)) to delete a file after Confirmation Window is displayed.

<Drive Select Window>

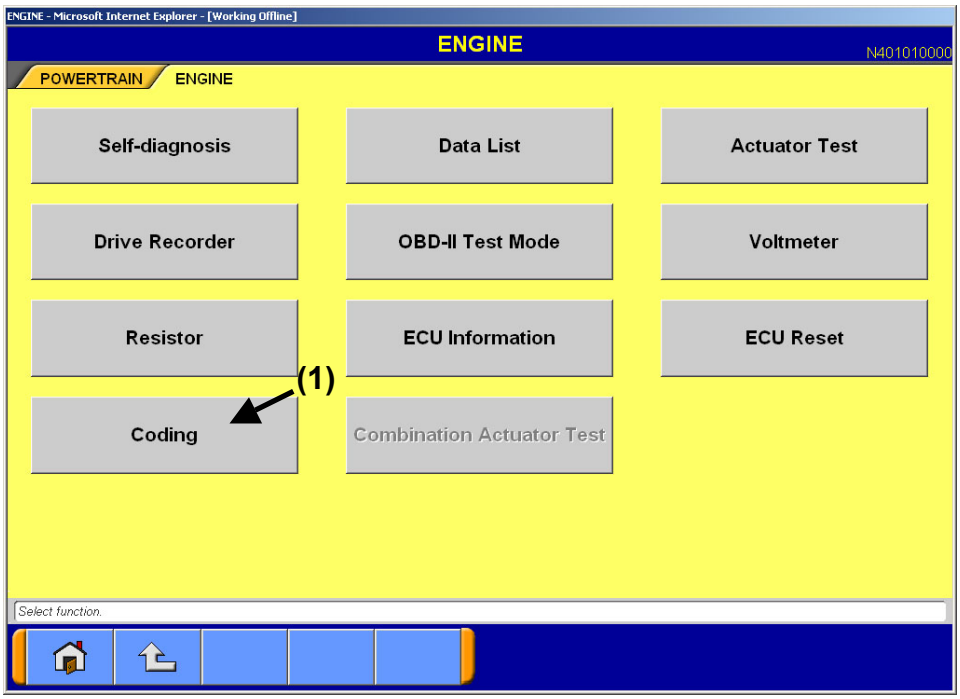


Window 7

- Select a removable disk (Window 7: (1)) to save data from Drive List.
- Press “Save” button (Window 7: (1)) to copy the selected file.

(2) All Data Writing

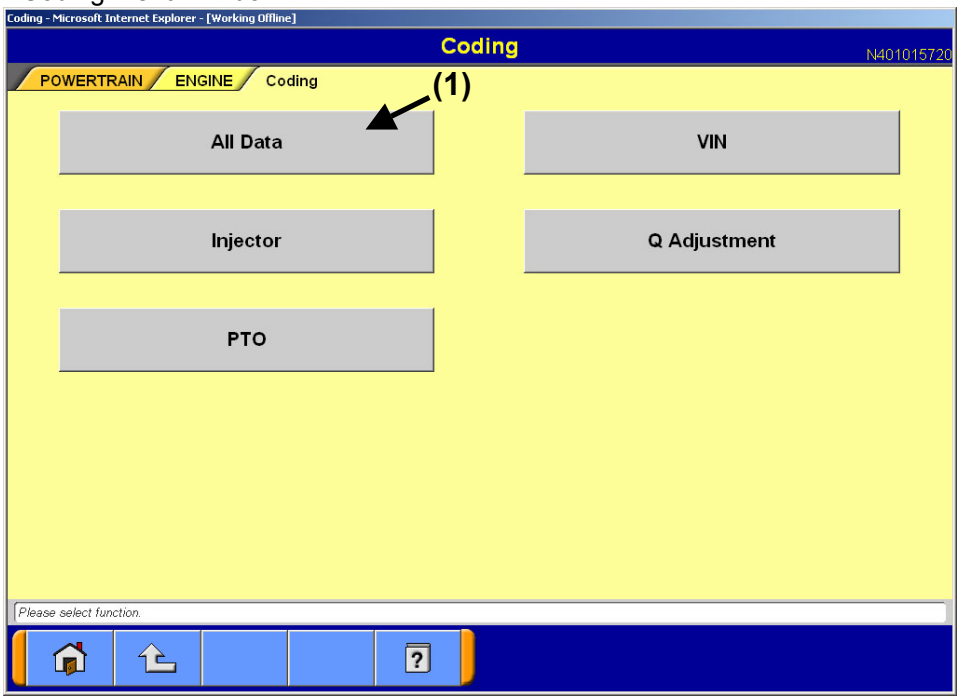
<Function Select Window>



Window 1

- Press “Coding” button (Window 1: (1)) to proceed to the Coding Menu Window (Window 2).

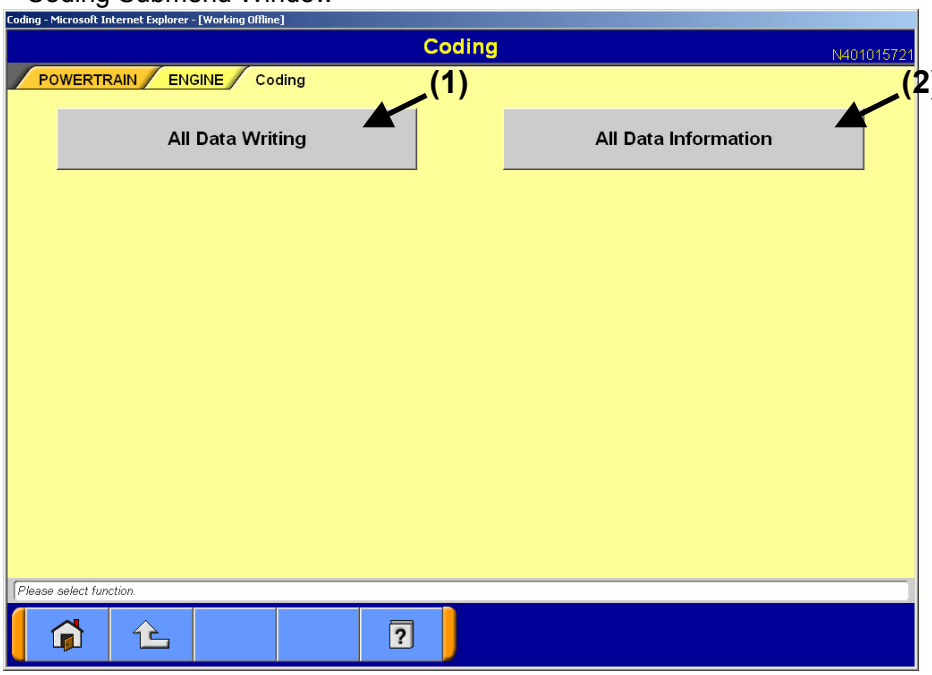
<Coding Menu Window>



Window 2

- Press “All Data” button (Window 2: (1)) to proceed to the Coding Submenu Window (Window 3).

<Coding Submenu Window>

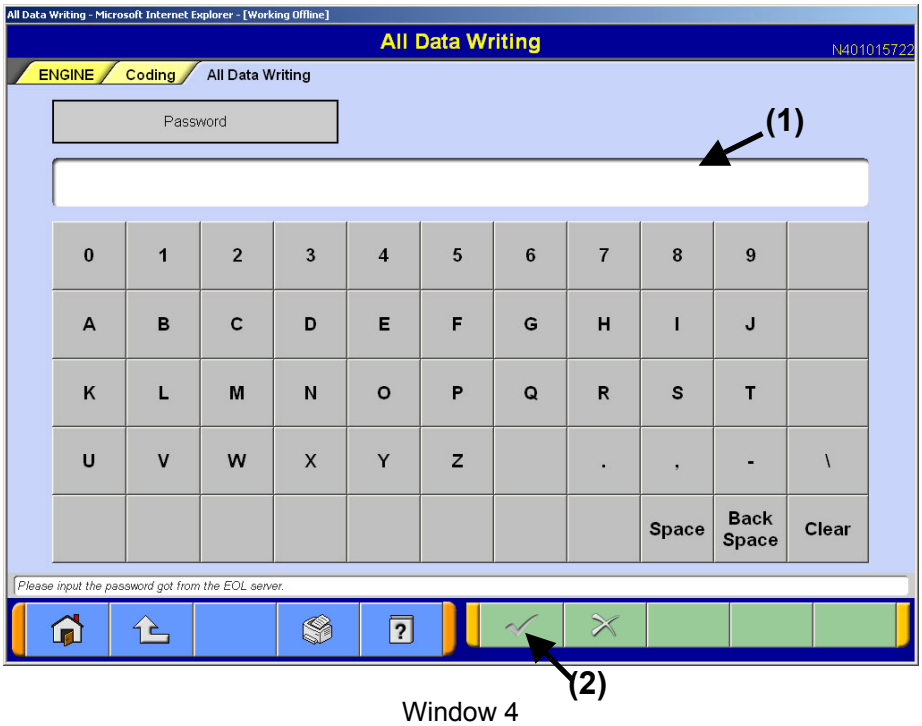


Window 3

- Press each Function button to proceed to the following windows.

Function button name	Next window	Remarks
All Data Writing (Window 3: (1))	Password Input Window (Window 4)	Write all coding data to ECU.
All Data Information (Window 3: (2))	All Data Display Window (Window 11)	Confirm coding related data which is written in ECU.

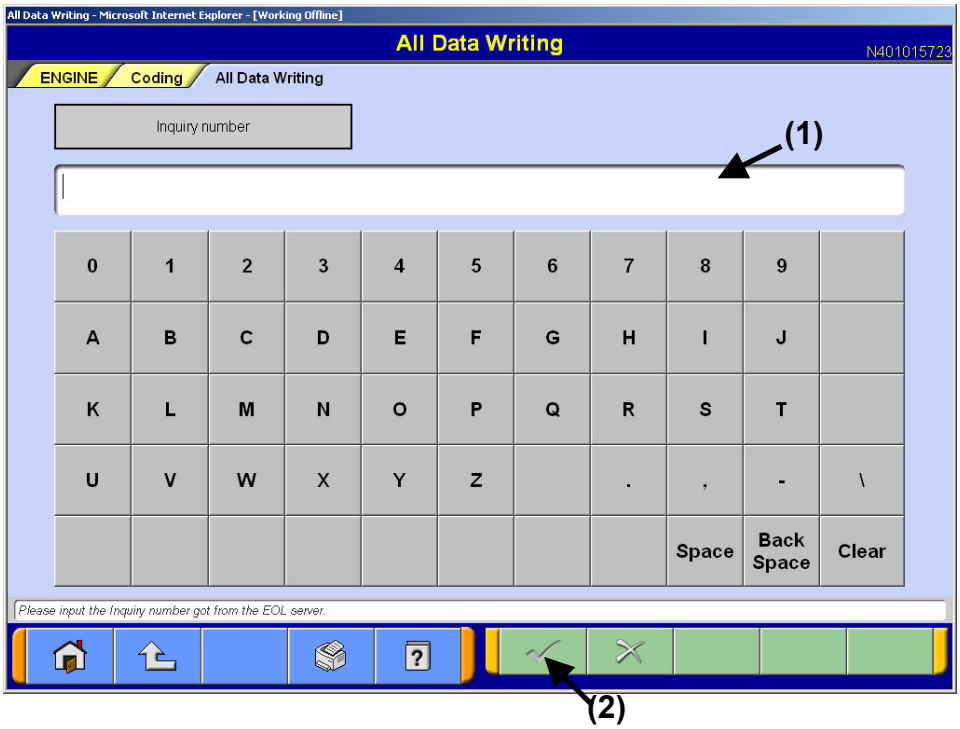
<Password Input Window>



Window 4

- Enter password obtained from EOL server into Password Input field (Window 4: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 4: (2)) to proceed to the Inquiry Number Input Window (Window 5).

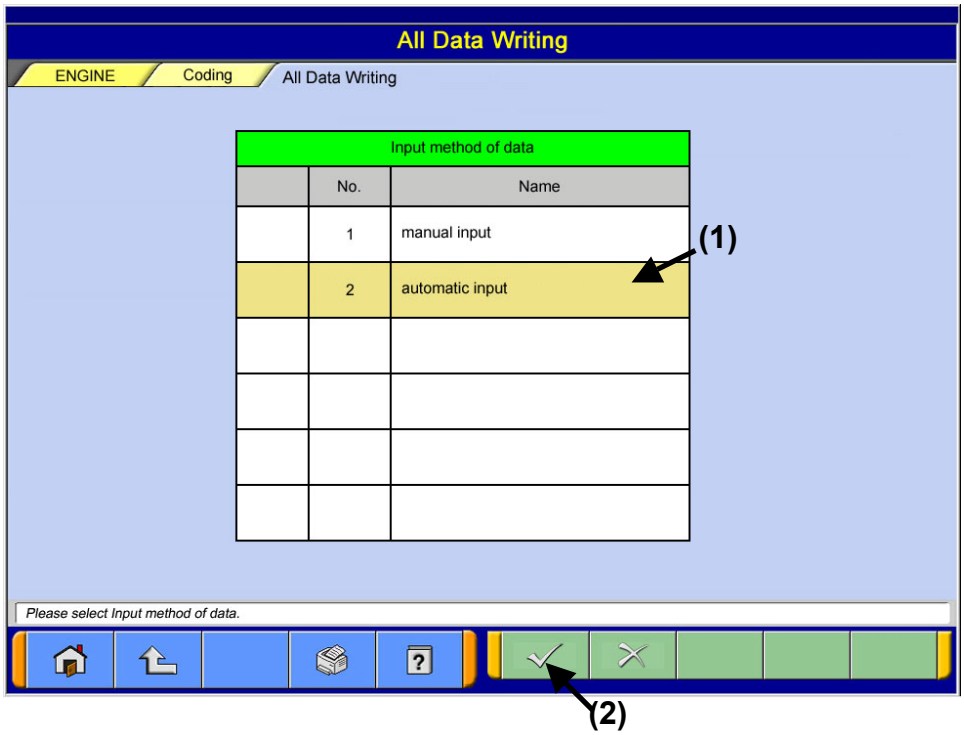
<Inquiry Number Input Window>



Window 5

- Enter inquiry number obtained from EOL server into Inquiry Number Input field (Window 5: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 5: (2)) to proceed to the Data Input Method Select Window (Window 6).

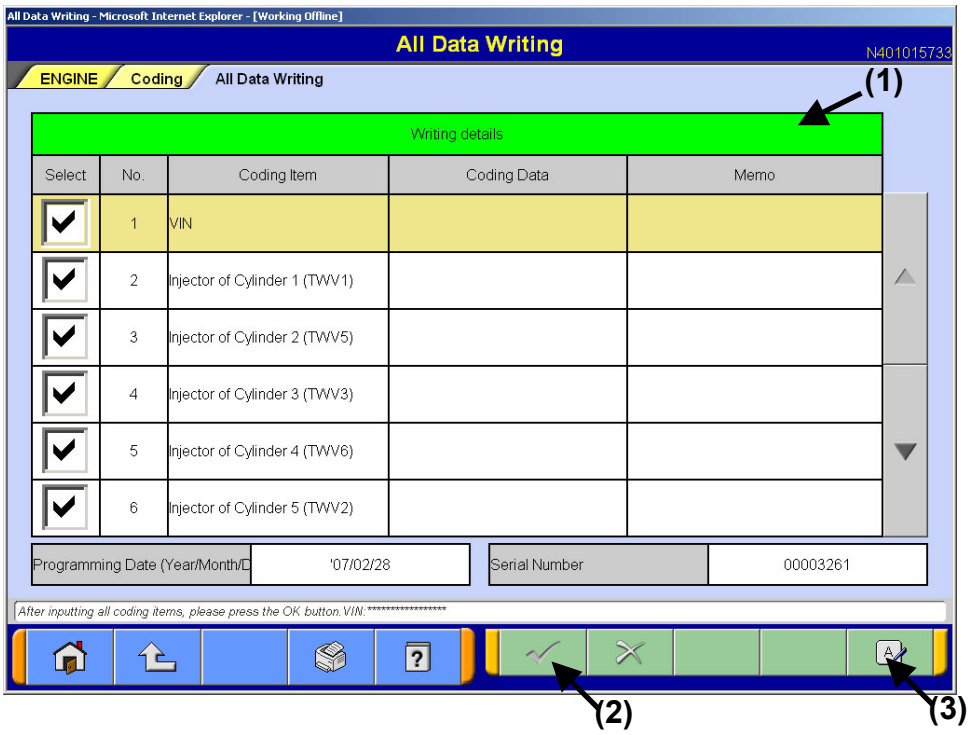
<Data Input Method Select Window>



Window 6

- Select “Automatic Input” (Window 6: (1)) and press OK button (Window 6: (2)) to proceed to the Coding Contents Confirmation Window (Window 7).

<Coding Contents Confirmation Window>

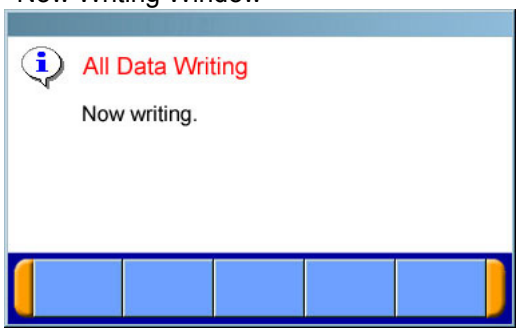


Window 7

- The writing target item related to diagnosis is displayed.
  (The coding data is automatically read from a file and displayed.)
- Uncheck coding Items which are not written.
  (All coding Items are checked by default.)
- Press Input Window Call button (Window 7: (3)) to enter “Memo”.
  (The input of work memo is optional and it needs not be entered.)

- Confirm the writing contents (Window 7: (1)) and press OK button (Window 7: (2)) to display Now Writing Window (Window 8) after Writing Confirmation Window is displayed.

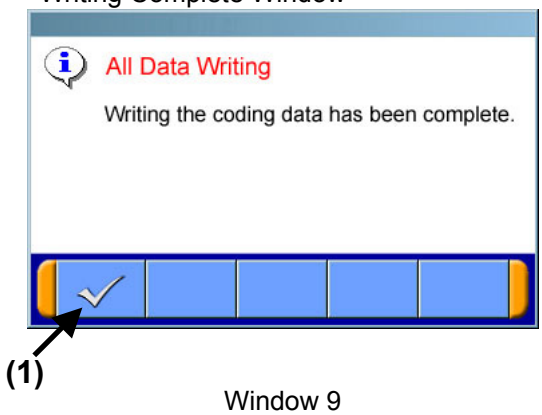
<Now Writing Window>



Window 8

- When writing is completed, Writing Complete Window (Window 9) is displayed.

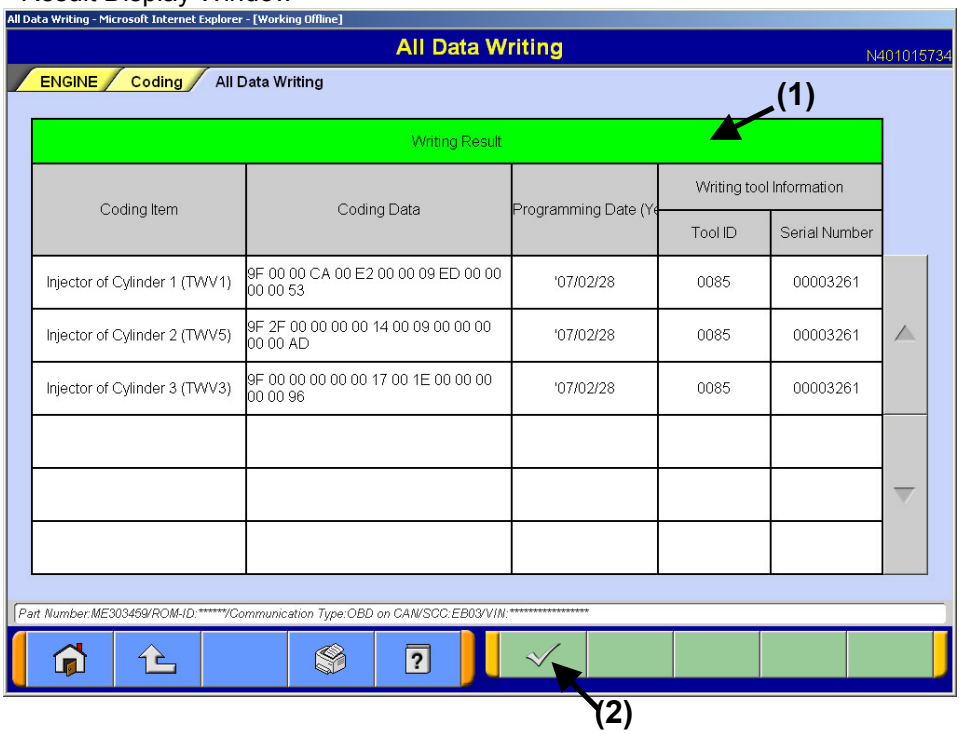
<Writing Complete Window>



Window 9

- Press OK button (Window 9: (1)) to proceed to Result Display Window (Window 10).

<Result Display Window>

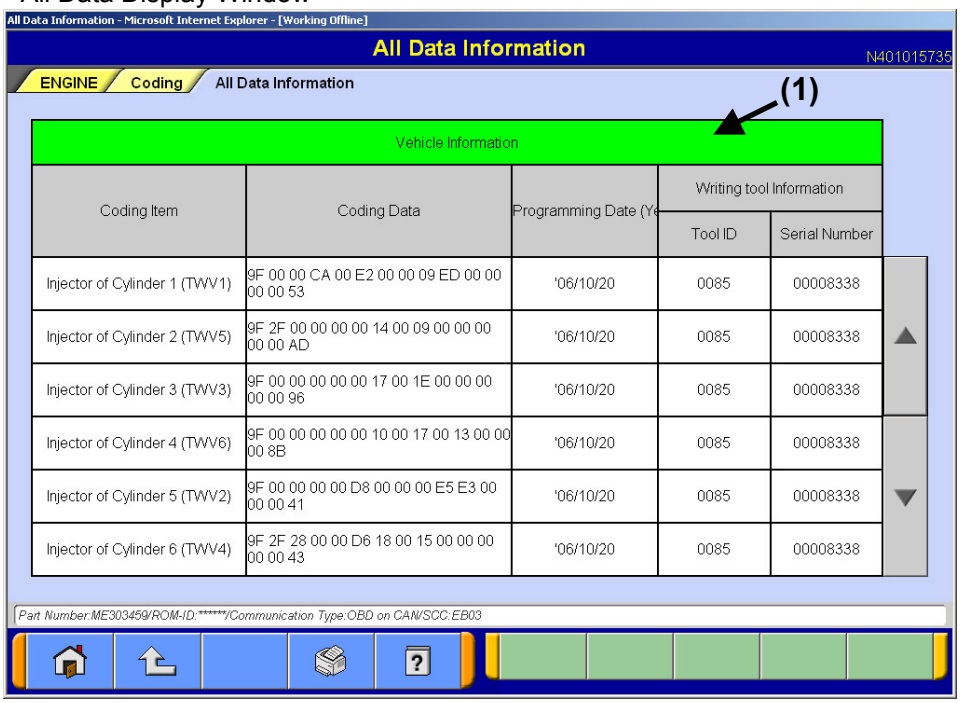


Window 10

- The writing result of coding Items for which the writing result (Window 10: (1)) is checked is displayed. (See below).
  (1) Value written in ECU
  (2) Date when rewriting is performed
  (3) ID of tool with which rewriting was performed (In case of MUT-III, “0085”)
  (4) Serial number of tool with which rewriting was performed (In case of MUT-III, serial number of V.C.I.)

- Press OK button (Window 10: (2)) to return to Coding Submenu Window (Window 3).

<All Data Display Window>

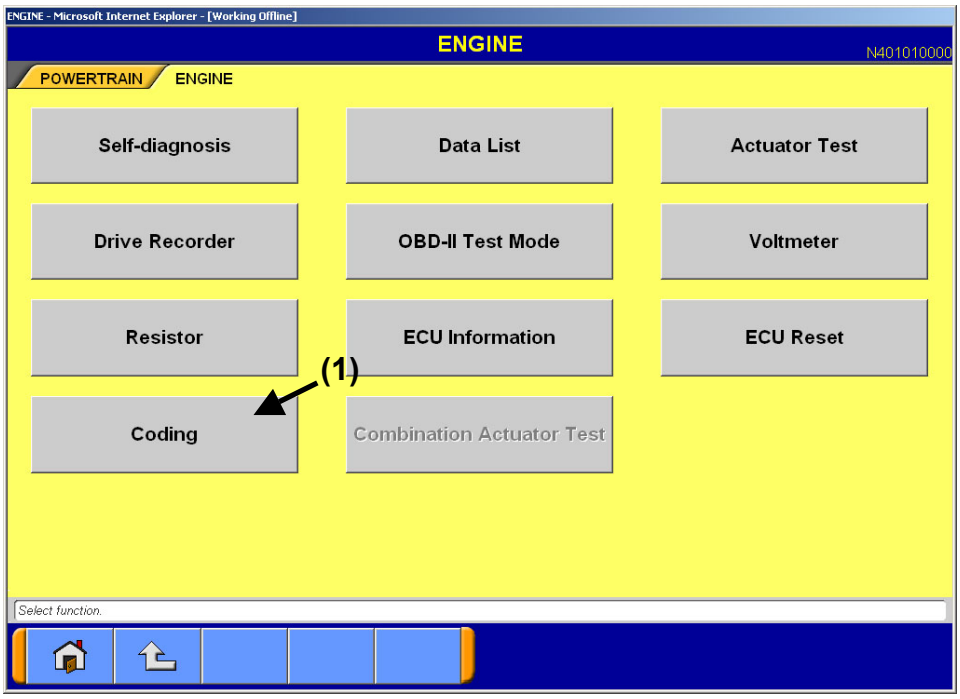


Window 11

- The following data which is written in ECU is displayed.
  (1) Value which is written in ECU
  (2) Date when rewriting was performed
  (3) ID of tool with which rewriting was performed (In case of MUT-III, “0085”)
  (4) Serial number of tool with which rewriting was performed (In case of MUT-III, serial number of V.C.I.)

(3) Injector Data Writing

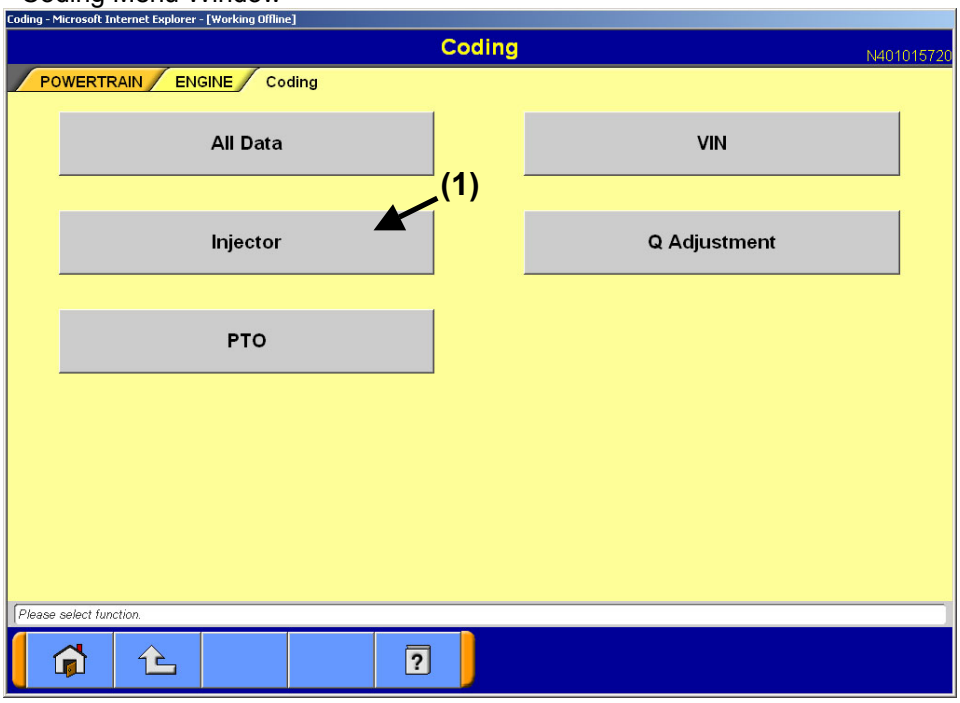
<Function Select Window>



Window 1

- Press “Coding” button (Window 1: (1)) to proceed to the Coding Menu Window (Window 2).

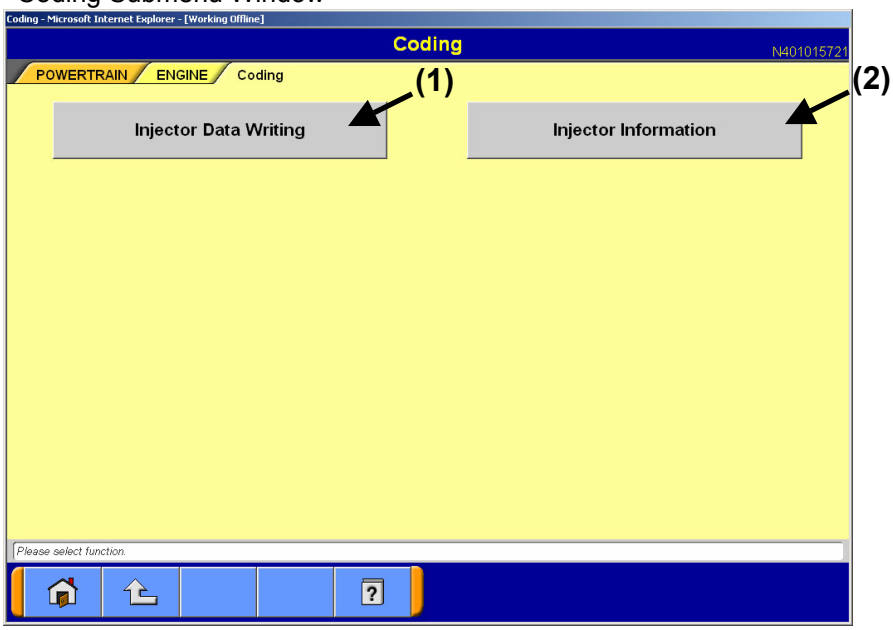
<Coding Menu Window>



Window 2

- Press “Injector” button (Window 2: (1)) to proceed to the Coding Submenu Window (Window 3).

<Coding Submenu Window>

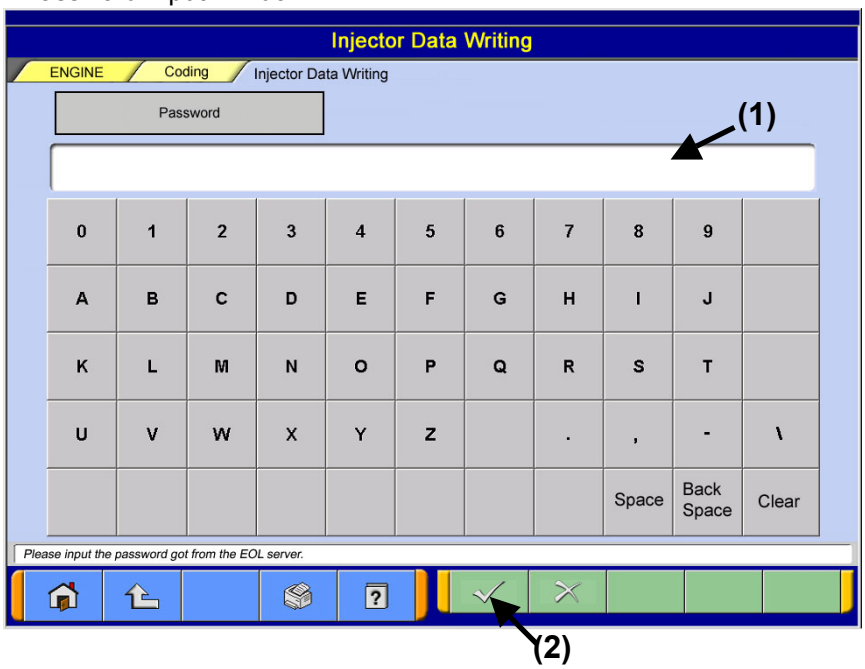


Window 3

- Press each Function button to proceed to the following windows.

Function button name	Next window	Remarks
Injector Data Writing (Window 3: (1))	Password Input Window (Window 4)	Write “correction data” of each injector.
Injector Information (Window 3: (2))	Injector Information Display Window (Window 14)	Confirm the injector information which is written in ECU (correction data, etc.).

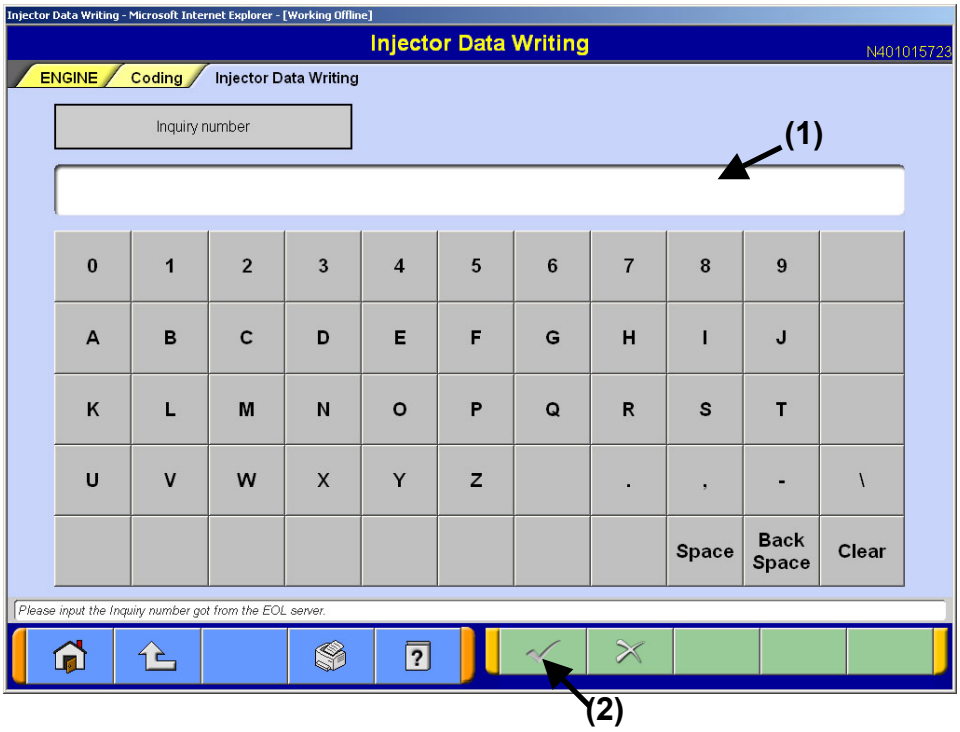
<Password Input Window>



Window 4

- Enter password obtained from EOL server in Password Input field (Window 4: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 4: (2)) to proceed to the Inquiry Number Input Window (Window 5).

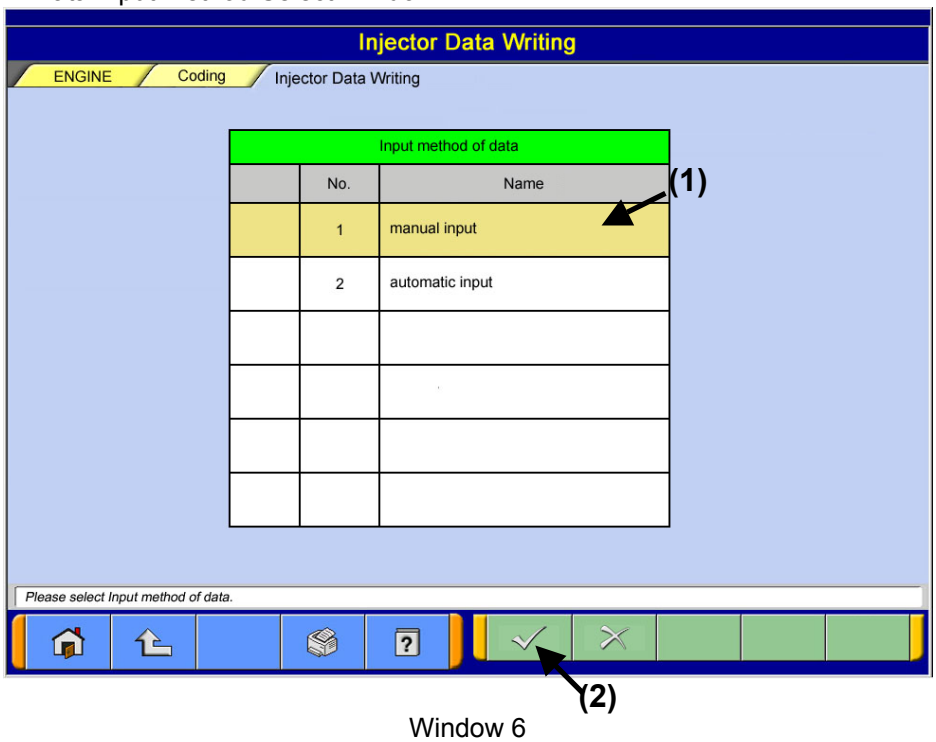
<Inquiry Number Input Window>



Window 5

- Enter inquiry number obtained from EOL server into Inquiry Number Input field (Window 5: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 5: (2)) to proceed to the Data Input Method Select Window (Window 6).

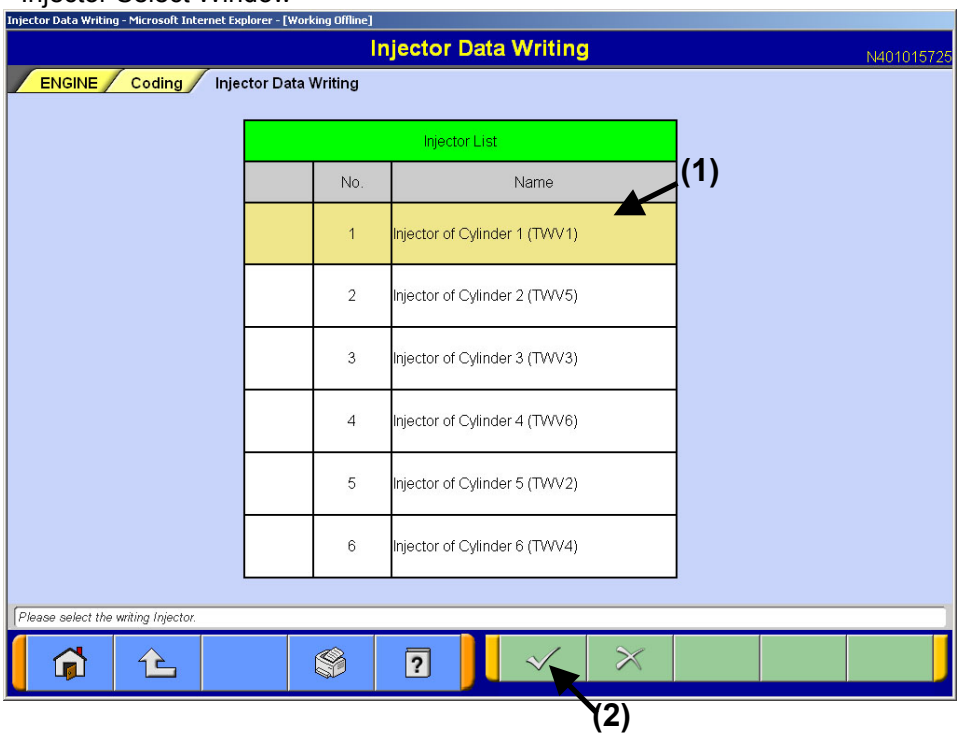
<Data Input Method Select Window>



Window 6

- Select “Manual Input” (Window 6: (1)) and press OK button (Window 6: (2)) to proceed to the Injector Select Window (Window 7).

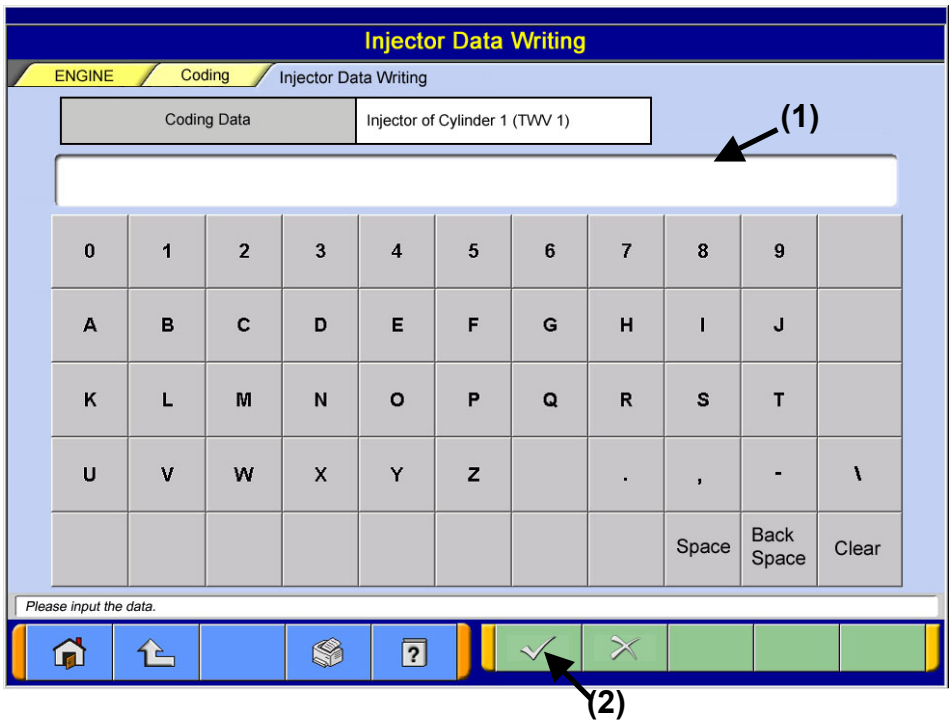
<Injector Select Window>



Window 7

- Select injector to which correction data is written from Injector List (Window 7: (1)).
- Press OK button (Window 7: (2)) to proceed to the Coding Data Input Window (Window 8).

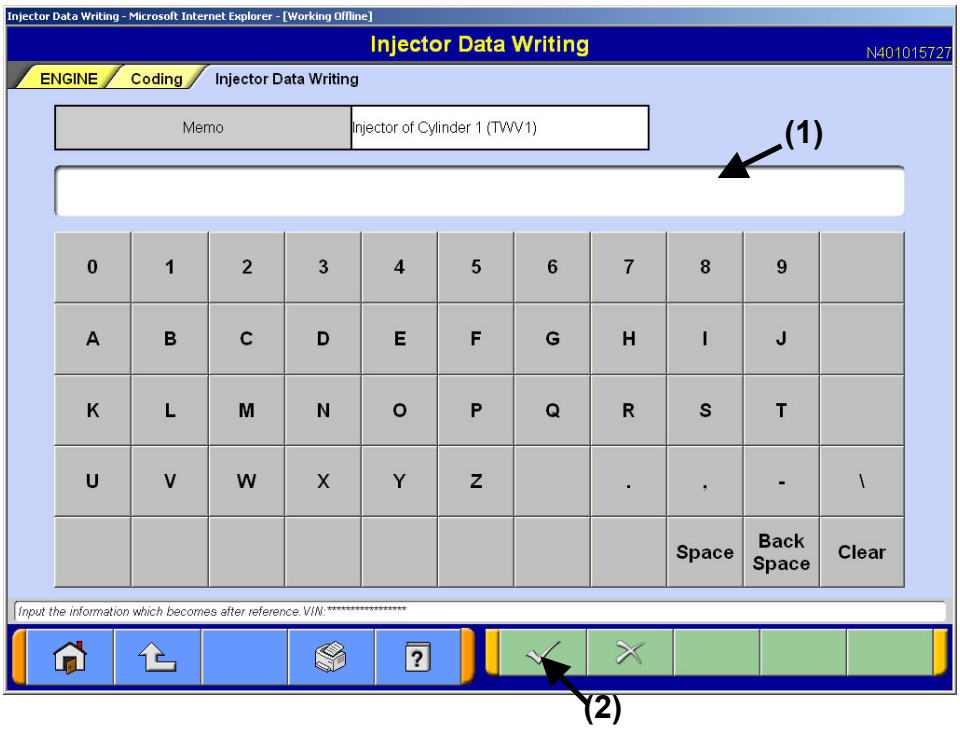
<Coding Data Input Window>



Window 8

- Enter “Correction data” which is described in Injector into Coding Data Input Field (Window 8: (1)) (4M: 6 digits, 6M: 30 digits) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 8: (2)) to proceed to the Work Memo Input Window (Window 9).

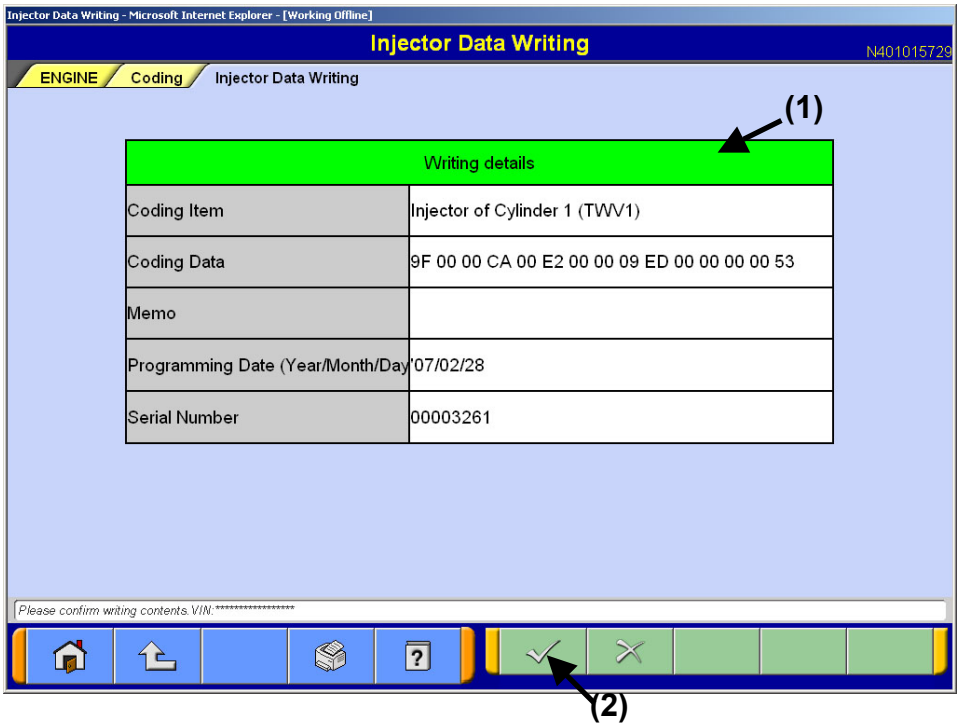
<Work Memo Input Window>



Window 9

- Enter memo for reference into Work Memo Input field (Window 9: (1)) from the keyboard of MUT Screen or PC main unit. (As the input is optional, it can be left blank.)
- Press OK button (Window 9: (2)) to proceed to the Coding Contents Confirmation Window (Window 10).

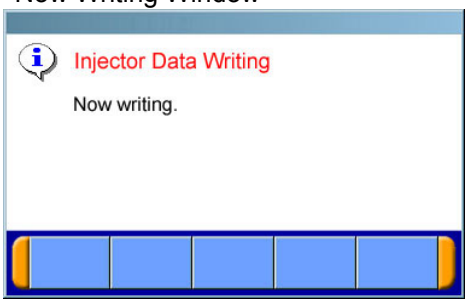
<Coding Contents Confirmation Window>



Window 10

- Confirm the writing contents (Window 10: (1)) and press OK button (Window 10: (2)) to proceed to the display Now Writing Window (Window 11) after Writing Confirmation Window is displayed.

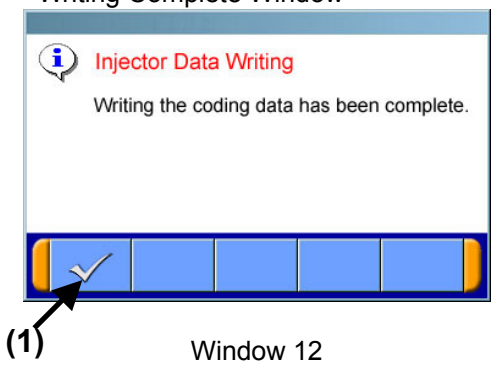
<Now Writing Window>



Window 11

- After writing is completed, Writing Complete Window (Window 12) is displayed.

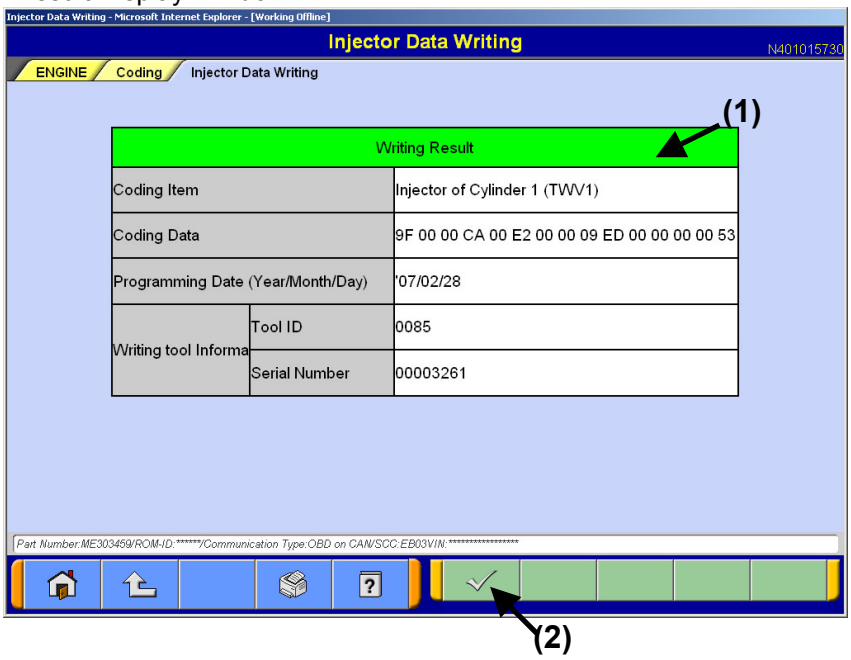
<Writing Complete Window>



Window 12

- Press OK button (Window 12: (1)) to proceed to the Result Display Window (Window 13).

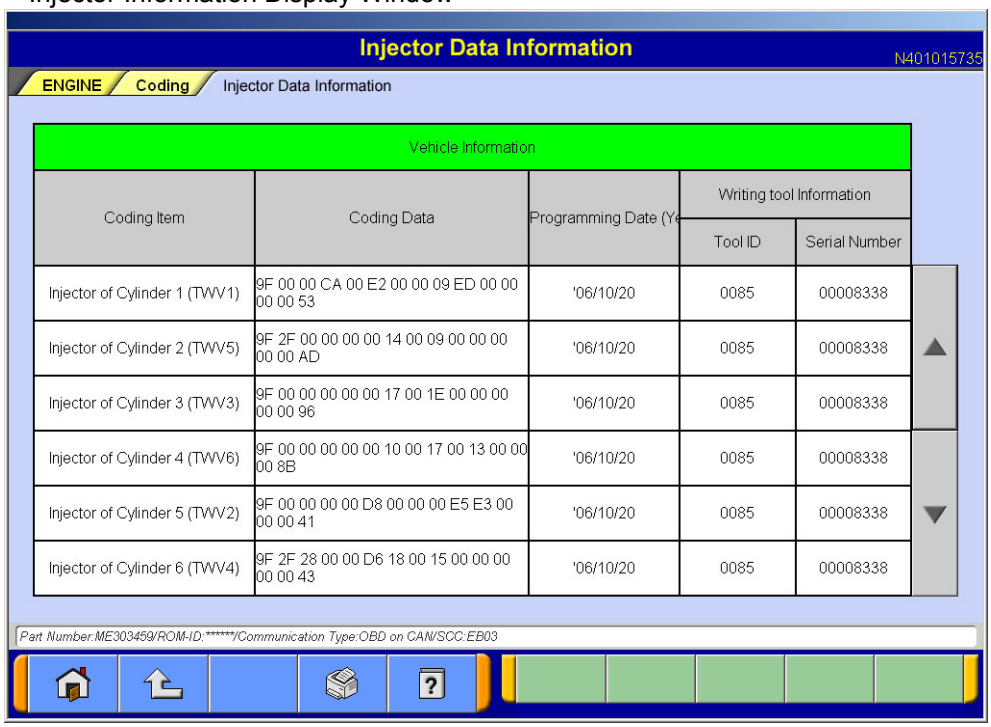
<Result Display Window>



Window 13

- The writing result is displayed in Writing Result Window (Window 13: (1)) (See below).
  (1) "Correction data" of injector
  (2) Date when rewriting was performed
  (3) ID of tool with which rewriting was performed (In case of MUT-III, "0085")
  (4) Serial number of tool with which rewriting was performed (In case of MUT-III, serial number of V.C.I.)
- Press OK button (Window 13: (2)) to proceed to the Coding Submenu Window (Window 3).

<Injector Information Display Window>

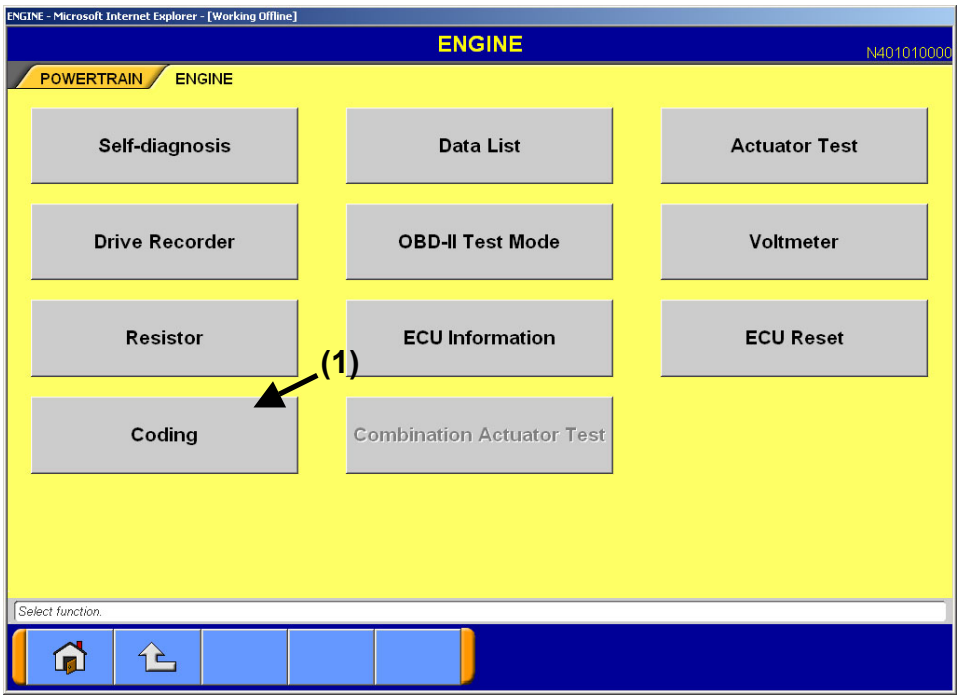


Window 14

- The following information which is written in ECU is displayed.
  (1) “Correction data” of injector
  (2) Date when rewriting was performed.
  (3) ID of tool with which rewriting was performed (In case of MUT-III, “0085”)
  (4) Serial number of tool with which rewriting was performed (In case of MUT-III, serial number of V.C.I.)

(4) PTO Idle Speed Writing

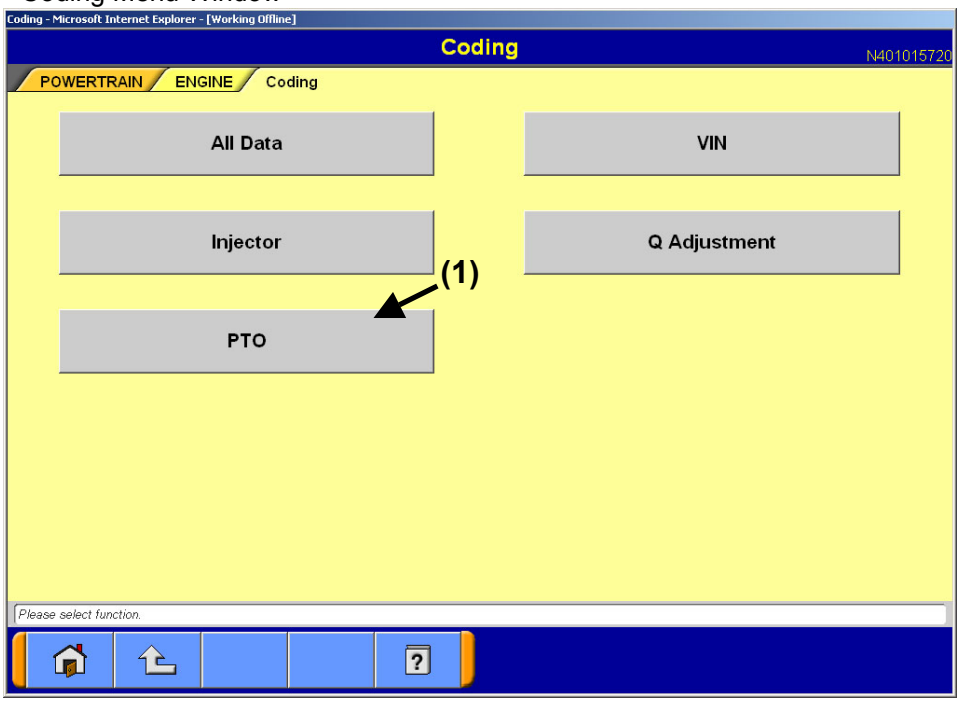
<Function Select Window>



Window 1

- Press “Coding” button (Window 1: (1)) in Function Select Window to proceed to the Coding Menu Window (Window 2).

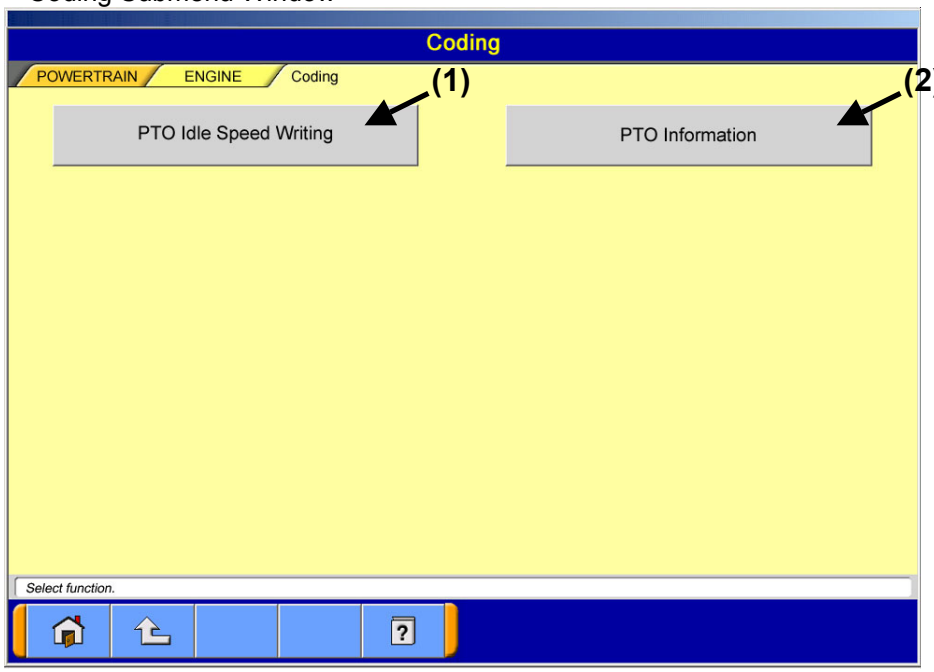
<Coding Menu Window>



Window 2

- Press “PTO” button (Window 2: (1)) to proceed to the Coding Submenu Window (Window 3).

<Coding Submenu Window>

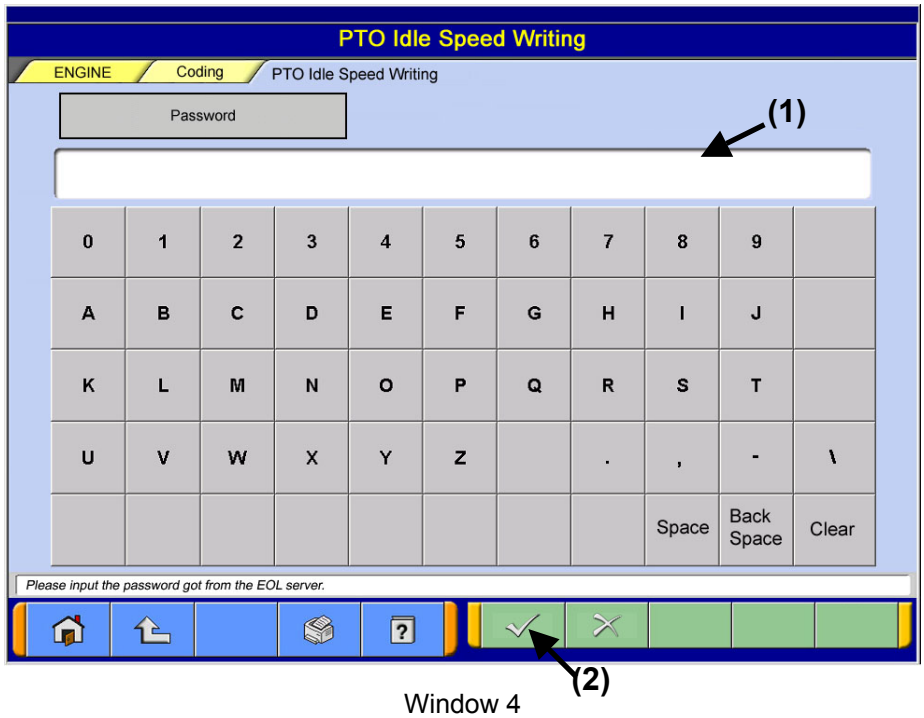


Window 3

- Press each Function button to proceed to the the following windows.

Function button name	NEXT window	Remarks
PTO Idle speed Writing (Window 3: (1))	Password Input Window (Window 4)	Write “PTO idle speed” manually/automatically.
PTO Information (Window 3: (2))	PTO Information Display Window (Window 13)	Confirm the PTO information written in ECU (PTO idle rotation number, etc.).

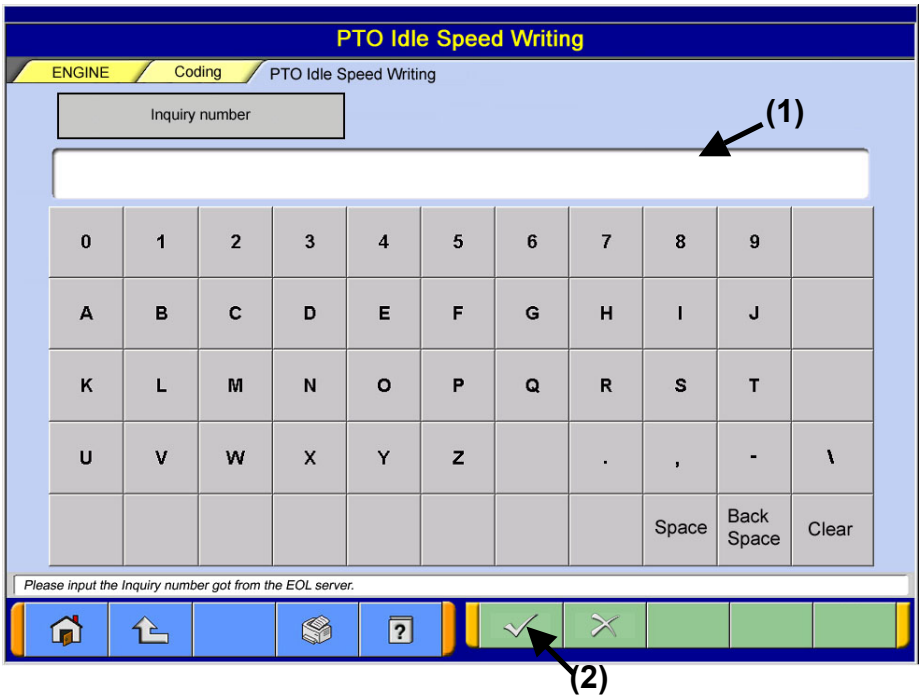
<Password Input Window>



Window 4

- Enter password in Password Input field (Window 4: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 4: (2)) to proceed to the Inquiry Number Input Window (Window 5).

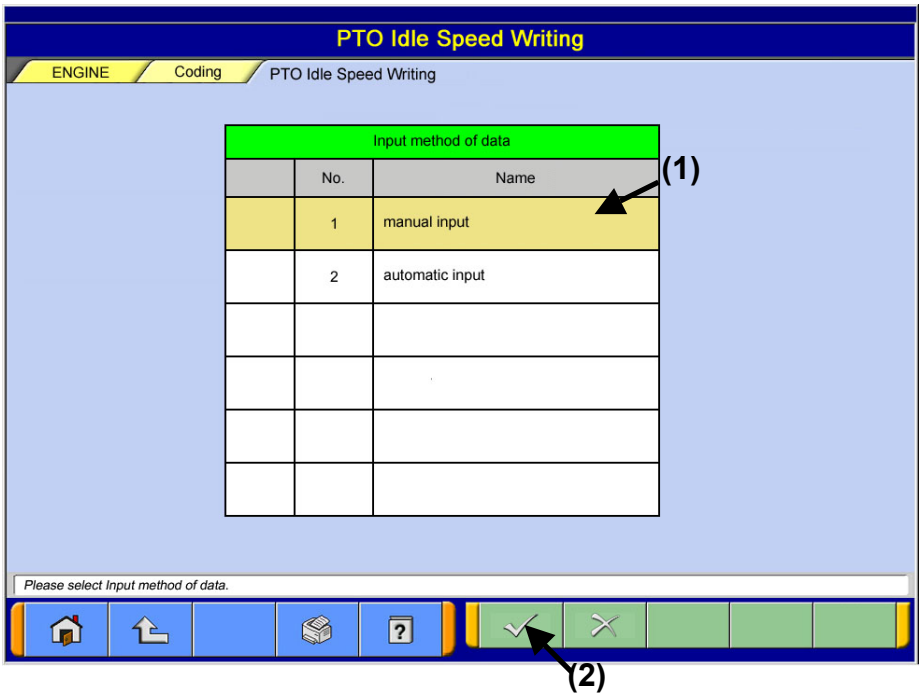
<Inquiry Number Input Window>



Window 5

- Enter inquiry number in Inquiry Number Input field (Window 5: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 5: (2)) to proceed to the Data Input Method Select Window (Window 6).

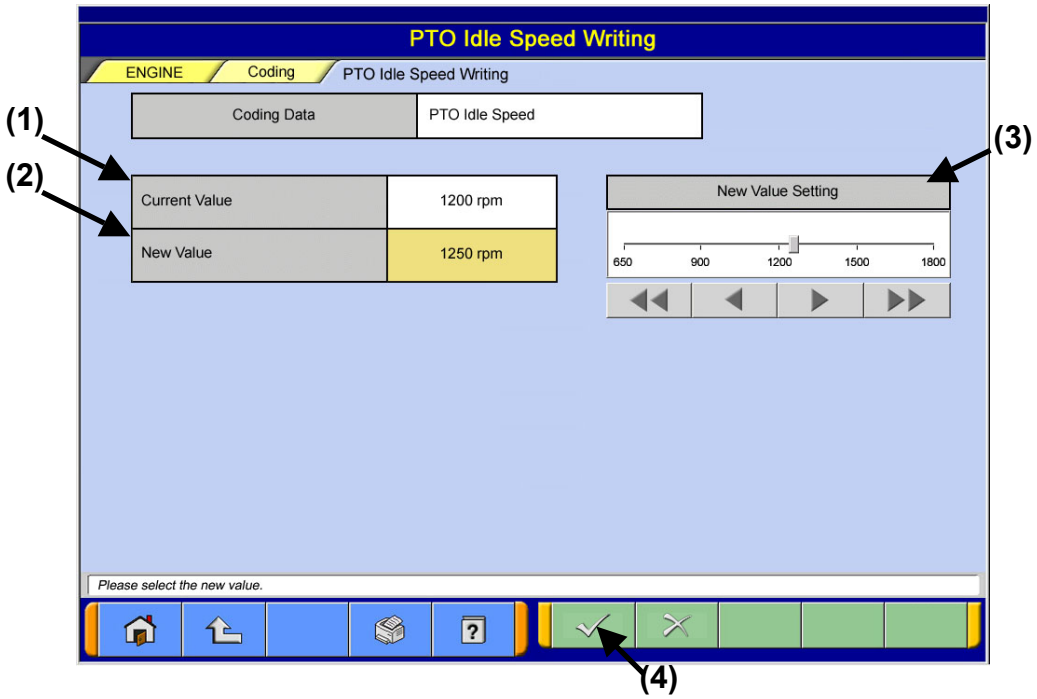
<Data Input Method Select Window>



Window 6

- Select “Manual input” (Window 6: (1)) and press OK button (Window 6: (2)) to proceed to the Coding Data Input Window (Window 7).

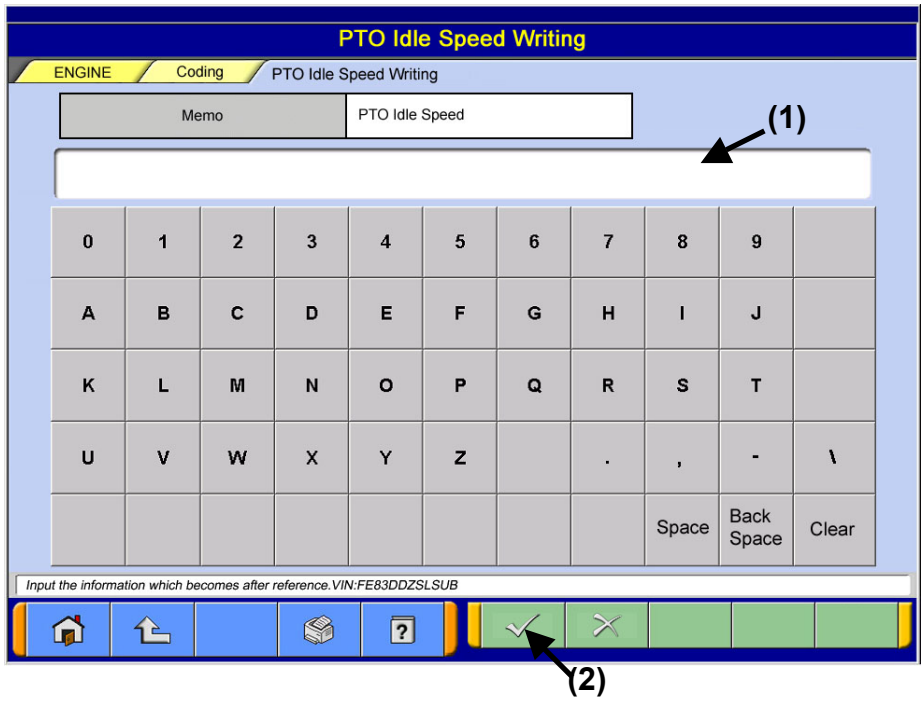
<Coding Data Input Window>



Window 7

- The current value written in “Current Value” (Window 7: (1)) in ECU is displayed.
- The value written in “New Value” (Window 7: (2)) in ECU is displayed.
- Select PTO idle rotation number using the slider in “New Value Setting” (Window 7: (3)) and up/down buttons.
- Press OK button (Window 7: (4)) to proceed to the Work Memo Input Window (Window 8).

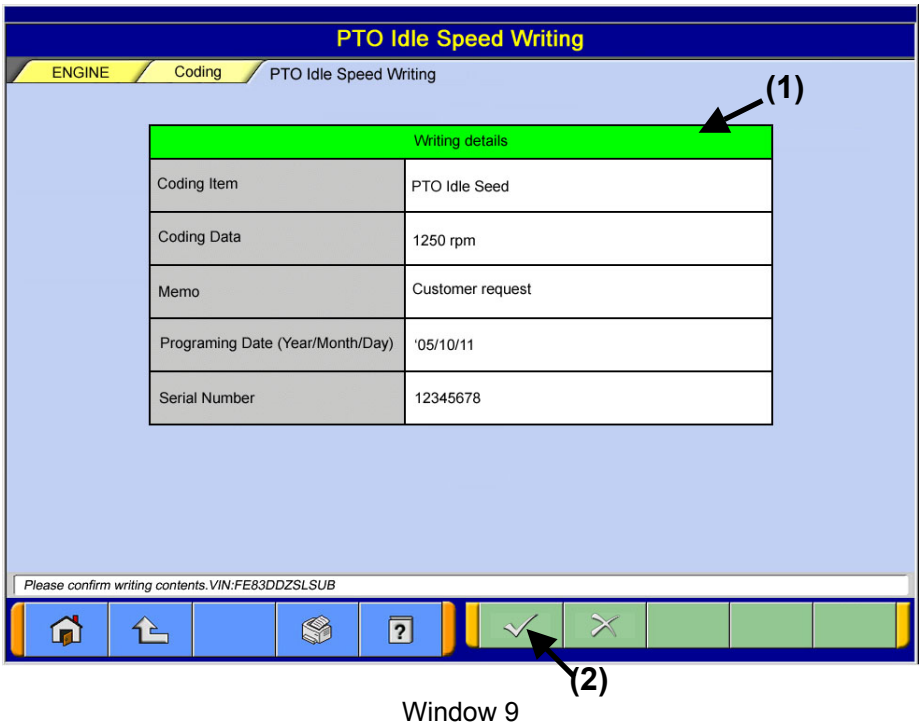
<Work Memo Input Window>



Window 8

- Enter memo in Work Memo Input field (Window 8: (1)) from the keyboard of MUT Screen or PC main unit, (It can be left blank)
- Press OK button (Window 8: (2)) to proceed to the Coding Contents Confirmation Window (Window 9).

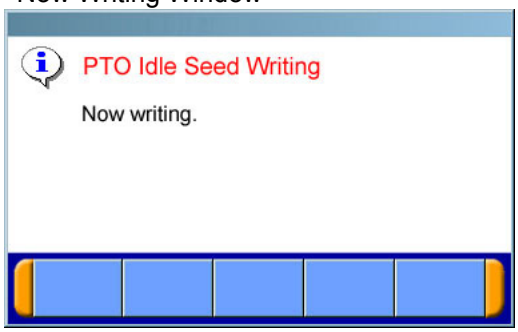
<Coding Contents Confirmation Window>



Window 9

- Confirm the writing contents (Window 9: (1)) and press OK button (Window 9: (2)) to display Now Writing Window (Window 10) after Writing Confirmation Window is displayed.

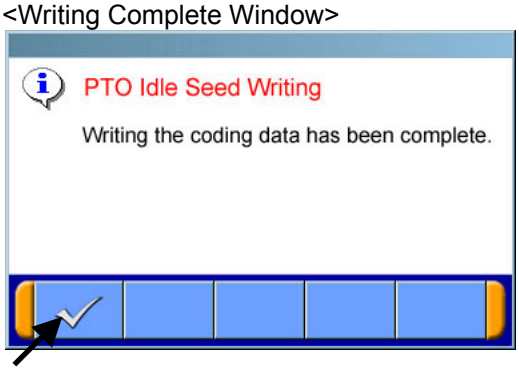
<Now Writing Window>



Window 10

- When writing is completed, Writing Complete Window (Window 11) is displayed.

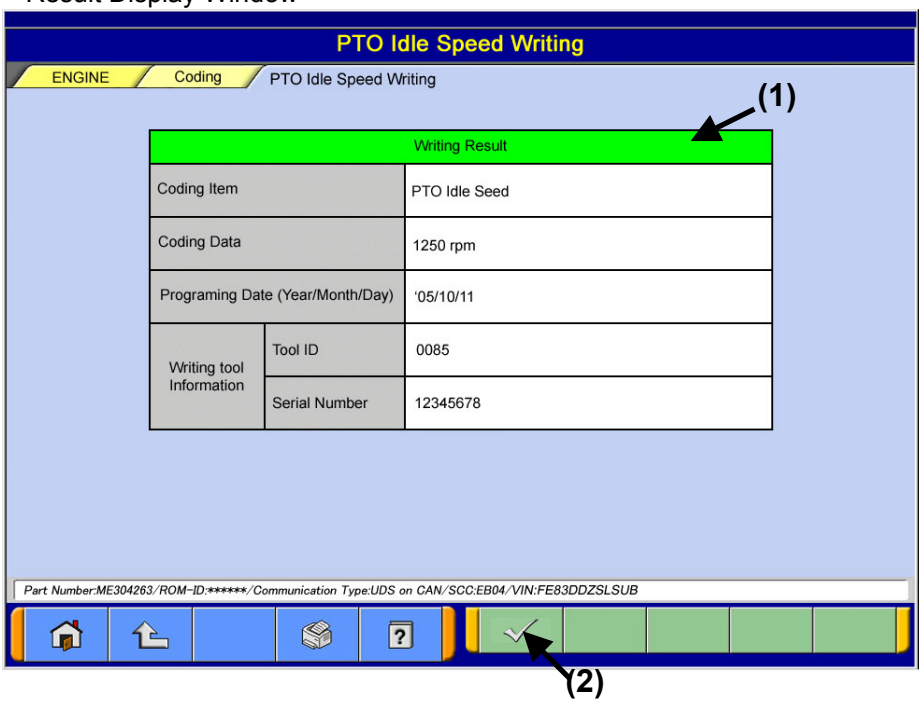
<Writing Complete Window>



Window 11

- Press OK button (Window 11: (1)) to proceed to the Result Display Window (Window 12).

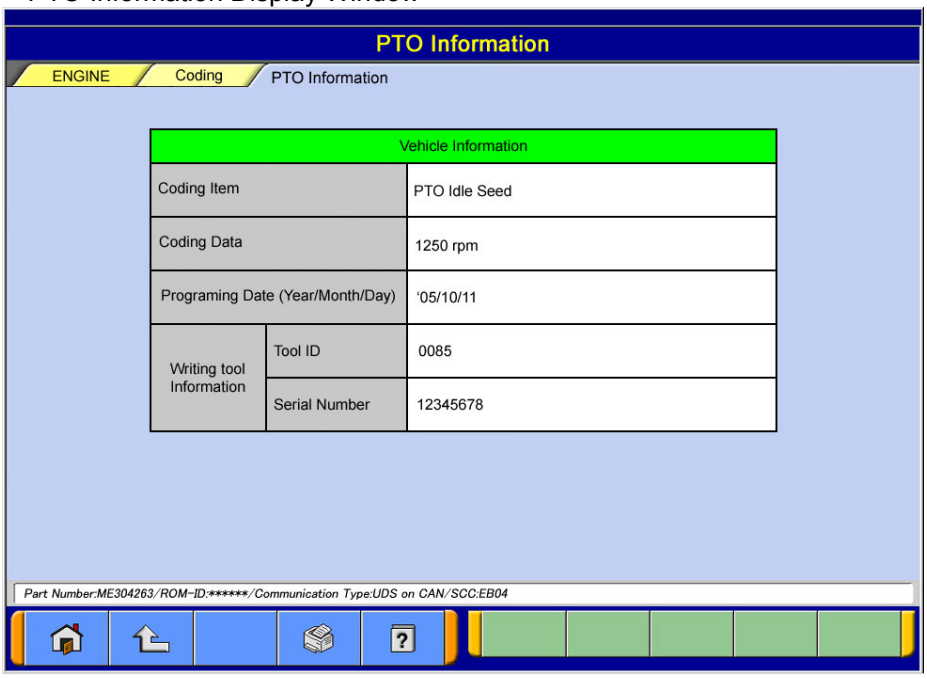
<Result Display Window>



Window 12

- Writing result is displayed in Writing Result Window (Window 12: (1)).
- Press OK button (Window 12: (2)) to return to Coding Submenu Window (Window 3).

<PTO Information Display Window>

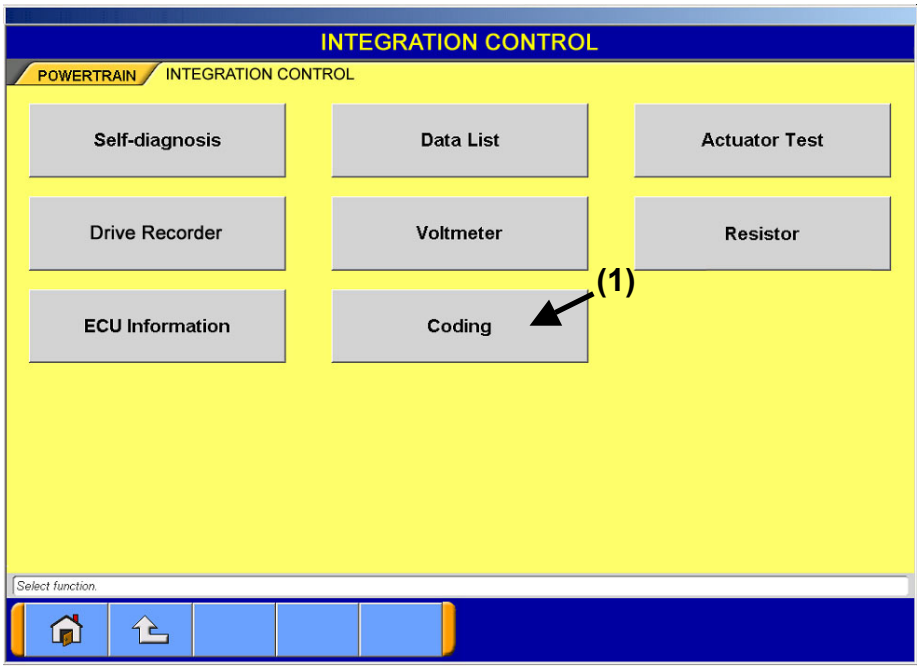


Window 13

- The “PTO idle rotation number” which is written in ECU is displayed.

(5) SLD Limited Speed Writing

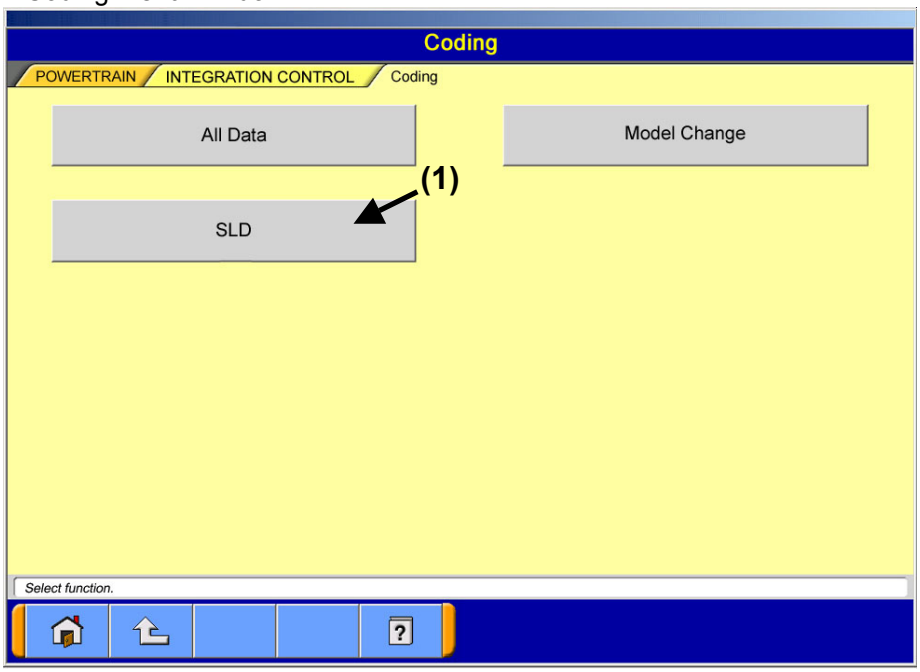
<Function Select Window>



Window 1

- Press “Coding” button (Window 1: (1)) in Function Select Window to proceed to the Coding Menu Window (Window 2).

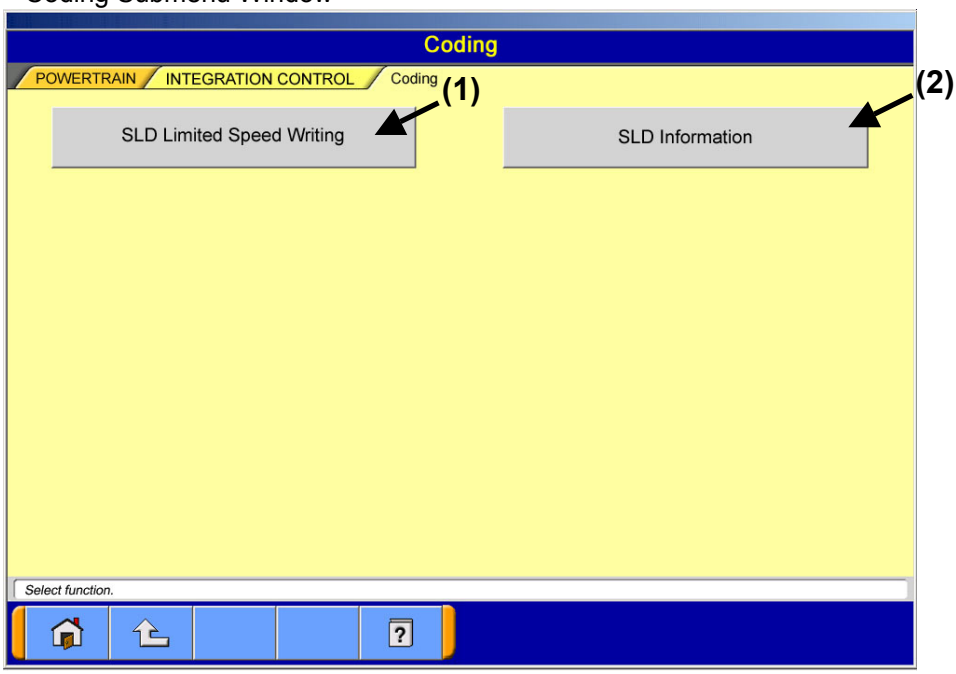
<Coding Menu Window>



Window 2

- Press “SLD” button (Window 2: (1)) to proceed to the Coding Submenu Window (Window 3).

<Coding Submenu Window>

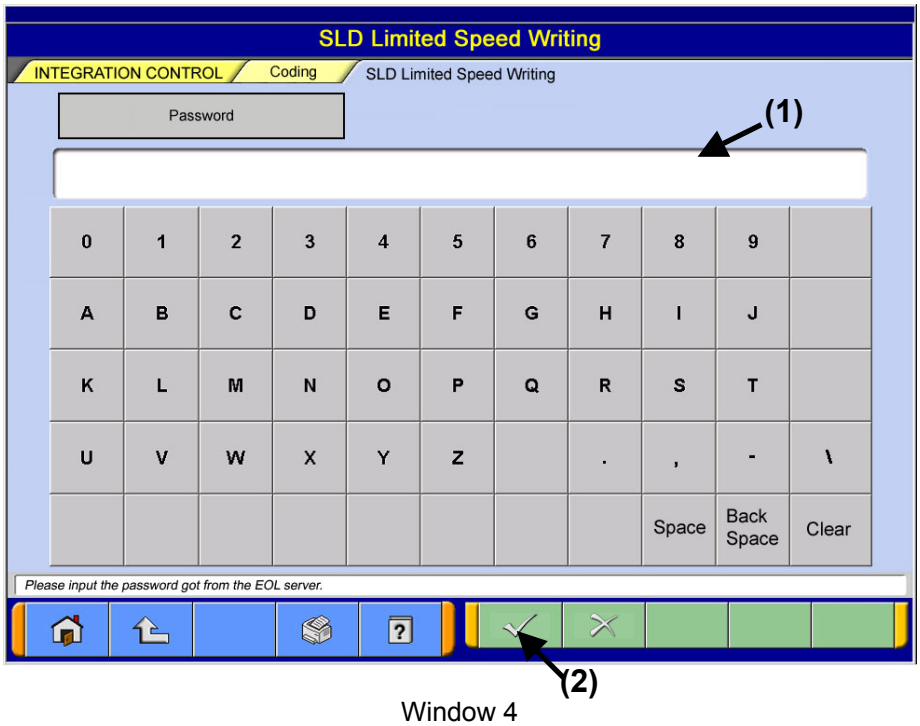


Window 3

- Press each Function button to proceed to the following windows.

Function button name	Next window	Remarks
SLD Limited Speed Writing (Window 3: (1))	Password Input Window (Window 4)	Write “SLD limit vehicle speed” manually/ automatically.
SLD Information (Window 3: (2))	SLD Information Display Window (Window 13)	Confirm the SLD information (SLD limit vehicle speed, etc.) which is written in ECU.

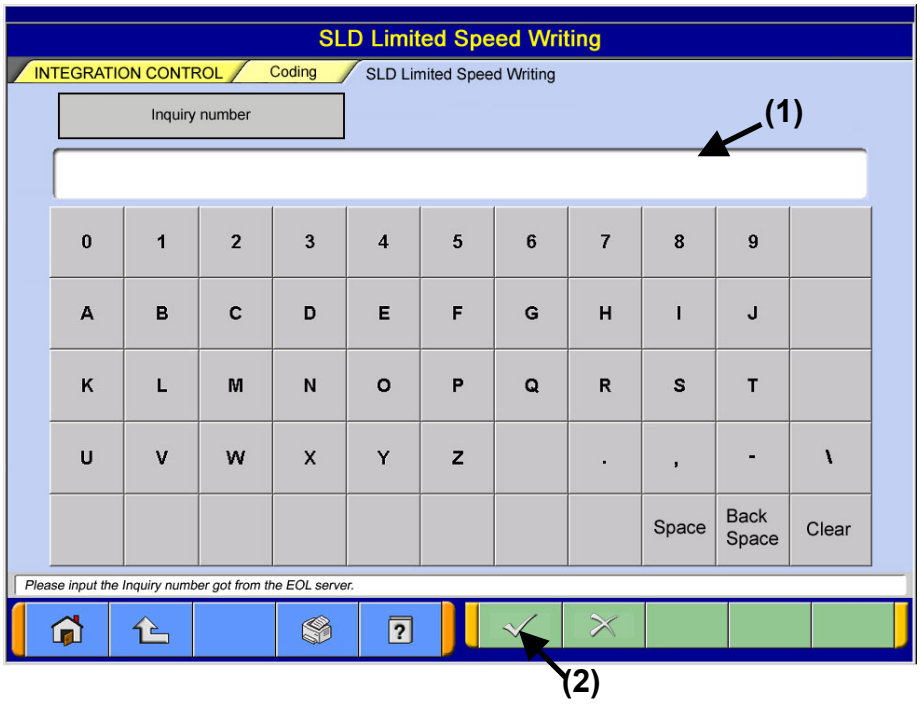
<Password Input Window>



Window 4

- Enter password in Password Input field (Window 4: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 4: (2)) to proceed to the Inquiry Number Input Window (Window 5).

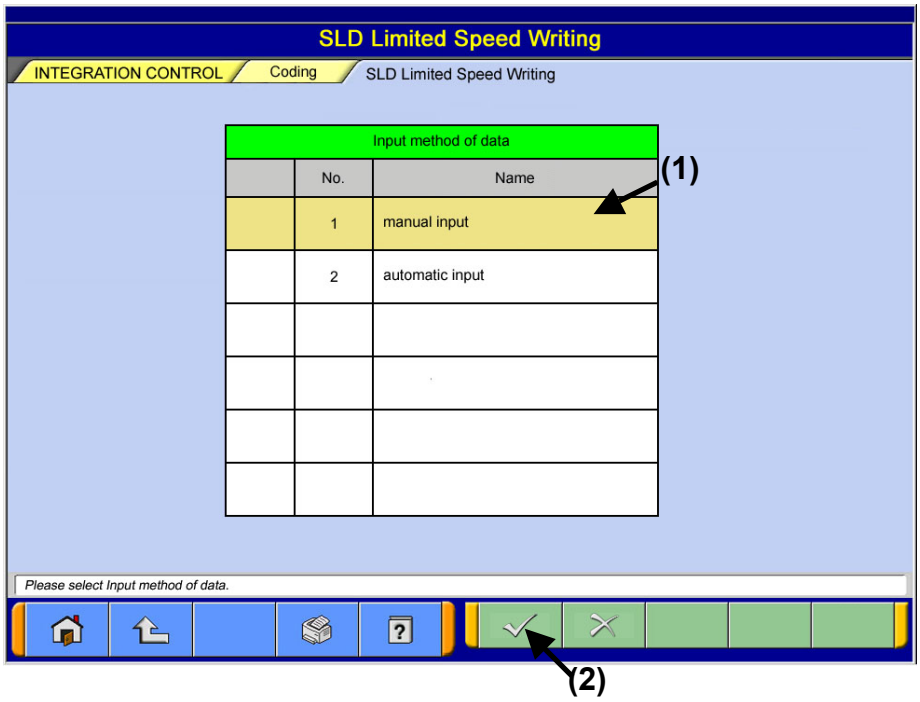
<Inquiry Number Input Window>



Window 5

- Enter inquiry number in Inquiry Number Input field (Window 5: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 5: (2)) to proceed to the Data Input Method Select Window (Window 6).

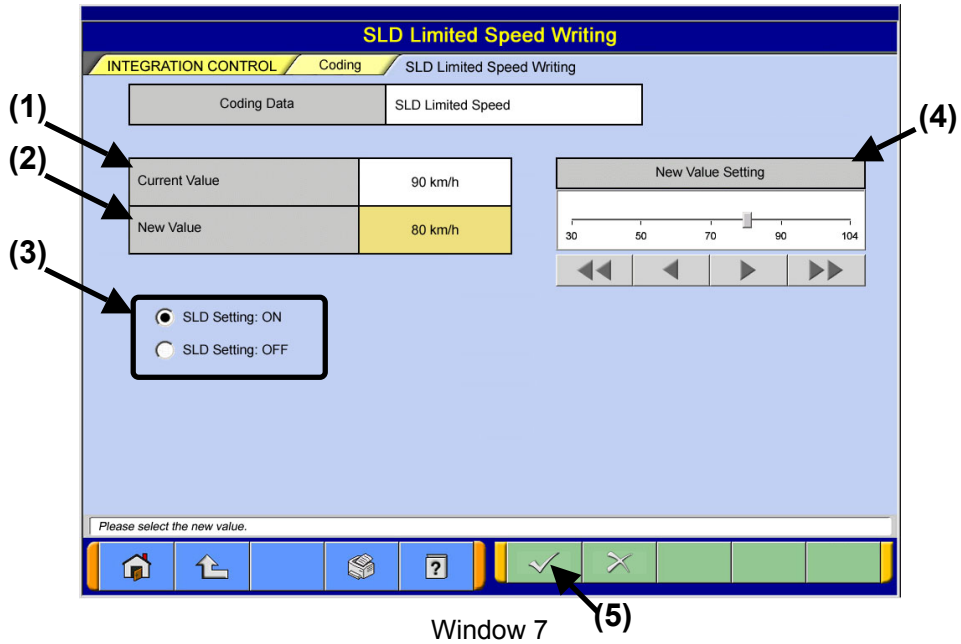
<Data Input Method Select Window>



Window 6

- Select “Manual input” (Window 6: (1)) and press OK button (Window 6: (2)) to proceed to the Coding Data Input Window (Window 7).

<Coding Data Input Window>



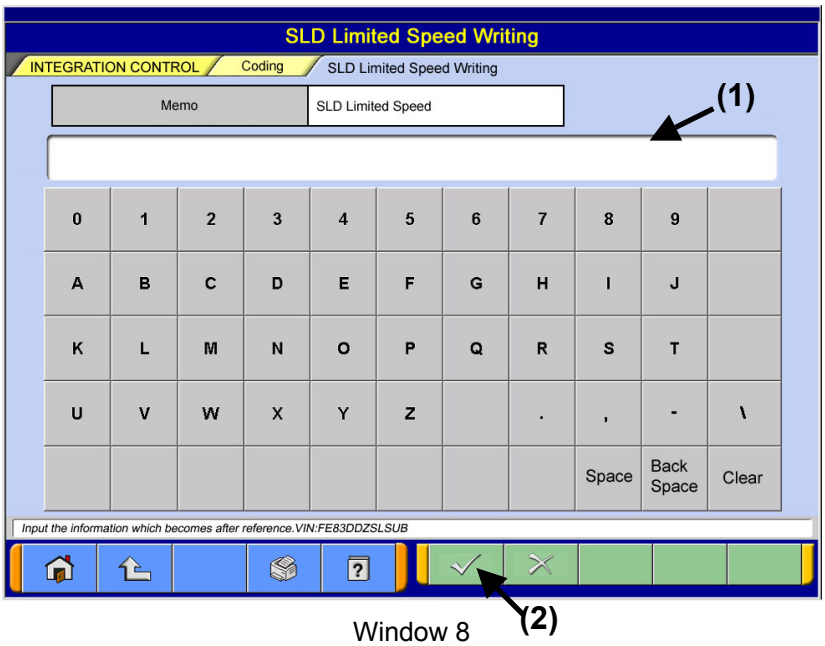
Window 7

- The current value written in “Current Value” (Window 7: (1)) in ECU is displayed.
- A value written in “New Value” (Window 7: (2)) in ECU is displayed.

- Select SLD ON/OFF in “SLD Setting” (Window 7: (3)).
  ON: Select SLD vehicle speed (30 km/h to 104 km/h) using the slider.
  OFF: No limit vehicle speed (255 km/h)
- Select SLD vehicle speed using slider in “New Value Setting” (Window 7: (4)) and increase/decrease button.

- Press OK button (Window 7: (5)) to proceed to the Work Memo Input Window (Window 8).

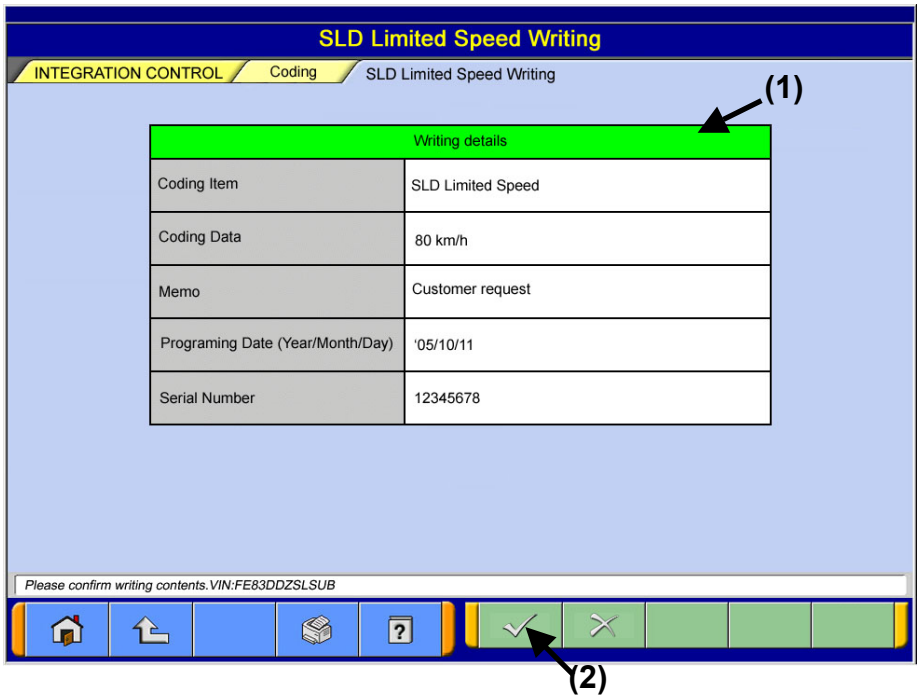
<Work Memo Input Window>



Window 8

- Enter memo in Work Memo Input field (Window 8: (1)) from the keyboard of MUT Screen or PC main unit (It can be left blank).
- Press OK button (Window 8: (2)) to proceed to the Coding Contents Confirmation Window (Window 9).

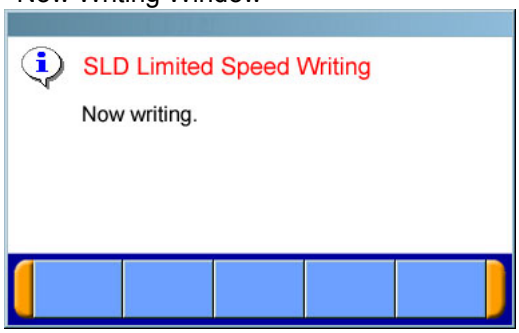
<Coding Contents Confirmation Window>



Window 9

- Confirm the writing contents (Window 9: (1)) and press OK button (Window 9: (2)) to display Now Writing Window (Window 10) after Writing Confirmation Window is displayed.

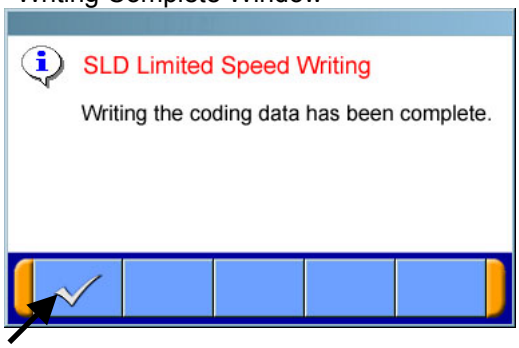
<Now Writing Window>



Window 10

- When writing is completed, Writing Complete Window (Window 11) is displayed.

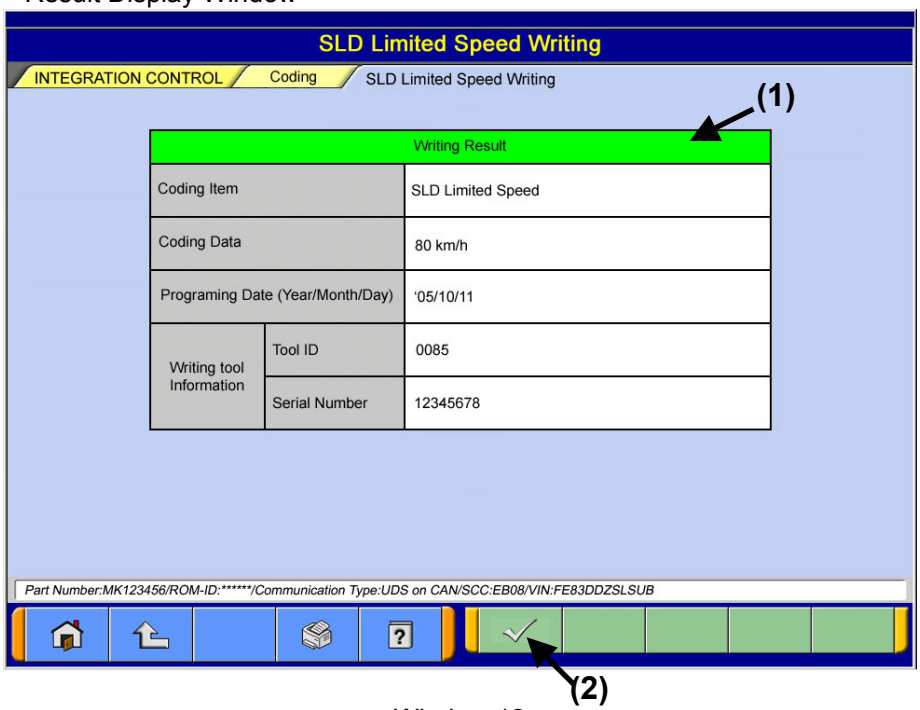
<Writing Complete Window>



Window 11

- Press OK button (Window 11: (1)) to proceed to the Result Display Window (Window 12).

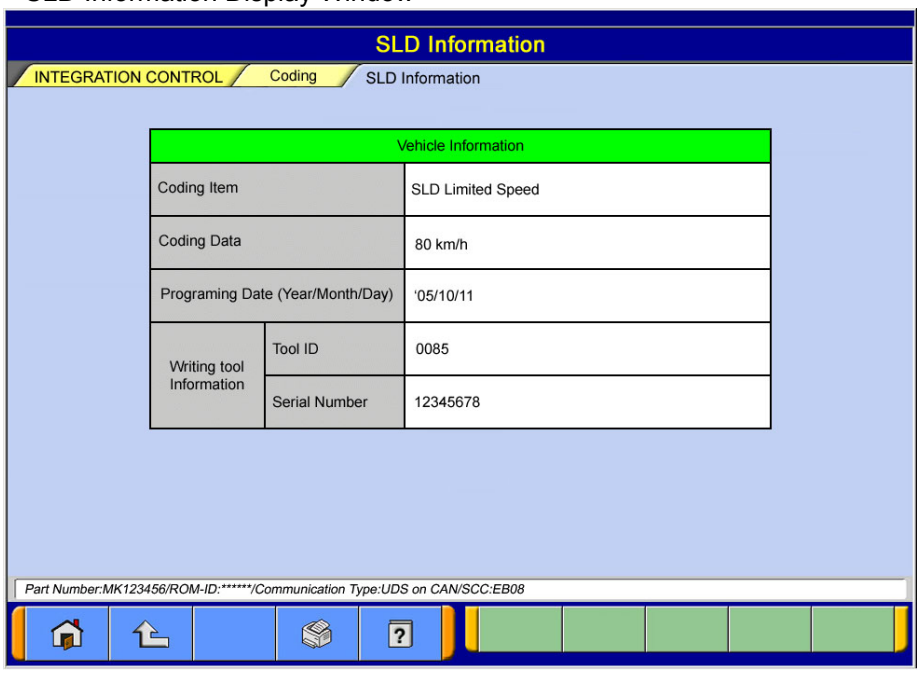
<Result Display Window>



Window 12

- Writing result written in Writing Result (Window 12: (1)) is displayed.
- Press OK button (Window 12: (2)) to return to Coding Submenu Window (Window 3).

<SLD Information Display Window>

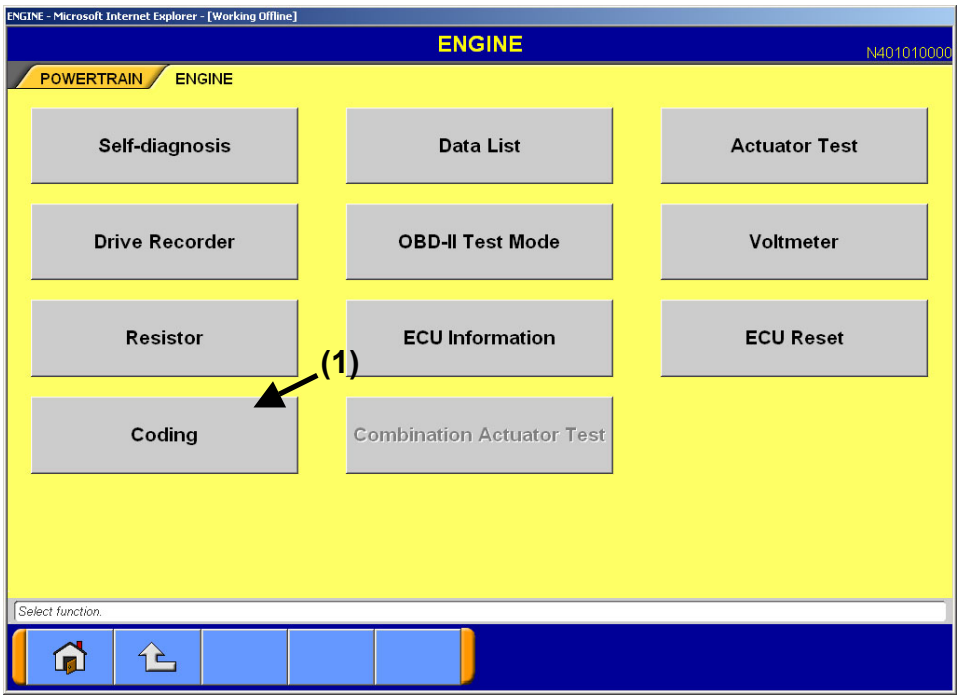


Window 13

- The value of “SLD limit vehicle speed” which is written in ECU is displayed.

(6) Ash Data Writing

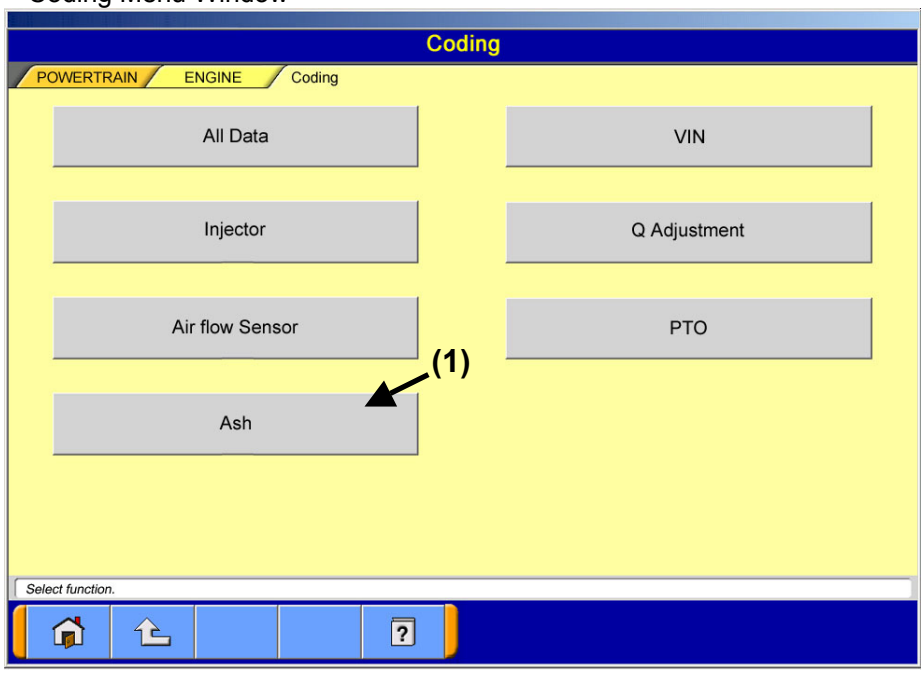
<Function Select Window>



Window 1

- Press “Coding” button (Window 1: (1)) in Function Select Window to proceed to the Coding Menu Window (Window 2).

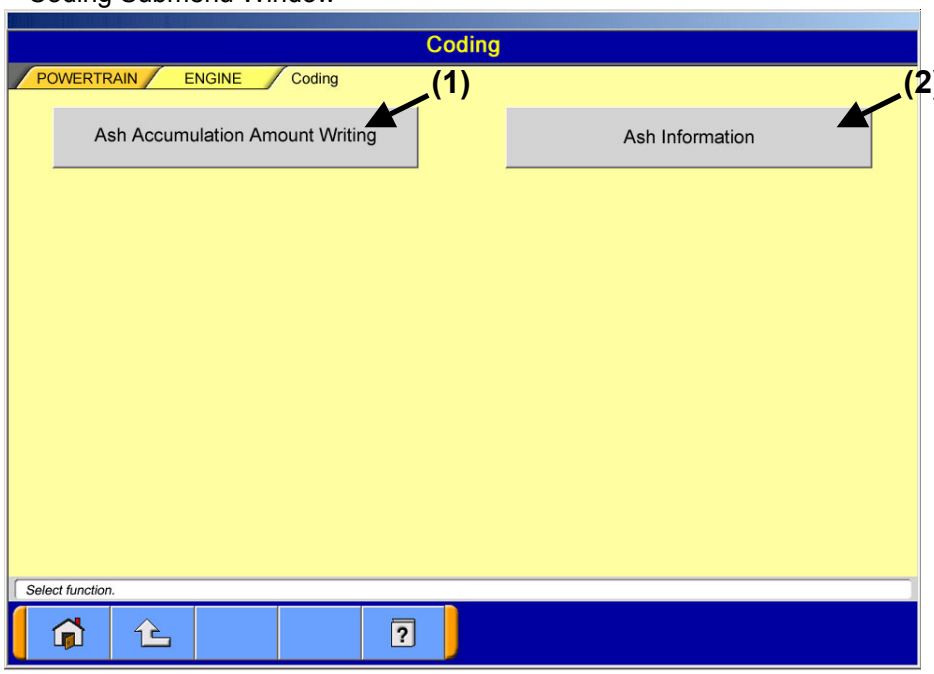
<Coding Menu Window>



Window 2

- Press “Ash” button (Window 2: (1)) to proceed to the Coding Submenu Window (Window 3).

<Coding Submenu Window>

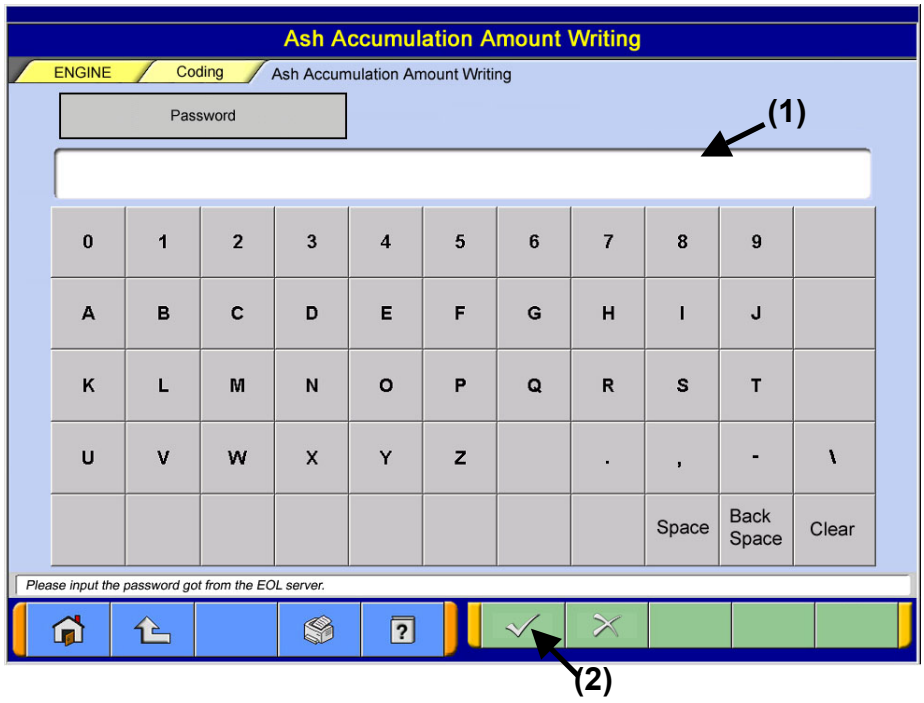


Window 3

- Press Function button to proceed to the following windows.

Function button name	Next window	Remarks
Ash Accumulation Amount Writing (Window 3: (1))	Password Input Window (Window 4)	Write “Ash data” manually/ automatically.
Ash Information (Window 3: (2))	Ash Information Display Window (Window 13)	Confirm the Ash information (Ash data) written in MUT.

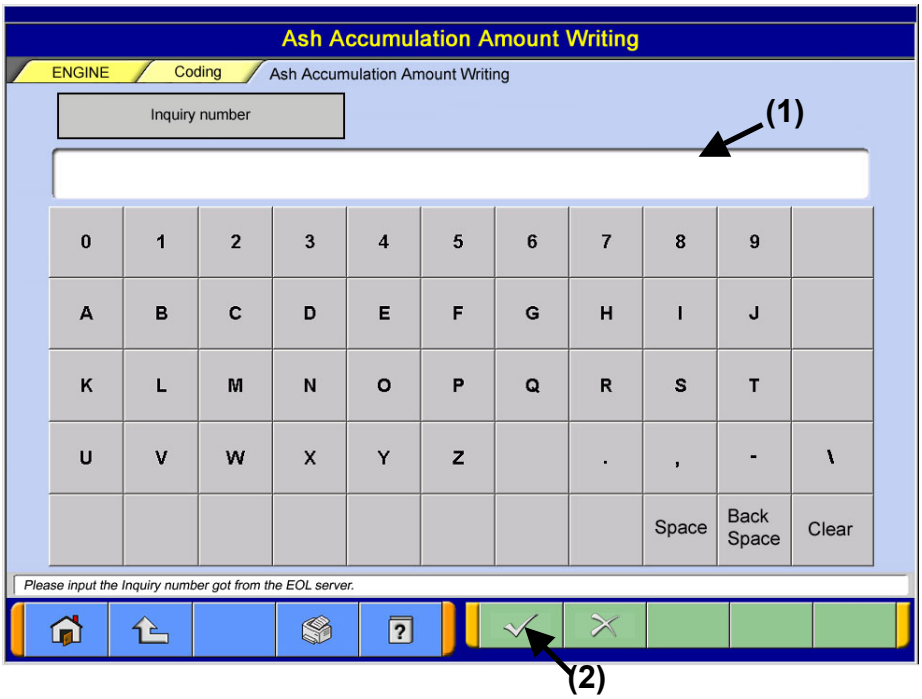
<Password Input Window>



Window 4

- Enter password in Password Input field (Window 4: (1)) from the keyboard of MUT screen or PC main unit.
- Press OK button (Window 4: (2)) to proceed to the Inquiry Number Input Window (Window 5).

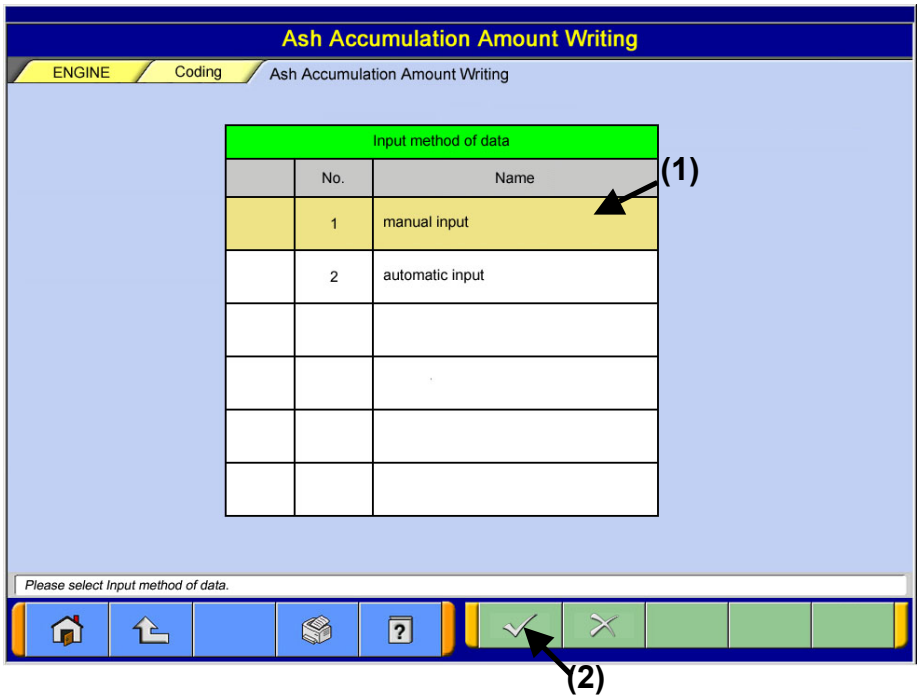
<Inquiry Number Input Window>



Window 5

- Enter Inquiry Number in Inquiry Number Input field (Window 5: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 5: (2)) to proceed to the Data Input Method Select Window (Window 6).

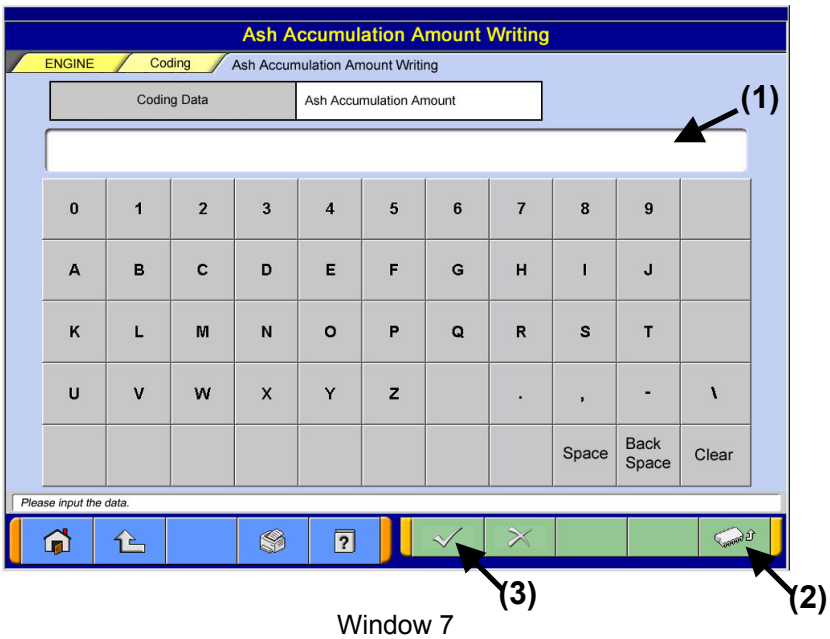
<Data Input Method Select Window>



Window 6

- Select “Manual input” (Window 6: (1)) and press OK button (Window 6: (2)) to proceed to the Coding Data Input Window (Window 7).

<Coding Data Input Window>



Window 7

<To write data which is read from ECU>

- Press “Read” button (Window 7: (2)) to read Ash data from ECU after the confirmation window [*1] is displayed and to display the data in the Coding Data Input field (Window 7: (1)).

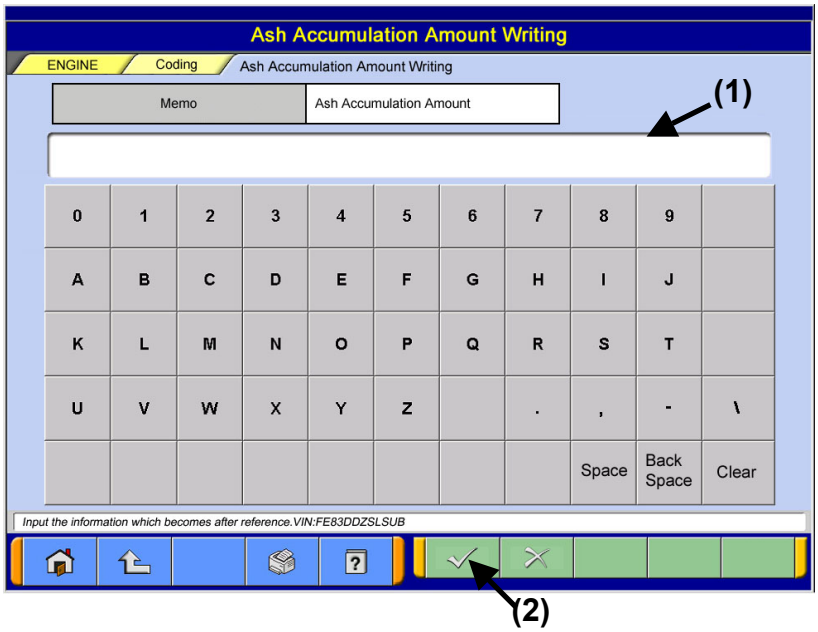
  [*1]: Check if the ECU before replacement is connected.

- Press OK button (Window 7: (3)) to proceed to the Work Memo Input Window (Window 8).

<To write Ash data by manually entering memo value>

- Enter the memo “Ash data” which is read from ECU before replacement in the Coding Data Input field (Window 7: (1)) from the keyboard of MUT Screen or PC main unit.
- Press OK button (Window 7: (3)) to proceed to the Work Memo Input Window (Window 8).

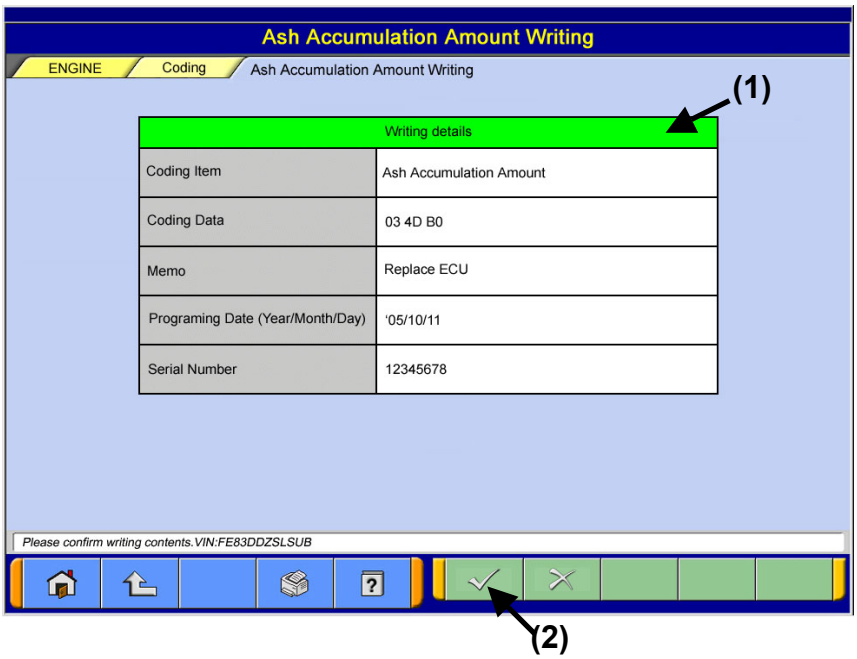
<Work Memo Input Window>



Window 8

- Enter memo in the Work Memo Input field (Window 8: (1)) from the keyboard of MUT Screen or PC main unit (It can be left blank).
- Press OK button (Window 8: (2)) to proceed to the Coding Contents Confirmation Window (Window 9).

<Coding Contents Confirmation Window>

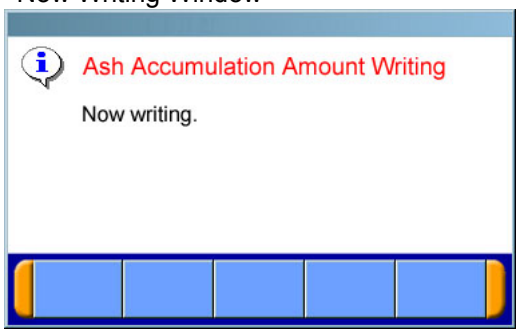


Window 9

- Confirm the writing contents (Window 9: (1)) and press OK button (Window 9: (2)) to display the Now Writing Window (Window 10) after the Writing Contents Writing Window [*1] is displayed.

  [*1]: Confirm if it is replaced with a new ECU.

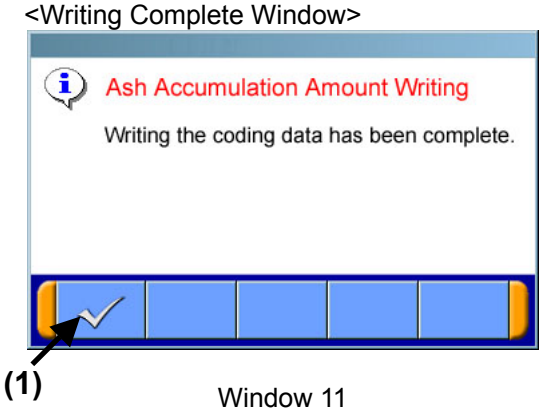
<Now Writing Window>



Window 10

- When writing is completed, Writing Complete Window (Window 11) is displayed.

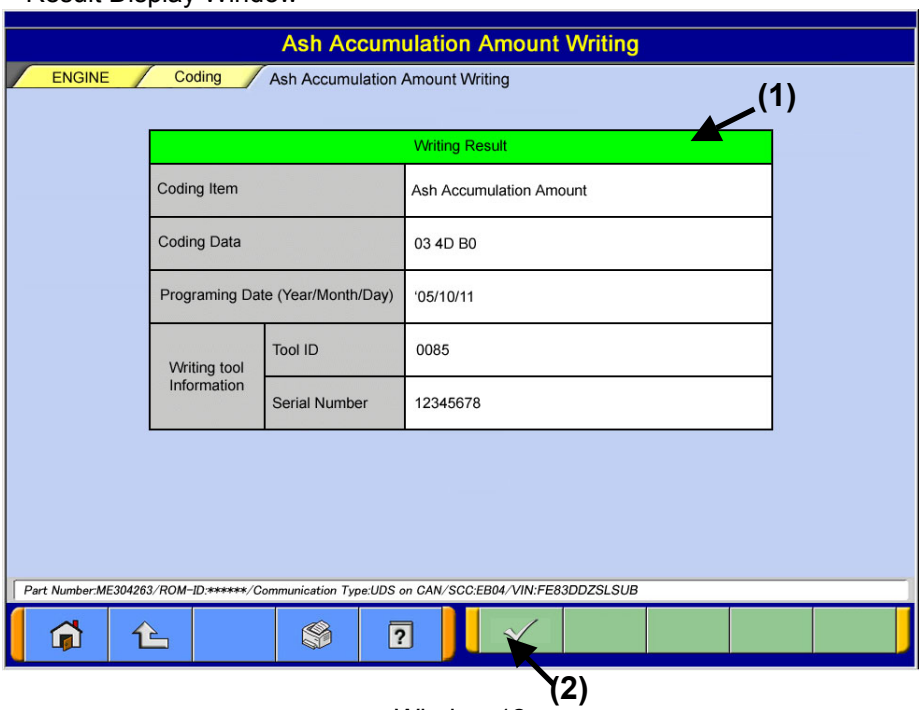
<Writing Complete Window>



Window 11

- Press OK button (Window 11: (1)) to proceed to the Result Display Window (Window 12).

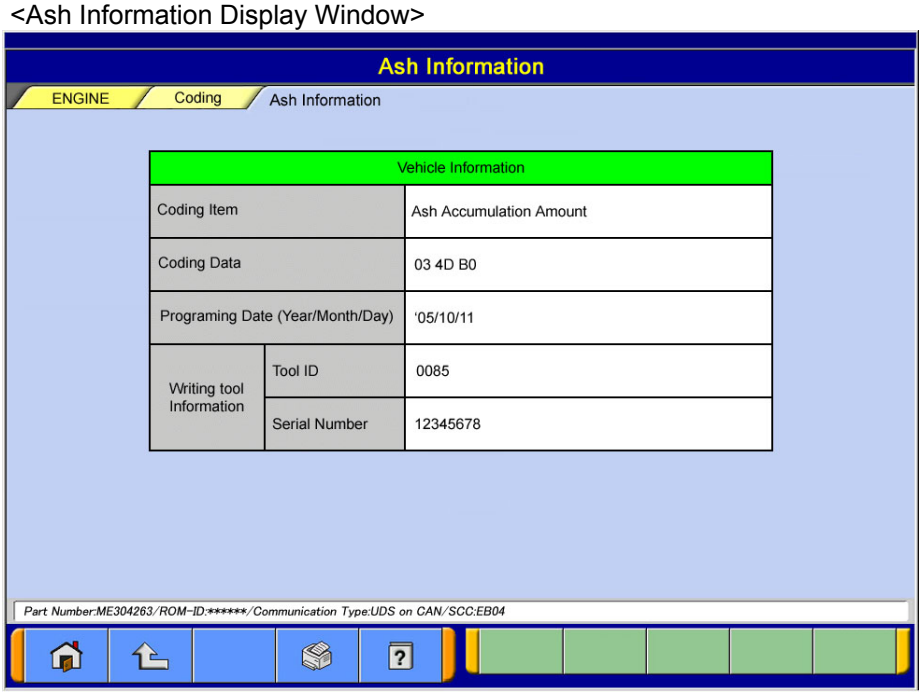
<Result Display Window>



Window 12

- Writing result is displayed in Writing Result Window (Window 12: (1)).
- Press OK button (Window 12: (2)) to return to the Coding Submenu Window (Window 3).

<Ash Information Display Window>



Window 13

- The “Ash data” value which is written in ECU is displayed.

ECU Field Rewriting Operation Manual

MITSUBISHI FUSO TRUCK & BUS CORP.

October 2007

84 (H)

GROUP 14 INDEX

SPECIFICATIONS 14-2

STRUCTURE AND OPERATION
1. **Cooling System (Flow of Coolant) 14-4**
2. **Thermostat 14-5**
3. **Water Pump 14-5**

TROUBLESHOOTING 14-6

ON-VEHICLE INSPECTION AND ADJUSTMENT
1. **Inspection and Adjustment of Belt Tension 14-8**
2. **Inspection of Cracks or Damage of the Belt 14-10**
3. **Coolant Replacement and Cleaning of Cooling System 14-11**
4. **Air Bleeding of Cooling System 14-13**
5. **Air/Gas Leakage Test 14-13**

DISCONNECTION AND CONNECTION OF HOSES AND PIPES . 14-14

RADIATOR, FAN SHROUD 14-18

COOLING FAN, V-BELT AND WATER PUMP 14-26

TENSION PULLEY 14-29

THERMOSTAT 14-30

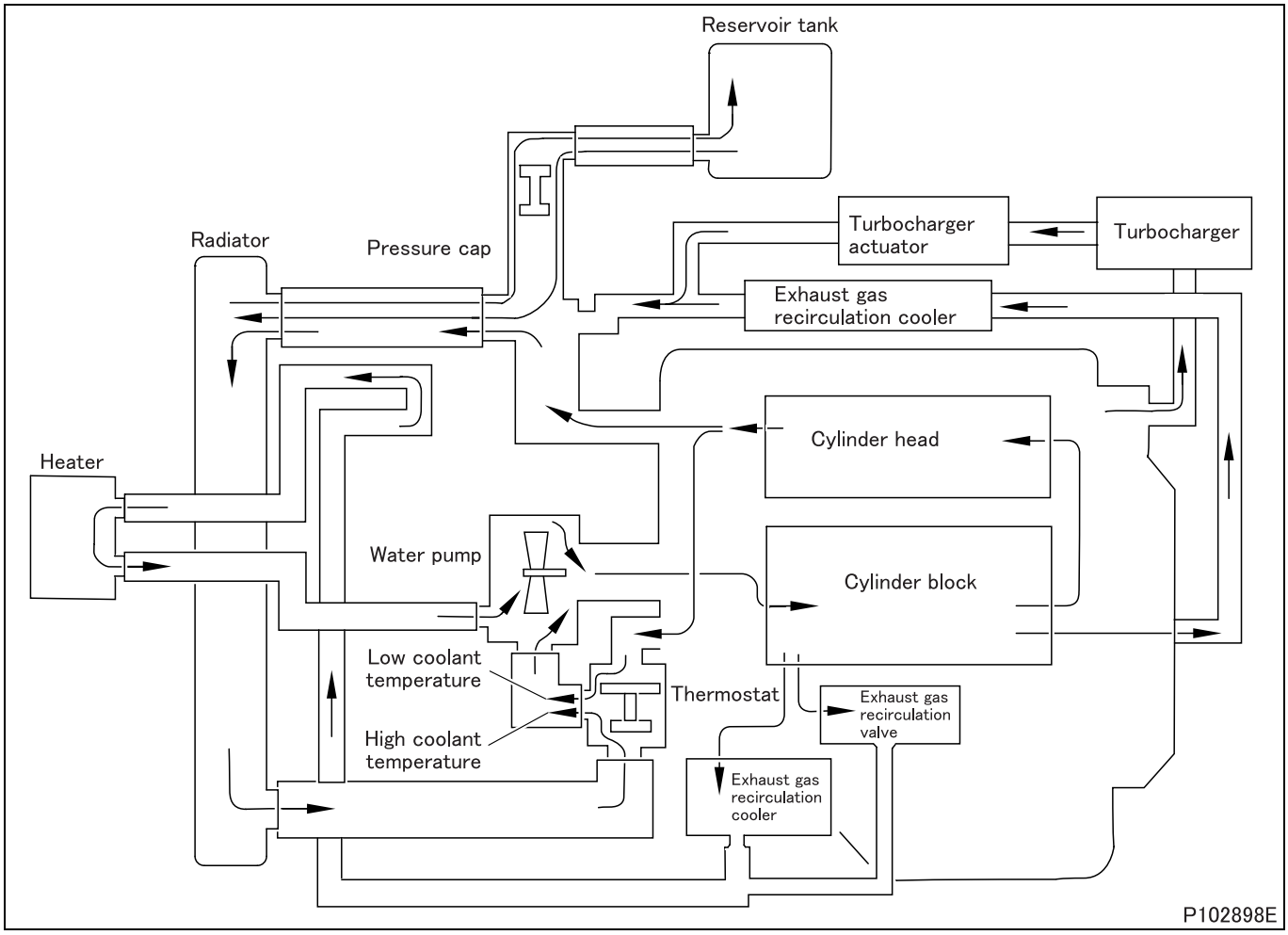
PRESSURE CAP AND WATER OUTLET CASE 14-32

SPECIFICATIONS

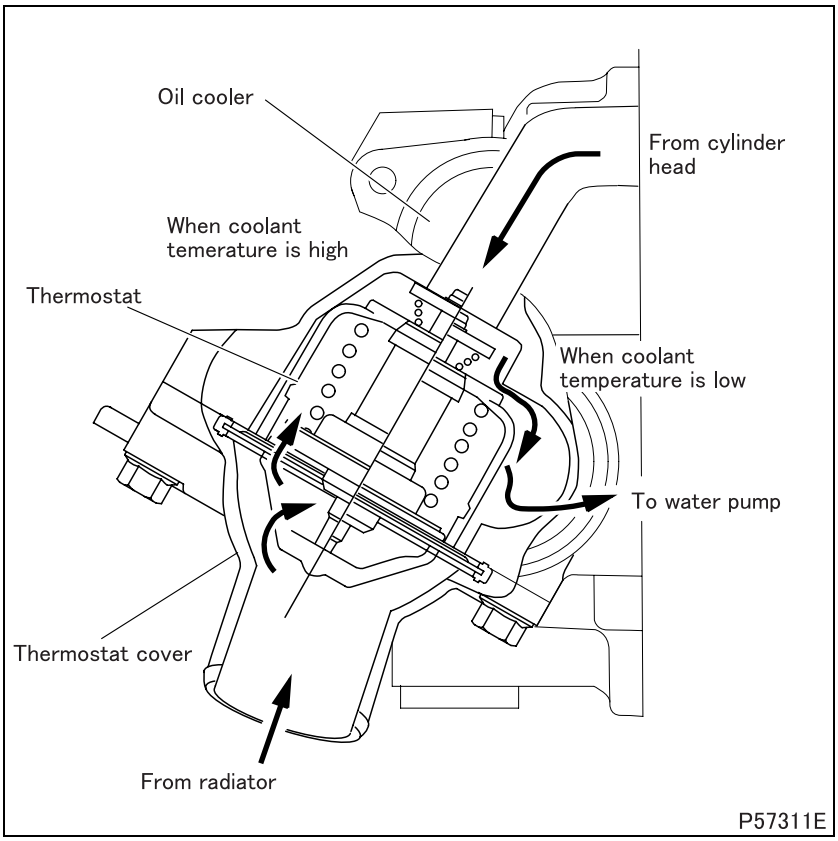
Item	Specifications
Cooling system	Forced water circulation system
Water pump	Belt-driven involute type
Thermostat	Wax pellet, bottom bypass type (with jiggle valve)
Automatic cooling fan coupling	Continuous control type
Radiator	Tube and corrugated fin type
Coolant capacity L {qts}	16.0 {17}

M E M O

1. Cooling System (Flow of Coolant)

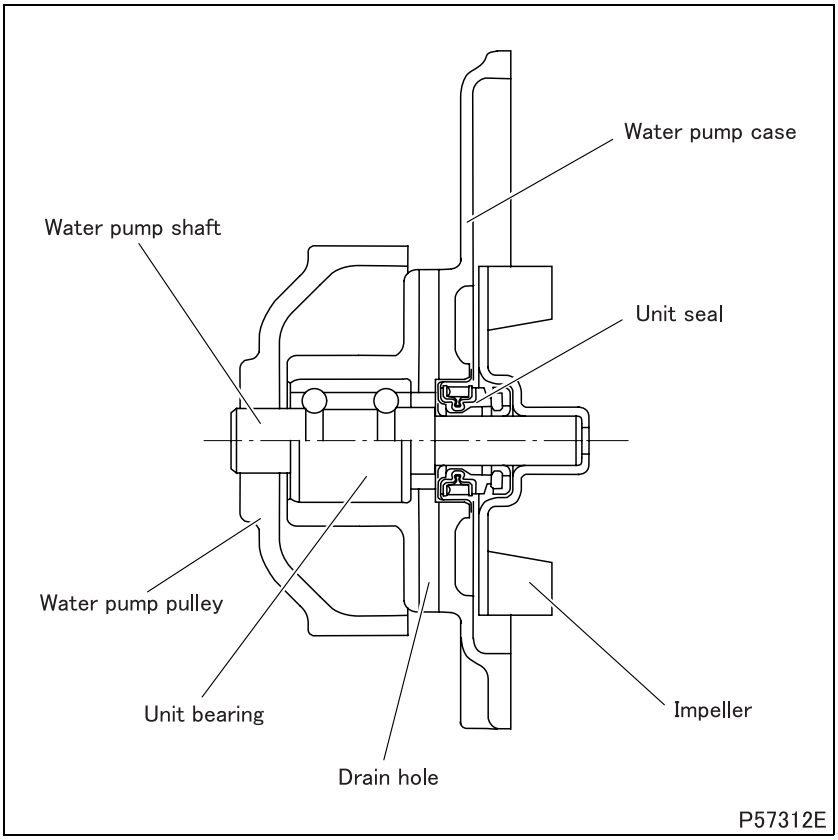


2. Thermostat



- It is a bottom bypass type that uses a wax-filled pellet as its flow-regulating element. When the wax is heated, it melts from solid to liquid, changing its total volume. This allows the valve to open or close in accordance with the coolant temperature, regulating and adjusting the flow of coolant to the radiator and to the cylinder head (bypassing the radiator).

3. Water Pump



- The water pump has a drain hole to prevent coolant from entering the unit bearing in the case of defect of the unit seal.

Possible causes \ Symptoms		Overheating (poor cooling)	Overcooling	Abnormal noise	Excessive coolant loss	Reference Gr
V-belt	Loose or damaged	O		O		
	Excessive tension			O		
	Oil on belt	O				
Water pump	Incorrectly mounted water pump	O			O	
	Defective gasket	O			O	
	Defective unit bearing	O		O		
	Defective impeller	O				
	Defective unit seal	O			O	
	Too loose fit of unit bearing on flange and impeller	O		O		
Thermostat	Incorrectly mounted case	O			O	
	Valve opening temperature too high (valve remains closed)	O				
	Valve opening temperature too low (valve remains open)		O			
Radiator	Clogged core	O				
	Cracked core and/or separation in welds	O			O	
	Cracks in upper tank and/or lower tank	O			O	
	Poor clinching of upper tank and/or lower tank	O			O	
	Defective packing of upper tank and/or lower tank	O			O	
Automatic cooling fan coupling	Defective bearing	O		O		
	Damaged bimetal	O				
	Contaminated bimetal	O	O			
	Silicon oil leakage	O		O		
Cylinder head	Incorrectly mounted cylinder head	O			O	Gr11
	Defective gasket	O			O	
Oil cooler	Incorrectly mounted oil cooler	O			O	Gr12
	Defective gasket	O			O	
	Leakage from coolant temperature sensor	O			O	
Exhaust gas recirculation system	Poor installation of exhaust gas recirculation cooler bracket	O			O	Gr17
	Poor installation of exhaust gas recirculation cooler	O			O	
	Poor installation of connectors	O			O	
	Poor installation of adapter	O			O	
	Damaged O-rings	O			O	

Possible causes \ Symptoms		Overheating (poor cooling)	Overcooling	Abnormal noise	Excessive coolant loss	Reference Gr
Breather cover	Poor installation of breather cover	O			O	Gr17
	Poor installation of gaskets	O			O	
	Damaged O-rings	O			O	
Poorly airtight pressure cap		O				
Insufficient coolant amount		O				
Clogged or scaled coolant passage		O				
Incorrectly connected hoses		O			O	
Poor installation of pipes		O			O	
Excessively low exterior temperature			O			

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspection and Adjustment of Belt Tension

CAUTION ⚠

- **Make sure that there is no oil or grease on the belts. Belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.**

Service standards (Unit: mm {in.})

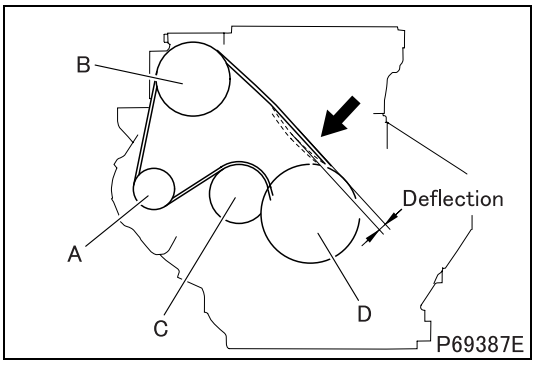
Location	Maintenance item			Standard value	Limit	Remedy
–	Belt tension	with air conditioner	When new	7 to 9 {0.28 to 0.35}	–	Adjust
			When reused	10 to 11 {0.39 to 0.43}		
		without air conditioner	When new	9 to 11 {0.35 to 0.43}		
			When reused	11 to 13 {0.43 to 0.51}		

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Nut (for alternator adjustment)	50 {37, 5.1}	–
–	Bolt (for alternator retention)	90 {66, 9.2}	–

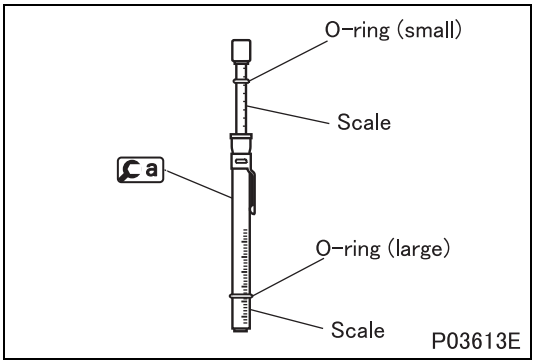
Special tools

Mark	Tool name and shape	Part No.	Application
Ⓐ	Belt tension gauge P03612	MH062345	Measurement of tension of belt

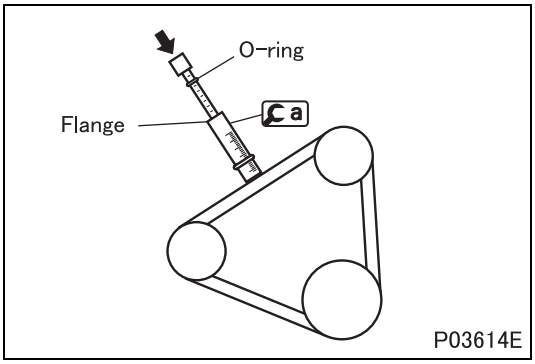


[Inspection]

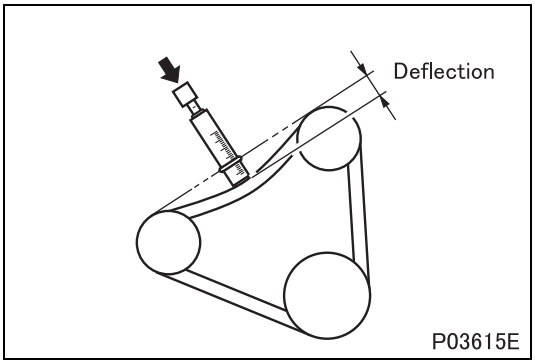
- Press each belt at a central portion between pulleys with a force of approximately 98 N {72 lbs, 10 kgf} as shown in the illustration and measure the amount of deflection of the belt.
  - **A:** Alternator pulley
  - **B:** Air conditioner compressor pulley
  - **C:** Water pump pulley
  - **D:** Fan pulley



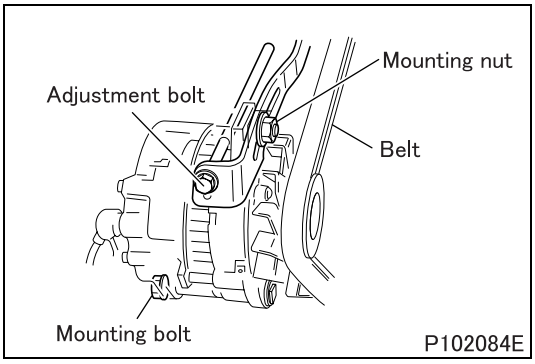
- Place the small O-ring on Ⓐ at the scale mark corresponding to 98 N {72 lbs, 10 kgf} (press force).
- Place the large O-ring on Ⓐ at the scale mark corresponding to the maximum permissible deflection value specified for the belt.



- Place Ca at a central portion between pulleys of the belt and push the handle (indicated by the arrow in the illustration) until the O-ring touches the flange.



- Measure the amount of deflection of the belt.
- If the measured value deviates from the standard value range, adjust the tension of the belt as follows.



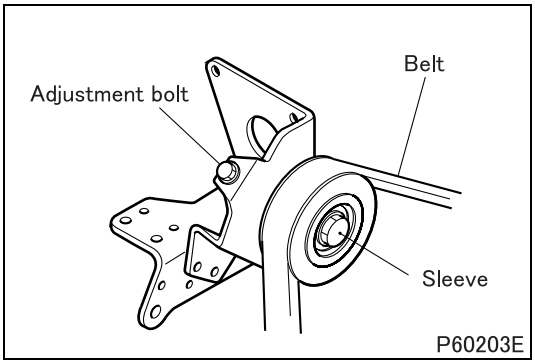
[Adjustment]

(1) Vehicles with air conditioner

- Loosen the alternator mounting nuts (2 locations) and adjust the tension of the belt by tightening or loosening the adjustment bolt.
- After the adjustment is completed, retighten the mounting nuts firmly.

CAUTION ⚠

- **Excessive tension in the belt may damage not only the belt itself but also the bearings of the related components.**



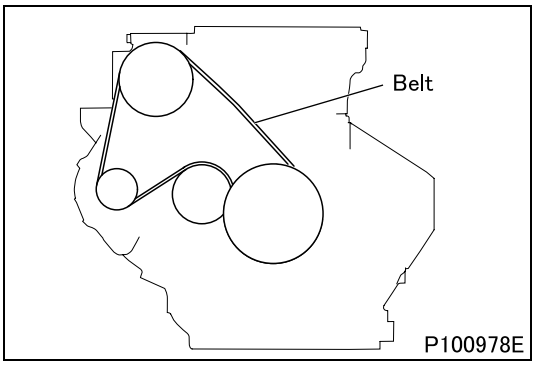
(2) Vehicles without air conditioner

- Loosen the tension pulley mounting sleeve and turn in or out the adjustment bolt to adjust the tension of the belt.
- After the adjustment is completed, retighten the mounting sleeve firmly.

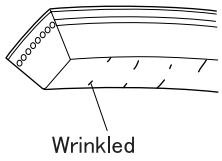
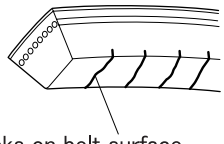
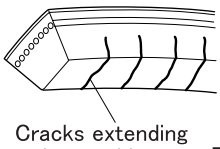
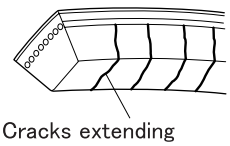
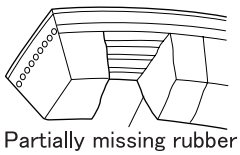
CAUTION ⚠

- **Excessive tension in the belt may damage not only the belt itself but also the bearings of the related components.**

2. Inspection of Cracks or Damage of the Belt



- Visually check the belts for possible cracks and damage.
- If any faults are found, replace the belts.

Belt condition	Remaining service life (reference)
 P69698E	• The driving distance over which the belt can still be used is at least as long as that over which the belt has been used since the vehicle was new or since the belt was replaced (whichever is more recent).
 P69699E	• The driving distance over which the belt can still be used is about half of that over which the belt has been used since the vehicle was new or since the belt was replaced (whichever is more recent).
 P69700E	• The driving distance over which the belt can still be used is about a quarter of that over which the belt has been used since the vehicle was new or since the belt was replaced (whichever is more recent).
 P69701E  P69702E	• The belt has reached the end of its service life and must be replaced.

3. Coolant Replacement and Cleaning of Cooling System

Tightening torque (Unit: N·m {lbf·ft, kgf·m})

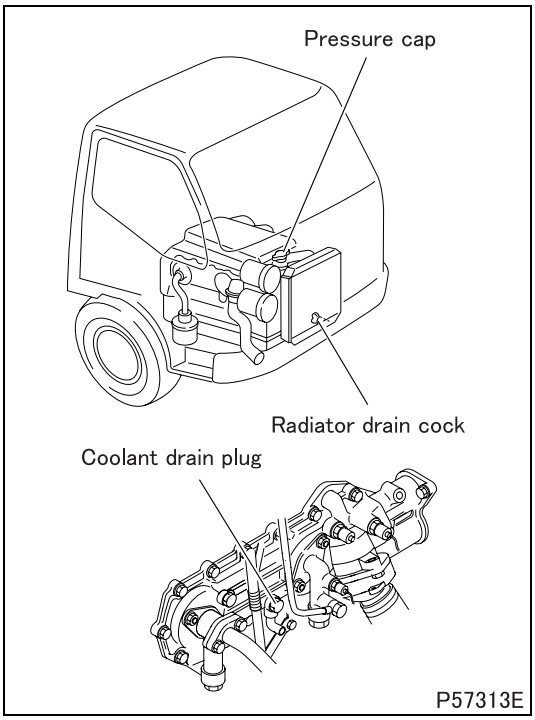
Mark	Parts to be tightened	Tightening torque	Remarks
–	Radiator drain cock	15 ± 0.3 {1.1 ± 0.2, 0.15 ± 0.03}	–
–	Water drain plug	24.5 ± 4.9 {18 ± 3.6, 2.5 ± 0.5}	–

- Using the radiator for extended periods of time without cleaning can increase chance of rust and scale formation, which may cause engine overheating. The cooling system must be cleaned periodically.

NOTE

- **Coolants containing longlife coolant require replacement every two years. This replacement interval can be extended to a maximum of six years by adding longlife coolant additive to the coolant once every year for the four years following the first two-year limit. For instructions on the use of this product, refer to the Owner's Handbook.**

3.1 Draining of coolant



- Before draining the coolant, loosen the pressure cap to reduce the pressure in the cooling system. Remember to drain the coolant out of the reservoir tank as well.

WARNING ⚠

- **Drain the coolant only after it has cooled sufficiently to avoid getting scalded.**
- **Opening the pressure cap while the coolant temperature is still high can cause hot coolant to spray out. Cover the pressure cap with a cloth, and loosen it slowly to let the pressure out before opening it fully.**

3.2 Cleaning procedure

- Keep the coolant temperature at approximately 90°C {195°F} so that the thermostat valve remains open and the coolant continues to circulate in the radiator.
- For the sake of convenience you can raise the coolant temperature quickly by covering the front of the radiator with corrugated cardboard or something similar.
- Set the temperature adjusting lever of the heater controller at maximum so that the coolant can circulate freely in the heater piping area.
- In cases where a great amount of rust has accumulated it often happens that as a result of cleaning the radiator starts leaking. Conduct a thorough check for leakage after cleaning.
- Soft water to be used should have the following properties.

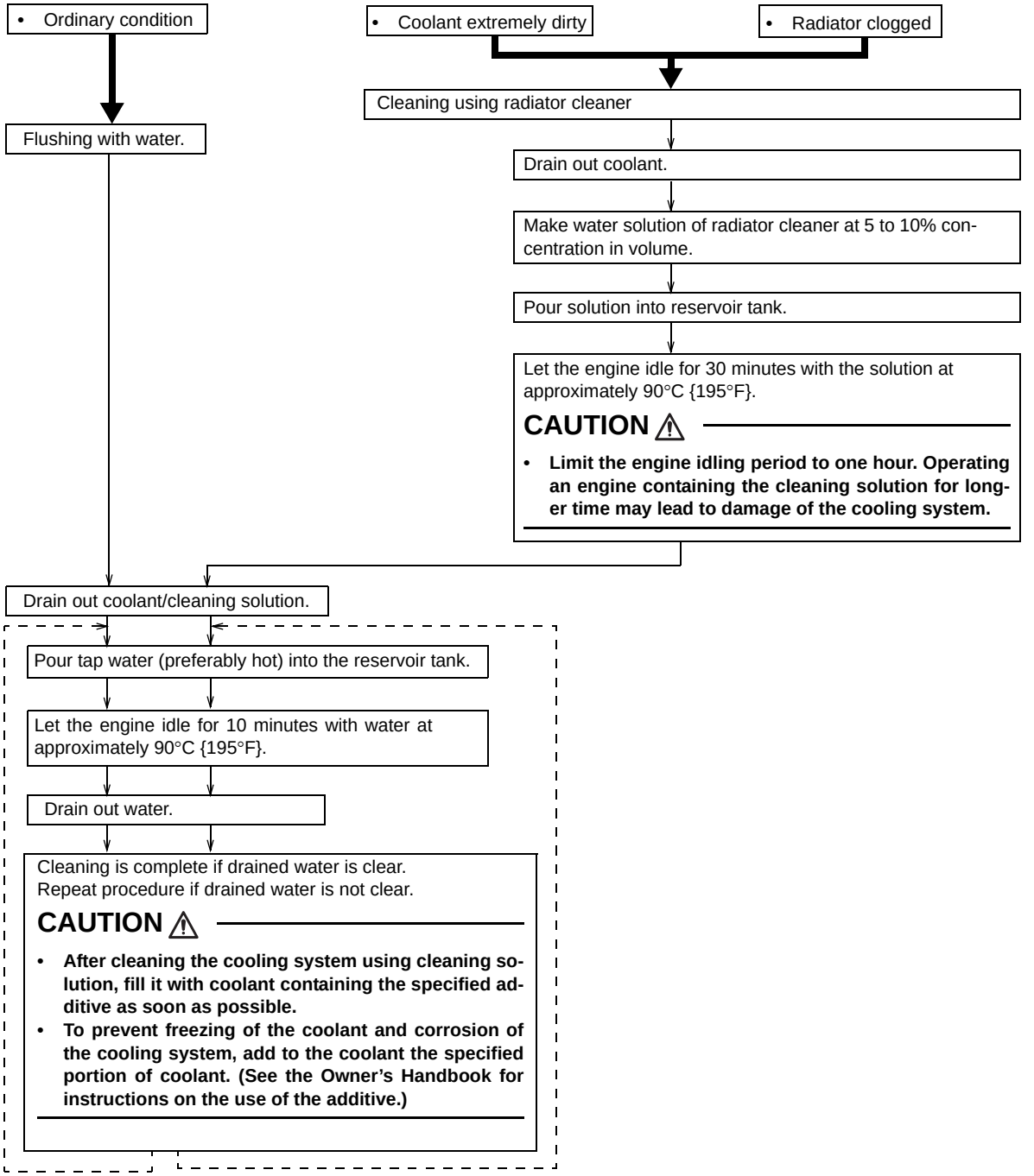
CAUTION ⚠

- **Do not use hard water as it causes scale and rust.**

Required properties of soft water

Total hardness	300 ppm or less
Sulfate SO_4^{--}	100 ppm or less
Chloride Cl^-	100 ppm or less
Total dissolved solids	500 ppm or less
pH	6 to 8

- Select an appropriate cleaning method according to the condition of the cooling system as shown below.



DANGER

- **If you accidentally splash coolant or antirust treatment products in your eyes, wash it out immediately with water and seek medical attention.**

WARNING

- **Coolant is flammable. Keep them away from heat and flames.**

4. Air Bleeding of Cooling System

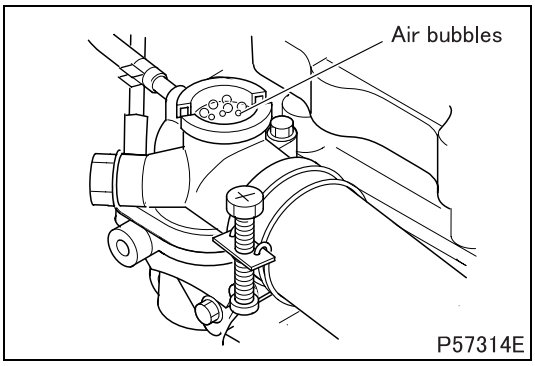
- With the pressure cap removed and the coolant temperature at 90°C {195°F}, let the engine idle in order to bleed air completely out of the cooling system.
- After air bleeding is completed, refill the reservoir tank with coolant as needed.

5. Air/Gas Leakage Test

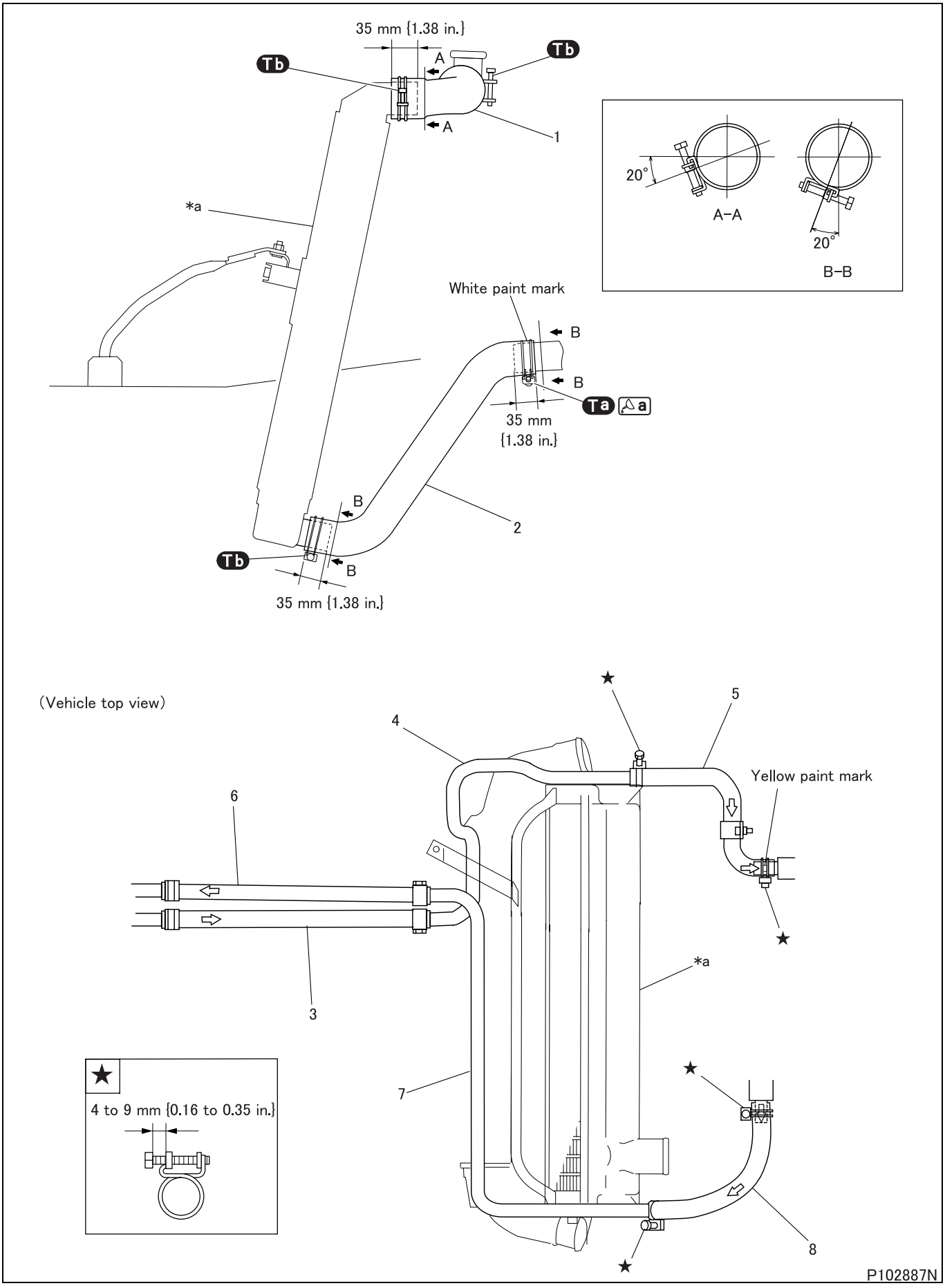
- Presence of air or exhaust gas in coolant accelerates corrosion of the cooling system components. To prevent this, carry out air/gas leakage tests in accordance with the following procedure.
- Remove the pressure cap.

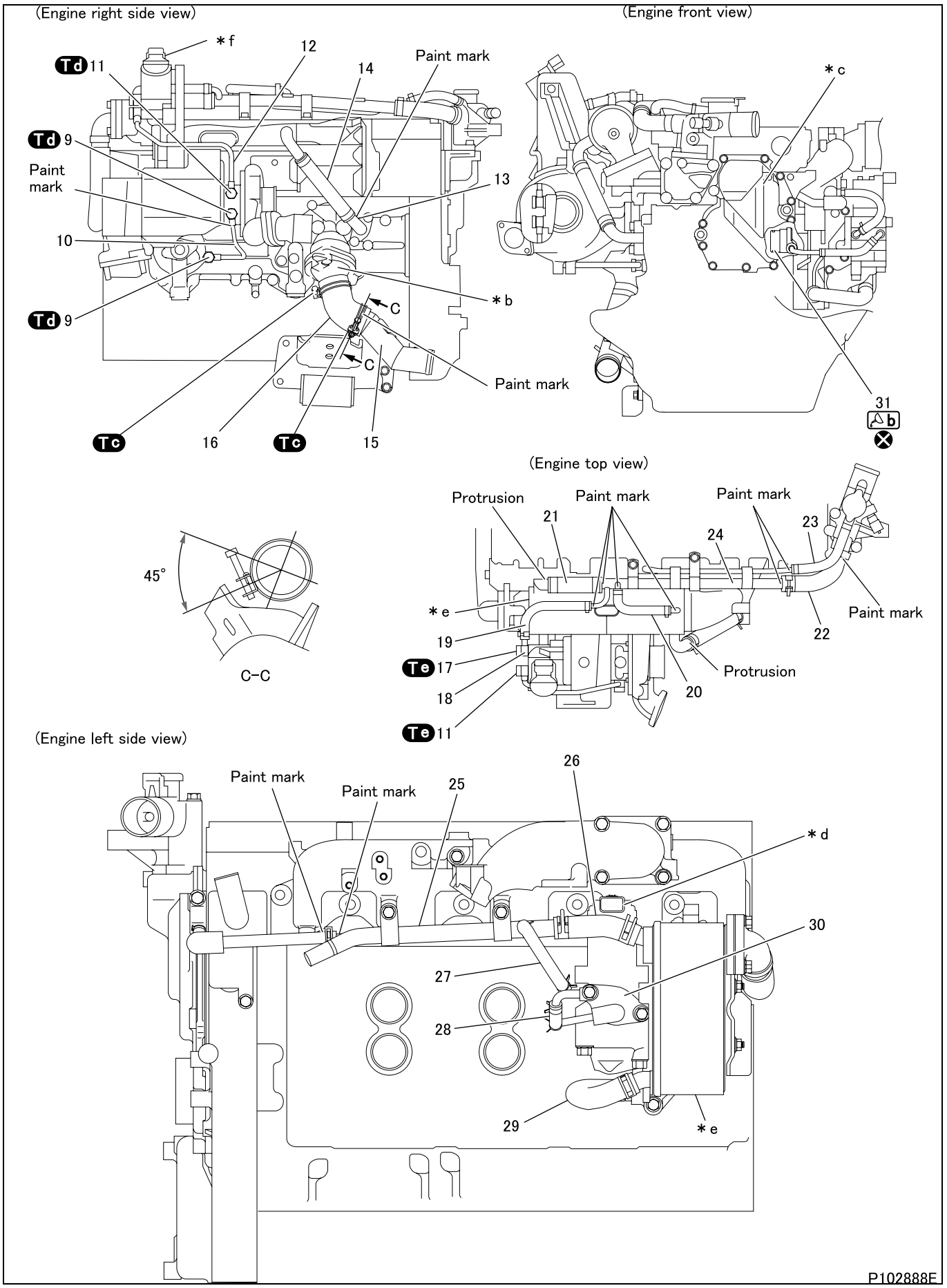
WARNING ⚠

- **If the engine is hot, boiling coolant may spurt out from the filler port when the pressure cap is loosened. To avoid a scold, make sure to remove the pressure cap only when the coolant is cold.**



- Run the engine until the coolant temperature rises to approximately 90°C {195°F}.
- If air bubbles appear continuously through the filler port, there is air or exhaust gas penetrating into the cooling system.
- Presence of air in coolant can be an indication of loose cylinder head bolts, loose water pump mounting bolts, loose hose connections, and/or a damaged hose.
- Presence of exhaust gas in coolant can be an indication of a damaged cylinder head gasket and/or cracks in the cylinder head.


35 mm {1.38 in.}
Tb
Tb
A
A
1
*a
20°
A–A
20°
B–B
White paint mark
B
B
Ta a
35 mm
{1.38 in.}
2
B
Tb
B
35 mm {1.38 in.}
(Vehicle top view)
★
5
4
Yellow paint mark
6
★
*a
3
★
4 to 9 mm {0.16 to 0.35 in.}
7
★
8
★
P102887N


(Engine right side view)
(Engine front view)
(Engine top view)
(Engine left side view)
Td 11
Td 9
Td 9
Tc
Tc
Te 17
Te 11
Paint mark
Paint mark
Paint mark
Paint mark
Paint mark
Paint mark
Protrusion
Protrusion
45°
C–C
C
C
* a
* b
* c
* d
* e
* f
10
12
13
14
15
16
18
19
20
21
22
23
24
25
26
27
28
29
30
31

P102888E

DISCONNECTION AND CONNECTION OF HOSES AND PIPES

● Removal sequence

1 Upper radiator hose
2 Lower radiator hose
3 Heater hose
4 Heater pipe
5 Heater hose
6 Heater hose
7 Heater pipe
8 Heater hose
9 Eyebolt
10 Water pipe
11 Eyebolt
12 Water pipe
13 Water exhaust gas recirculation inlet pipe
14 Water hose
15 Water pipe
16 Water hose
17 Eyebolt
18 Joint swivel
19 Water hose
20 Water hose
21 Water hose
22 Water hose
23 Water hose
24 Water exhaust gas recirculation outlet pipe
25 Water pipe
26 Water-out hose
27 Water hose
28 Water hose
29 Water-in hose
30 Adapter
31 O-ring

∗**a**: Radiator
∗**b**: Thermostat cover
∗**c**: Breather cover
∗**d**: Exhaust gas recirculation valve
∗**e**: Exhaust gas recirculation cooler
∗**f**: Turbocharger actuator
⊗: Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- **Install each hose clamp to the angle indicated in the illustration so that sufficient clearance is assured between the hose clamp and its surrounding parts.**
- **Keep the O-ring free of engine oil. Engine oil will make the O-ring swell, which may cause leakage.**

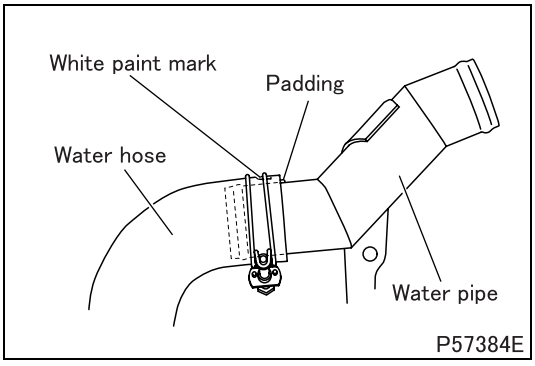
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	1.5 to 2.0 {1.1 to 1.5, 0.15 to 0.2}	Wet
Tb	Clamp	3.0 to 4.5 {2.2 to 3.3, 0.3 to 0.5}	–
Tc	Clamp	4 {3.0, 4.0}	–
Td	Eyebolt (water pipe mounting)	26 {19, 2.7}	–
Te	Eyebolt (water pipe mounting)	21 {15, 2.1}	

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Clamp screw threads	Engine oil	As required
b	O-ring	Soapy water	As required

◆Installation procedure◆

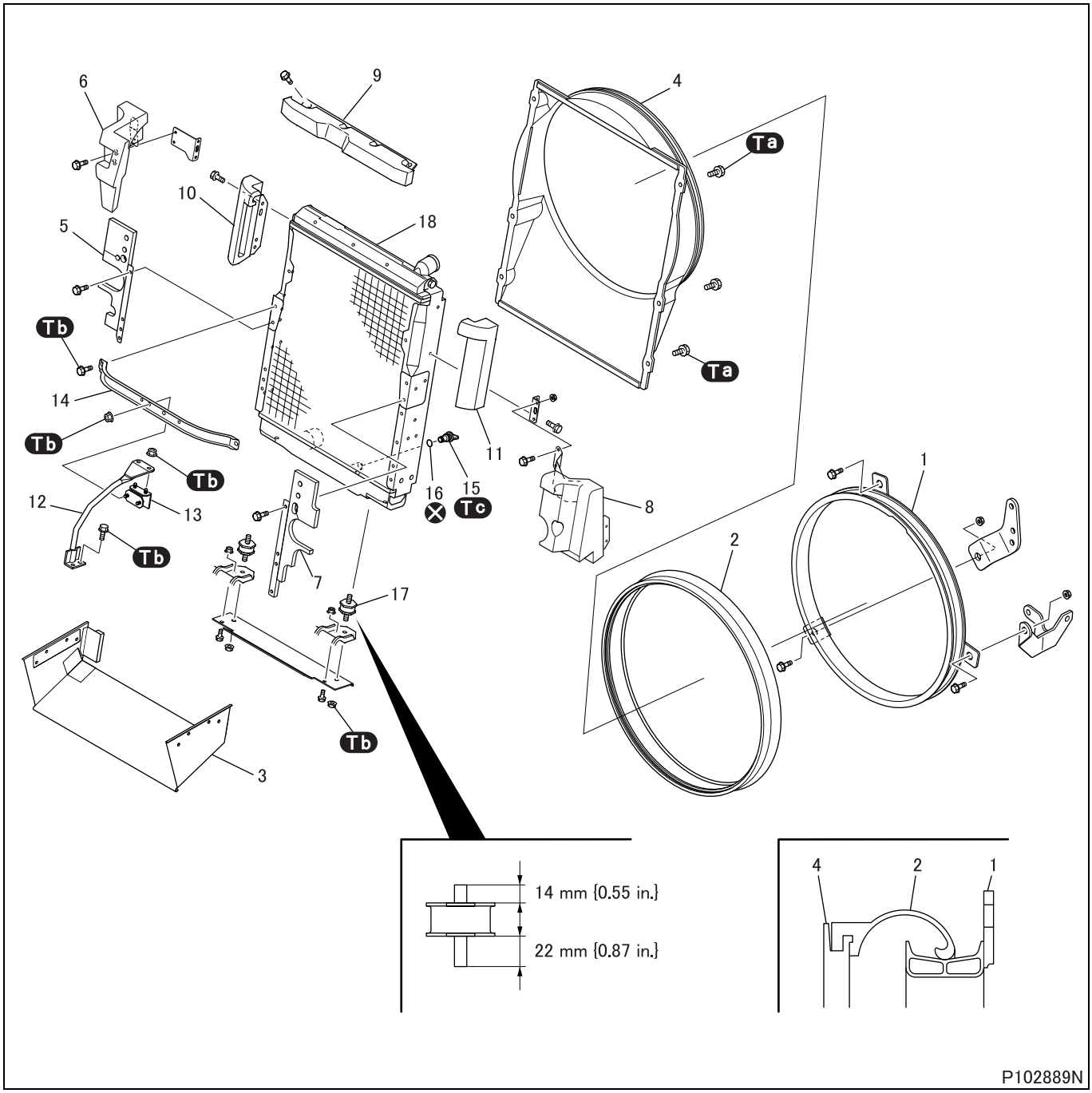


■ Installation: Water hose

- Install the water hose with the white mark on its end aligned with the padding on the water pipe.

M E M O

RADIATOR, FAN SHROUD



● Removal sequence

1 Fan shroud
2 Shroud seal
3 Air scoop
4 Radiator shroud
5 Baffle plate RH
6 Baffle plate RH
7 Baffle plate LH
8 Baffle plate LH
9 Baffle plate upper
10 Baffle plate RH
11 Baffle plate LH
12 Support rod
13 Support cushion
14 Upper support
15 Radiator drain cock
16 O-ring
17 Support cushion
18 Radiator
(See later section.)

⊗: Non-reusable parts

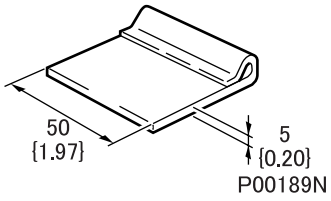
● Installation sequence

Follow the removal sequence in reverse.

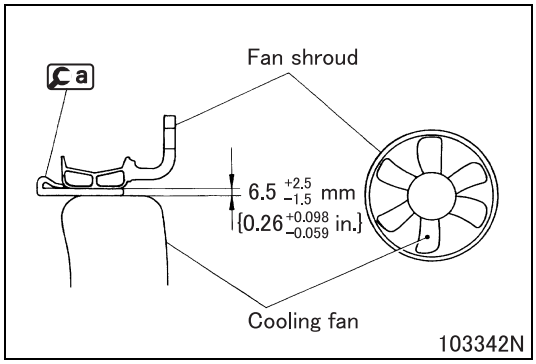
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (upper shroud mounting)	5 to 7 {3.7 to 5.2, 0.5 to 0.7}	–
	Bolt (lower shroud mounting)		
Tb	Bolt (support rod mounting)	12 to 15 {8.9 to 11, 1.18 to 1.47}	–
	Nut (support cushion mounting)		
	Bolt (upper support mounting)		
	Nut (support cushion mounting)		
Tc	Radiator drain cock	2.5 ± 0.5 {1.8 ± 0.4, 0.25 ± 0.05}	–

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
Ca	Tip clearance spacer 	MC019470	Adjusting clearance between fan shroud and cooling fan

◆Installation procedure◆

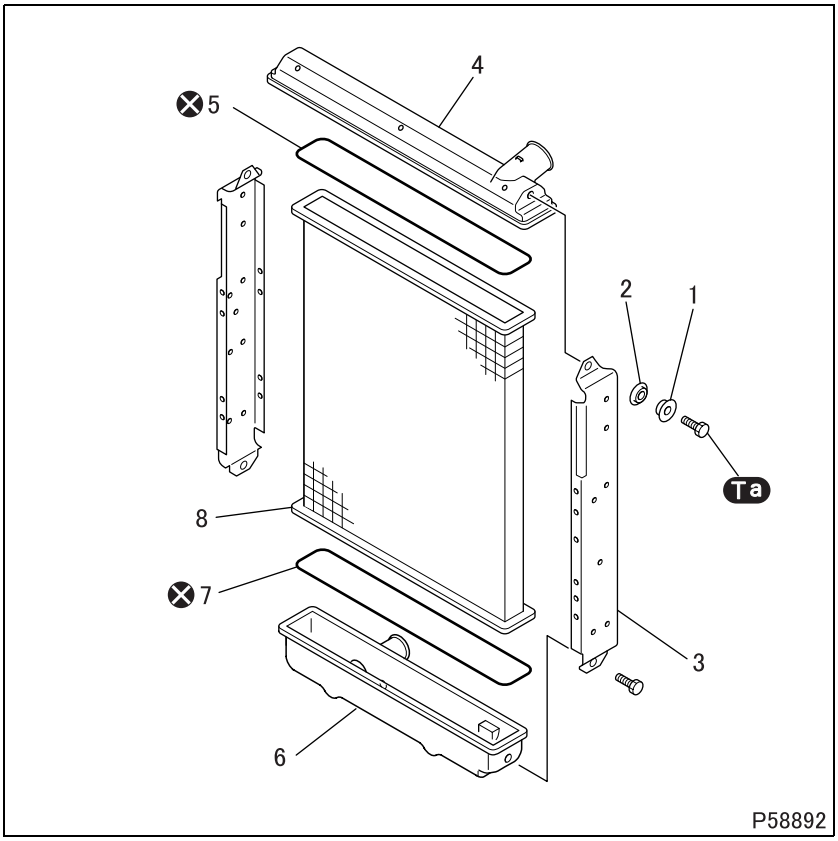


■Installation: Fan shroud

- Using Ca, adjust the clearance between the fan shroud and cooling fan blades to the dimension shown in the illustration.

RADIATOR, FAN SHROUD

Radiator



● Disassembly sequence

1 Pipe
2 Bush
3 Side member
4 Upper tank
5 Packing
6 Lower tank
7 Packing
8 Core

⊗: Non-reusable parts

CAUTION ⚠

- **Do not disassemble the radiator unless defects are evident.**
- **Handle the upper tank and lower tank carefully, as they are made of plastic and may crack under impact.**
- **Check the number of paint marks put near the upper tank and lower tank mounting tabs. The number of paint marks corresponds to the number of times the tabs have been unbent and re-clinched. If the core has already two paint marks, replace it with a new one.**

● Assembly sequence

Follow the disassembly sequence in reverse.

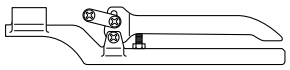
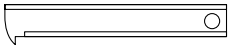
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Air leakage from radiator (air pressure 147 kPa {21 psi, 1.47 kgf/cm^2})	0 cm^3 {0 mL}	–	Repair or replace

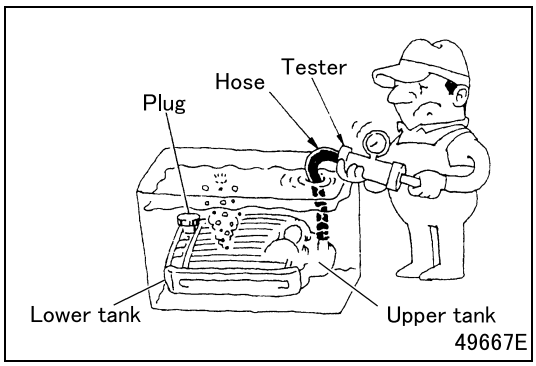
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (side member mounting)	13 {9.6, 1.3}	–

Special tools

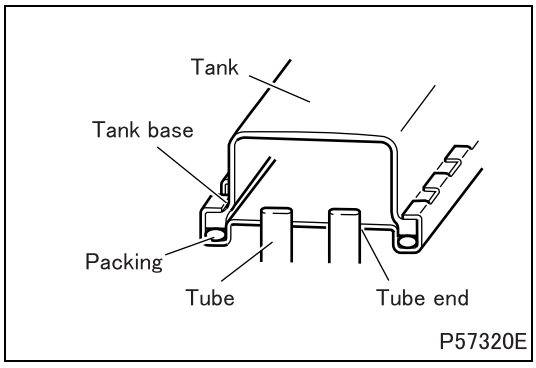
Mark	Tool name and shape	Part No.	Application
a	Overhaul handle  P51240	MH062875	Installation and removal of upper tank and lower tank
b	Claw  P51241	MH062876	
c	Punch assembly P51242	MH062877	

◆Inspection before removal◆



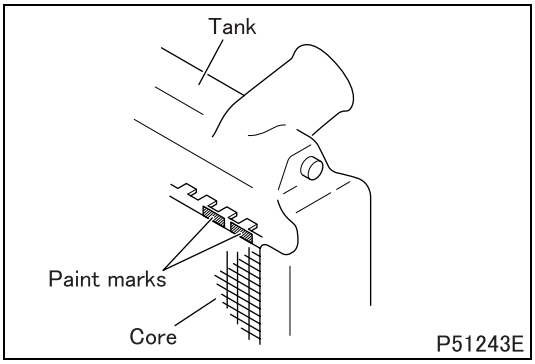
■ **Inspection: Radiator air leakage**

- Connect a hose and radiator cap tester to the upper tank.
- Plug the lower tank and put the entire radiator into a tank filled with water.
- If air leakage is found, repair or replace the radiator.
- Apply a specified air pressure using radiator cap tester, and check for any air leakage.



- Replace the following parts according to the area of leakage.

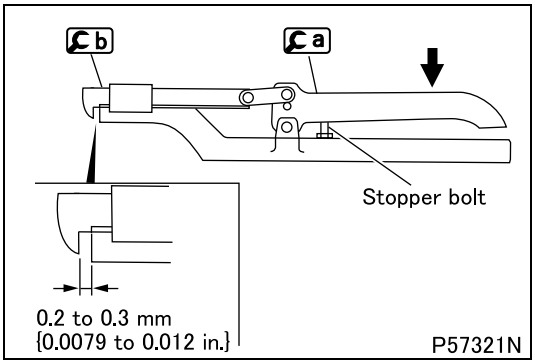
Area of leakage		Cause
Upper tank Lower tank	Tank body	Cracks in tank
	Tank base	Defective tabs Defective packing Cracks in tank
Tube body, tube ends		Cracks in tube



NOTE

- **The core may have paint marks that indicate the number of times the upper tank and lower tank mounting tabs have been unbent and re-clinched. Replace the core if it has already two paint marks.**
- **One paint mark is made every time the tabs are unbent and re-clinched. Upper tank paint marks should be counted separately from lower tank paint marks.**

◆Removal procedure◆

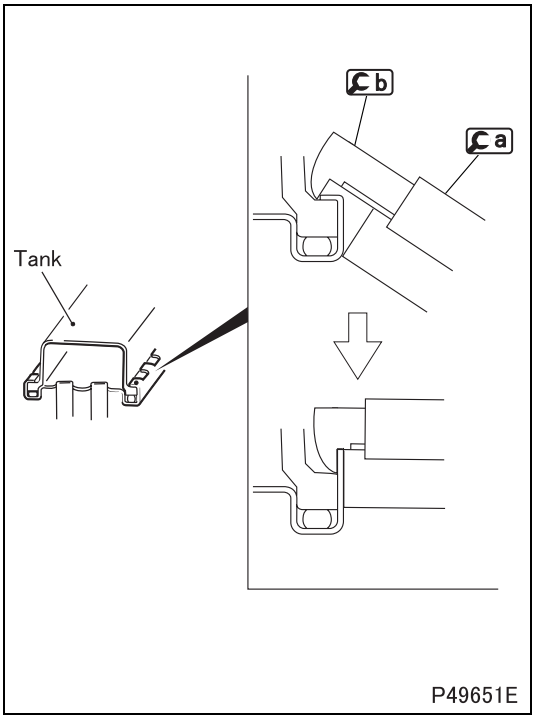


■Removal: Upper tank and lower tank

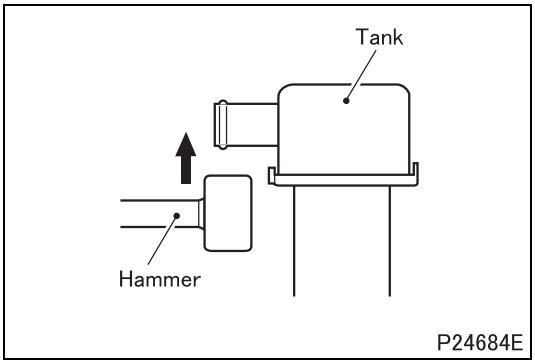
- Attach b onto a.
- Using the stopper bolt on a, adjust the jaw span of b to the dimension indicated in the illustration.

CAUTION ⚠

- **Make sure to adjust the stopper bolt before using the tools. Failure to do so may cause damage to b.**



- Using b, undo the tabs that are holding the tank in place.
- Once each tab is unbent, grip a more tightly to straighten it out completely.
- Undo all the tabs on the entire periphery of the tank, then remove the tank using the inlet hose fitting as a grip.

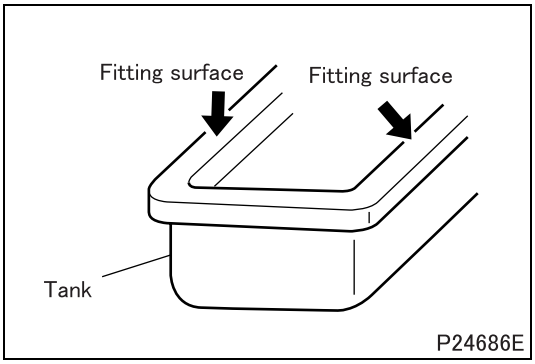


- If the tank does not come off easily, tap it lightly with a soft-face hammer (rubber or plastic hammer) to loosen it.

CAUTION ⚠

- **Handle the tanks carefully, as they are made of plastic and may crack easily under impact.**

◆Inspection procedure◆

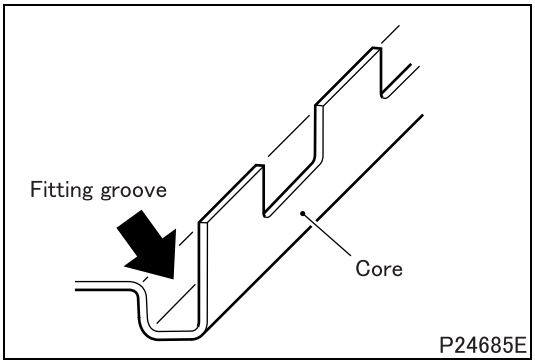


■ Inspection: Core fitting surfaces of tank

- Inspect the core fitting surfaces of the tank for any dirt or damage. If necessary, clean them thoroughly.
- Replace the tank(s) if defective.

CAUTION ⚠

- **Carry out the inspection with your bare hands to avoid putting foreign matter on the fitting surfaces.**

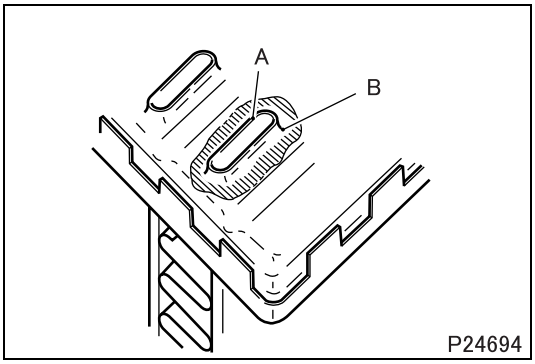


■ Inspection: Tank fitting groove of core

- Check the tank fitting groove of the core for any foreign matter or cracks.
- If foreign matter is found on the groove surfaces, lightly scrub it off with a No.1000 sandpaper taking care not to damage the surfaces, or blow it off with compressed air.
- If a crack is found on the groove surfaces, repair the crack or replace the core.

CAUTION ⚠

- **Installing a packing and tank on the core without removing foreign matter from the groove surfaces can lead to coolant leakage. Make sure to inspect the entire groove surfaces extremely carefully. Even one strand of hair is enough to cause leakage.**

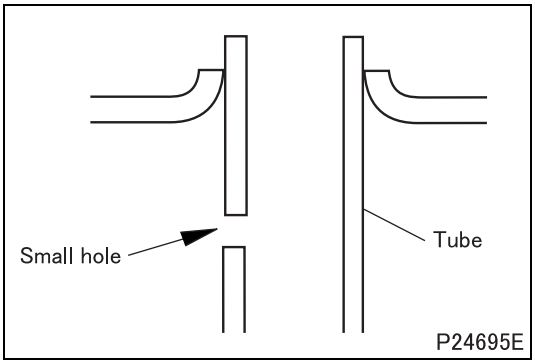


Repair of core

CAUTION ⚠

- **The following core repair procedure involves tungsten inert gas arc welding (TIG arc welding). Only personnel competent for doing this type of welding should carry out the job.**
- **Dry the core completely before performing welding. Welding wet parts could be extremely dangerous.**

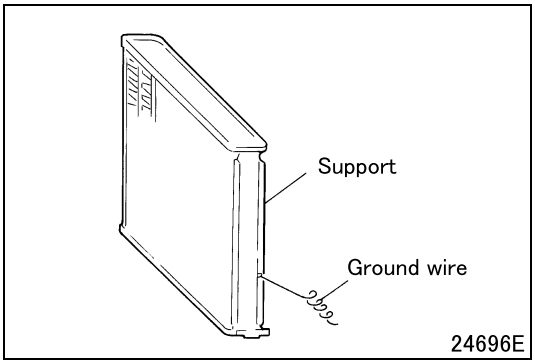
- Scrub both ends **A** of a leaky tube as well as the surrounding areas **B** of each end with a stainless wire brush. Continue scrubbing until the aluminum layer becomes exposed.



- Drill a small hole in the tube to let the air out when both ends of the tube are welded closed.

CAUTION ⚠

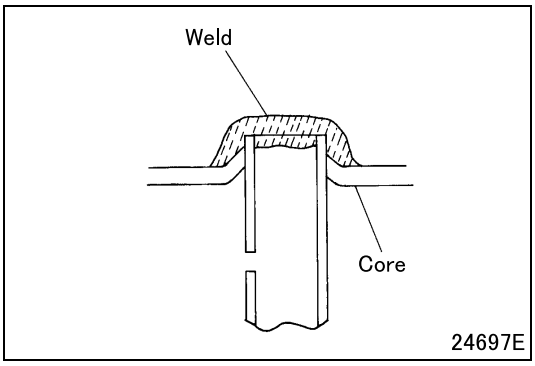
Failure to drill an air release hole in the tube may cause pinholes to form in the welds.



- Connect one of the support edges of the core to ground with a wire.

CAUTION ⚠

- **Inadequate connection of the ground wire can cause a short circuit to a part of the core, which may cause the part to melt.**

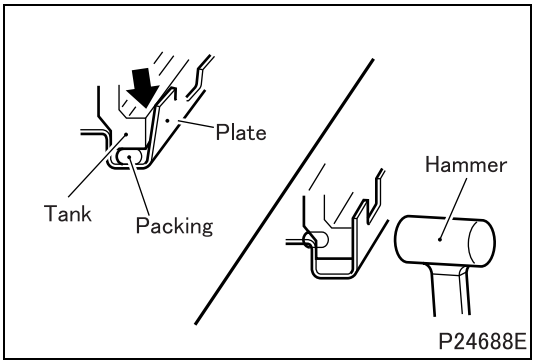


- Close both ends of the tube by TIG arc welding.
  Welding conditions
  - Welding rod: A4043
    (diameter approximately 2 mm {ϕ0.079 in.})
  - Welding current: AC80A
- After the welding is completed, check for the following defects. If any of these defects are spotted, repair the defect or replace the core.
  - Undercuts
  - Cracks in weld bead
  - Cracks in base metal

CAUTION ⚠

- **Make sure that welds are proper. Any defect in welding can lead to recurrence of leakage.**

◆Installation procedure◆

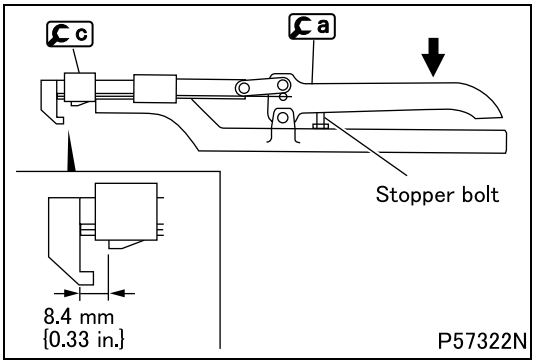


■ Installation: Upper tank and lower tank

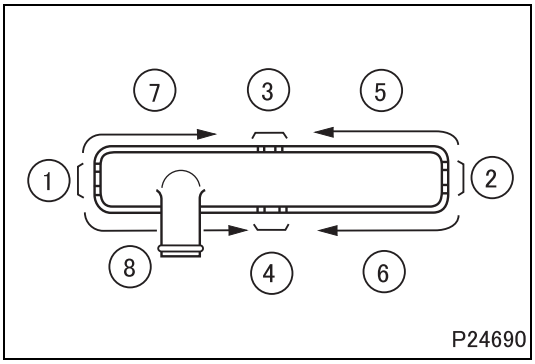
- If there is a gap between the tank and core's tank holding plate when the tank is placed in position, lightly tap the plate with a rubber or plastic hammer to eliminate the gap.

CAUTION ⚠

- **When installing the tank and packing, use your bare hands to avoid putting foreign matter on the parts.**



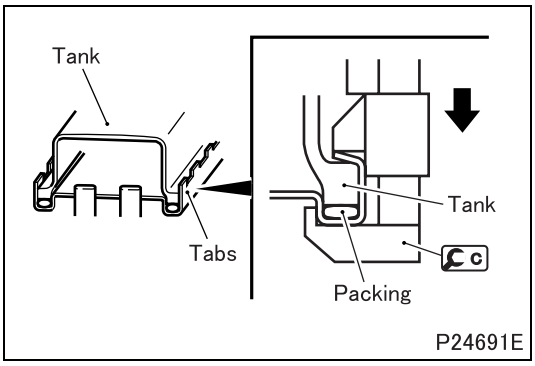
- Attach [c] onto [a].
- Using the stopper bolt on [a], adjust the jaw span of [c] to the dimension indicated in the illustration.



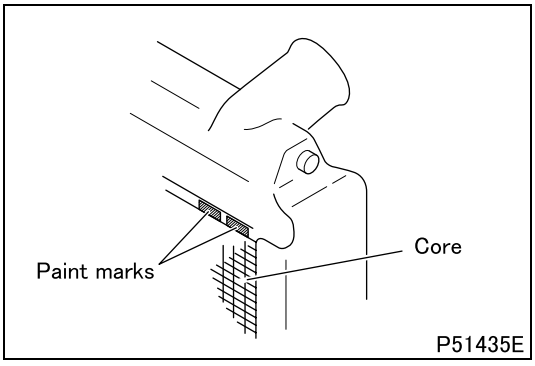
- Bend and clinch the tabs of the core over the brim of the tank in the sequence indicated in the illustration.
  1 to 4: Clinch the two tabs at the center on each side of the tank.
  5 to 8: Clinch the rest of the tabs in the order indicated by the arrows.

CAUTION ⚠

- **The tabs on sides 1 and 2 cannot be clinched using [c]. Use a pair of pliers with the noses wrapped with vinyl tape to clinch these tabs.**



- After clinching all the tabs, check for leakage.

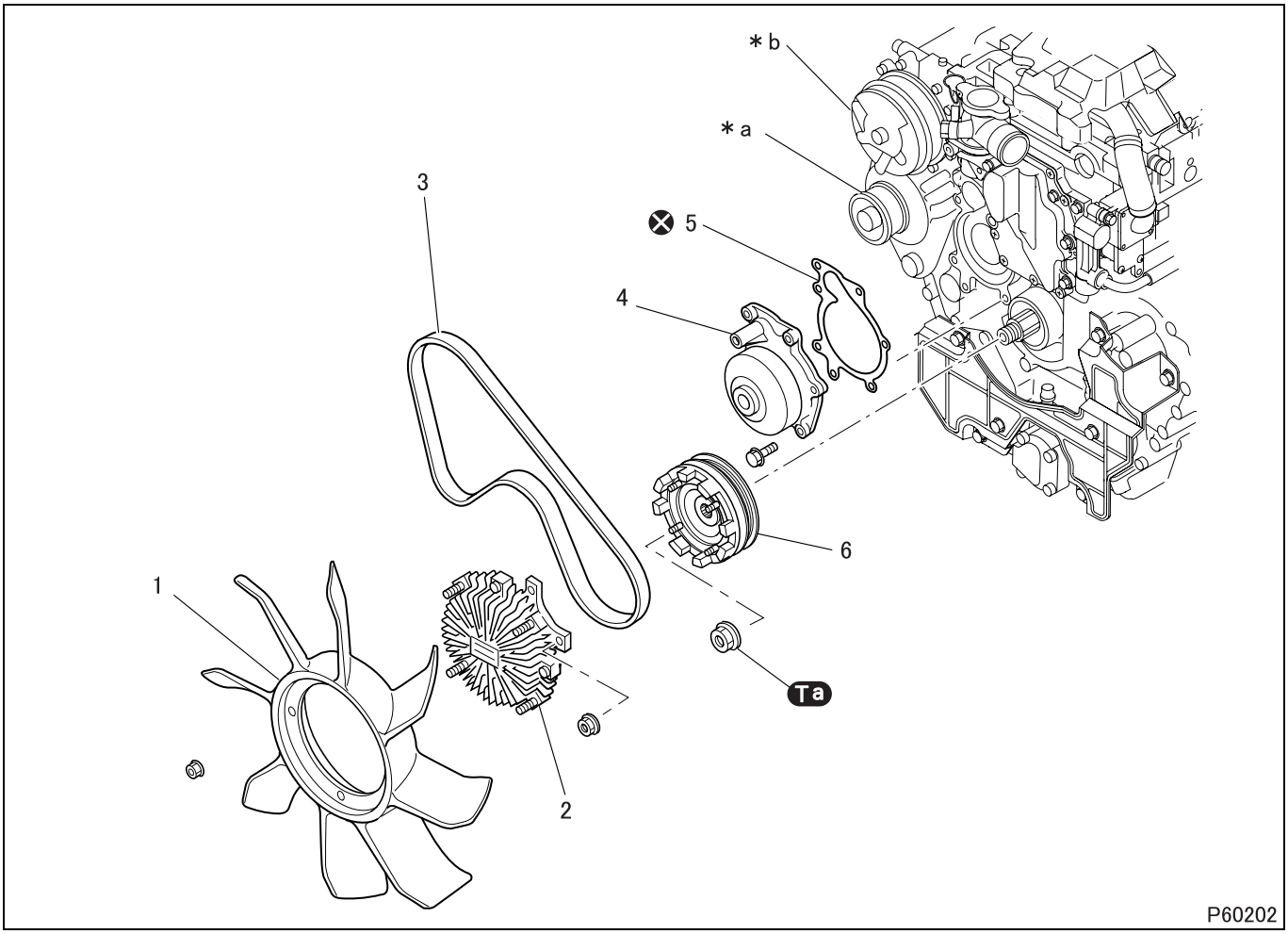


- Put a paint mark on a clearly visible area of the core to indicate the number of times the tabs have been unbent and re-clinched.

CAUTION ⚠

- **One paint mark should be made for each of the upper and lower tanks every time the tabs for it are unbent and re-clinched.**

COOLING FAN, V-BELT AND WATER PUMP



● **Removal sequence**

1 Cooling fan
2 Automatic cooling fan coupling
3 V-belt
4 Water pump
5 Gasket
6 Fan pulley

***a**: Alternator
***b**: Compressor
<With air conditioner>
Tension pulley
<Without air conditioner>

⊗: Non-reusable parts

● **Installation sequence**

Follow the removal sequence in reverse.

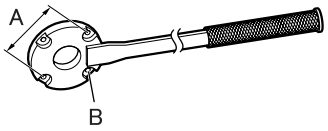
CAUTION ⚠

- **The automatic cooling fan coupling and the water pump cannot be disassembled. It must be replaced if defective.**
- **Make sure that there is no oil or grease on the V-belts. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.**

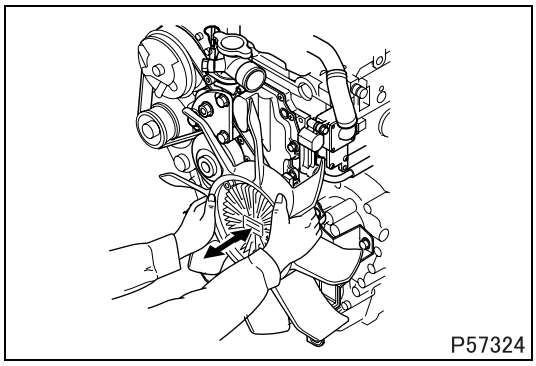
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (fan pulley mounting)	370 {270, 38}	–

Special tools (Unit: mm {in.})

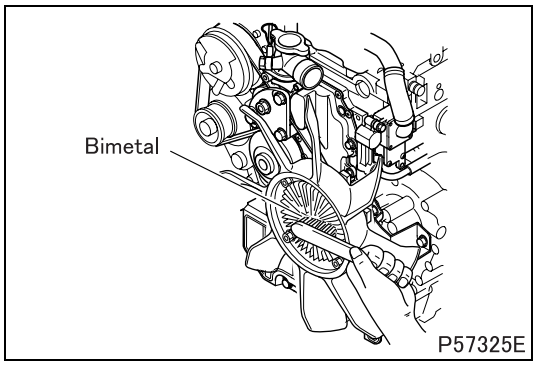
Mark	Tool name and shape	Part No.	Application
ⓐ	Holding bar A: 114 {4.49}, B: ϕ9 {ϕ0.35}  P69433	MH062970	Holding of fan pulley

◆Inspection and cleaning procedure◆



■ Inspection: Automatic cooling fan coupling

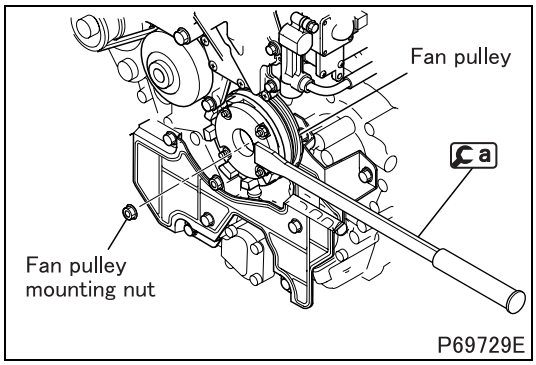
- Make an inspection of the following points. Replace the automatic cooling fan coupling if defective.
  Check that:
  - the hydraulic oil sealed inside the coupling is not leaking;
  - the coupling does not make any abnormal noise or rotate unevenly due to defects in the inside bearing when rotated manually; and
  - the automatic cooling fan coupling does not move too much when pushed and pulled in the axial directions when the engine is cold.



■ Cleaning: Automatic cooling fan coupling

- When removing foreign matter from the bimetal, be careful not to press too hard against the bimetal.

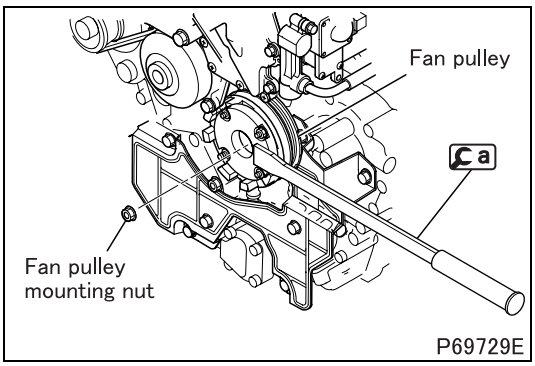
◆Removal procedure◆



■ Removal: Fan pulley

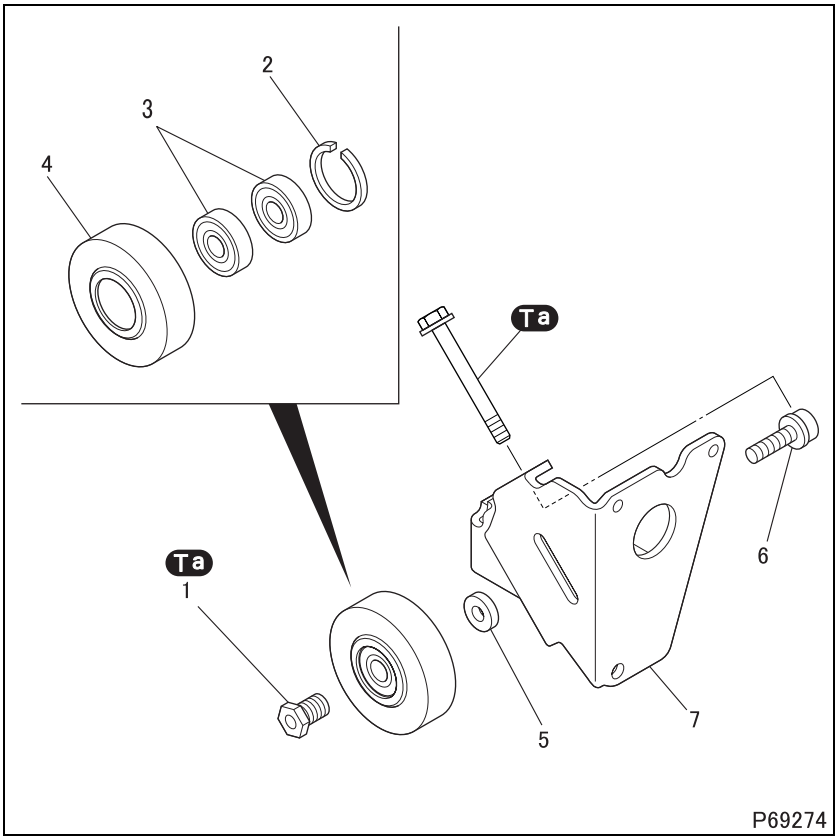
- Put ⓐ in position on the studs of the fan pulley and fix the tool by using nuts.
- While holding ⓐ, loosen the fan pulley mounting nut.

◆Installation procedure◆



■Installation: Fan pulley

- Put a in position on the studs of the fan pulley and fix the tool by using nuts.
- Tighten the fan pulley mounting nut to the specified torque while holding a.



● Disassembly sequence

1 Sleeve
2 Snap ring
3 Bearing
4 Tension pulley
5 Spacer
6 Shaft
7 Tension pulley bracket

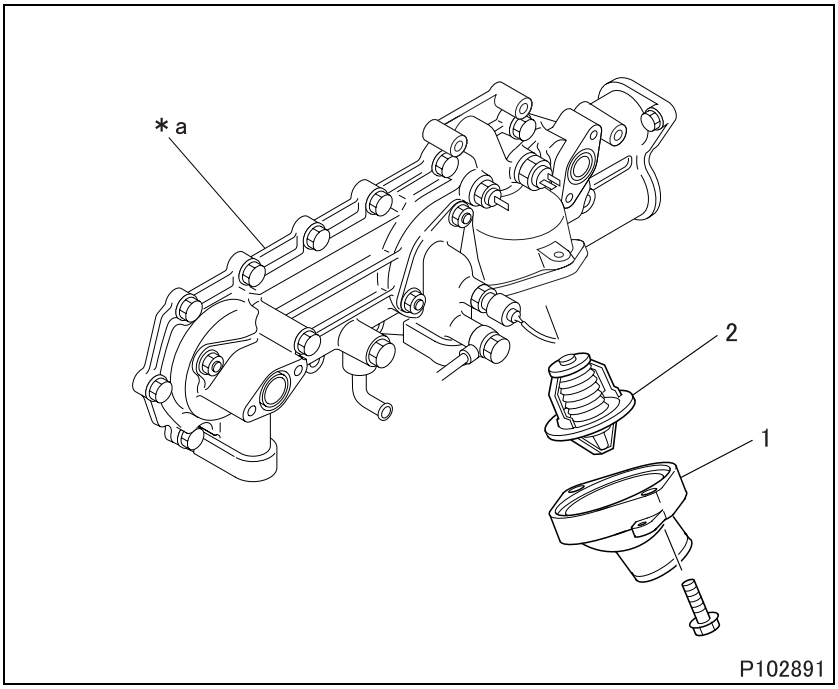
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Sleeve	15 {11, 1.5}	–

THERMOSTAT



● Disassembly sequence

1 Thermostat cover
2 Thermostat

***a**: Oil cooler

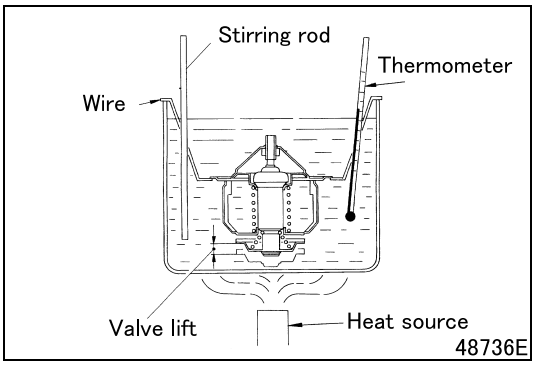
● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
2	Thermostat	Valve opening temperature	82 ± 2°C {180 ± 3.6°F}	–	Replace
		Valve lift / temperature	10 {0.39} or more / 95°C {205°F}		

◆Inspection procedure◆



■ Inspection: Thermostat

- Stir the water using a stirring rod to maintain an even water temperature in the container, then conduct the tests indicated below.
- If the measured values deviate from the standard value ranges, replace the thermostat.

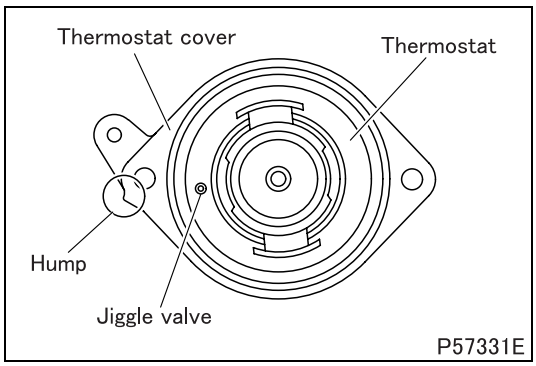
(1) Valve opening temperature

- Hold the thermostat with wire to keep it away from the heat source.
- Heat the water gradually to the valve opening temperature.
- Maintain this temperature for five minutes and make sure that the valve is completely open.
- Make sure that the valve closes completely when the water temperature drops below 65°C {150°F}.

(2) Valve lift

- Heat the water to a temperature slightly higher than the valve opening temperature. Maintain this temperature for five minutes and measure the valve lift.

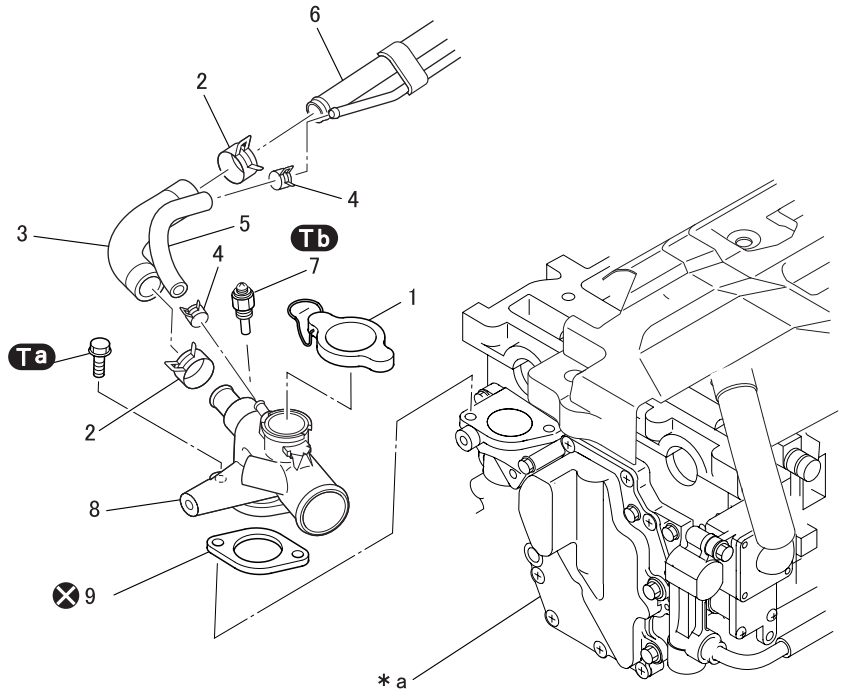
◆Installation procedure◆



■Installation: Thermostat

- Mount the thermostat on the thermostat cover in the illustrated direction.

PRESSURE CAP AND WATER OUTLET CASE



P102892

● Disassembly sequence

1 Pressure cap
2 Clip
3 Water hose
4 Clip
5 Water hose
6 Exhaust gas recirculation outlet pipe
7 Overheating switch
8 Water outlet case
9 Gasket

***a**: Breather cover
⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

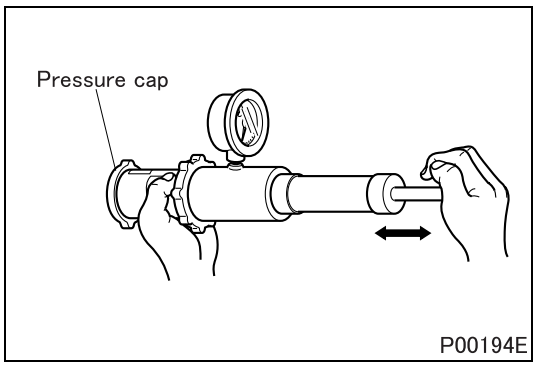
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
1	Pressure cap valve opening pressure	110 ± 15 kPa {16 ± 2.2 psi, 1.1 ± 0.15 kgf/cm^3}	–	Replace

Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (water outlet case mounting)	24 {18, 2.4}	–
Tb	Overheating switch	35 {26, 3.6}	–

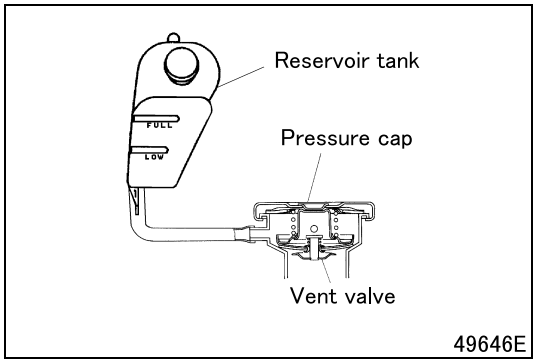
◆Inspection procedure◆



■Inspection: Pressure cap

(1) Pressure valve opening pressure

- Replace the pressure cap if the measured value deviates from the standard value range.



(2) Inspection of vent valve

- Before starting the inspection, check the level of coolant in the reservoir tank.
- Run the engine at full speed. Stop the engine when the level of coolant in the reservoir tank noticeably rises.
- Wait until the coolant temperature drops to the ambient temperature. Then, check if the coolant in the reservoir tank has returned to the same level as that confirmed before the engine was started.
- If the coolant has failed to return to its original level, the vent valve is defective. In this case, replace the pressure cap.

CAUTION ⚠

- **Be aware that removing the pressure cap before the coolant cools down to the ambient temperature will result in loss of vacuum in the radiator, which disables the coolant from being returned to the reservoir tank.**

INDEX

SPECIFICATIONS 15-2

STRUCTURE AND OPERATION

1. **Air Cleaner 15-2**
2. **Turbocharger 15-3**
3. **Turbocharger Control System 15-4**
4. **Diesel Particulate Filter 15-8**

TROUBLESHOOTING 15-18

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. **Measurement of Turbocharger Boost Pressure 15-19**

AIR DUCT AND AIR CLEANER 15-20

DIESEL PARTICULATE FILTER INSPECTION 15-24

TURBOCHARGER 15-30

INTERCOOLER 15-34

INTAKE MANIFOLD 15-37

EXHAUST MANIFOLD 15-39

EXHAUST PIPE 15-40

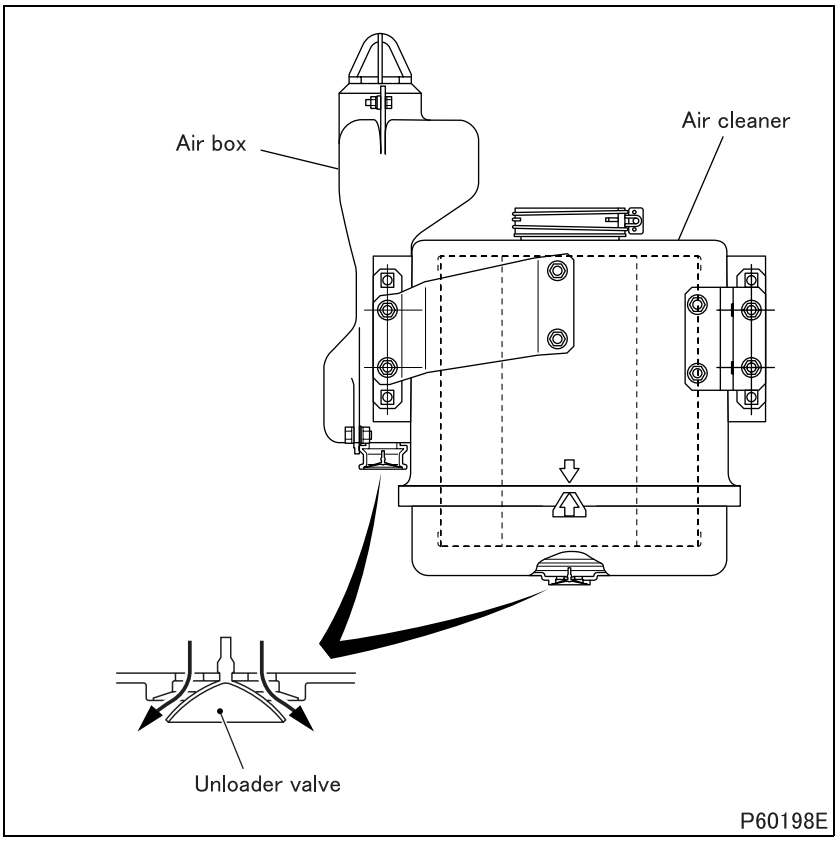
DIESEL PARTICULATE FILTER 15-42

SPECIFICATIONS

Item		Specifications
Air cleaner element		Filter paper type
Turbocharger	Model	TD04
	Manufacturer	Mitsubishi Heavy Industries, Ltd.
Intercooler		Tube and corrugated fin type air-to-air heat exchanger
DPF (Diesel Particulate Filter) type		Regeneration control type diesel particulate filter system

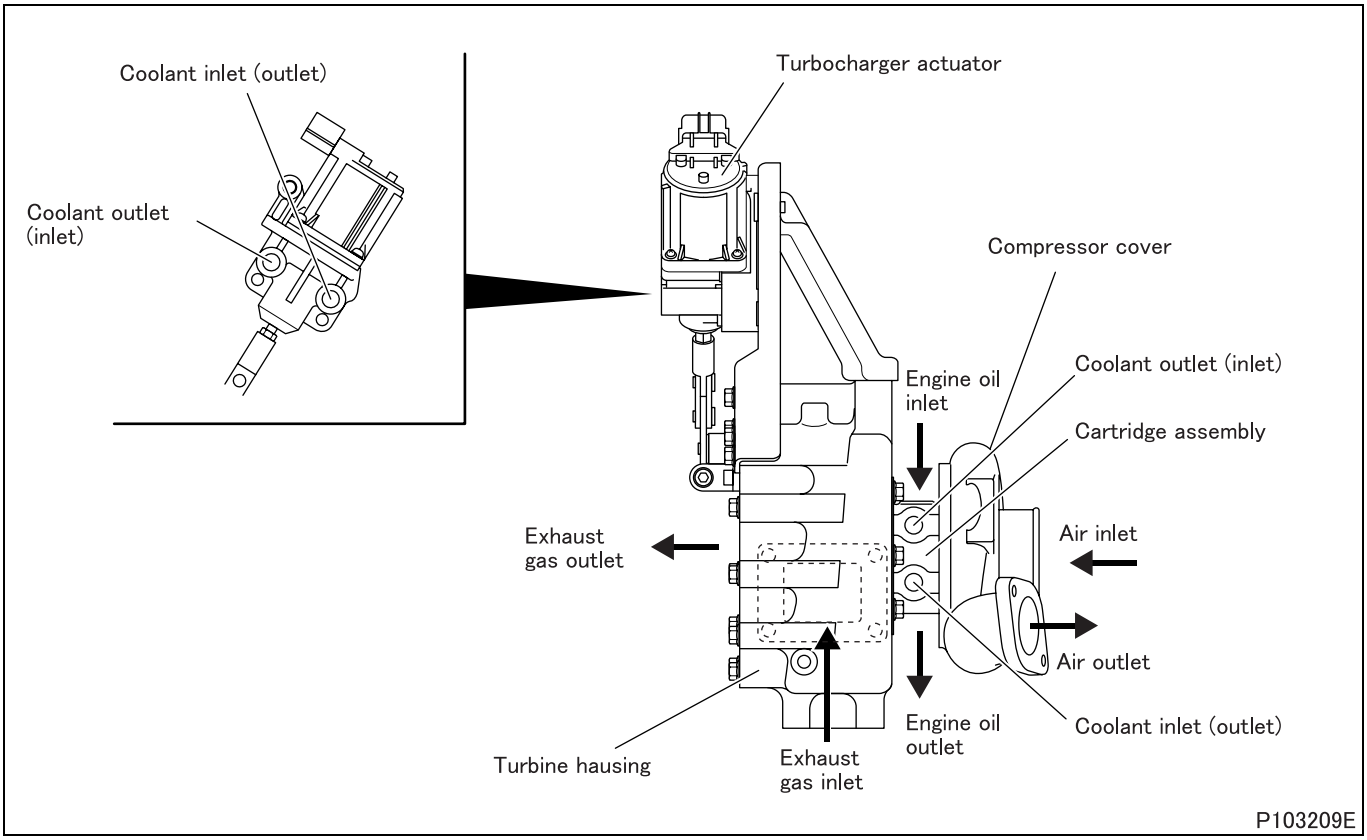
STRUCTURE AND OPERATION

1. Air Cleaner



- The air cleaner is a single element type.
- When the engine slows down below the predetermined speed, the level of vacuum changes and causes the unloader valve to vibrate. Vibration of the unloader valve allows the air cleaner to automatically discharge any water and dust that has accumulated in its inside.

2. Turbocharger

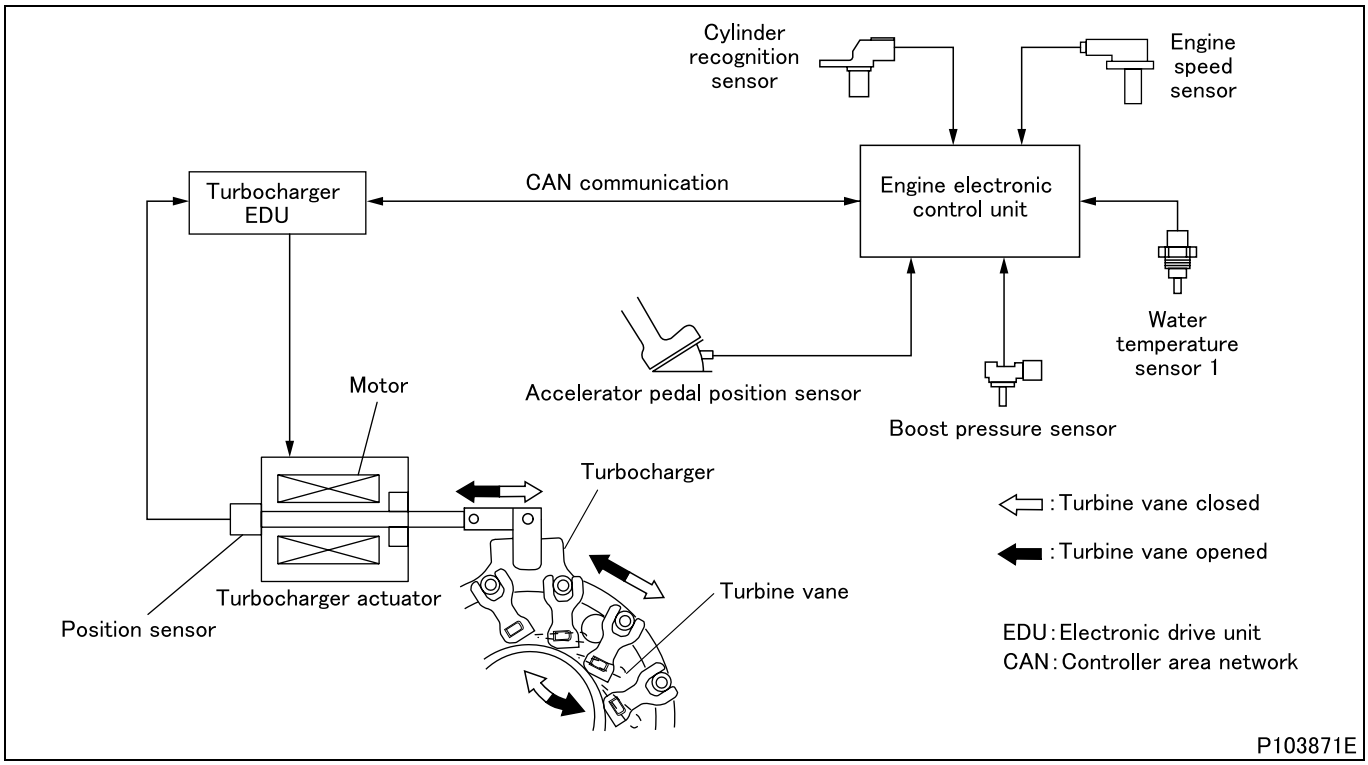


- TD05 model is equipped with turbocharger, which is a variable nozzle vane type turbocharger with adjustable, heat-resistive alloy turbine vanes provided at the turbine exhaust gas inlet port.

3. Turbocharger Control System

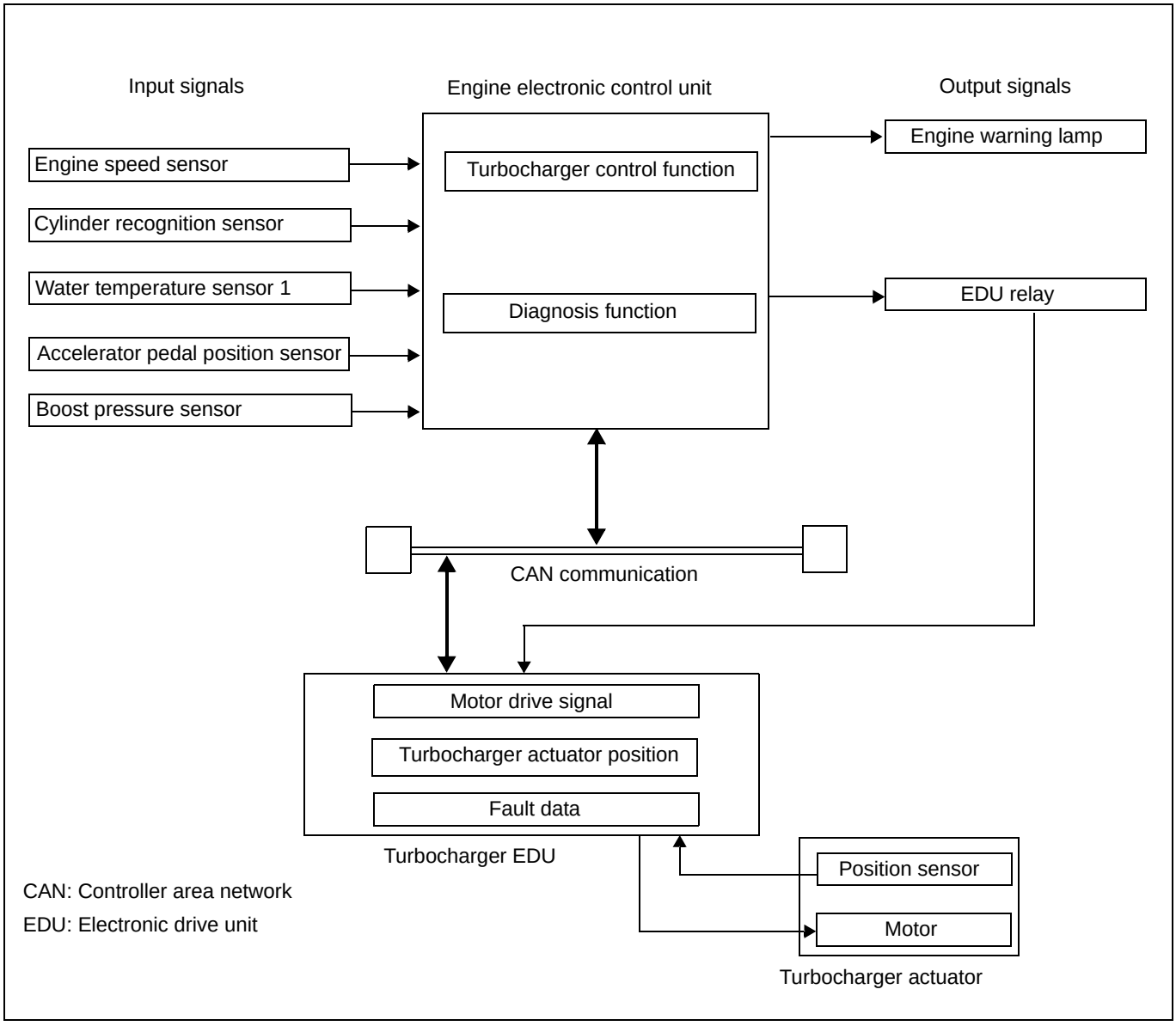
3.1 General description

- In the turbocharger control system, various engine-related information (engine speed, coolant temperature, accelerator position) and driving status are collected by the relevant sensors and are sent to the engine electronic control unit and turbocharger electronic drive unit which then control the engine based on the information received.
- The turbocharger actuator controls the opening of turbine vanes according to control signals to ensure low fuel consumption and high torque operation over the entire speed range.



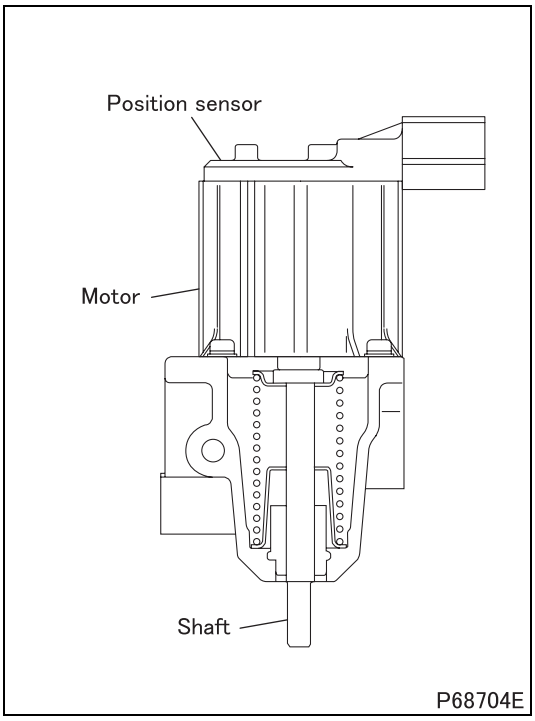
3.2 Electronic control system

(1) System block diagram



(2) Turbocharger control function

- In response to output data from various sensors, the engine electronic control unit determines the opening of turbine vanes as required by the engine operating status and sends necessary control signals to the turbocharger electronic drive unit. (target opening of turbine vanes)
- The turbocharger electronic drive unit activates the turbocharger actuator motor to detect the amount of resultant shaft position by means of the position sensor and sends it to the engine electronic control unit. (actual opening of turbine vanes)
  Thus, the target opening of turbine vanes can be accurately maintained as commanded by the engine electronic control unit.



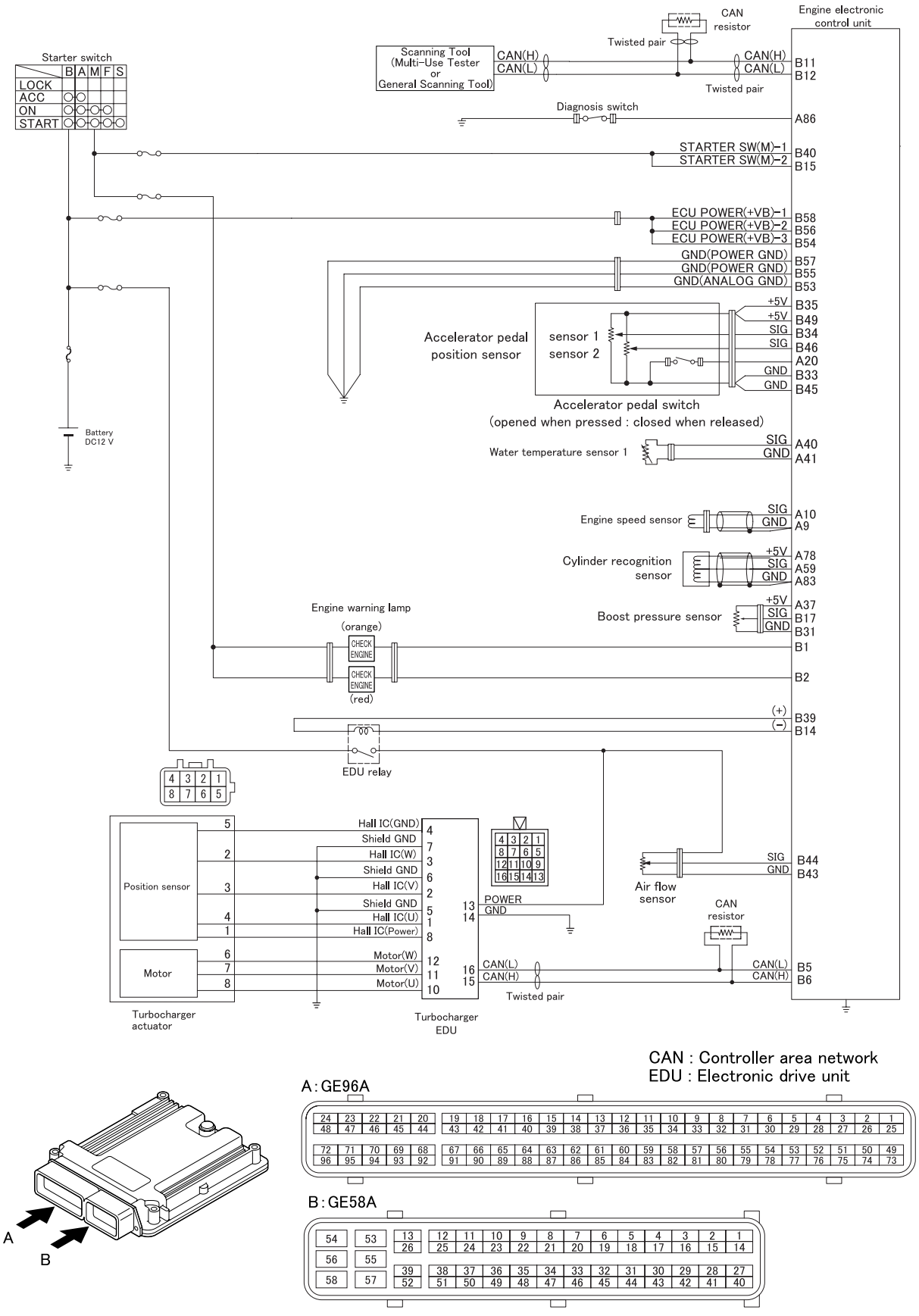
(2.1) Turbocharger actuator

- In response to command signals from the turbocharger electronic drive unit, the turbocharger actuator moves the shaft up and down by means of its DC motor to open and close the turbine vanes.

(3) Fault diagnosis function

- The engine electronic control unit continuously monitors the electronic drive units and sensors for faults. In the event that the engine electronic control unit finds a component faulty, it causes an indication to be made in the meter cluster to alert the driver. At the same time, it memorizes the fault location in the form of a diagnosis code and starts a control during fault.
- While the engine is running, the turbocharger electronic drive unit continuously monitor communication with the position sensor and motor of the turbocharger actuator communication with the engine electronic control unit. In the event that they identify a fault, they send fault data to the engine electronic control unit.
- While control necessitated by a fault is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.
- The control during fault recovers by servicing the faults. However, for some diagnosis codes, the warning lamp stays illuminated until the normal signals are input for several times.
- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

3.3 Electronic control unit wiring diagram



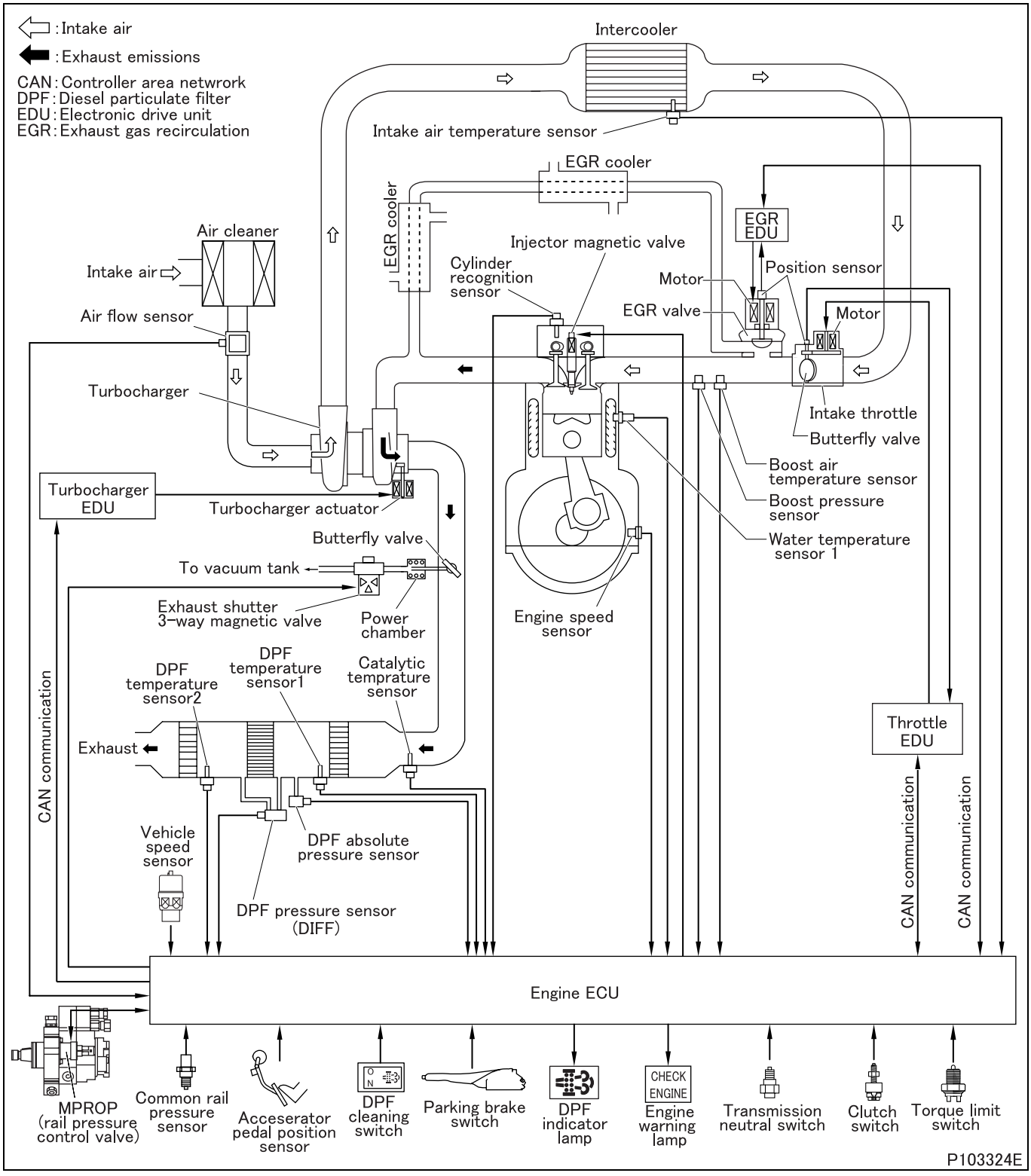
See Gr13EA for control concerning engine electronic control unit.

P103755E

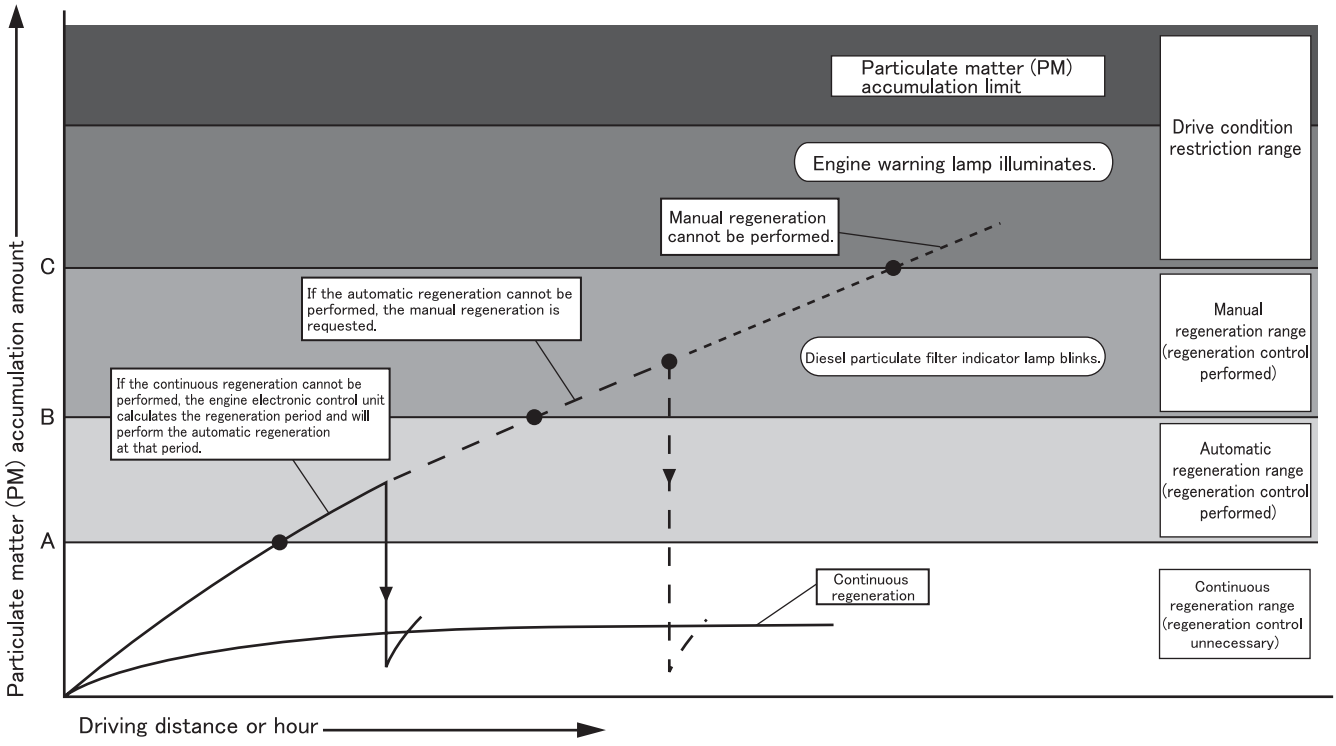
4. Diesel Particulate Filter Regeneration Control System

4.1 General

- The diesel particulate filter regeneration control system burns and removes the particulate matter (PM) in the ceramic filter using high temperature exhaust gas to prevent excessive accumulation of particulate matter in the ceramic filter. Thus the diesel particulate filter is regenerated.
- The regeneration is divided into two types. One is the continuous regeneration utilizing high temperature exhaust gas during high-speed or high-load operations. The other is the automatic or manual regeneration which uses high temperature exhaust gas created by the regeneration control by the engine electronic control unit.
- For automatic or manual regeneration, the engine electronic control unit estimates the accumulated amount of particulate matter from the vehicle operating hours, driving distance and the engine condition during driving, and the regeneration is performed by controlling the fuel injection (amount and timing), turbocharger, exhaust shutter and intake throttle to make high temperature exhaust gas.


: Intake air
: Exhaust emissions
CAN : Controller area netwrork
DPF : Diesel particulate filter
EDU : Electronic drive unit
EGR : Exhaust gas recirculation
Intercooler
Intake air temperature sensor
EGR cooler
EGR cooler
Air cleaner
Intake air
Air flow sensor
Injector magnetic valve
Cylinder recognition sensor
EGR EDU
Position sensor
Motor
EGR valve
Motor
Turbocharger
Intake throttle
Butterfly valve
Boost air temperature sensor
Boost pressure sensor
Water temperature sensor 1
Turbocharger EDU
Turbocharger actuator
Butterfly valve
To vacuum tank
Exhaust shutter 3-way magnetic valve
Power chamber
Engine speed sensor
DPF temperature sensor2
DPF temperature sensor1
Catalytic temprature sensor
Exhaust
Throttle EDU
CAN communication
Vehicle speed sensor
DPF absolute pressure sensor
DPF pressure sensor (DIFF)
CAN communication
CAN communication
Engine ECU
MPROP (rail pressure control valve)
Common rail pressure sensor
Acceserator pedal position sensor
DPF cleaning switch
Parking brake switch
DPF indicator lamp
CHECK ENGINE
Engine warning lamp
Transmission neutral switch
Clutch switch
Torque limit switch
P103324E

4.2 Continuous regeneration and regeneration control



- The above diagram shows the relations between the driving distance or hours and the particulate matter accumulation amount, and the range of each diesel particulate filter regeneration operation.
- The particulate matter accumulation amount increases as the driving distance or hours increase. However, by conducting the regeneration operation that matches the vehicle operating condition and the particulate matter accumulation amount, the particulate matter accumulation amount is reduced to keep the performance of the diesel particulate filter.
- The regeneration is divided into two types – the continuous regeneration utilizing exhaust gas during normal driving operation and the automatic or manual regeneration which uses exhaust gas created by the regeneration control.

(1) Continuous regeneration

- When exhaust gas temperature is high during high-speed or high-load operation, NO_2 created by the action of the front oxidation catalyst continuously burns the particulate matter accumulated in the ceramic filter.

(2) Regeneration control

(2.1) Automatic regeneration

- When the particulate matter accumulation level is between A and B on the diagram, the engine electronic control unit decides the regeneration period and the automatic regeneration will be performed at an appropriate period. During regeneration, the unburnt fuel (HC) supplied by the post injection is oxidized by the front oxidation catalyst, and the oxidation heat from that reaction burns the particulate matter accumulated in the ceramic filter.

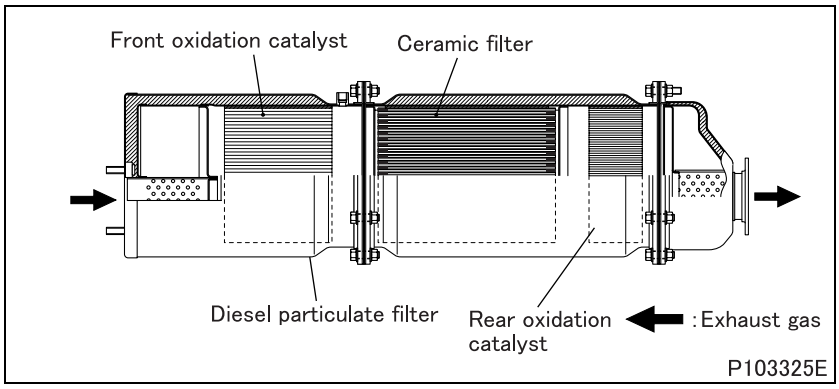
(2.2) Manual regeneration

- When the particulate matter accumulation level is between B and C on the diagram, the engine electronic control unit makes the diesel particulate filter indicator lamp blink. If the diesel particulate filter cleaning switch is turned on by the driver when the following conditions are met, the manual regeneration will take place.
  - Engine has warmed up (coolant temperature: 70°C {158°F} or higher)
  - Diesel particulate filter cleaning switch: ON (Press the switch until the diesel particulate filter indicator stays on.)
  - Accelerator pedal released (accelerator pedal position sensor: 0%)
  - Parking brake applied (parking brake switch: ON)
  - Transmission in neutral position (transmission neutral switch: OFF)
  - Clutch pedal released (clutch pedal switch: ON)
  - Power take-off inactive (power take-off switch: OFF)
- During regeneration, the diesel particulate filter indicator lamp blinks in two intervals (slow and fast) in accordance with the particulate matter accumulation amount.
- The exhaust gas temperature increase procedure and the particulate matter burning procedure are the same as that for the automatic regeneration.

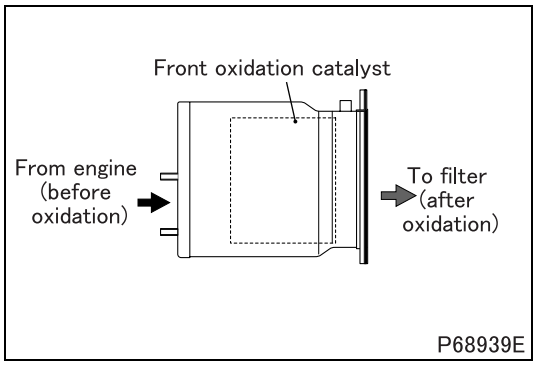
(2.3) Restriction on drive conditions

- When the particulate matter accumulation level exceeds C on the diagram, the engine warning lamp illuminates and some restrictions are applied to the driving conditions.

4.3 Diesel particulate filter unit

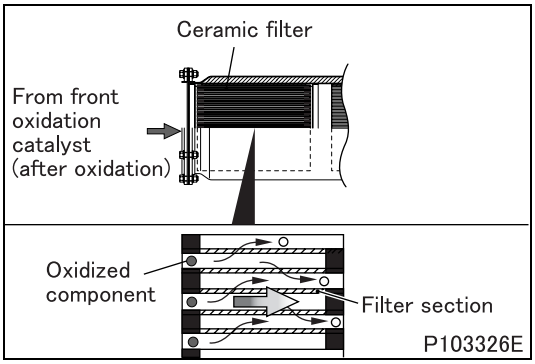


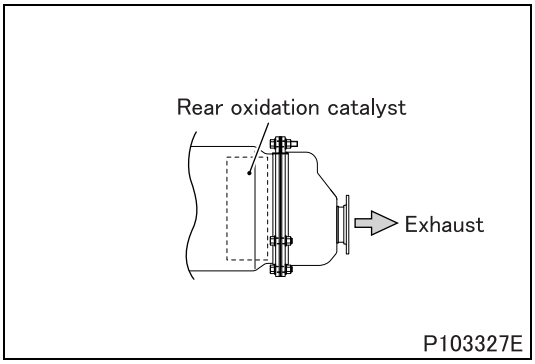
- Diesel particulate filter unit consists of the front oxidation catalyst, ceramic filter and rear oxidation catalyst.



(1) Front oxidation catalyst

- In normal driving condition, unburnt fuel (HC) and part of the particulate matter in the exhaust gas from the engine is purified by this catalyst.
- During filter regeneration, the unburnt fuel (HC) supplied by the post injection is oxidized by the front oxidation catalyst, and the oxidation heat raises exhaust gas temperature.





(2) Ceramic filter

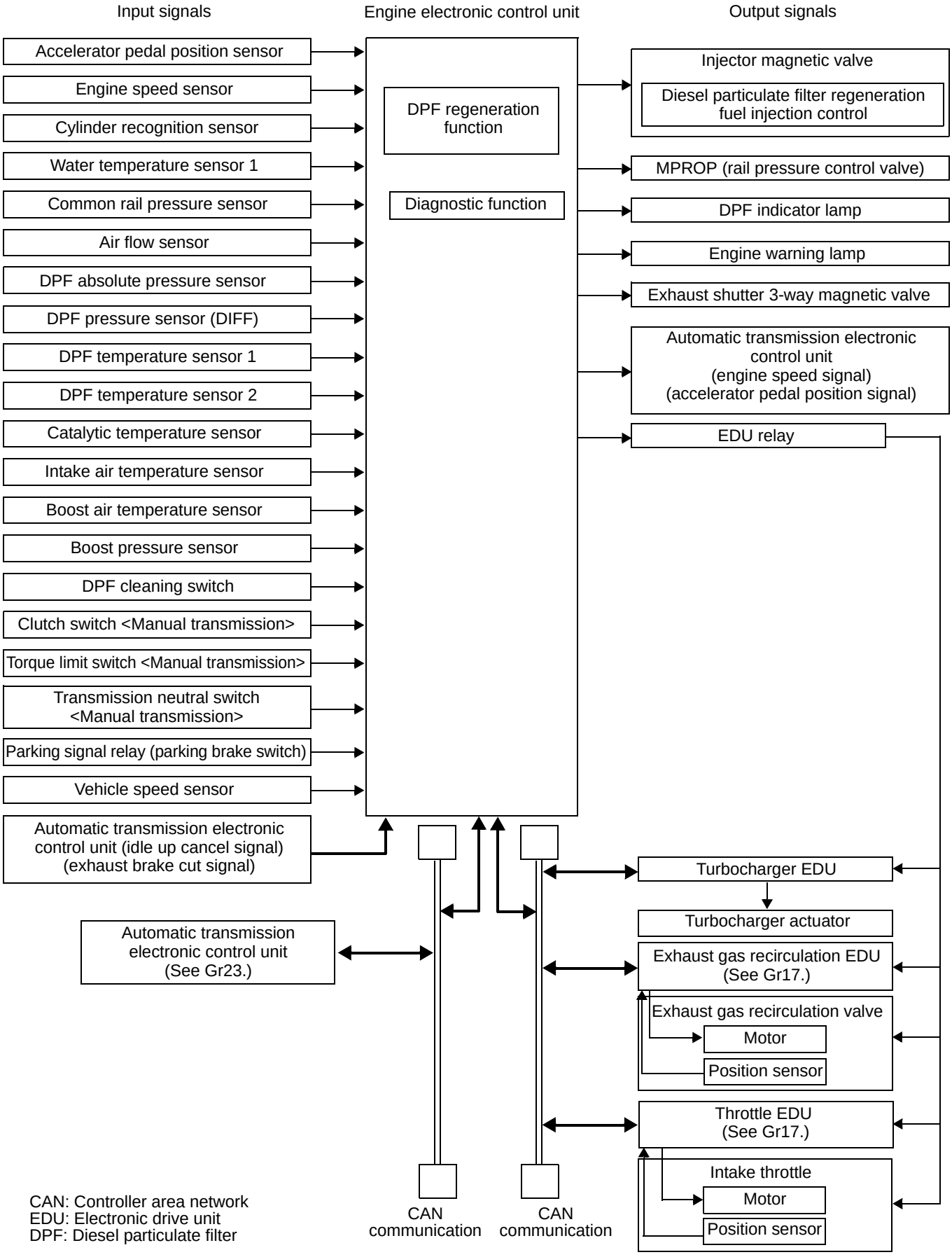
- The ceramic filter is an aggregate of thin tubes, and these tubes are closed at either end alternatively. During normal operation, particulate matter is trapped when the exhaust gas enters a tube and passes through the wall of the tube (filter section) to the adjacent tube.
- During regeneration, the particulate matter accumulated in the filter is cleared by burning at high temperature. This, however, cannot remove the calcium (ash) contained in the engine oil and the ash will accumulate in the filter. The excessively accumulated ash may cause early clogging of the ceramic filter. Therefore, the ceramic filter must be cleaned periodically.

(3) Rear oxidation catalyst

- The rear oxidation catalyst oxidize and remove the components (HC and CO) which remain untreated through the diesel particulate filter.

4.4 Electronic control system

(1) System block diagram

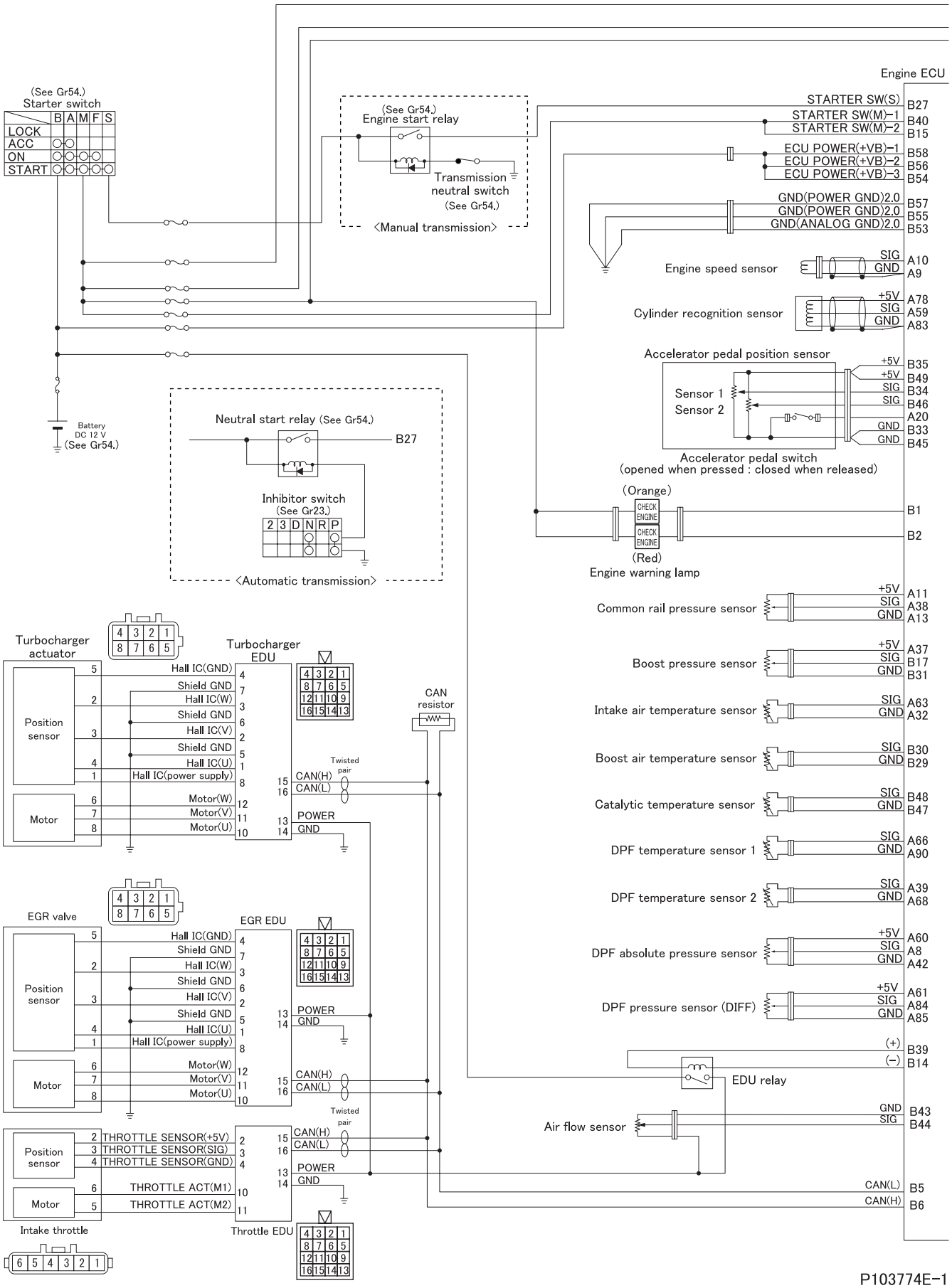


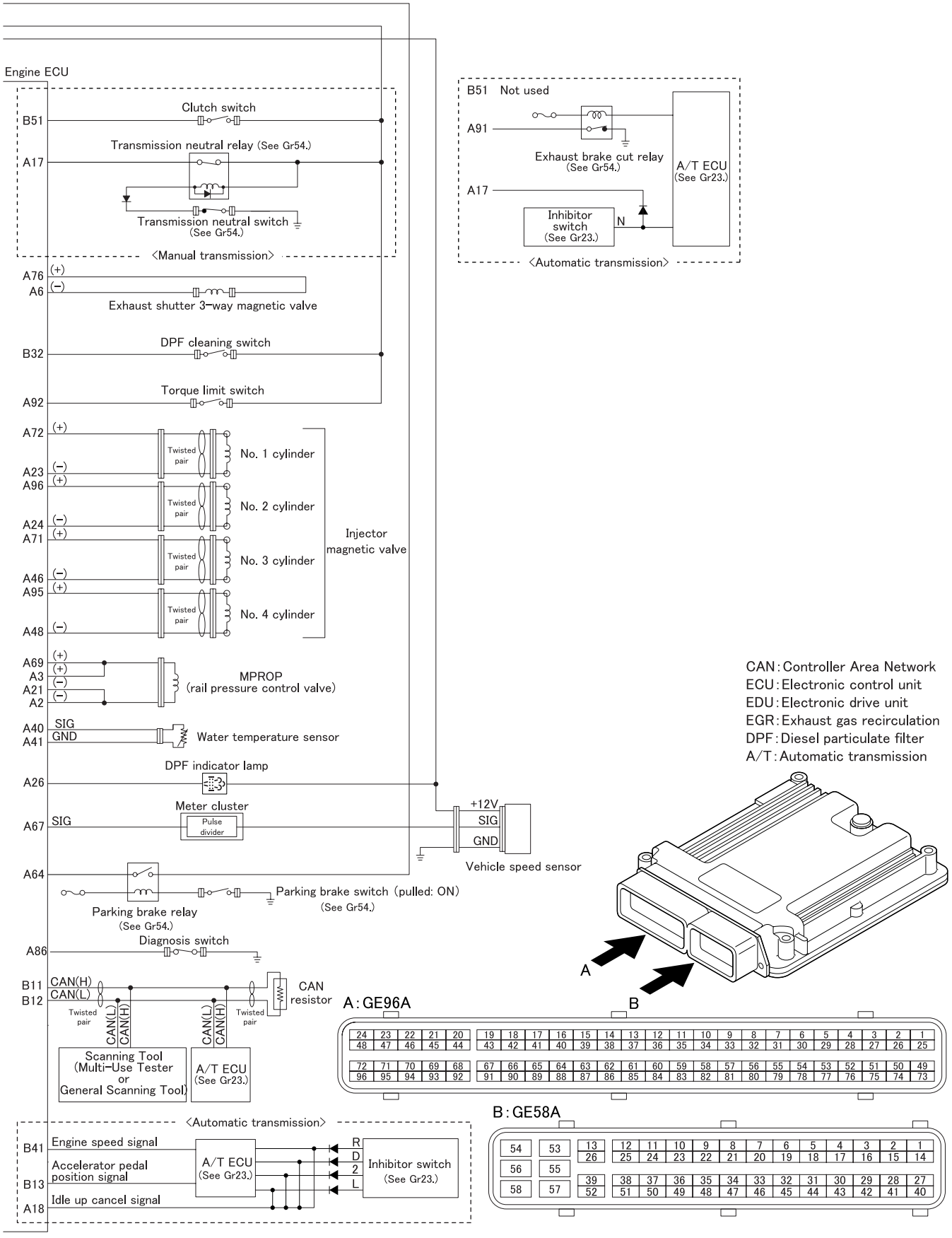
Part	Main function/operation
Accelerator pedal position sensor	Detection of extent of accelerator pedal depression
Engine speed sensor	Detection of engine speed
Cylinder recognition sensor	Cylinder recognition
Water temperature sensor 1	Detection of coolant temperature
Common rail pressure sensor	Sensing of common rail pressure
Air flow sensor	Detection of intake air flow rate
DPF absolute pressure sensor	Detection of DPF absolute pressure
DPF pressure sensor (DIFF)	Detection of DPF differential pressure
DPF temperature sensor 1	Detection of ceramic filter inlet temperature
DPF temperature sensor 2	Detection of ceramic filter outlet temperature
Catalytic temperature sensor	Detection of front catalyst inlet temperature
Intake air temperature sensor	Detection of upper stream side intake air temperature (in the intercooler)
Boost air temperature sensor	Detection of downstream side intake air temperature (after joining the exhaust gas recirculation)
Boost pressure sensor	Sensing of boost pressure
DPF cleaning switch	ON/OFF changeover of DPF manual regeneration
Clutch switch <Manual transmission>	Detection of released/pressed condition of clutch pedal (OFF with pedal released)
Torque limit switch <Manual transmission>	Detection of 1st and reverse positions
Transmission neutral switch <Manual transmission>	Detection of transmission neutral condition (OFF with transmission in neutral)
Parking signal relay (parking brake switch)	Detection of parking condition (turns ON when the parking brake is applied)
Injector magnetic valve	DPF regeneration fuel injection control
MPROP (rail pressure control valve)	Control of fuel injection pressure
DPF indicator lamp	Illuminates when the particulate matter accumulation in the DPF exceeds a certain value.
Engine warning lamp	Indication of system abnormalities Illuminates when the particulate matter accumulation in the DPF is excessive.
Exhaust shutter 3-way magnetic valve	ON/OFF changeover of exhaust shutter
Automatic transmission electronic control unit (engine speed data for automatic transmission control)	Output of engine speed for automatic transmission control
Automatic transmission electronic control unit (accelerator pedal position for automatic transmission control)	Output of extent of accelerator pedal depression for automatic transmission control
EDU relay	Switching ON/OFF supply of power to EGR EDU, turbocharger EDU and throttle EDU
Automatic transmission electronic control unit (idle up cancel signal and exhaust brake cut signal)	• Releasing the idle-up other than N range • Prohibition of the activation of auxiliary brake when the vehicle speed is 10 km/h or lower
Controller area network communication (automatic transmission electronic control unit)	• Engine data recognized by the engine electronic control unit are outputted to the controller area network bus to enable systems to obtain data that they need for control. • Each automatic transmission electronic control unit issues signals to the engine electronic control unit to enable it to effect engine control appropriate for each type of system control. (See Gr23 for control of automatic transmission electronic control unit)
Controller area network communication (turbocharger EDU, throttle EDU and EGR EDU)	• Engine data recognized by the engine electronic control unit are outputted to the controller area network bus to enable systems to obtain data that they need for control. • Each EDU opens/closes the valves to increase exhaust gas temperature for DPF regeneration. (See Gr17 for control of throttle EDU and EGR EDU)

(2) Fault diagnosis function

- The engine electronic control unit continuously monitors the electronic drive units and sensors for faults. In the event that the engine electronic control unit finds a component faulty, it causes an indication to be made in the meter cluster to alert the driver. At the same time, it memorizes the fault location in the form of a diagnosis code and starts a control during fault.
- While control necessitated by a fault is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.
- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

4.5 Electronic control unit wiring diagram





See Gr13EA for control concerning engine electronic control unit.

P103774E-2

Possible causes / Symptoms			Engine is difficult to start	Exhaust gas is black	Exhaust gas is white	Engine output is insufficient	Fuel consumption is too high	Intake and exhaust system vibrates and/or makes abnormal noises	Reference Gr
Air cleaner		Clogged air cleaner element	O	O		O			
Turbocharger	Cartridge assembly	Defective bearing		O		O		O	
		Carbon deposits on turbine wheel		O		O			
		Interference between turbine wheel and turbine back plate		O		O		O	
		Interference between turbine wheel and turbine housing		O		O		O	
		Bent shaft		O		O		O	
		Damaged turbine wheel		O		O		O	
		Interference between compressor wheel and compressor cover		O		O		O	
		Seizure of thrust sleeve and/or thrust bearing		O		O		O	
		Damaged compressor wheel		O		O		O	
		Oil leakage due to worn piston ring and/or insert		O	O		O		
		Poorly installed piston ring					O		
		Unsmooth sliding of inner parts due to clogged lubricating oil pipe and/or eyebolt		O		O			
		Damaged oil seals due to clogged oil return pipe			O		O		
	Poorly mounted compressor cover			O		O	O	O	
	Poorly mounted turbine housing					O		O	
Intercooler						O			
Throttle actuator		Butterfly valve stuck in closed position		O	O	O			Gr13E
		Poorly adjusted butterfly valve		O	O	O			
Deformed front pipe, muffler, and/or tail pipe								O	
Poorly installed front pipe, muffler, and/or tail pipe								O	
Inappropriate valve clearance				O					Gr11
Defective cylinder head gasket				O					
Worn valve and valve seat and/or carbon deposits				O					
Weakened valve springs				O					
Worn and/or damaged piston rings					O		O		
Worn and/or damaged piston ring grooves					O		O		
Malfunctioning cooling system				O					Gr14
Excessive engine oil level					O				Gr12
Seizure of main moving parts				O					Gr11
Uneven or excessive fuel injection				O					Gr13E

1. Measurement of Turbocharger Boost Pressure

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Boost pressure	126 to 164 kPa {37.2 to 48.4 in.Hg, 945 to 1230 mmHg}	–	Replace

1.1 Preparation

- Place the transmission in neutral. (in the parking range P for automatic transmissions.)
- Hold the steering wheel in neutral position.
- Turn off lamps and accessory devices not to increase the engine speed.
- Connect the Multi-Use Tester. (See Gr00.)
- If any fault exists (corresponding diagnosis code is issued), rectify it.
- Warm up the engine until the engine coolant has been heated to more than 60°C {140°F}. (Determine coolant temperature from service data [32: Water temperature].)
- Check that the non-load minimum speed (idling speed) is as specified. (See Gr13A.)

1.2 Measurement and correction of boost pressure

- Set the diagnosis switch to OFF (disconnect the fuse). (See Gr00.)
- Select [A4: VGT1] in [Actuator Test] of the Multi-Use Tester. Set [Target Value] to 80% and execute.
- When [A4: VGT1] is executed, the engine speed should be automatically increased to 2500 rpm.
- Maintain the state of [Target Value] having been executed (for 5 to 15 minutes) until boost pressure is stabilized.
- Measure the following items from among [Service Data].
  20: Atmospheric pressure (measured atmospheric pressure)
  21: Boost pressure (measured boost pressure)
  30: Intake Air Temp. (upper stream) (measured air temperature)
  After the measurements, set the diagnosis switch to ON (connect the fuse).
- Obtain boost pressure correction value respectively by calculating above Service Data.

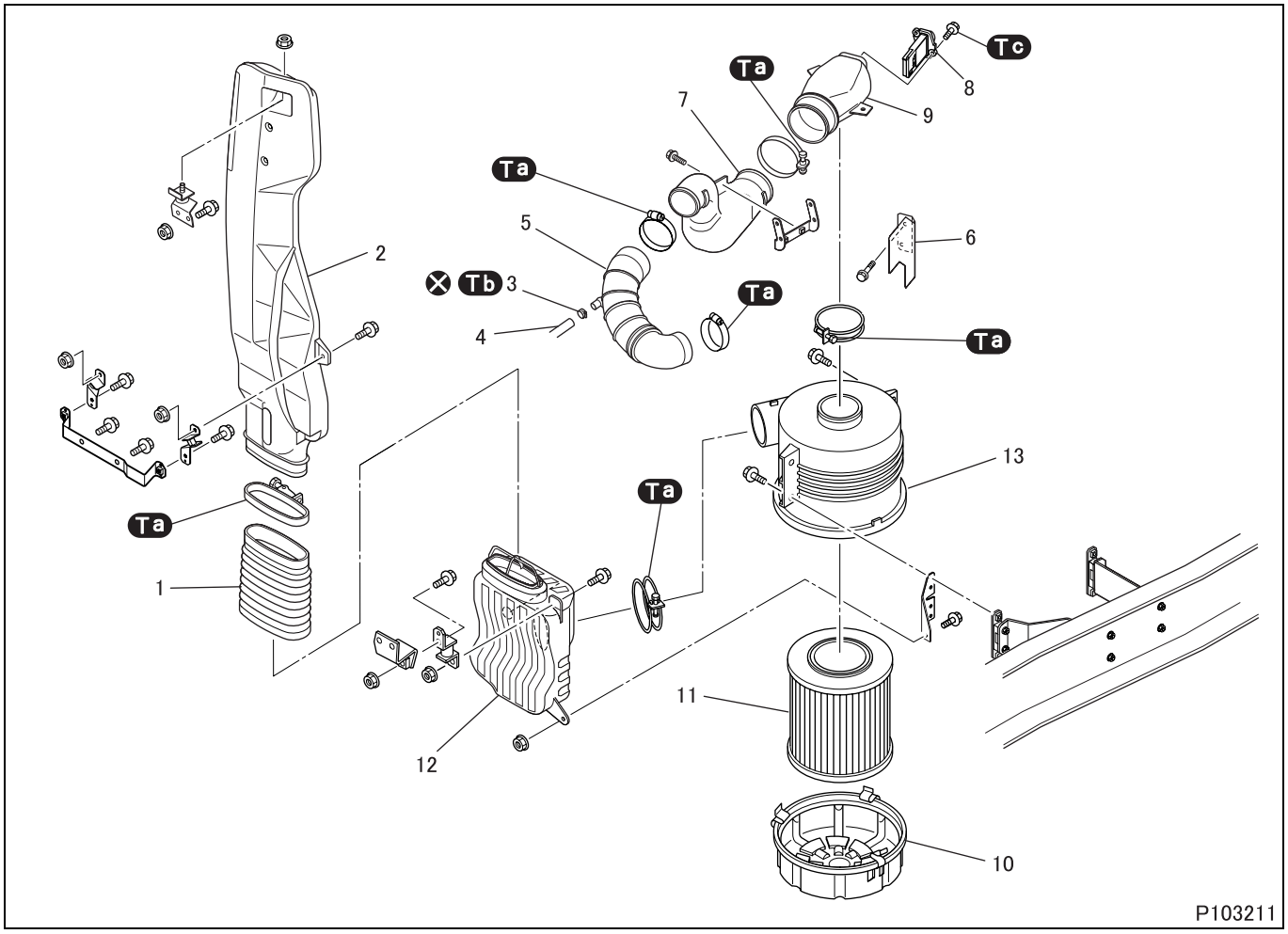
[Calculation of atmospheric pressure correction value]

Atmospheric temperature correction value = Measured atmospheric temperature –100

[Calculation of boost pressure correction value]

- Obtain the boost pressure correction value using the following equation.
  Boost pressure correction value = Measured boost pressure – atmospheric temperature correction value
- If boost pressure correction value deviates from the standard value, replace the turbocharger.

AIR DUCT AND AIR CLEANER



● Disassembly sequence

1 Connector
2 Air inlet duct
3 Clamp
4 PCV hose
5 Air hose
6 Insulator
7 Air duct
8 Air flow sensor
9 Connector
10 Air cleaner cap
11 Air cleaner element
12 Air box
13 Air cleaner case

⊗: Non-reusable parts
PCV: Positive Crankcase Ventilation

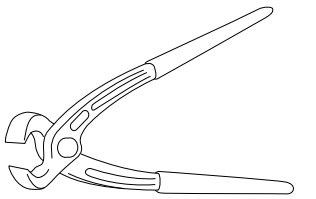
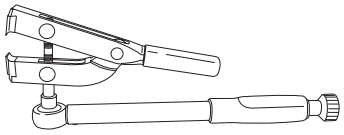
● Assembly sequence

Follow the disassembly sequence in reverse.

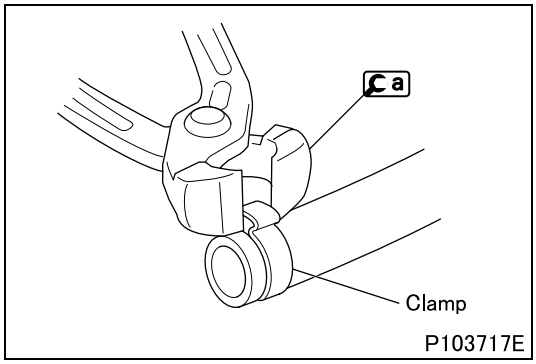
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3.0 to 3.4 {2.2 to 2.5, 0.3 to 0.35}	–
Tb	Clamp	9.0 to 11 {6.6 to 8.1, 0.9 to 1.1}	–
Tc	Bolt (air flow sensor mounting)	1.2 to 1.8 {0.9 to 1.3, 0.1 to 0.2}	–

Special tools

Mark	Tool name and shape	Part No.	Application
a	Pincer  P103715	MH063865	Removal of hose clamp
b	Clamp installation tool  P103716	MH063866	Installation of hose clamp

◆Removal procedure◆

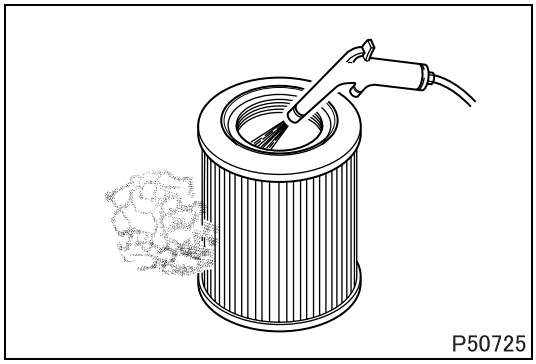


P103717E

■ **Removal: Clamp**

- To remove the clamp, cut the clamp using a.

◆Cleaning procedure◆


P50725

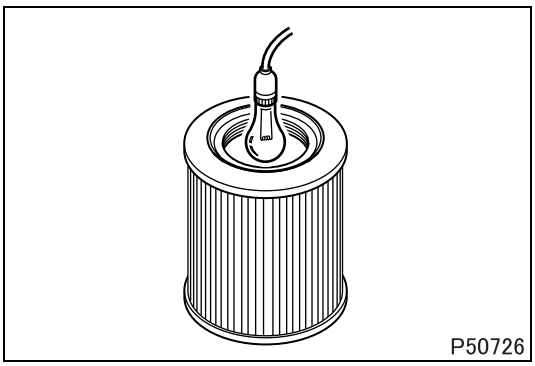
■ **Cleaning: Filter element**

- Blow a jet of compressed air at a pressure not higher than 685 kPa {100 psi, 7 kgf/cm^2} against the inside surfaces of the element.
- Move the compressed air jet up and down along all pleats of the filter paper element.

CAUTION ⚠

- **Do not strike the element or hit it against another object to remove dust.**
- **Do not blow compressed air against outside surfaces of the element.**

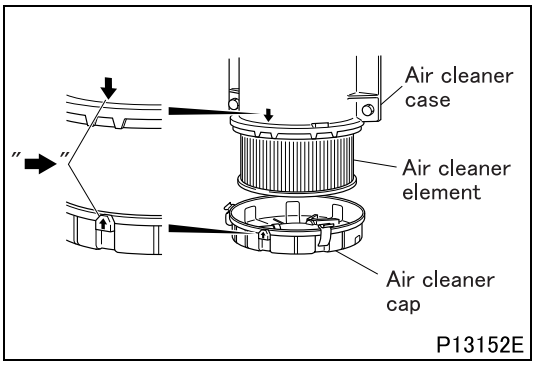
◆Inspection procedure◆



■ **Inspection: Element**

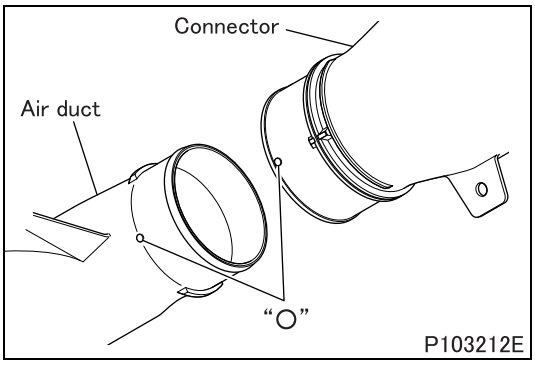
- Shine some electric light inside the element.
- Replace the element if thin spots or broken parts are evident in the filter paper, or if the packing at the top of the element is damaged.
  Also replace the element if the dust on the element is damp with oily smoke or soot, regardless of the replacement schedule.

◆Installation procedure◆



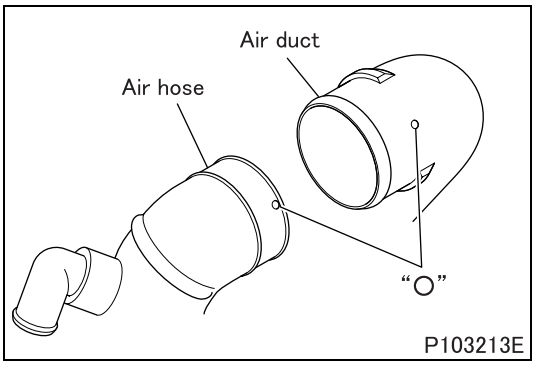
■ **Installation: Air cleaner cap**

➡: Alignment mark



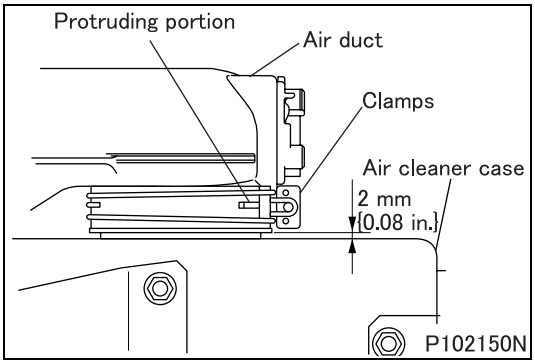
■ **Installation: Air duct**

- Align the marks " ○ " on air duct and push it in until it hits stopper.



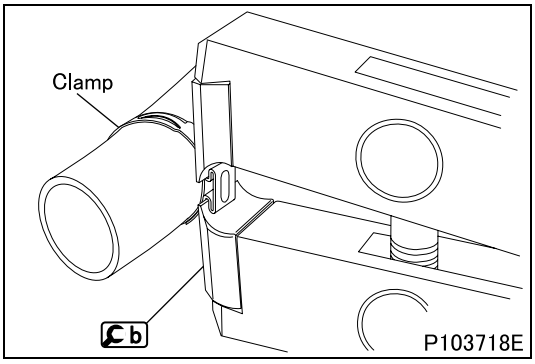
■ **Installation: Air hose**

- Align the marks " ○ " on air hose and push it in until it hits stopper.



■ **Installation: Air duct**

- The protruding portion of the connector is put between clamps.
- Installation is such that the space between the connector and the air cleaner case measures the amount shown in the figure.



■ **Installation: Clamp**

- Pinch the projecting part of the clamp with b and tighten to the specified torque.

DIESEL PARTICULATE FILTER INSPECTION

2. Diesel Particulate Filter Unit Inspection for Clogging and Cleaning the Diesel Particulate Filter Unit

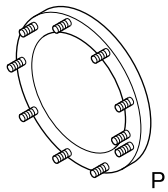
CAUTION ⚠

- **Diesel particulate filter has become very hot after the operation of engine. Cool down the diesel particulate filter sufficiently so as not to get burnt.**
- **The ceramic filter must be cleaned at first 176,000 km {110,000 miles} of driving, and then every 104,000 km {65,000 miles} of driving. Otherwise, ash will accumulate in the filter and the filter may be damaged.**

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Diesel particulate filter differential pressure (after regeneration and cleaning, at no-load max. speed)	Less than 15 kPa {2.2 psi, 0.2 kgf/cm^2}	15 kPa or more {2.2 psi, 0.2 kgf/cm^2}	Replace

Special tools

Mark	Tool name and shape	Part No.	Application
a	Adapter  P103810	MH063867	Washing of ceramic filter
b	Flange nut (M10)	MF434105	
c	Drain plug (M12 × 1.25)	MF665003	
d	Drain plug (M14 × 1.5)	MF665004	
e	Gasket (M12)	MF665004	
f	Gasket (M14)	MF660065	

2.1 Preparation

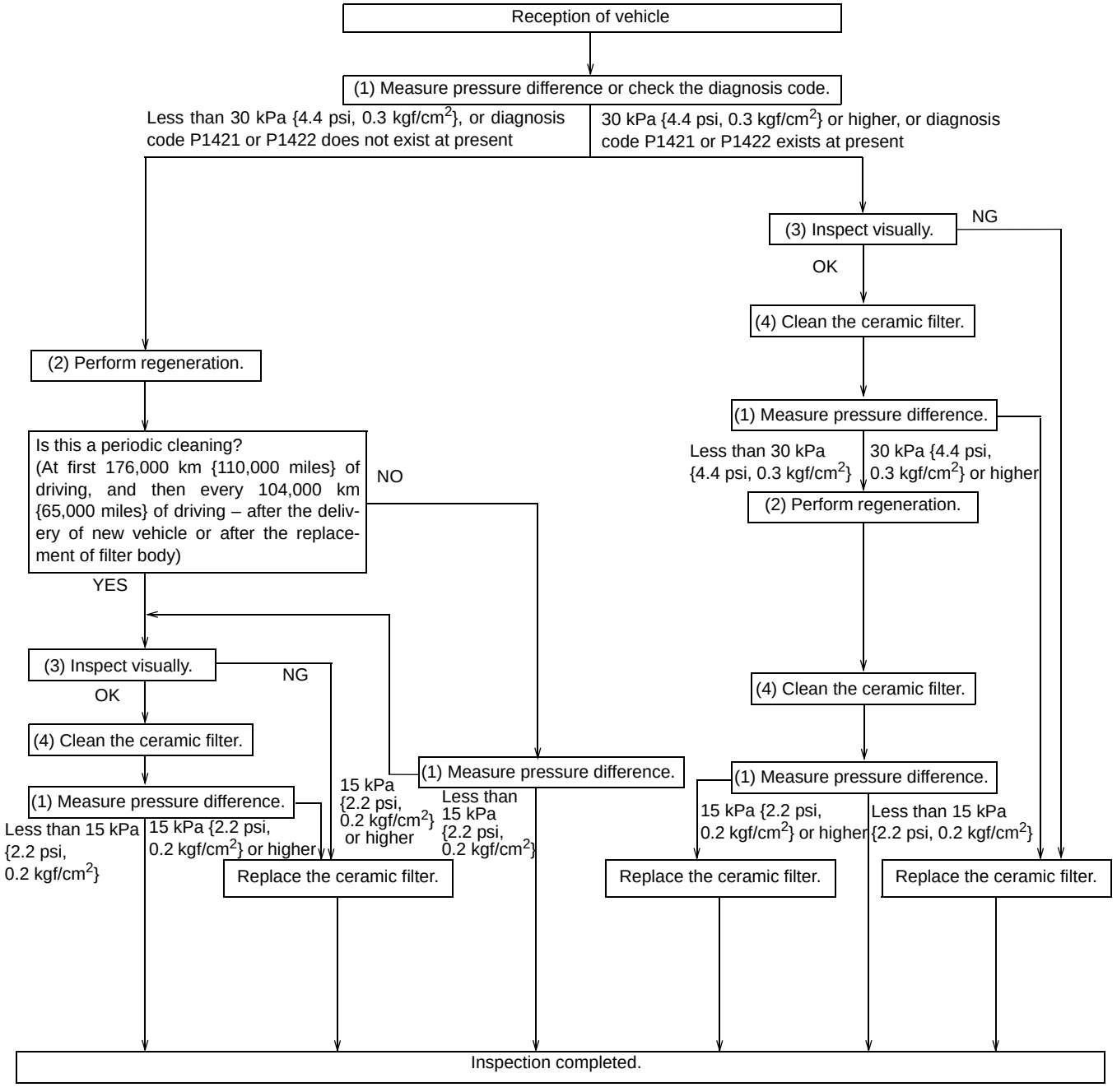
- Place the transmission to neutral position.
- Turn the steering wheel in neutral position. Apply the parking brake securely.
- Turn off the air conditioner not to increase the engine speed.
- Connect the Multi-Use Tester. (See Gr00.)
- Check if there is any diagnosis code stored in the memories of the electronic control units. Repair if any fault is found.
- Warm up the engine until the coolant temperature becomes 70°C {158°F}. (Check this by Multi-Use Tester service data “35: coolant temperature”.)
- Perform resetting of electronic control unit “History reset” using Multi-Use Tester. (See later section.)

2.2 Inspection procedure

- Perform the inspection in accordance with the following flowchart.

CAUTION ⚠

- **The differential pressure of diesel particulate filter, that is, the pressure difference between the inlet and outlet of the diesel particulate filter, may exceed 30 kPa {4.4 psi, 0.3 kgf/cm^2} due to the clogging of the ceramic filter. If the diesel particulate filter regeneration is performed using Multi-Use Tester actuator test "DPF regeneration (park)", the abnormal combustion of the particulate matter may make the diesel particulate filter excessively high temperature, resulting in damage of the diesel particulate filter. Before performing the diesel particulate filter regeneration, therefore, be sure to check that the diesel particulate filter differential pressure is less than 30 kPa {4.4 psi, 0.3 kgf/cm^2}.**
- **When replacing the electronic control unit to a new one, current ash accumulation data must be copied to the new electronic control unit.**
- **For data copying procedure, consult your nearest STERLING TRUCKS dealer or STERLING TRUCKS CORPORATION.**



DIESEL PARTICULATE FILTER INSPECTION

(1) Measurement of pressure difference

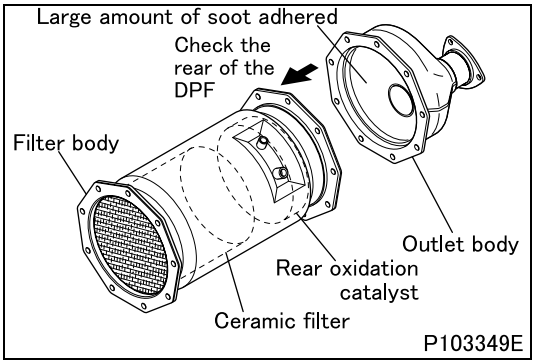
- Measure the pressure difference with the accelerator pedal fully pressed.
- Measurement can be performed using Multi-Use Tester service data “32: DPF pressure difference”.

(2) Regeneration

- Perform Multi-Use Tester actuator test “A5: DPF regeneration (parked)”.

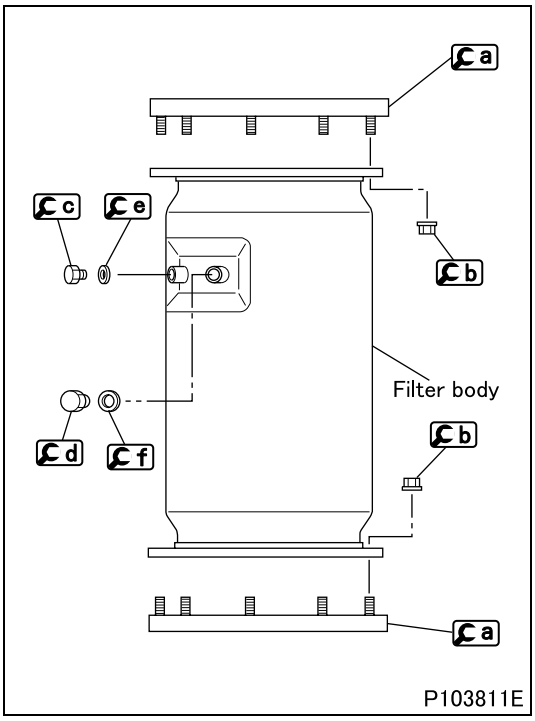
CAUTION ⚠

- **The exhaust gas during regeneration is extremely hot. Be sure to confirm that there is no flammables around the rear of the vehicle.**



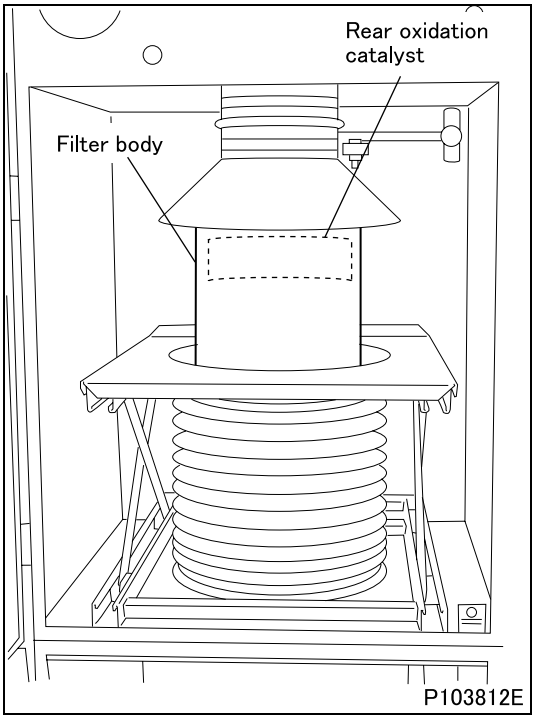
(3) Visual inspection

- Disassemble the diesel particulate filter and check the following.
  - Check if a large amount of soot adheres inside the diesel particulate filter outlet body.
  - Check the rear oxidation catalyst after the ceramic filter for damage.
- If a large amount of soot adheres inside the outlet body or if a damage is found on the rear oxidation catalyst, engine-related fault may be suspected. Replace the diesel particulate filter.



(4) Cleaning

- Fit a to the filter body with b and tighten b to the specified torque (43 N·m {32 ft.lbs, 4.4 kgf·m}).
  Fit c and e to the sensor mounting hole on the filter body and tighten them to the specified torque (30 N·m {22 ft.lbs, 3.1 kgf·m}).
  Fit d and f to the sensor mounting hole on the filter body and tighten them to the specified torque (40 N·m {30 ft.lbs, 4.1 kgf·m}).



- Set the filter body in the cleaning machine with its rear oxidation catalyst side upward.
- Be sure to fit the cleaning machine and the filter body with no air leaks between them.
- Set the air pressure to 620 kPa {90 psi, 6.3 kg/cm^2}.
- Set the timer to 10 to 15 minutes (25 pulses/once) and perform cleaning.
- For the handling procedure of the cleaning machine, refer to its instruction manual.

3.Resetting the DPF-related Information (Resetting Electronic Control Unit)

•On the regeneration control type as diesel particulate filter system, the engine electronic control unit stores many DPF-related information to control the diesel particulate filter regeneration as diesel particulate filter history.

•This history is automatically reset by the engine electronic control unit when the diesel particulate filter regeneration is performed.

•If the ceramic filter is replaced or cleaned without regeneration, reset the DPF history using Multi-Use Tester as follows.

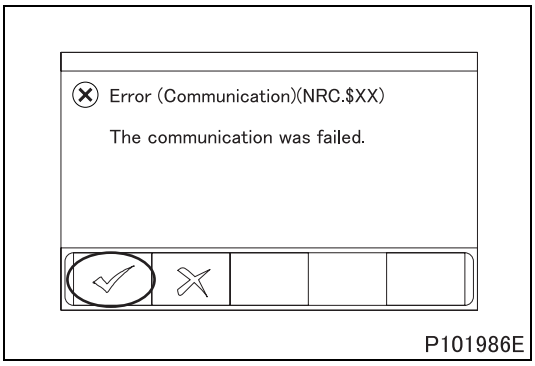
3.1 Preparation

- This operation should be performed under the following conditions.
  - Starter switch: ON (but do not start the engine)
  - Vehicle parked
  - Diagnosis switch: ON (fuse installed)
  - Transmission: Neutral (or P position for automatic transmission)

3.2 Resetting procedure

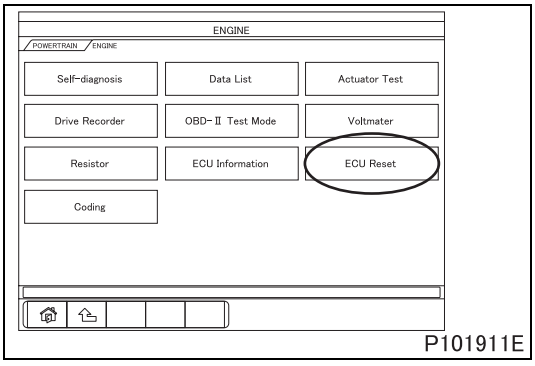
(1) Error while operating the Multi-Use Tester

[Communication error] screen

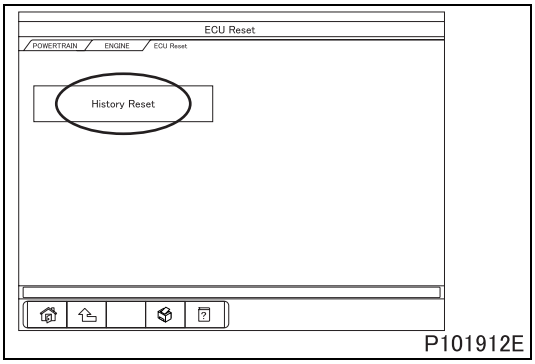


- This screen will appear when a reject response signal is sent from the engine electronic control unit to the Multi-Use Tester while performing any operation.
- In this case, check if the conditions for the execution of the procedure are satisfied and retry from the beginning.
- Click “OK”.

(2) System selection



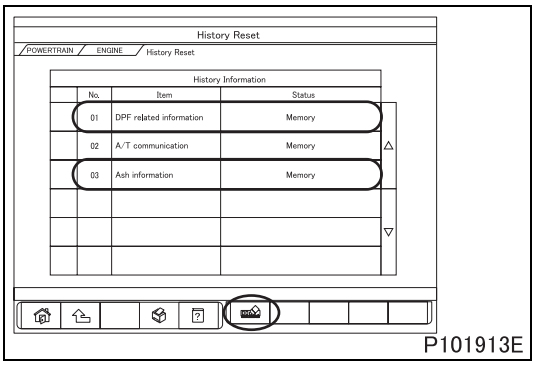
- From the System selection menu, select “Engine/Transmission”. The engine control-related menu will appear.
- Select “ECU Reset”.



(3) ECU reset function selection

[ECU reset] screen

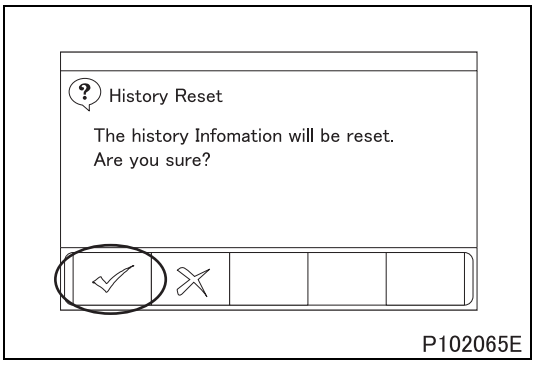
- Select “History Reset”.



(4) History reset

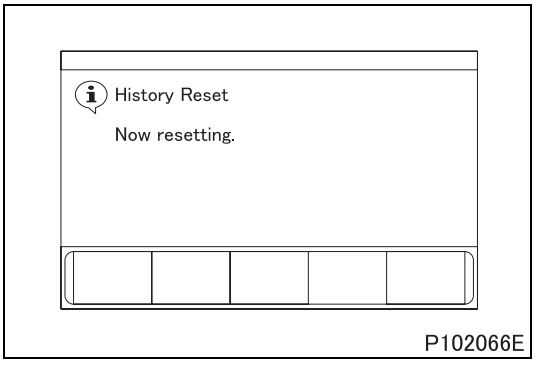
[History reset] screen

- Depending on the action performed on the ceramic filter, the contents of resetting differ.
  Filter replacement: 01 “DPF-related information”
  Filter cleaning: 03 “Ash information”
- Click “Reset” button.
  If the status column shows “No memory stored”, no resetting action required. Finish this procedure.



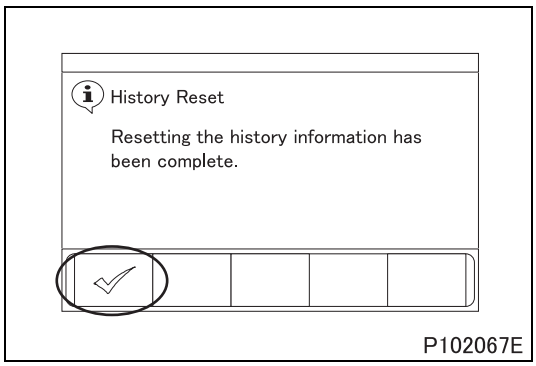
[History reset confirmation] screen

- Click “OK” button.



[History resetting] screen

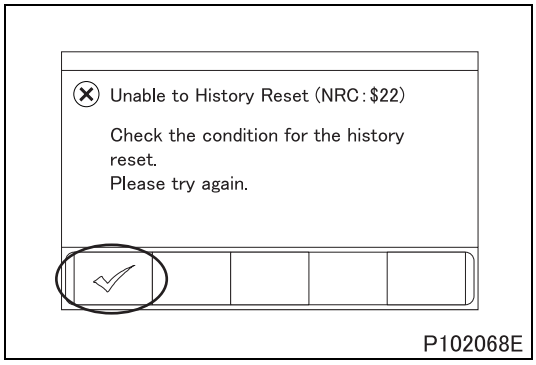
- During resetting, do nothing and wait for a while.



P102067E

[History reset completed] screen

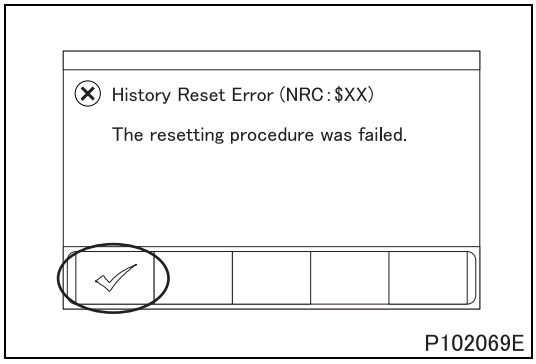
- This screen will appear when resetting of the history has finished. Click “OK” button and return to [History reset] screen.



P102068E

[History reset condition error] screen

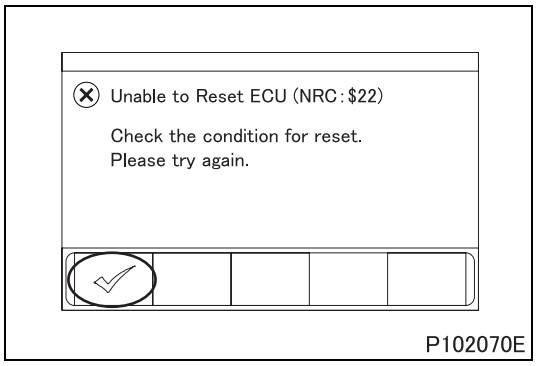
- This screen will appear when a failure signal is sent from the engine electronic control unit to the Multi-Use Tester during resetting.
- In this case, check if the Multi-Use Tester and the vehicle (engine electronic control unit) is connected correctly and if the conditions for the execution of this procedure are satisfied. Then click “OK” to return to the [History reset] screen.



P102069E

[History reset failed] screen

- This screen will appear when the communication error between Multi-Use Tester and the engine electronic control unit or the resetting error occurs.
- In this case, check if the Multi-Use Tester and the vehicle (engine electronic control unit) is connected correctly and if the conditions for the execution of this procedure are satisfied. Then click “OK” to return to the [History reset] screen.

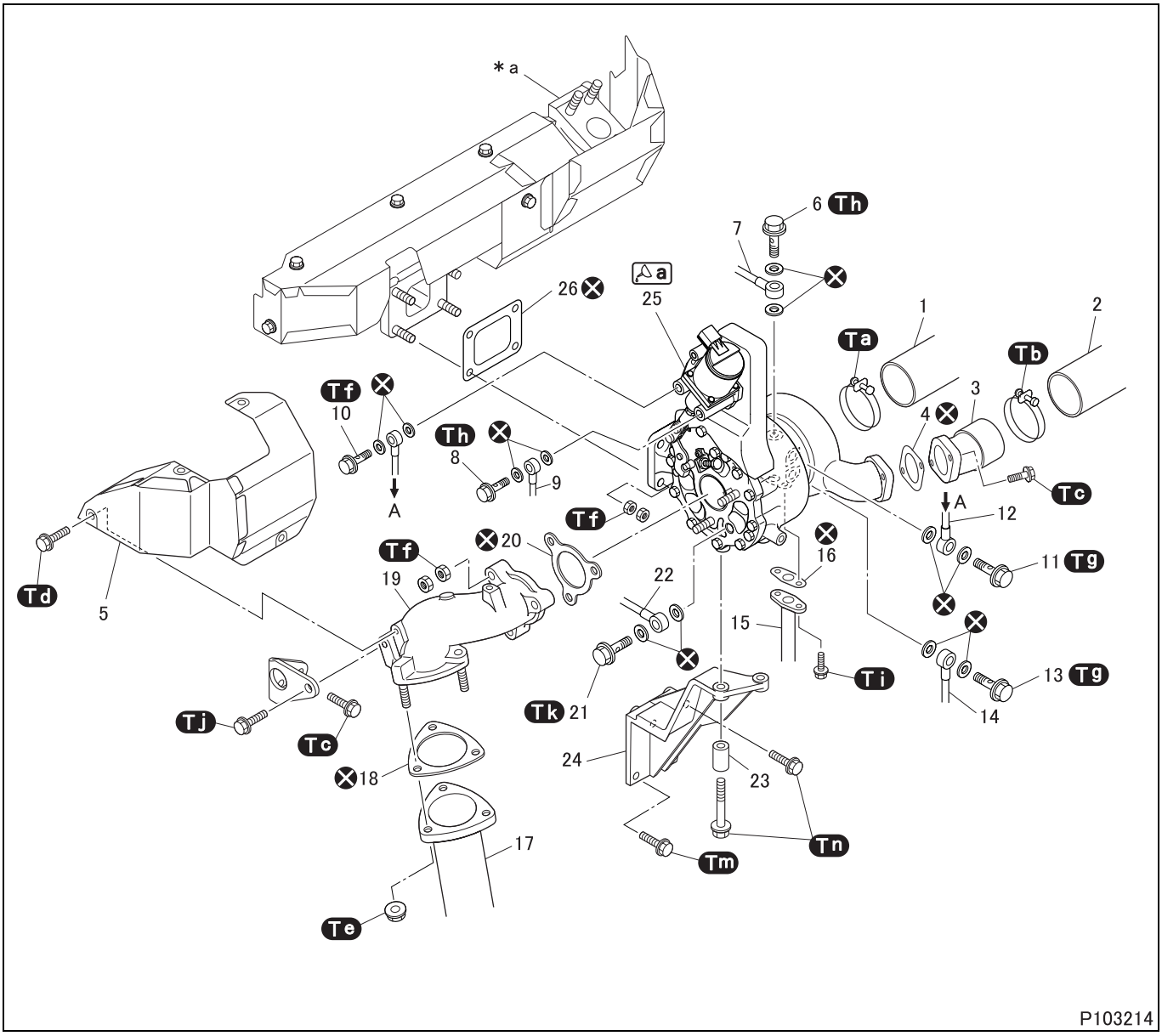


P102070E

[ECU reset condition error] screen

- This screen will appear when a execution failure signal is sent from the engine electronic control unit to the Multi-Use Tester during resetting.
- In this case, recheck the conditions of the vehicle and retry from the beginning.
- Click “OK” to return to the [History reset] screen.

TURBOCHARGER



● **Removal sequence**

1 Air duct
2 Air inlet hose
3 Turbocharger coupler
4 Gasket
5 Insulator
6 Eyebolt
7 Oil pipe
8 Eyebolt
9 Water pipe
10 Eyebolt
11 Eyebolt
12 Water pipe
13 Eyebolt
14 Water pipe
15 Oil return pipe
16 Gasket
17 Front pipe
18 Gasket
19 Exhaust coupler
20 Gasket
21 Eyebolt
22 Air pipe
23 Spacer
24 Bracket
25 Turbocharger (See later section.)
26 Gasket

★a: Exhaust manifold
⊗: Non-reusable parts

●Installation sequence

Follow the removal sequence in reverse.

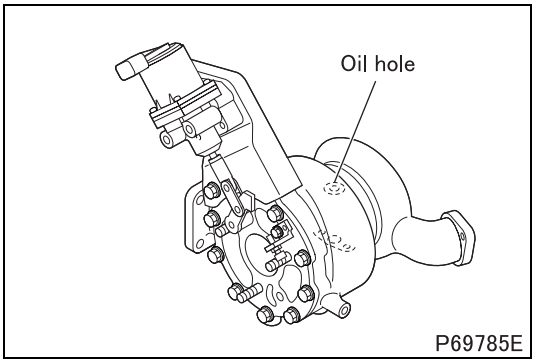
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3 to 3.4 {2.2 to 2.5, 0.3 to 0.35}	–
Tb	Clamp	3.9 to 4.9 {2.9 to 3.6, 0.4 to 0.5}	–
Tc	Bolt (turbocharger coupler mounting)	24 {18, 2.4}	–
	Bolt (exhaust coupler stay mounting)		
Td	Bolt (insulator mounting)	20 {15, 2.0}	–
Te	Nut (front pipe mounting)	25 to 30 {18 to 22, 2.5 to 3.1}	–
Tf	Nut (exhaust coupler mounting)	50 {37, 5.1}	–
	Nut (turbocharger mounting)		
Tg	Eyebolt (water pipe mounting)	26 {19, 2.7}	–
Th	Eyebolt (water pipe mounting)	21 {15, 2.1}	–
	Eyebolt (oil pipe mounting)		
Ti	Bolt (oil pipe mounting)	5 {3.7, 0.5}	–
Tj	Bolt (exhaust coupler stay mounting)	42 {31, 4.3}	–
Tk	Eyebolt (air pipe mounting)	39 {29, 4.0}	–
Tm	Bolt (bracket mounting)	64 {47, 6.5}	–
Tn	Bolt (turbocharger mounting)	33 {24, 3.4}	–
	Bolt (bracket mounting)		

Lubricant and/or sealant

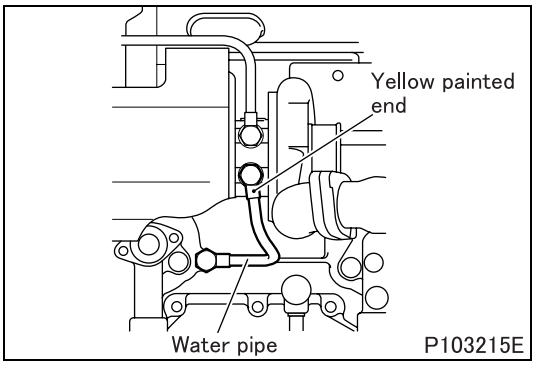
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Pouring into turbocharger	Engine oil	As required

◆Installation procedure◆



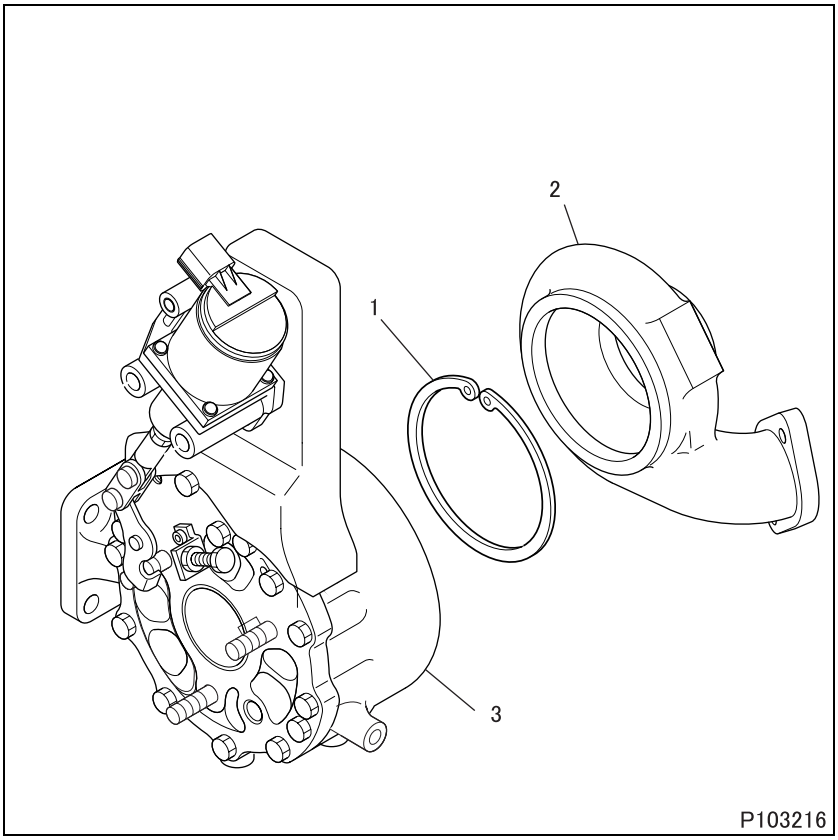
■ **Installation: Turbocharger**

- Before installing the turbocharger assembly, pour engine oil into the oil hole to ensure smooth operation of the internal parts.



■ **Installation: Water pipe**

- Install the water pipe with its yellow painted end toward the turbocharger.



● Removal sequence

1 Snap ring
2 Compressor cover
3 Turbine assembly

- Do not unseal and try to adjust the turbine assembly. It should be replaced as an assembly if any failure is found.

CAUTION ⚠

- **The blades on the turbine assembly are easily bent. Make sure that they do not strike the compressor cover.**
- **The turbine assembly is a non-disassemble component. When it becomes unsmooth in rotation or has a damaged compressor wheel, replace the turbocharger.**

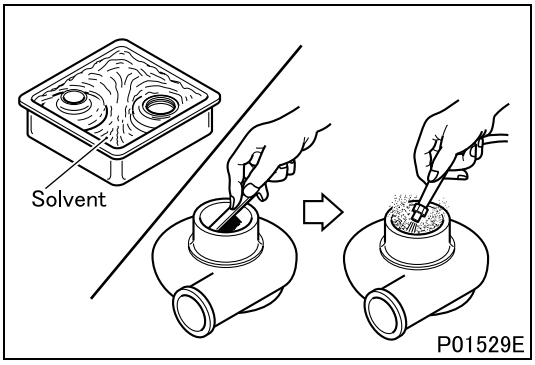
● Installation sequence

Follow the removal sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3	Play in shaft axis direction of turbine assembly	0.39 to 0.67 {0.015 to 0.026}	–	Replace

◆Work after disassembly◆



■ Cleaning

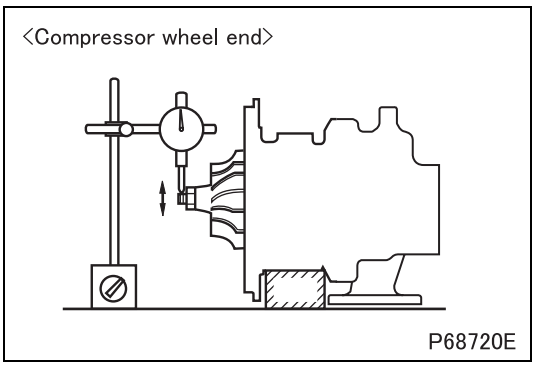
- Before cleaning, visually check the disassembled parts for scorches, abrasion and other marks that may be difficult to see after cleaning. Replace any part that appears defective.
- Immerse the disassembled parts in a non-flammable solvent (a 5 to 10 aqueous solution of Oil Clean from New Hope Co., Ltd.). Take out the parts and blow them dry with compressed air. Remove any hard deposits with a stiff brush or plastic scraper.

CAUTION ⚠

- **Do not immerse the cartridge assembly in the solvent. Doing so will cause the O-ring inside the cartridge assembly to sell up, which may adversely affect turbocharger operation.**

- Again, immerse the parts in the solvent.
- Blow them dry using compressed air.

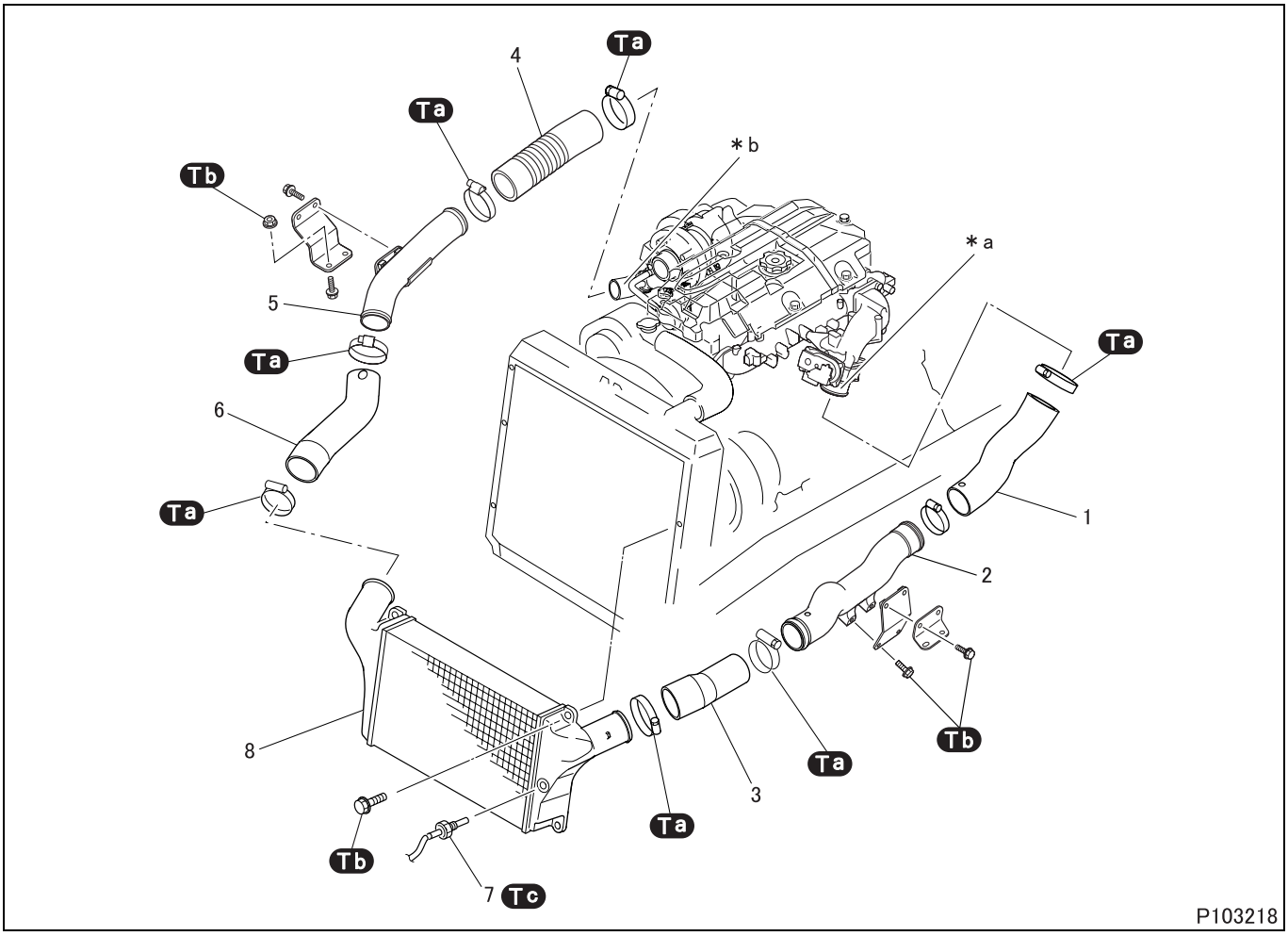
◆Inspection procedure◆



■Inspection: Play in shaft axis direction of turbine assembly

- With the flange of the turbine assembly attached to a flat plate, measure the play with a dial gauge.
- If the measurement exceeds the specified limit, replace the turbine assembly.

INTERCOOLER



●Disassembly sequence

1 Air inlet hose
2 Air inlet pipe LH
3 Air inlet hose
4 Air inlet hose
5 Air inlet pipe RH
6 Air inlet hose
7 Intake air temperature sensor
8 Intercooler

***a**: Intake throttle
***b**: Turbocharger coupler

CAUTION ⚠

- **Do not remove forcedly the air inlet hose using a screwdriver or other similar tool. Doing so could damage the fluorine treatment layer on the inside surface of the hose, deteriorating the resistance to oil of the hose.**

●Assembly sequence

Follow the disassembly sequence in reverse.

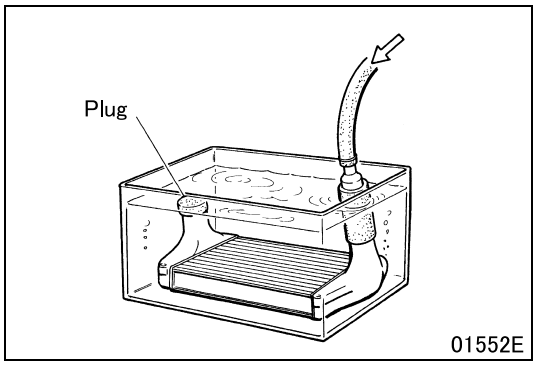
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
8	Intercooler air leakage (air pressure: 200 kPa {29 psi, 2.0 kgf/cm^2} maintained for 30 seconds)	0 cm^3 {0 cu.in.}	–	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

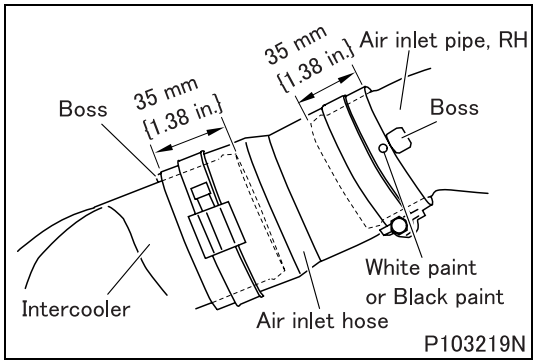
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3.9 to 4.9 {2.9 to 3.6, 0.4 to 0.5}	–
Tb	Bolt (bracket mounting)	12 to 15 {8.9 to 11, 1.2 to 1.5}	–
	Nut (bracket mounting)		
	Bolt (intercooler mounting)		
Tc	Intake air temperature sensor	14.7 to 24.5 {11 to 18, 1.5 to 2.5}	–

◆Inspection procedure◆



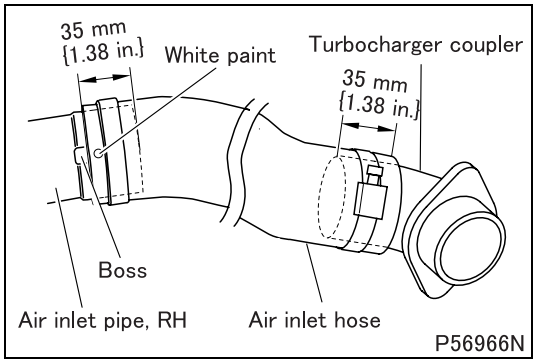
■ Inspection: Intercooler

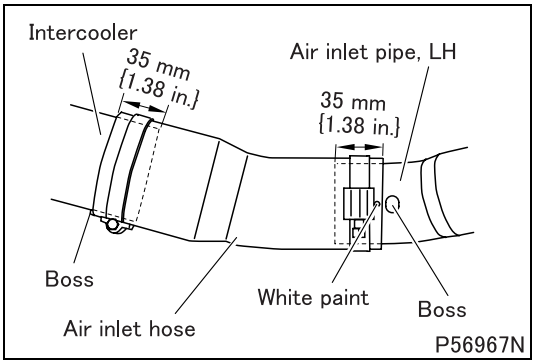
- Plug one of the air ports on the intercooler and connect an air source to the other port. Place the intercooler in a tank of water and apply air pressure of the specified level (200 kPa {29 psi, 2.0 kgf/cm^2}) to the intercooler and retain the pressure for 30 seconds.
- Replace the intercooler if any air leakage is evident.

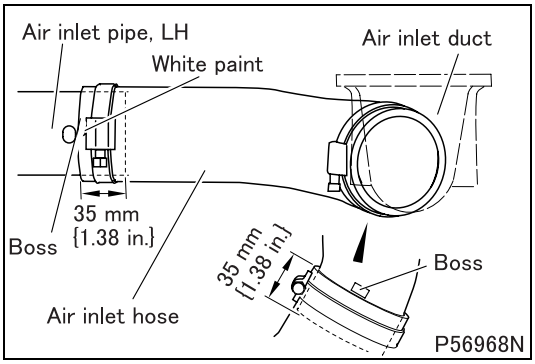


■ Installation: Air inlet hose

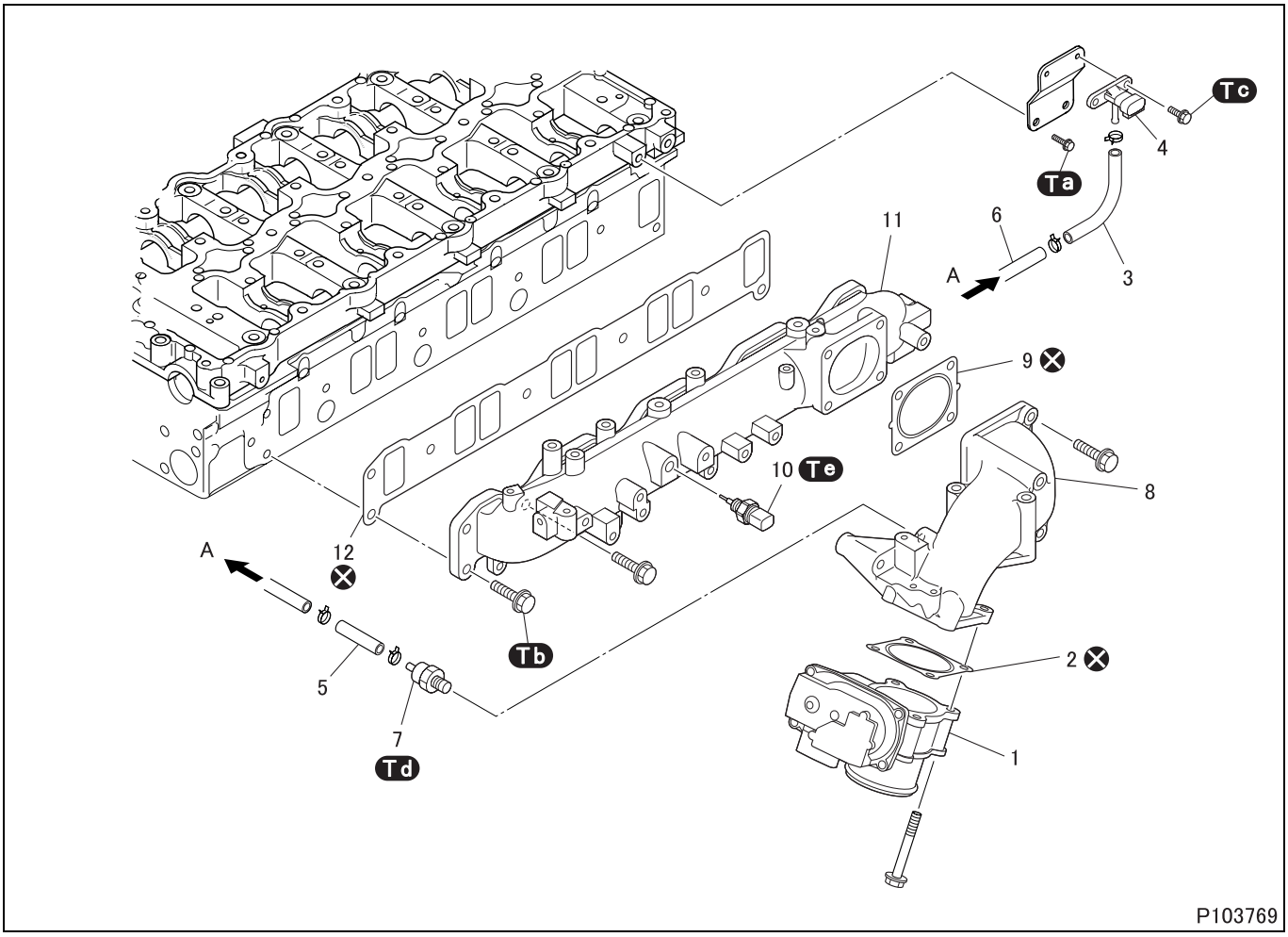
- Connect the air inlet hose to the RH air inlet pipe with the white paint on the hose aligned with the boss on the pipe.
- Connect the air inlet hoses to the intercooler, RH air inlet pipe and turbocharger coupler to the dimensions indicated in the illustrations.







- Connect the air inlet hose to the LH air inlet pipe with the white paint on the hose aligned with the boss on the pipe.
- Connect the air inlet hoses to the intercooler, LH air inlet pipe and air inlet duct to the dimensions indicated in the illustrations.



● **Disassembly sequence**

1 Intake throttle
2 Gasket
3 Vacuum hose
4 Boost pressure sensor
5 Vacuum hose
6 Vacuum pipe
7 Gas filter
8 Air inlet pipe
9 Gasket
10 Boost air temperature sensor
11 Intake manifold
12 Gasket

⊗: Non-reusable parts

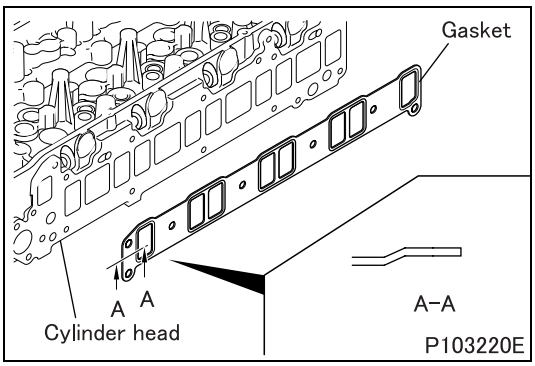
● **Assembly sequence**

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (boost pressure sensor bracket mounting)	24 {18, 2.4}	–
Tb	Bolt (intake manifold mounting)	46 {34, 4.7}	–
Tc	Bolt (boost pressure sensor mounting)	5.5 {4.1, 0.6}	–
Td	Gas filter	14.7 to 19.6 {11 to 14, 1.5 to 2.0}	–
Te	Boost air temperature sensor	25 {18, 2.5}	–

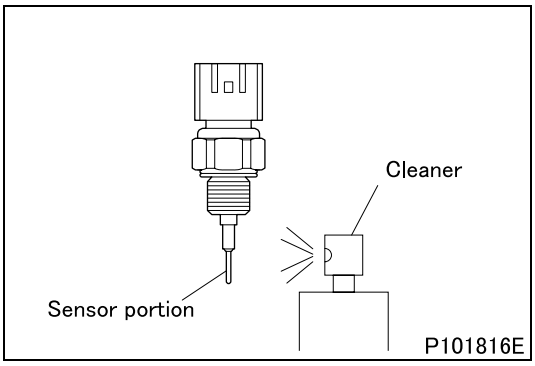
◆INSTALLATION procedure◆



■ **Installation: Gasket**

- Install the gasket on the cylinder head in the illustrated direction.

◆Inspection procedure◆



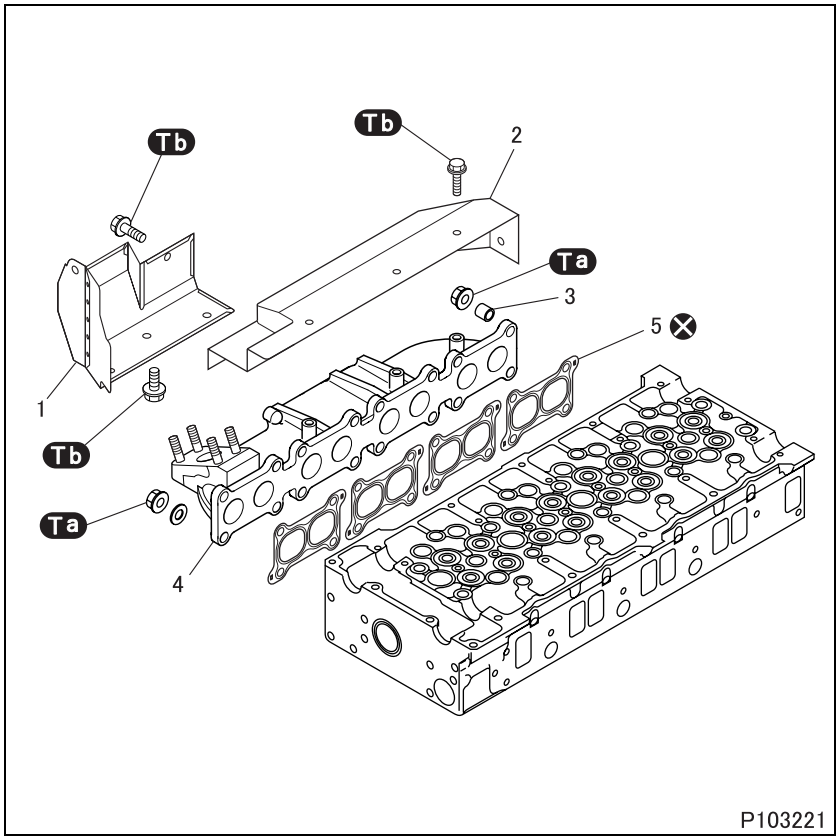
■ **Inspection: Boost air temperature sensor**

- Check that the sensor portion is free of soot, oily substance, etc.
- If not, clean the sensor portion as follows.
- Spray a cleaner on the sensor portion from 2 or 3 cm {0.79 or 1.18 in.} away.
  Recommended cleaners:
  Nonchlorinated solvent
- In 20 to 30 seconds after spraying, wipe the sensor portion clear of the sprayed cleaner using a soft waste cloth the like.

CAUTION ⚠

- **Be sure to wait for 20 to 30 seconds before wiping. It takes the cleaner that long to dissolve foreign matter.**

- If the sensor portion is fouled excessively, the positive crankcase ventilation (PCV) may be faulty. Inspect the PCV valve and filter to locate the cause and remove it.



● Disassembly sequence

1 Exhaust manifold insulator
2 Exhaust manifold insulator
3 Distance piece
4 Exhaust manifold
5 Gasket

⊗: Non-reusable parts

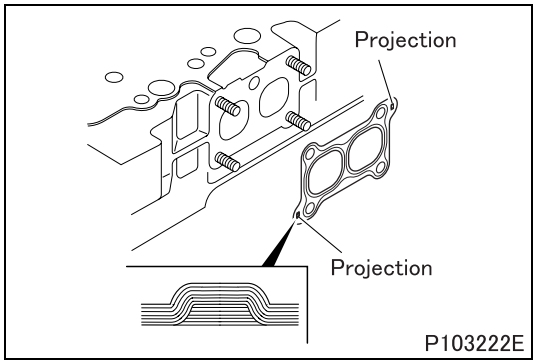
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (exhaust manifold mounting)	42 {31, 4.3}	–
Tb	Bolt (exhaust manifold insulator mounting)	20 {15, 2.0}	–

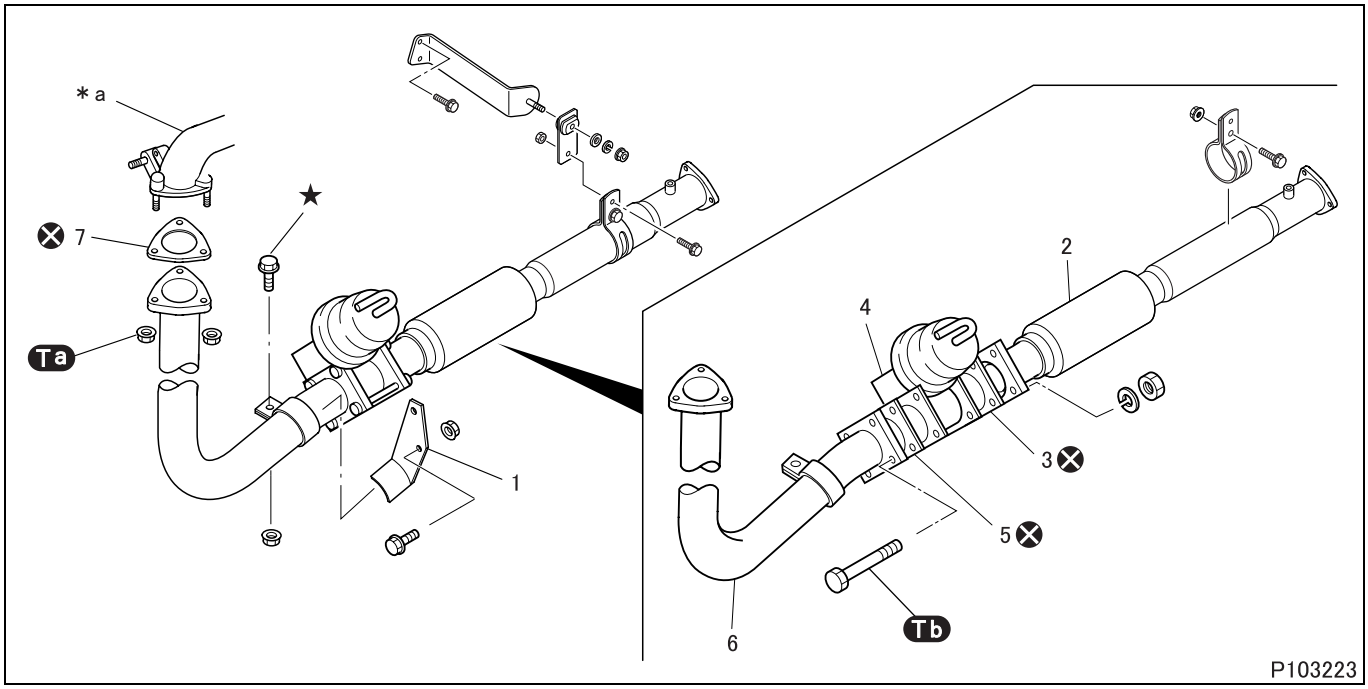
◆Installation procedure◆



■ Installation: Gasket

- Install the gasket on the cylinder head with their surfaces facing in the illustrated directions.

EXHAUST PIPE



● Disassembly sequence

1 Brace bracket
2 Front pipe
3 Gasket
4 Exhaust brake unit (See Gr35A.)
5 Gasket
6 Front pipe
7 Gasket

***a**: Exhaust coupler
⊗: Non-reusable parts

CAUTION ⚠

- **Loosen the ★ marked bolt first to prevent undue forces from being applied to the exhaust pipe.**

● Assembly sequence

Follow the disassembly sequence in reverse.

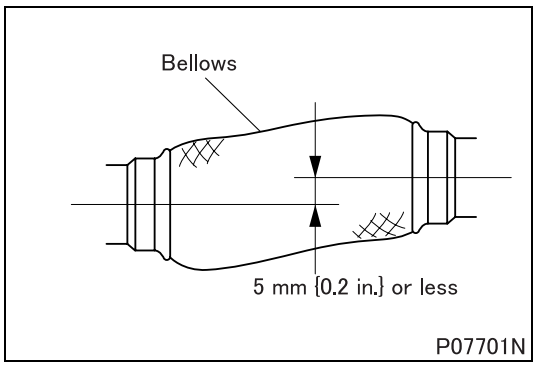
CAUTION ⚠

- **Tighten the ★ marked bolt last to prevent undue forces from being applied to the exhaust pipe.**

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (front pipe mounting)	25 to 30 {18 to 22, 2.5 to 3.1}	–
	Bolt (front pipe mounting)		
Tb	Bolt (exhaust brake unit mounting)	25 to 28 {18 to 21, 2.5 to 2.9}	–

◆Installation procedure◆



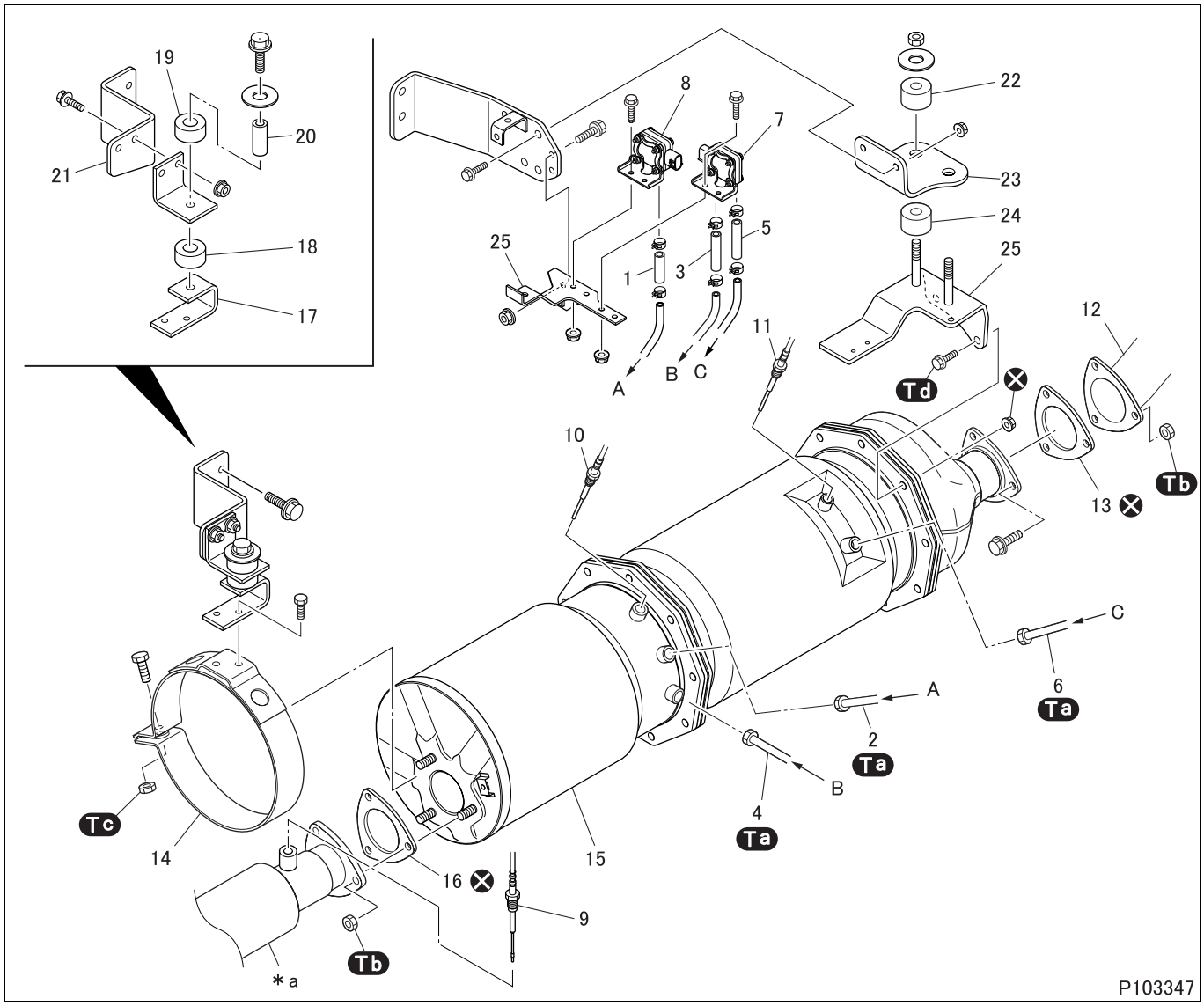
■Installation: Front pipe

- Install the front pipe so that the amounts of offset in both vertical and horizontal directions between the pipes in front of and behind the bellows are smaller than the dimension indicated in the illustration.

CAUTION ⚠

- **The bellows on the front pipe have the purpose of reducing the level of noise from the vehicle. It is not intended for compensating for misalignment that may result from improper installation of the front pipe. Install the front pipe properly to avoid excessive tension or other stress on the bellows.**

DIESEL PARTICULATE FILTER



● Removal sequence

1 Pressure hose
2 Pressure pipe
3 Pressure hose
4 Pressure pipe
5 Pressure hose
6 Pressure pipe
7 DPF pressure sensor (DIFF)
8 DPF absolute pressure sensor
9 Catalytic temperature sensor
10 DPF temperature sensor 1
11 DPF temperature sensor 2
12 Tail pipe
13 Gasket
14 DPF band
15 DPF (See later section.)
16 Gasket
17 Stay
18 Cushion rubber
19 Cushion rubber
20 Collar
21 Bracket
22 Cushion rubber
23 Bracket
24 Cushion rubber
25 Bracket

***a**: Front pipe
⊗: Non-reusable parts
DPF: Diesel particulate filter

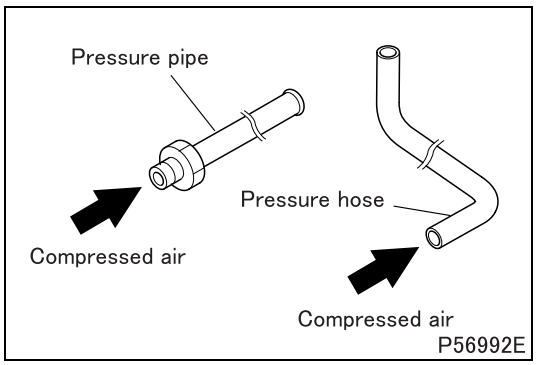
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Pressure pipe	40 {30, 4.0}	–
Tb	Nut (front pipe mounting)	26 to 33 {2.0 to 24, 2.7 to 3.4}	–
	Nut (tail pipe mounting)		
Tc	Nut (diesel particulate filter band mounting)	45 to 55 {33 to 4.1, 4.5 to 5.6}	–
Td	Bolt (bracket mounting)	49 to 63.7 {36 to 47, 5.0 to 6.4}	–

◆Inspection procedure◆

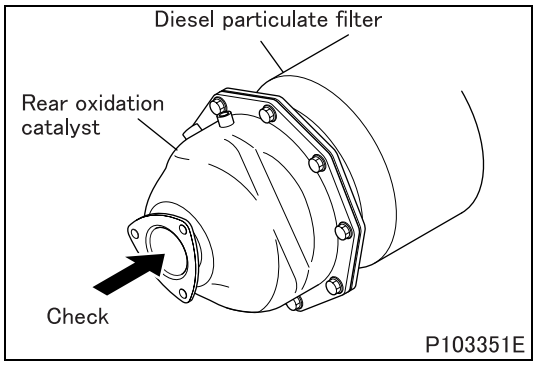


■ Inspection: Pressure pipe and hose

- Check the pressure pipe and hose for clogging by blowing compressed air into the pipe and hose.

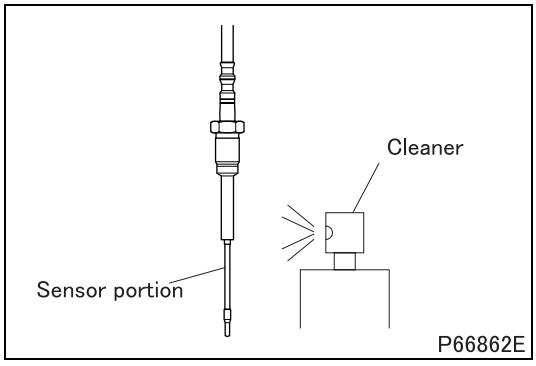
CAUTION ⚠

- **Inspection must be performed on an individual pressure pipe or hose.**
- **If compressed air is blown into the pressure pipe or hose with diesel particulate filter pressure sensor still installed, the sensor may become damaged.**



■ Inspection: Diesel particulate filter

- Check the inside of the rear oxidation catalyst and the diesel particulate filter for adhesion of soot.
- If a large amount of soot is adhered, replace the ceramic filter as it may be damaged.



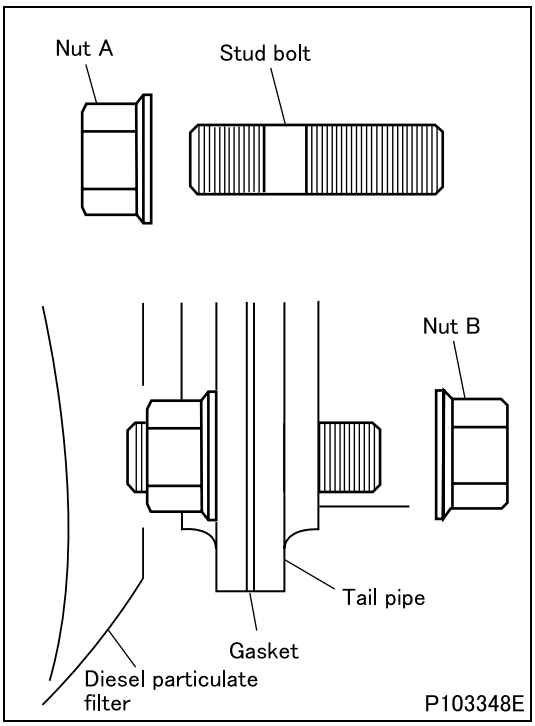
■ Inspection: Temperature sensor

- Check that the sensor portion is free of soot, oily substance, etc.
- If not, clean the sensor portion as follows.
- Spray a cleaner on the sensor portion from 2 or 3 cm {0.79 or 1.18 in.} away.
  Recommended cleaners:
  Nonchlorinated solvent
- In 20 to 30 seconds after spraying, wipe the sensor portion clear of the sprayed cleaner using a soft waste cloth the like.

CAUTION ⚠

- **Be sure to wait for 20 to 30 seconds before wiping. It takes the cleaner that long to dissolve foreign matter.**

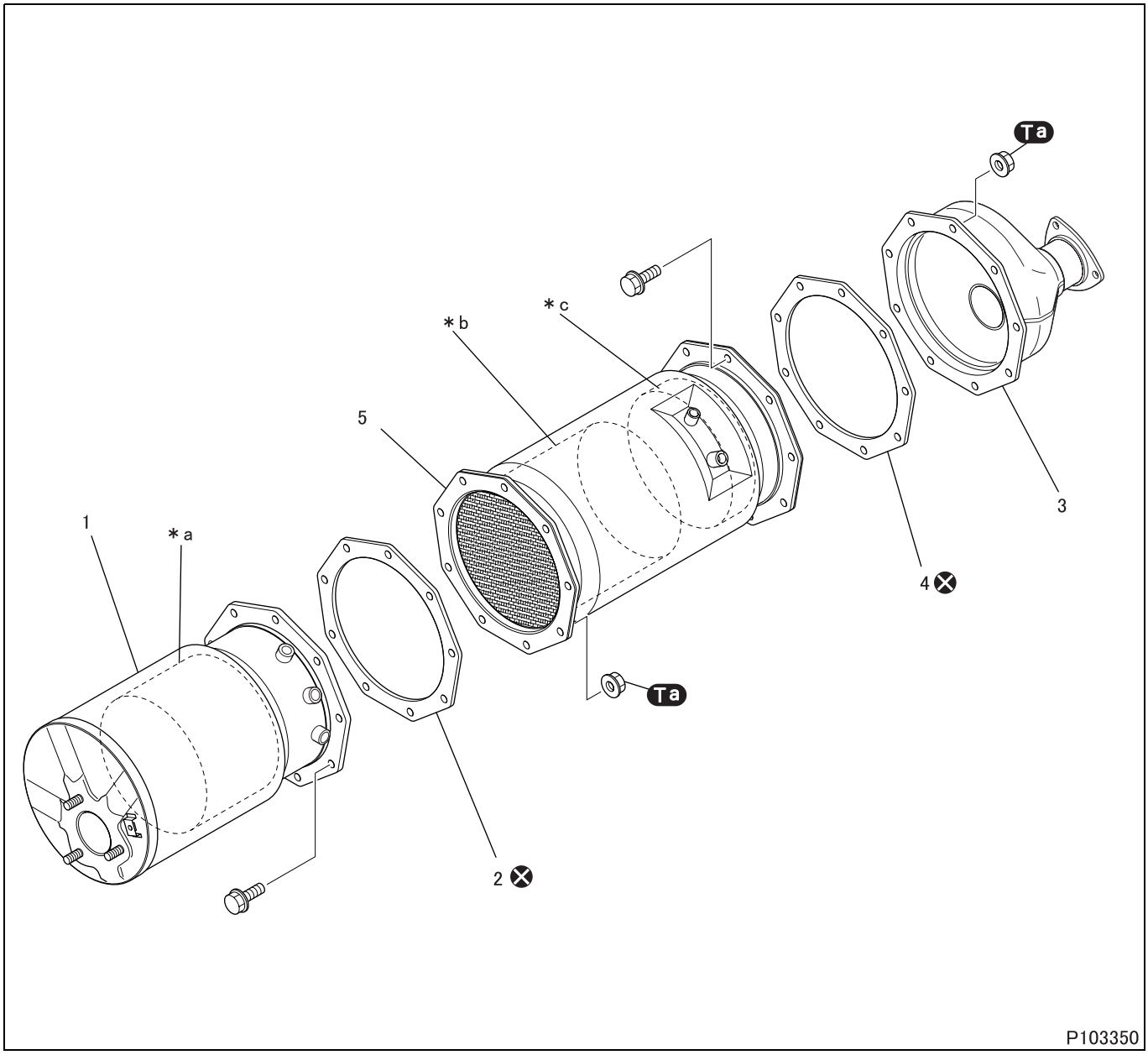
◆Installation procedure◆



■Installation: Tail pipe

- Install nut A to the shorter thread end of a stud bolt. Tighten the nut fully.
- From the diesel particulate filter side, insert the assembled stud bolt and nut A into the bolt hole. Fit the gasket and the tail pipe and tighten nut B to the specified torque.

DPF



● Disassembly sequence

1 Inlet body
2 Gasket
3 Outlet body
4 Gasket
5 Filter body

✱a: Front oxidation catalyst
✱b: Ceramic filter
✱c: Rear oxidation catalyst
⊗: Non-reusable parts

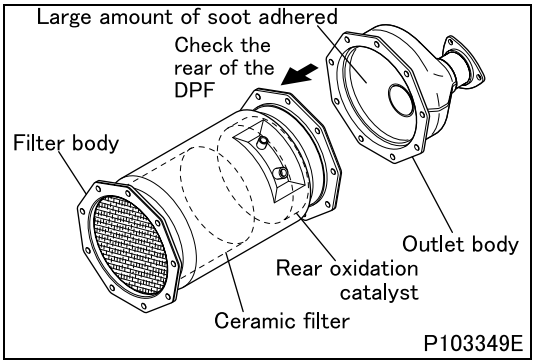
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (inlet body mounting)	49 to 63.7 {36 to 47, 5.0 to 6.4}	–
	Nut (outlet body mounting)		

◆Inspection procedure◆



■ Inspection: Inlet body

- Visually inspect the front oxidation catalyst.
- If there is any abnormality or damage, replace the inlet body.

■ Inspection: Outlet body

- Check if a large amount of soot adheres inside the diesel particulate filter outlet body.
- If a large amount of soot adhesion is found, replace the diesel particulate filter.

■ Inspection: Filter body

- Check the rear oxidation catalyst at the rear of the ceramic filter for damage.
- If any abnormality is found, replace the filter body.
- If no abnormality is found but cleaning of the filter is required, clean the ceramic filter. (See “DIESEL PARTICULATE FLITER INSPECTION”.)

INDEX

STRUCTURE AND OPERATION

1. **Exhaust Gas Recirculation System 17-2**
2. **Crankcase Emission Control System 17-7**

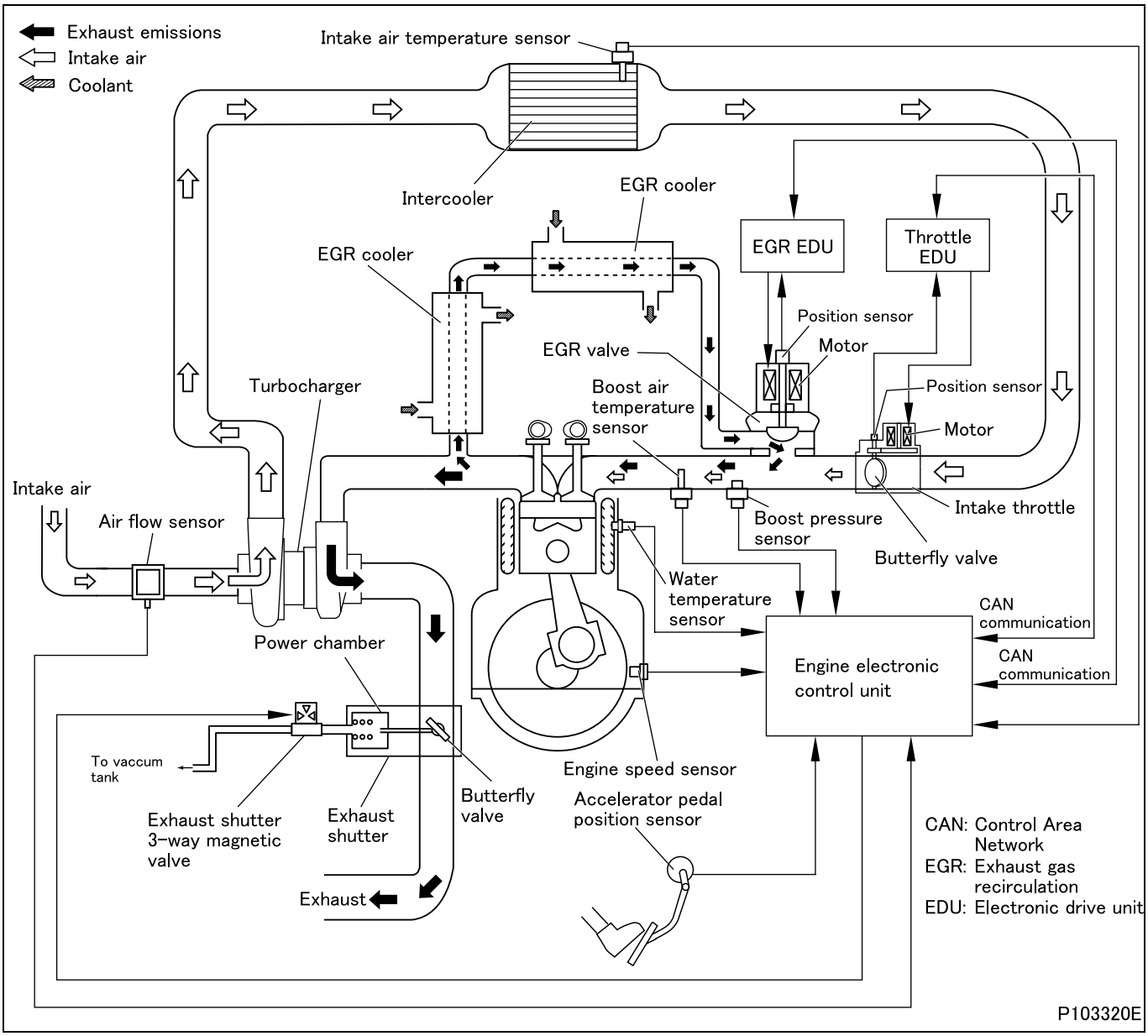
EXHAUST GAS RECIRCULATION VALVE, PIPE AND COOLER 17-8

CRANKCASE EMISSION CONTROL SYSTEM 17-12

1. Exhaust Gas Recirculation System

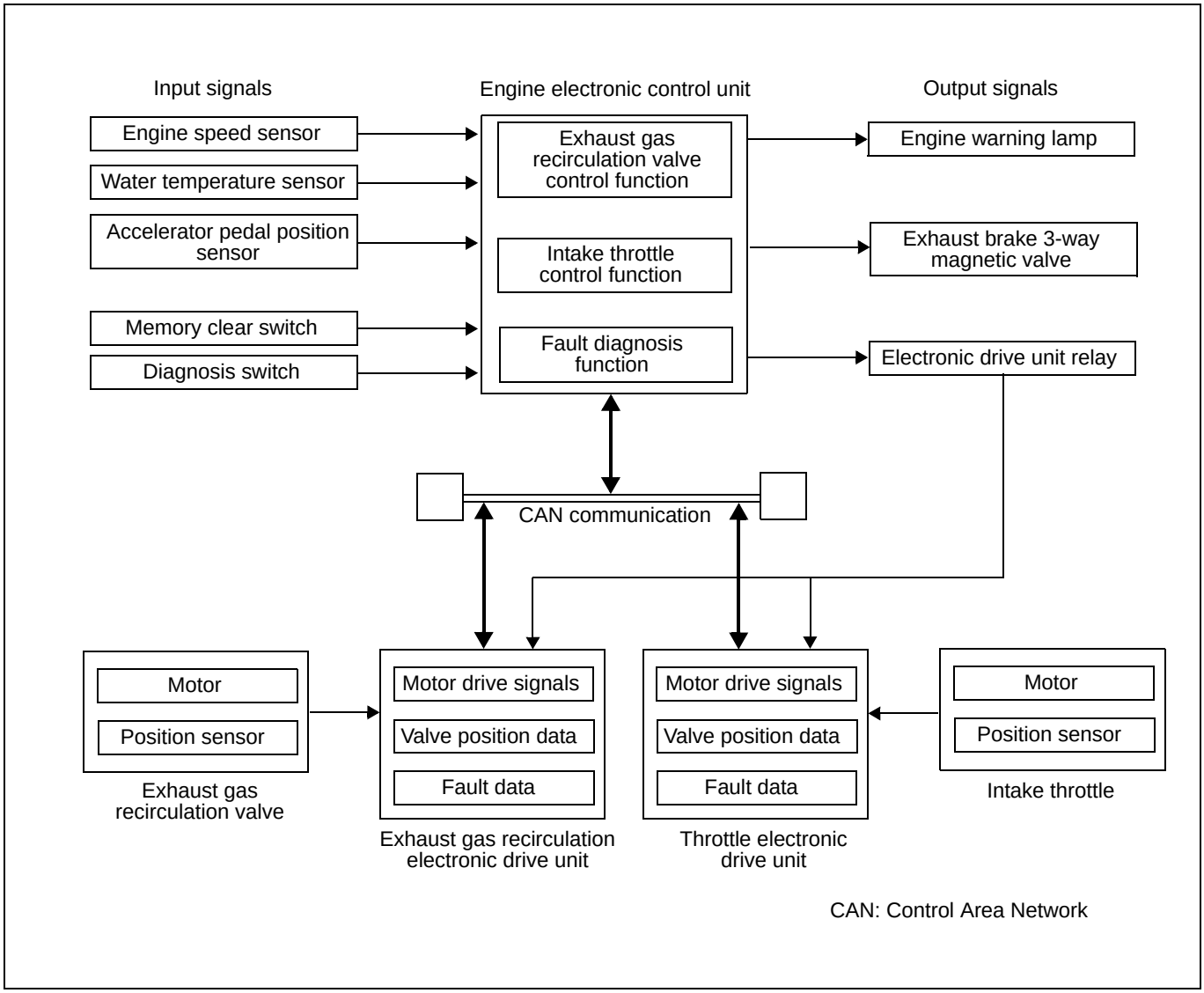
1.1 Overview

- In the exhaust gas recirculation system, the engine electronic control unit and multiple electronic drive units control the exhaust gas recirculation valve and intake throttle in accordance with information from sensors on various aspects of the engine (engine speed, coolant temperature, throttle opening, etc.).
- Exhaust gas recirculation involves the introduction of inert gases in the post-combustion exhaust emissions into the intake manifold. By reducing the combustion temperature, it reduces the amount of nitrogen oxides (NOx), which are harmful, in the exhaust emissions. Further, an exhaust gas recirculation cooler cools the recirculated exhaust emissions, thereby reducing the peak combustion temperature.
- The intake air quantity is adjusted by means of intake throttle control such that the effectiveness of exhaust gas recirculation is maximized.



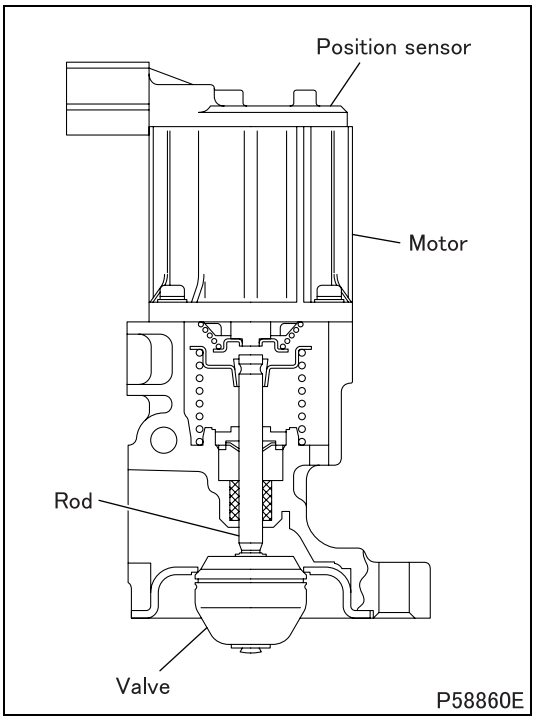
1.2 Electronic control system

(1) System block diagram



(2) Exhaust gas recirculation valve control function

- In accordance with data from sensors, the engine electronic control unit determines the exhaust gas recirculation valve opening that suits the operating condition and sends a control signal (this indicates the target exhaust gas recirculation valve opening) to the exhaust gas recirculation electronic drive unit.
  When necessary to prevent black smoke emissions and engine speed instability (for example, when the engine is heavily loaded, when the engine is lightly loaded, and when the exhaust brake is operating), the engine electronic control unit stops exhaust gas recirculation valve control.
- The exhaust gas recirculation electronic drive unit activates the exhaust gas recirculation valve motor. At the same time, it monitors the extent of valve lift using a position sensor and sends this information (this indicates the actual exhaust gas recirculation valve opening) to the engine electronic control unit.
  This operation makes it possible for the target exhaust gas recirculation valve opening indicated by the engine electronic control unit to be precisely maintained.

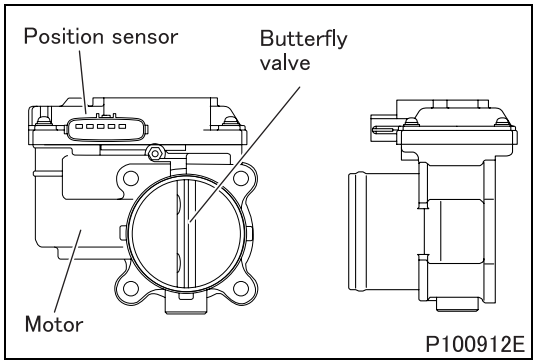


(2.1) Exhaust gas recirculation valve

- A motor in the exhaust gas recirculation valve is driven by control signals from the exhaust gas recirculation electronic drive unit. Via a rod, the motor's operation opens and closes the valve.

(3) Intake throttle control function

- When the engine electronic control unit determines from sensor data on the engine speed and engine loading that the vacuum pressure in the intake manifold is low, it increases the amount of exhaust emissions introduced into the intake manifold by determining an appropriate butterfly valve opening and by sending corresponding control signals (these indicate the target throttle opening) to the throttle electronic drive unit.
- The throttle electronic drive unit activates the valve motor. At the same time, it monitors the valve opening using a position sensor and sends this information (this indicates the actual throttle opening) to the engine electronic control unit.
  This operation makes it possible for the target throttle opening indicated by the engine electronic control unit to be precisely maintained.



(3.1) Intake throttle

- In accordance with signals from the throttle electronic drive unit, the motor opens and closes the butterfly valve, thereby adjusting the intake air amount such that the effectiveness of exhaust gas recirculation is maximized.

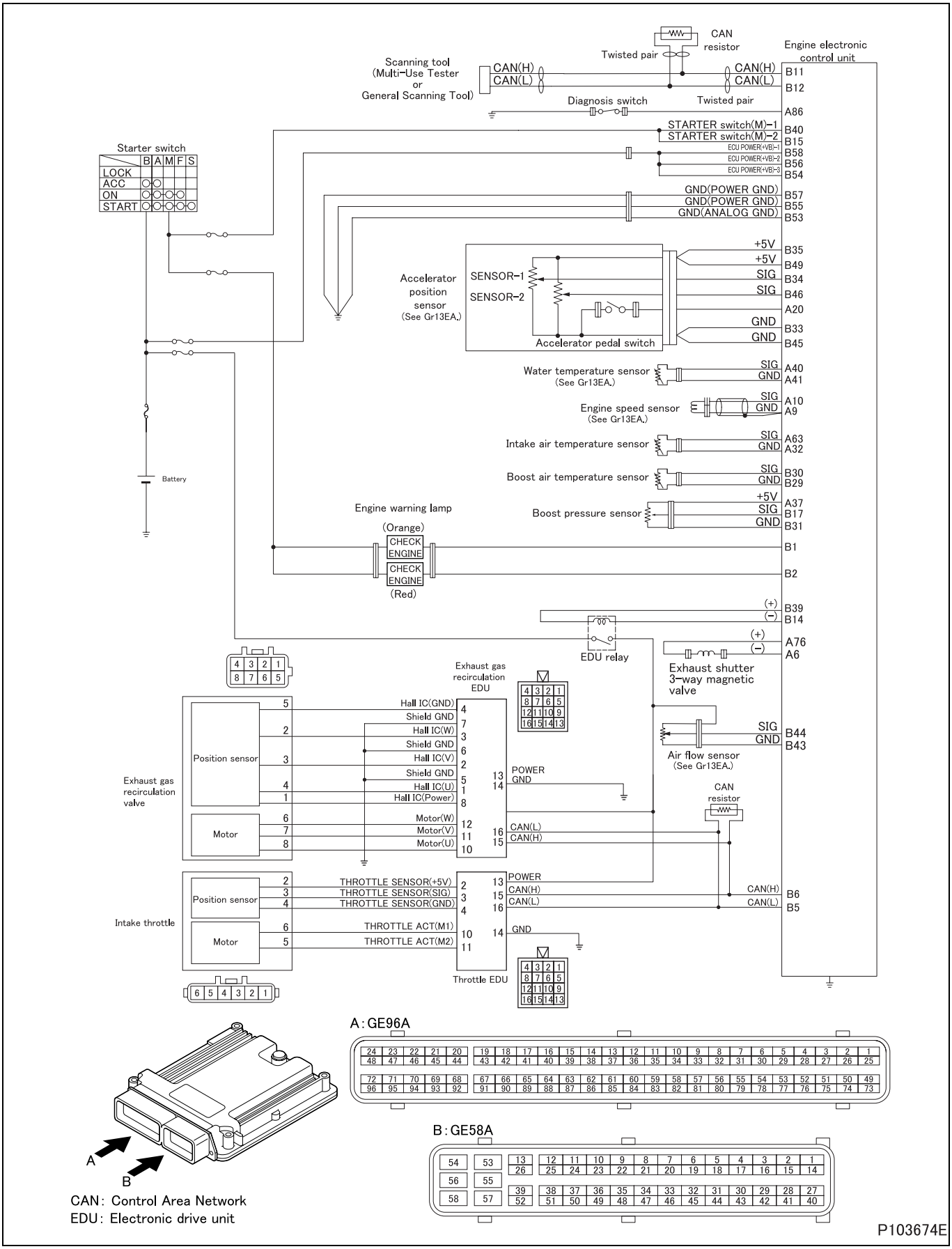
(4) Fault diagnosis function

- While the starter switch is in the ON position, the engine electronic control unit continuously monitors the electronic drive units and sensors for faults. In the event that the engine electronic control unit finds a component faulty, it causes an indication to be made in the meter cluster to alert the driver. At the same time, it memorizes the fault location in the form of a diagnosis code and starts a control during fault.
- While the engine is running, the exhaust gas recirculation electronic drive unit and throttle electronic drive unit continuously monitor communication with the position sensor and motor of the exhaust gas recirculation valve, communication with the position sensor and motor of the intake throttle, and communication with the engine electronic control unit. In the event that they identify a fault, they send fault data to the engine electronic control unit.
- While control necessitated by a fault is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.

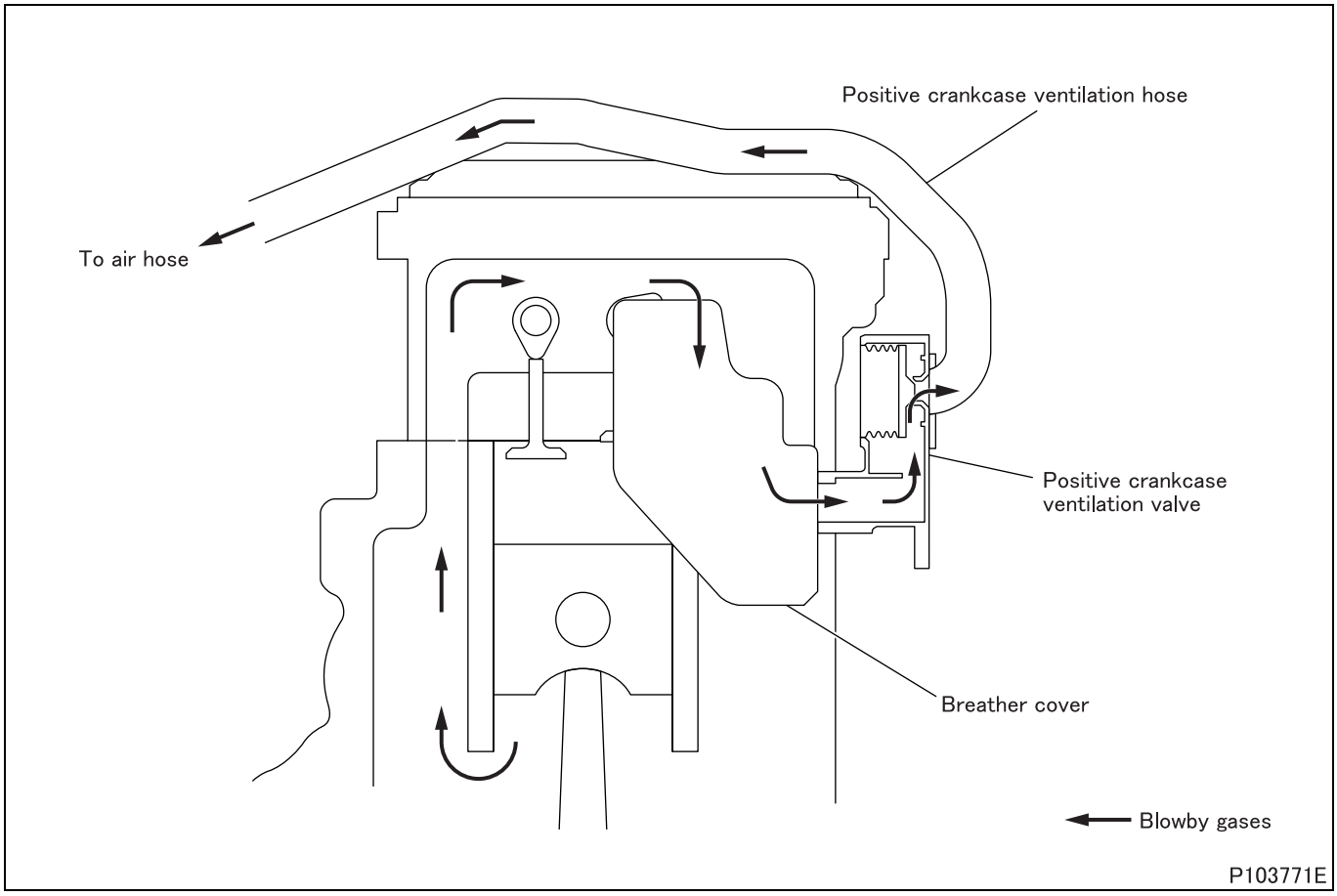
NOTE

- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

1.3 Electronic control unit connection diagram

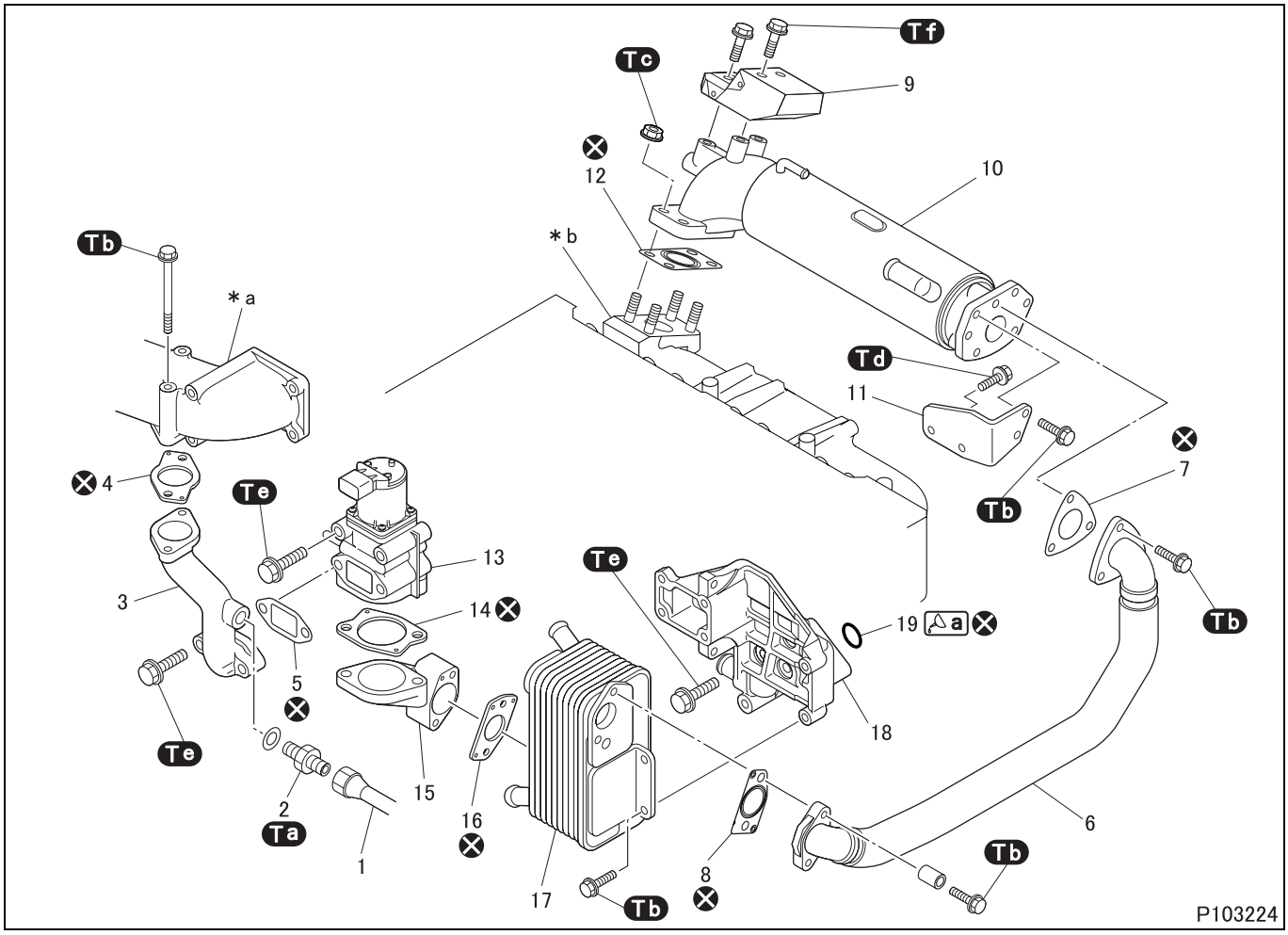


2. Crankcase Emission Control System



- The crankcase emission control system returns blowby gases to an air duct to prevent them from being released to the outside air.
- The positive crankcase ventilation valve keeps constant the pressure inside the crankcase.

EXHAUST GAS RECIRCULATION SYSTEM



● Removal sequence

1	Air pipe	**9**	EGR cooler insulator	**17**	EGR cooler
2	Connector	**10**	EGR cooler	**18**	EGR cooler bracket
3	EGR pipe C	**11**	EGR cooler bracket	**19**	O-ring
4	EGR gasket	**12**	EGR cooler gasket		
5	EGR gasket A	**13**	EGR valve	✱**a**:	Air inlet pipe
6	EGR pipe A	**14**	EGR gasket B	✱**b**:	Exhaust manifold
7	EGR pipe gasket	**15**	EGR pipe B	⊗:	Non-reusable parts
8	EGR gasket	**16**	EGR gasket	EGR:	Exhaust gas recirculation

NOTE

- **Even when all coolant in the crankcase has been drained out, approximately 1L {1.1qt.} of coolant remains in the exhaust gas recirculation cooler. Before removing the exhaust gas recirculation cooler, make ready a container to catch the coolant.**

● Installation sequence

Perform installation by following the removal sequence in reverse.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
10	Air leakage from EGR cooler	Leakage into coolant (air pressure: 300 kPa {44 psi, 3.1 kgf/cm^2})	0 cm^3 {0 mL}	–	Replace
		Leakage into exhaust gas (air pressure: 400 kPa {58 psi, 4.1 kgf/cm^2})	0 cm^3 {0 mL}		
17	Air leakage from EGR cooler	Leakage into coolant (air pressure: 196 kPa {28 psi, 2.0 kgf/cm^2})	0 cm^3 {0 mL}	–	Replace
		Leakage into exhaust gas (air pressure: 294 kPa {43 psi, 3.0 kgf/cm^2})	0 cm^3 {0 mL}		

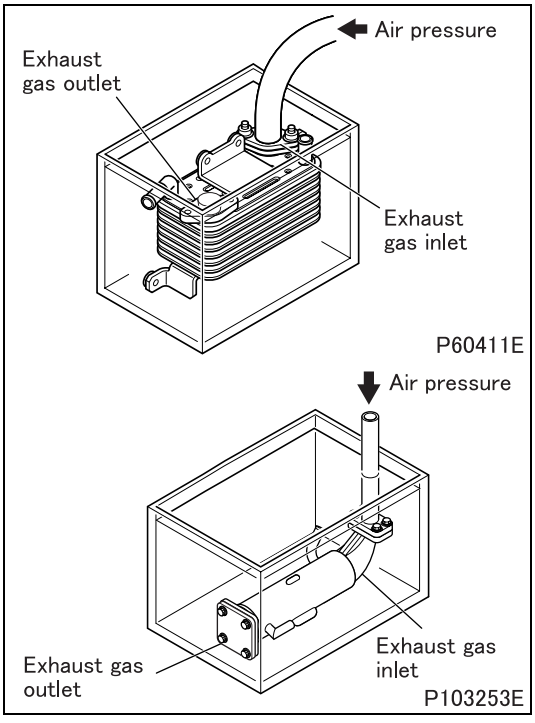
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Connector	58 {43, 5.9}	–
Tb	Bolt (EGR pipe A mounting)	24 {18, 2.5}	–
	Bolt (EGR pipe C mounting)		
	Bolt (EGR cooler mounting)		
Tc	Nut (EGR cooler mounting)	41 {30, 4.2}	–
Td	Bolt (EGR cooler bracket mounting)	28 {21, 2.9}	–
Te	Bolt (EGR valve mounting)	46 {34, 4.7}	–
	Bolt (EGR pipe C mounting)		
	Bolt (EGR cooler bracket mounting)		
Tf	Bolt (EGR cooler insulator mounting)	20 {15, 2.0}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Soapy water	As required

◆Inspection procedures◆

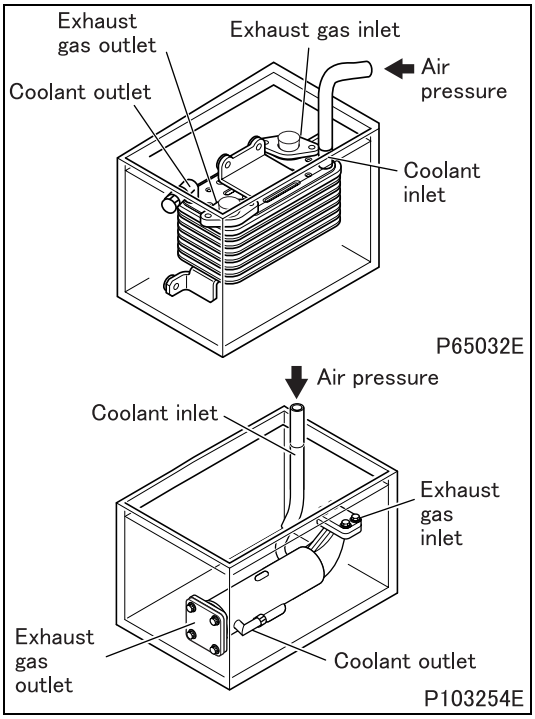


■Inspection: Exhaust gas recirculation cooler

- Perform the following inspection. If any abnormality is found, replace the exhaust gas recirculation cooler.

(1) Exhaust gas passage side

- Fit a cover over the exhaust gas outlet of the exhaust gas recirculation cooler, and connect a hose to the exhaust gas inlet. Then, submerge the exhaust gas recirculation cooler in a container of water. Make sure the coolant passage is full of water.
- Apply specified air pressure through the hose. Check that air does not leak from any part of the exhaust gas recirculation cooler.

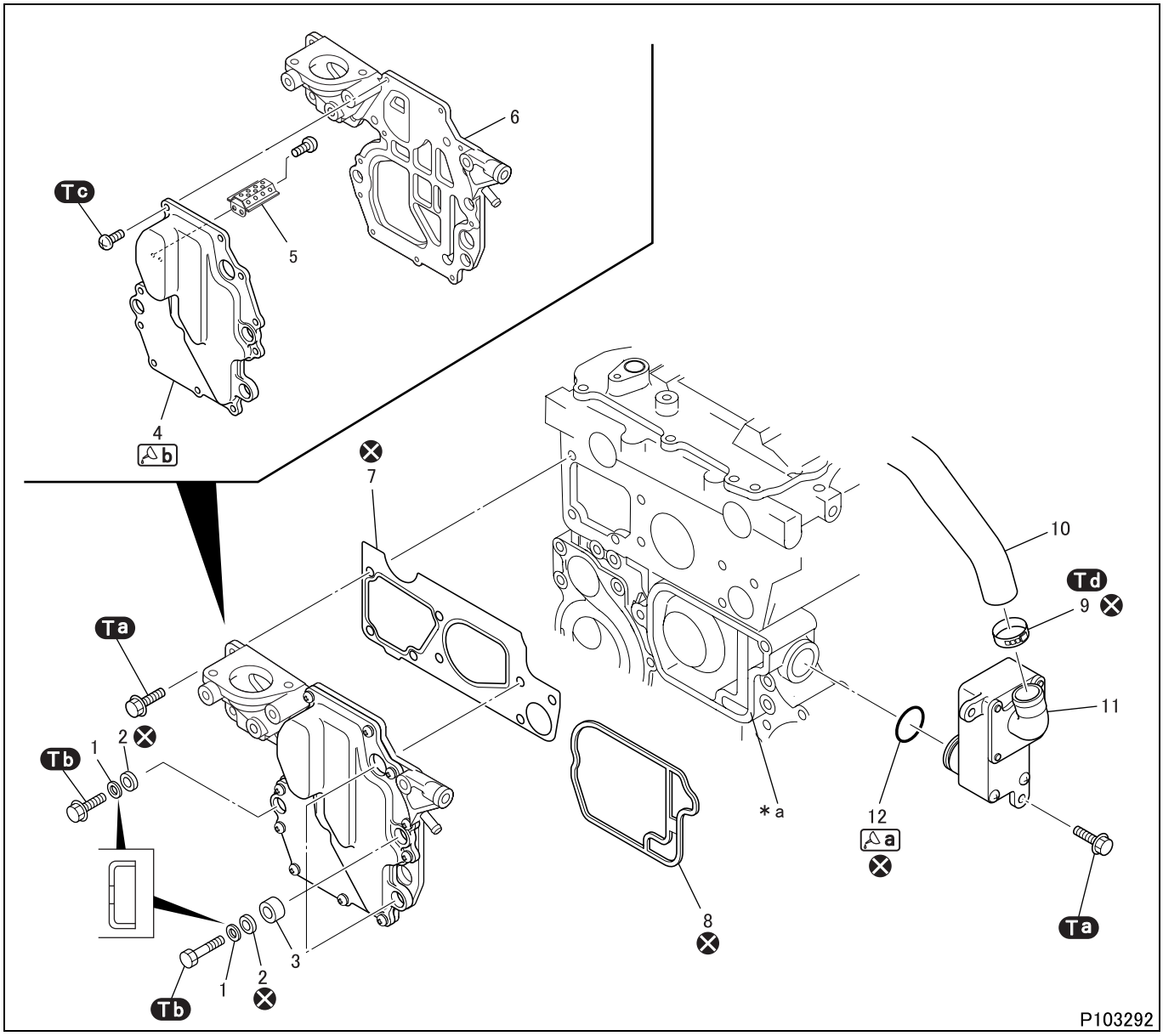


(2) Coolant passage side

- Fit covers over the exhaust gas recirculation cooler's exhaust gas inlet, exhaust gas outlet, and coolant outlet, and connect a hose to the coolant inlet. Then, submerge the exhaust gas recirculation cooler in a container of water.
- Apply air pressure of 196 kPa {28 psi, 2 kgf/cm^2} through the hose. Check that air does not leak from any part of the exhaust gas recirculation cooler.
- If there is any abnormality, replace the exhaust gas recirculation cooler.

M E M O

CRANKCASE EMISSION CONTROL SYSTEM



● **Removal sequence**

1 Washer
2 Rubber bushing
3 Spacer
4 Breather cover A
5 Separator plate
6 Breather cover B
7 Gasket
8 Breather gasket
9 Clamp
10 PCV hose
11 PCV valve
12 O-ring

***a**: Front case
⊗: Non-reusable parts
PCV: Positive crankcase ventilation

● **Installation sequence**

Perform installation by following the removal sequence in reverse.

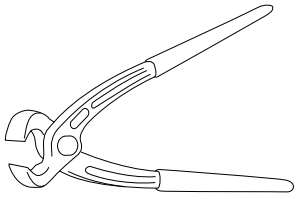
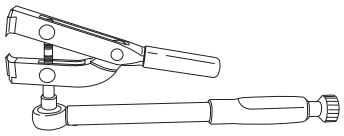
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (mounting of breather cover A, B)	23.2 {17, 2.4}	–
	Bolt (mounting of PCV valve)		
Tb	Bolt (mounting of breather cover A, B)	9.8 {7.2, 1.0}	–
Tc	Screw (mounting of breather cover A)	2 to 3 {1.5 to 2.2, 0.2 to 0.3}	–
Td	Clamp	9 to 11 {6.6 to 8.1, 0.9 to 1.1}	–

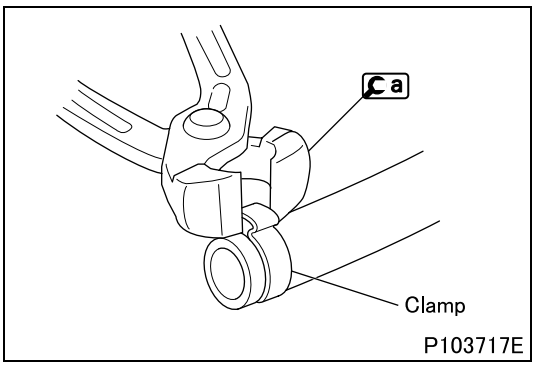
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required
b	Mating surface of breather cover A	ThreeBond 1216	As required

Special tools

Mark	Tool name and shape	Part No.	Application
a	Pincer  P103715	MH063865	Removal of hose clamp
b	Clamp installation tool  P103716	MH063866	Installation of hose clamp

◆Removal procedure◆

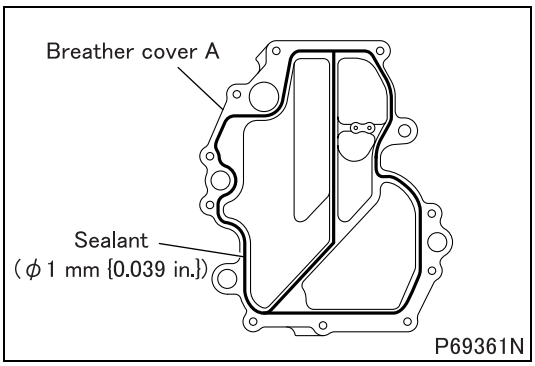


P103717E

■ Removal: Clamp

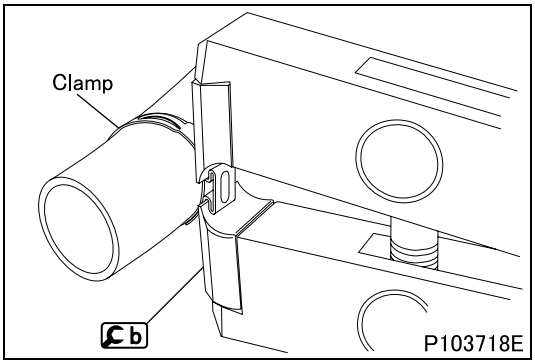
- To remove the clamp, cut the clamp using a.

◆Installation procedures◆



■Installation: Breather cover A

- Clean the sealant application surfaces of each part.
- Apply a bead of sealant to the breather cover A evenly and without any breaks as shown in the illustration.
- Install the lower crankcase within three minutes of applying the sealant to the upper crankcase, being careful not to dislodge the sealant.



■Installation: Clamp

- Pinch the projecting part of the clamp with b and tighten to the specified torque.

INDEX

SPECIFICATIONS 23-2

STRUCTURE AND OPERATION
1. Overview 23-3
2. Electronic Control System 23-9
3. Electronic Control Unit Connection Diagram 23-14

TROUBLESHOOTING
1. Diagnosis Procedure.....23-16
2. Diagnostic Precautions 23-16
3. Inspections Based on Diagnosis Codes.....23-17
4. Multi-Use Tester Service Data 23-315
5. Possible Causes of Symptoms 23-318

ON-VEHICLE INSPECTION AND ADJUSTMENT
1. Inspection of Area Around Automatic Transmission 23-322
2. Inspection of Play in Companion Flange and Looseness in Lock Nut 23-322
3. Stall Test 23-323
4. Time Lag Test 23-324
5. Line Pressure Test 23-325
6. Road Test 23-327
7. Inspection of Automatic Transmission Fluid 23-328
8. Replacement of Automatic Transmission Fluid 23-329
9. Dealer Adjust 23-331

REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION 23-334

PARKING BRAKE 23-340

AUTOMATIC TRANSMISSION CONTROL 23-342

OIL COOLER 23-352

REPLACEMENT OF PARTS OF AUTOMATIC TRANSMISSION MAIN BODY 23-354

INSPECTION OF ELECTRICAL EQUIPMENT 23-358

INSTALLED LOCATIONS OF PARTS 23-362

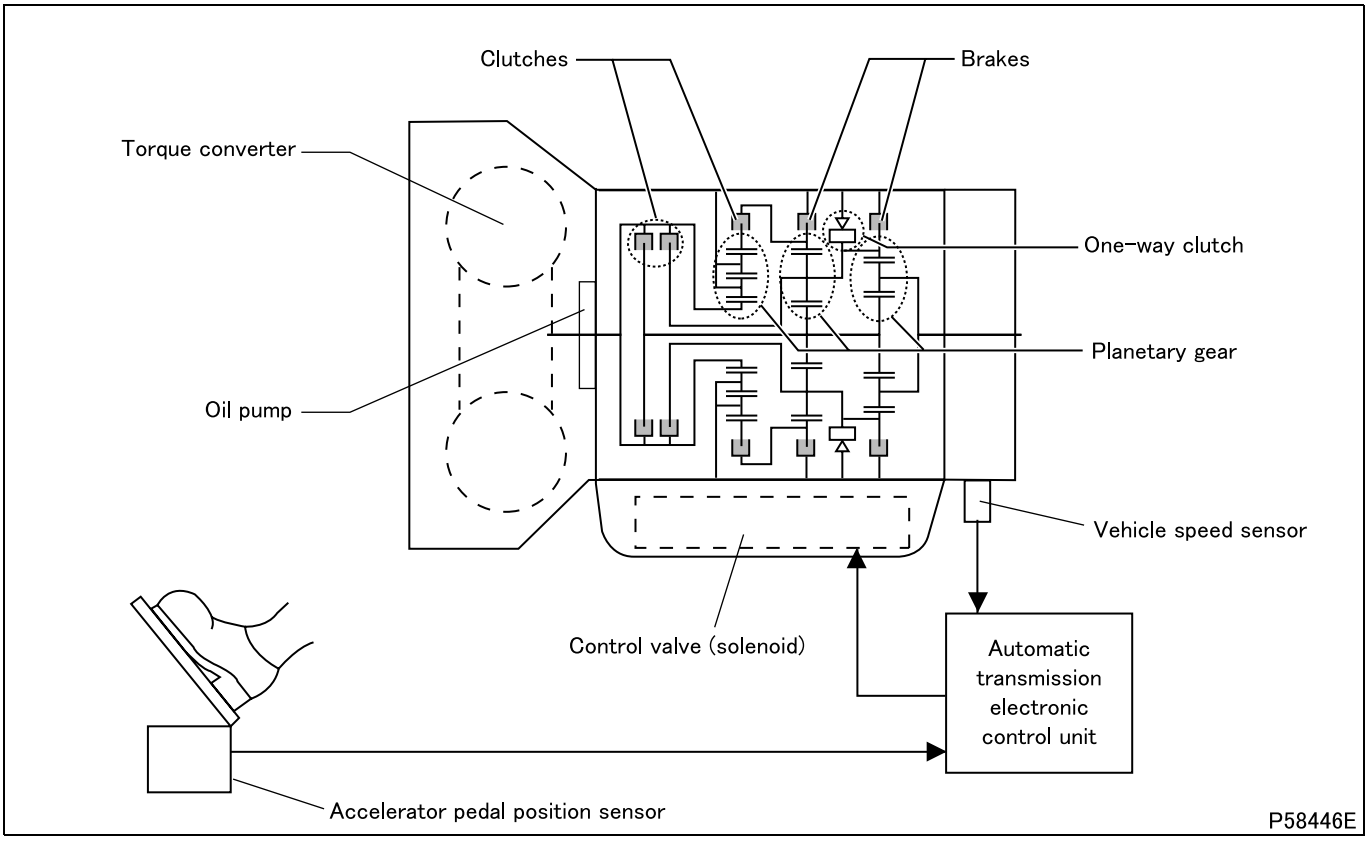
ELECTRIC CIRCUIT DIAGRAM 23-365

SPECIFICATIONS

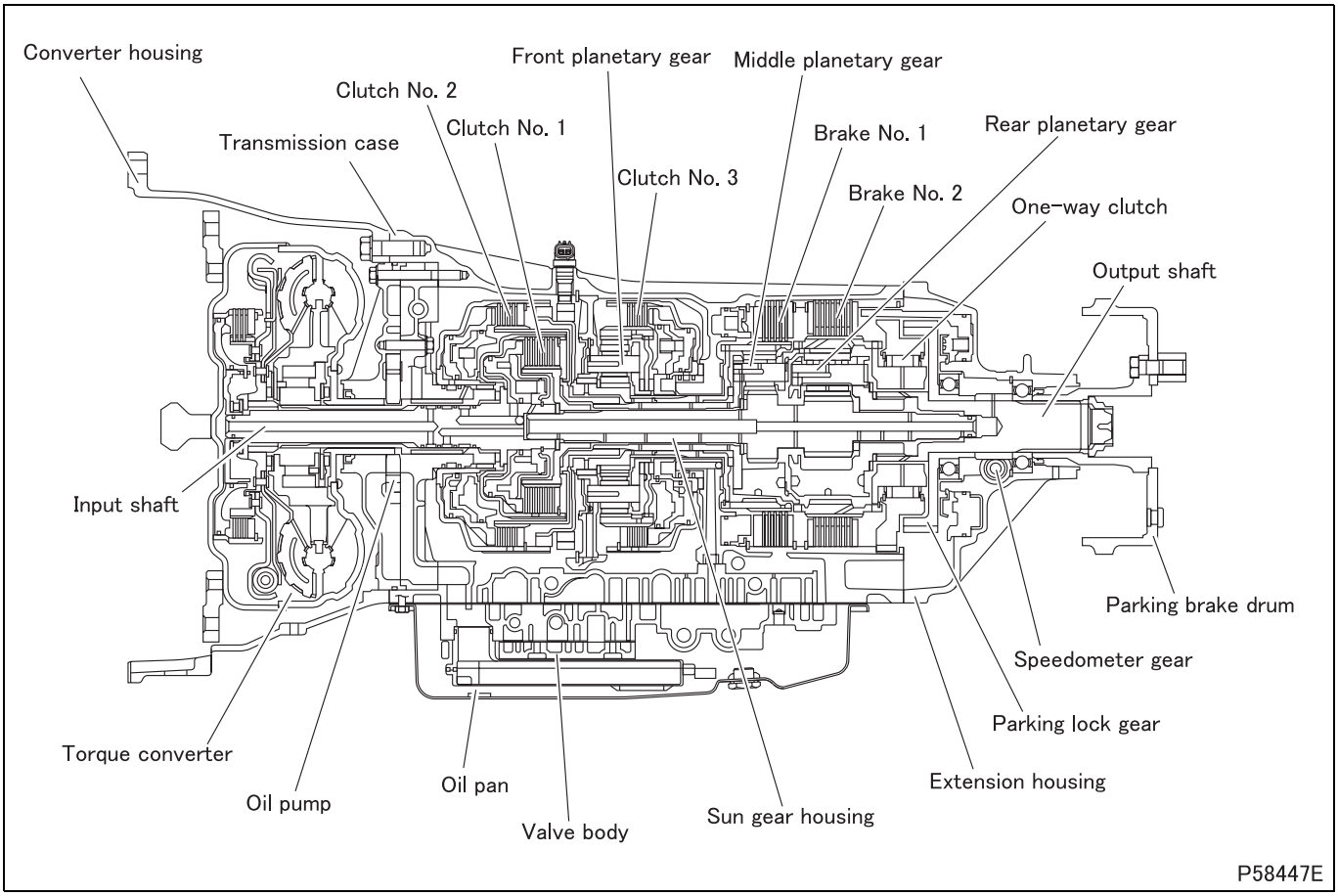
Item			Specifications
Manufacturer			Aisin Seiki Co., Ltd.
Transmission model			M036A6
Torque converter	Type		3-element, single-stage, 2-phase (with lockup clutch)
	Stall torque ratio		1.60
Transmission	Type		Planetary gear type; 6 forward gears, 1 reverse gear
	Gear ratios	1st	3.742
		2nd	2.003
		3rd	1.343
		4th	1.000
		5th	0.773
		6th	0.634
		Rev	3.539
Range selection pattern			P-R-N-D-3-2 (engine startup possible in P and N only)
Automatic transmission fluid	Type		Mobil ATF3309 or equivalent
	Total quantity L {qts.}		13 {14}
	Quantity at time of replacement L {qts.}	Replaced with drain plug removed	Approx. 6.4 {6.8}
		Replaced with oil pan removed	Approx. 8.4 {8.9}

1. Overview

- The automatic transmission forms a system in which gearshifts are automatically realized through direction of automatic transmission fluid on various paths by solenoid valves in accordance with sensor information on the vehicle speed, throttle opening, and other aspects of vehicle operation.
- The automatic transmission electronic control unit provides various control functions. These include a diagnosis function (here, the automatic transmission electronic control unit monitors the main components and warns the driver of any abnormality), a failsafe function (here, the automatic transmission electronic control unit stops control of the automatic transmission when necessitated by an abnormality), and a function (here, the automatic transmission electronic control unit changes the control method to enable continued driving in the event of a relevant abnormality).
- The system consists mainly of electronically controlled control valves (solenoid valves), a torque converter, planetary gears, brakes, clutches, and the automatic transmission electronic control unit and sensors that are used for control of the aforementioned components.



1.1 Automatic transmission



- The automatic transmission combines a torque converter (this has a lockup mechanism) and a fully automatic 6-speed gear system.

(1) Torque converter

- The torque converter serves as the input device for the transmission. It functions as a fluid coupling that increases the torque transmitted from the engine and absorbs shock during standing starts and during gearshifts. At vehicle speeds above a certain level, a lockup mechanism in the torque converter eliminates slippage and thus improves transmission efficiency.

(2) Transmission

- The transmission consists of a gear system with 6 forward gears and 1 reverse gear. It effects gearshifts using 1 one-way clutch, 3 planetary gear sets (each of these consists of a sun gear, pinion gears, and a ring gear), 3 hydraulically activated, wet, multi-plate clutches, and 2 hydraulically activated, wet, multi-plate brakes.

(3) Hydraulic control arrangement

- Extensive electronic control effected by a microcomputer (the automatic transmission electronic control unit) over the hydraulic circuitry enables precise control over gearshifts.

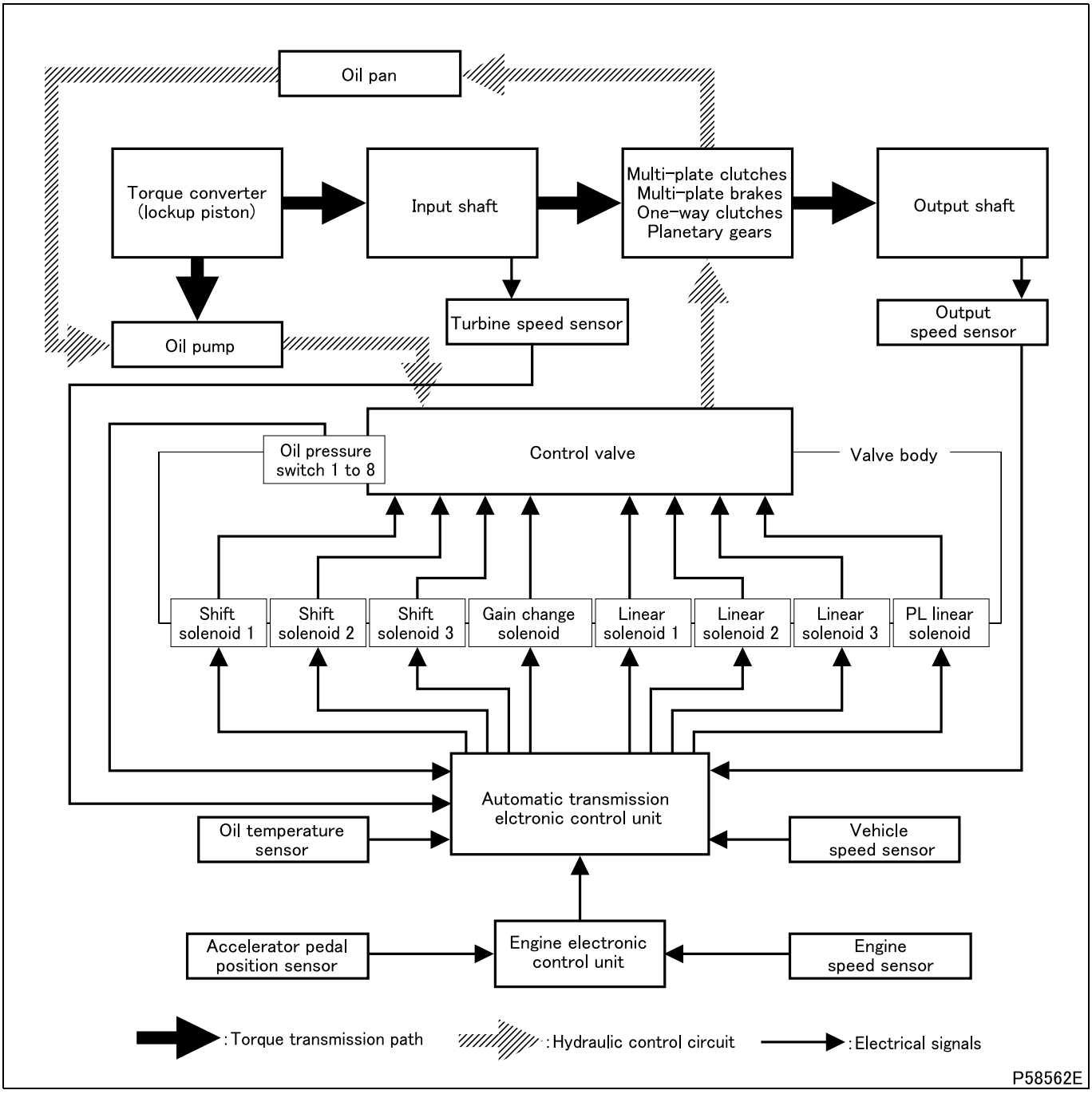
(4) Oil pump

- The gears in the oil pump turn in time with the input shaft rotation to suck in oil from the oil pan. The oil is then compressed and discharged into the hydraulic control components and other parts that need to be lubricated.

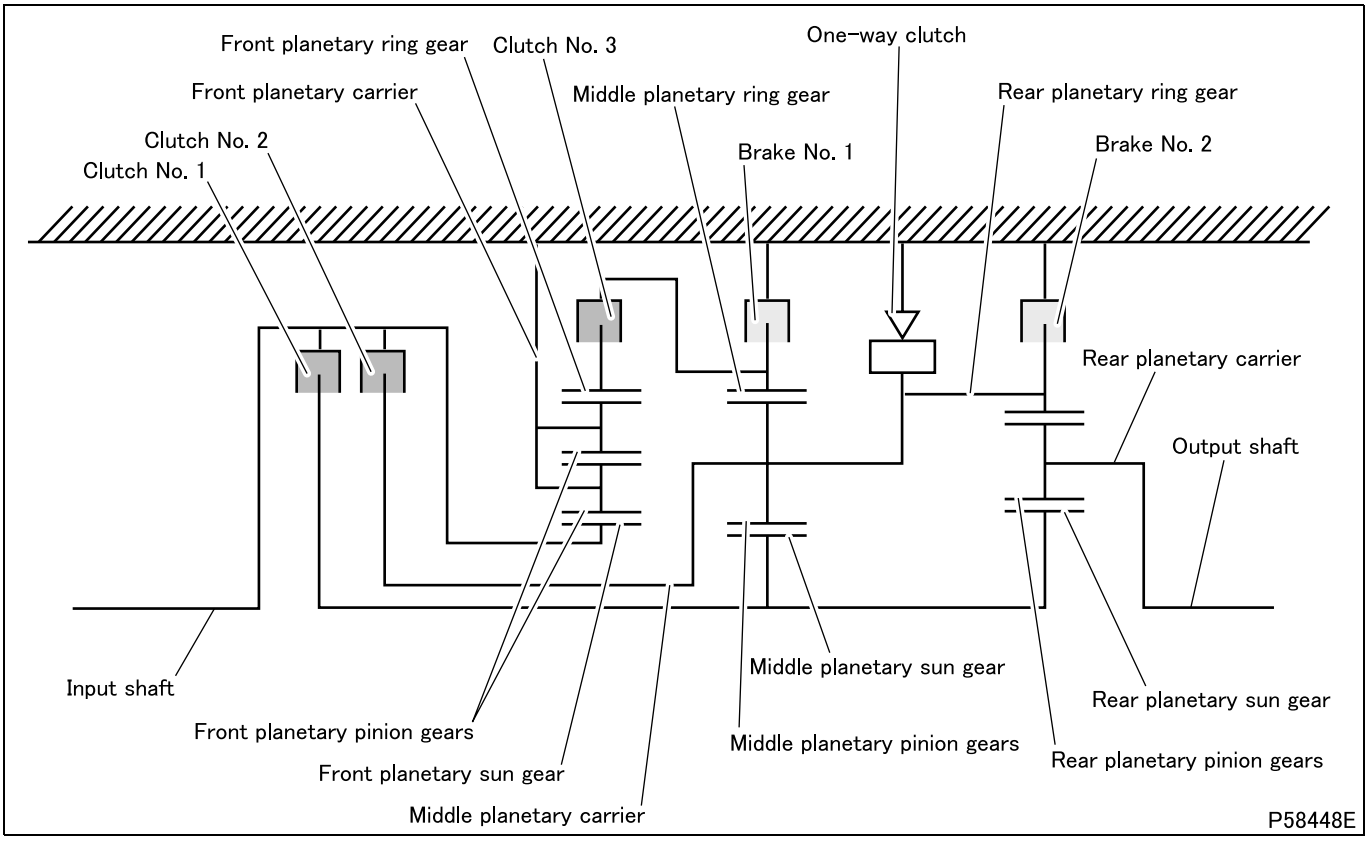
(5) Valve body

- The valve body consists of the solenoids that are activated by command signals from the electronic control unit to select necessary hydraulic circuit and a control valve that actually changes the operating modes of the brakes and clutches and regulates hydraulic pressure through the selected hydraulic circuit.

1.2 Automatic transmission block diagram



1.3 Transmission



(1) Functions of clutches and brakes

Component	Function
Clutch No. 1	Engage input shaft with middle and rear planetary sun gears
Clutch No. 2	Engage input shaft with middle planetary carrier and rear planetary ring gear
Clutch No. 3	Engage front planetary ring gear with middle planetary ring gear
Brake No. 1	Lock middle planetary ring gear
Brake No. 2	Lock front planetary carrier and rear planetary ring gear
One-way clutch	Lock front planetary carrier and rear planetary ring gear against counterclockwise rotation (only allowing them to rotate clockwise)

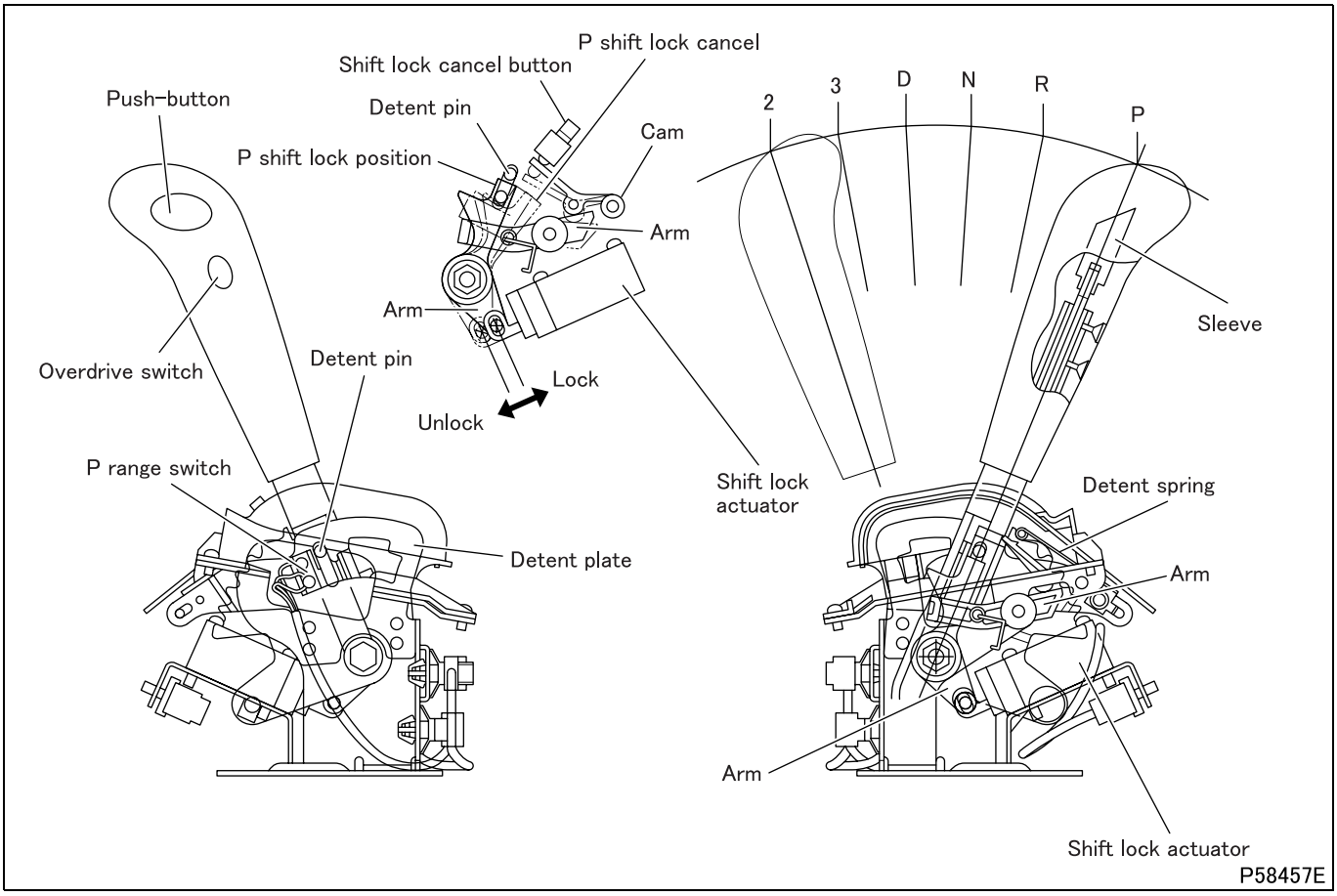
(2) Operation timing of clutches, brakes and solenoids

Shifter position		Shift solenoid			Linear solenoid			Clutch No.			Brake No.		One-way clutch
		1	2	3	1	2	3	1	2	3	1	2	
P	Parking		O	O		O						O	
R	Rev (high torque)	O		O		O	O			O		O	
	Rev (low torque)	O	O	O		O	O			O		O	
N	Neutral		O	O		O						O	
D	1st			O		O		O				O	●
	2nd				O			O			O		
	3rd	O				O		O		O			
	4th	O	O		O			O	O				
	5th		O			O			O	O			
	6th		O		O				O		O		

O :In operation

● :Only in operation when driven

1.4 Range selector lever



- The P range switch indicates whether the P range is selected. It is used for the key interlock function.
- The shift lock actuator is used in control of the P shift lock function.
- The shift lock cancel button cancels the P shift lock function in a way that bypasses the shift lock actuator. It is used in the event of a fault.

(1) Key interlock function

(1.1) Locked condition

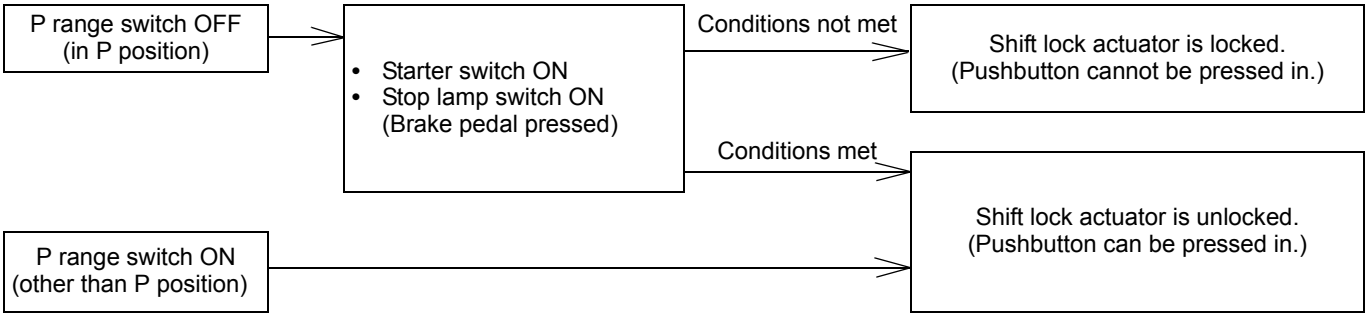
Input signal	Key interlock electronic control unit	Output signal
P Range switch ON (range selector lever in position except P)	Key interlock activation	Key interlock solenoid ON (key cannot be turned to LOCK position)

(1.2) Lock cancellation

Input signal	Key interlock electronic control unit	Output signal
P Range switch OFF (range selector lever in P position)	Key interlock cancellation	Key interlock solenoid OFF (key can be turned to LOCK position)

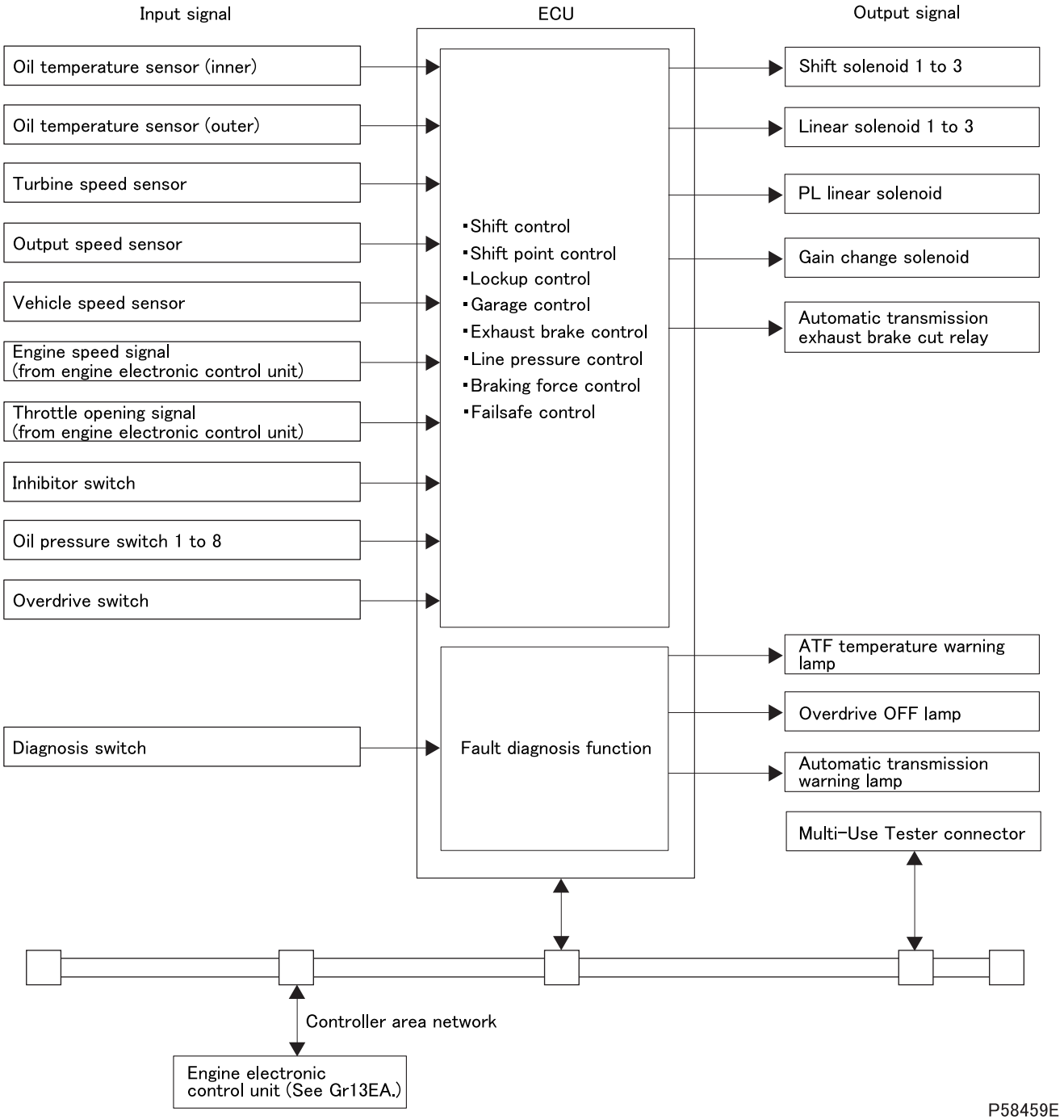
(2) P shift lock function

- When the required condition is not satisfied, the shift lock actuator operates to prevent the push-button from being pushed, effectively preventing movement of the lever from the P position.



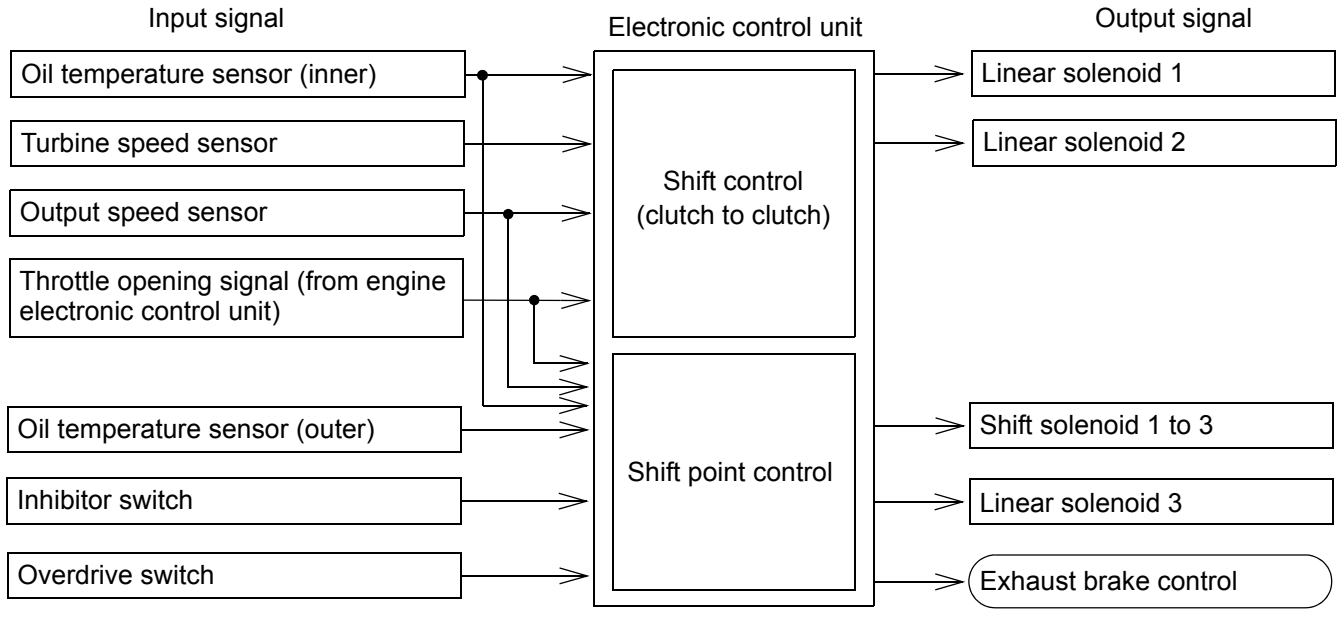
2. Electronic Control System

2.1 System block diagram



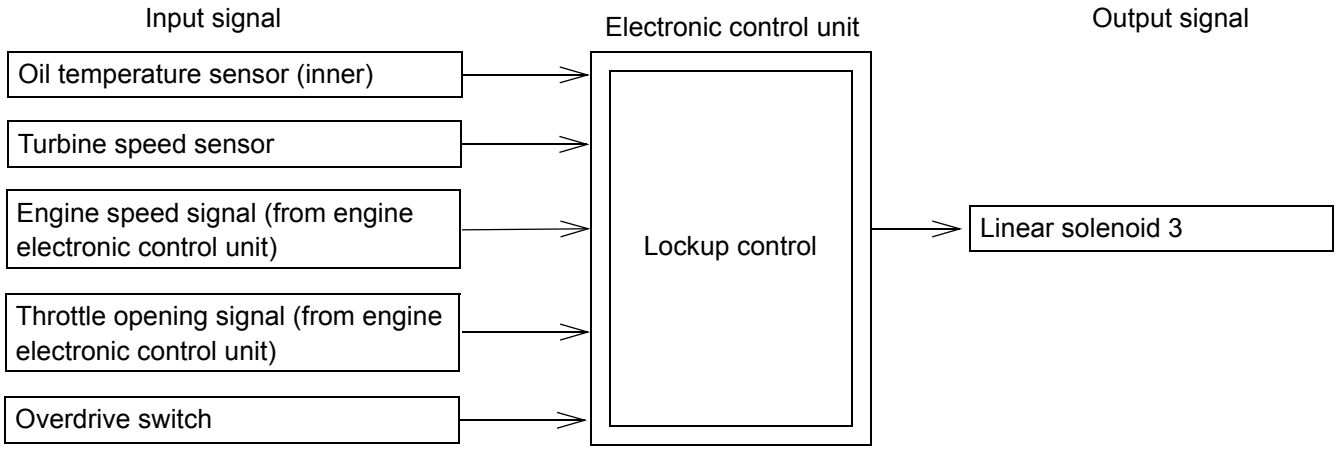
Part name	Major function or operation
Oil temperature sensor (inner and outer)	Detection of automatic transmission fluid temperature
Turbine speed sensor	Detection of input shaft speed
Output speed sensor	Detection of output shaft speed
Vehicle speed sensor	Detection of vehicle speed
Engine electronic control unit (engine speed signal)	Detection of engine speed
Engine electronic control unit (throttle opening signal)	Detection of throttle opening angle
Inhibitor switch	Detection of range selector lever position
Oil pressure switch 1 to 8	Detection of oil pressure
Overdrive switch	Detection of overdrive OFF condition
Diagnosis switch	Displaying diagnosis codes
Shift solenoid 1 to 3	Gear shifting for speed change
Linear solenoid 1, 2	
Linear solenoid 3	Gear shifting for speed change, activation of lockup, shifting from neutral to forward or reverse
PL linear solenoid	Control of line pressure
Gain change solenoid	Change of range where the gearshift pressure is regulated
Automatic transmission exhaust brake cut relay	Cut-off of exhaust brake
ATF temperature warning lamp	Display of abnormal automatic transmission fluid temperature
Overdrive OFF lamp	Display of overdrive OFF
Automatic transmission warning lamp	Display of system fault and diagnosis codes
Multi-Use Tester connector	Communication with Multi-Use Tester; displaying and erasing diagnosis codes

2.2 Shift control and shift point control



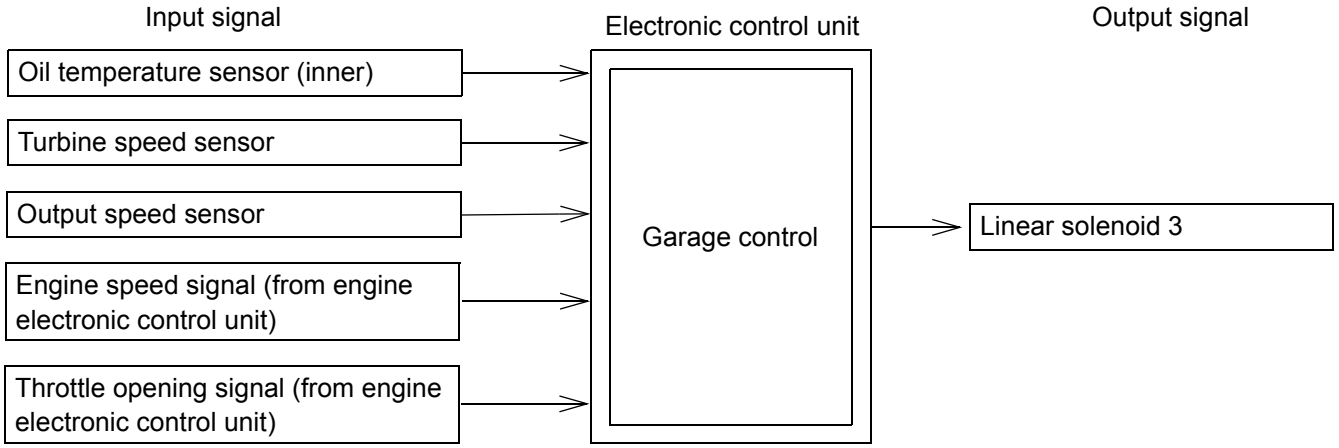
- For automatic selection of the optimal gear, the throttle opening signal and the output speed sensor signals (which correspond to the vehicle speed) cause the automatic transmission electronic control unit to issue relevant signals in accordance with a predetermined shift map to shift solenoid 1-3 and linear solenoid 1 and 2, which are mounted on the valve body.
- Clutch selection for shift control is performed by means of clutch-to-clutch control, whereby one clutch is disengaged as another is engaged.

2.3 Lockup control



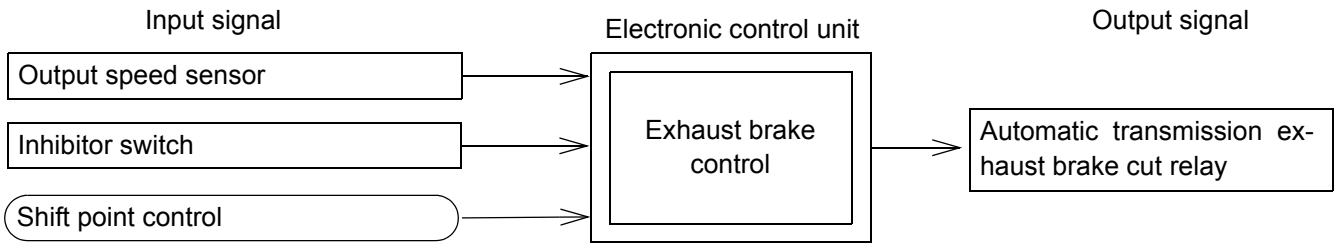
- Lockup control enables slippage in the torque converter to be eliminated for increased transmission efficiency. The throttle opening signal and the output speed sensor signals (which correspond to the vehicle speed) cause the automatic transmission electronic control unit to issue relevant signals in accordance with a predetermined shift map to linear solenoid 3 (this is mounted on the valve body) for lockup ON-OFF-slip selection.

2.4 Garage control



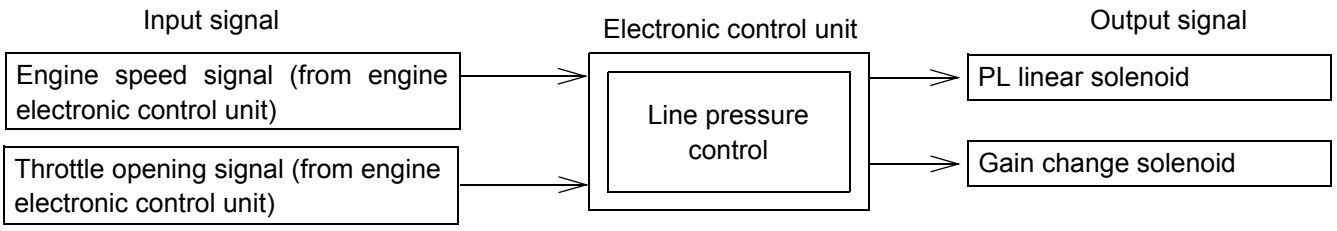
- When the inhibitor switch signal changes from N to a driving range (D or R), a signal is issued by the automatic transmission electronic control unit to linear solenoid 3 (this is mounted on the valve body) to realize a forward or reverse gear.

2.5 Exhaust brake control



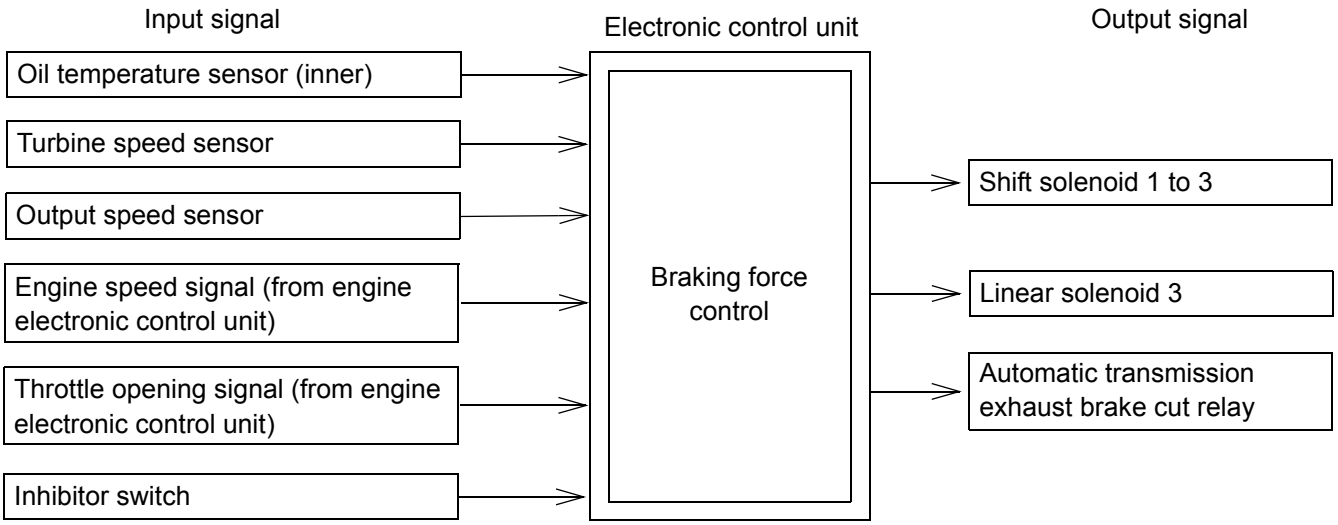
- The exhaust brake is released under any of the following conditions.
  - Range selector lever is in P or N
  - Low speed driving
  - During automatic transmission shifting
  - ATF temperature is high

2.6 Line pressure control



- The line pressure control optimizes the automatic transmission line pressure in accordance with the throttle opening signal and engine speed signal.

2.7 Braking force control



- If the accelerator pedal is released when the vehicle speed is higher than a certain level, a gear is selected in accordance with the road grade and cargo weight to realize optimal engine braking.

2.8 Failsafe control

- Failsafe control is designed to maintain the highest possible level of driveability in the event of an abnormality in either output speed sensor, in the engine speed signal, throttle opening signal, oil temperature sensor, or inhibitor switch, or in any solenoid or mechanical valve.

(1) Inhibitor switch

If, with the vehicle either stationary or moving, an inhibitor switch abnormality occurs such that no signals are applied to the automatic transmission electronic control unit, the automatic transmission electronic control unit selects and holds 3rd gear. If multiple signals are applied to the automatic transmission electronic control unit, the automatic transmission electronic control unit maintains driveability by effecting control in the following order of range precedence: P > N > range signals prior to duplicate signal input. The selected hydraulic circuit in the valve body is determined by the manual valve in accordance with the range selector lever position, so the actual vehicle condition is as shown below.

Actual range selector lever position	Inhibitor switch input signals	Vehicle operating condition
P	P and another select signal	P
R	R and another select signal (except P or N range signal)	R
N	N and another select signal	N
D	D and another select signal (except P or N range signal)	3rd gear
3	3 and another select signal (except P or N range signal)	3rd gear
2	2 and another select signal (except P or N range signal)	3rd gear

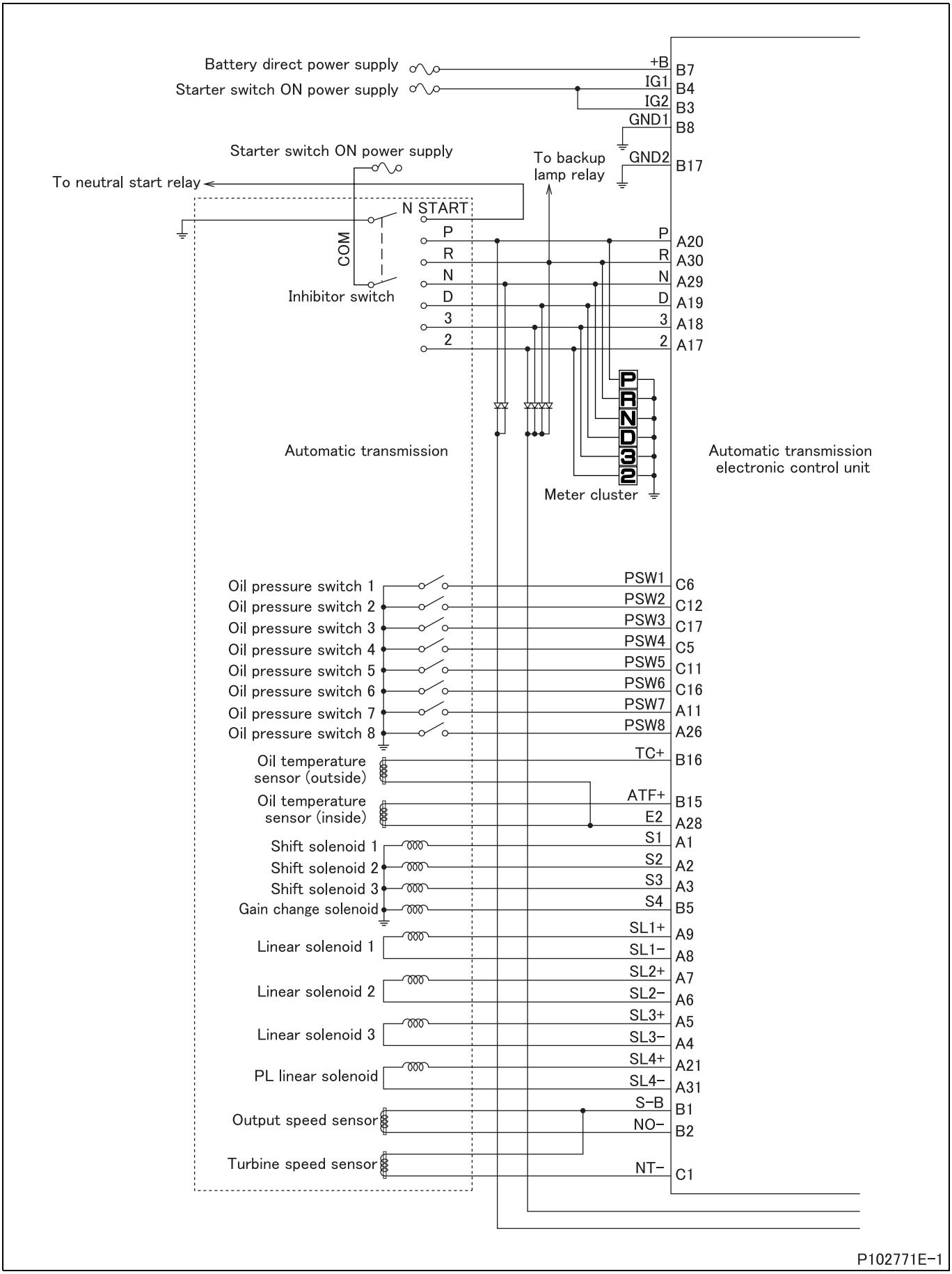
2.9 Fault diagnosis function

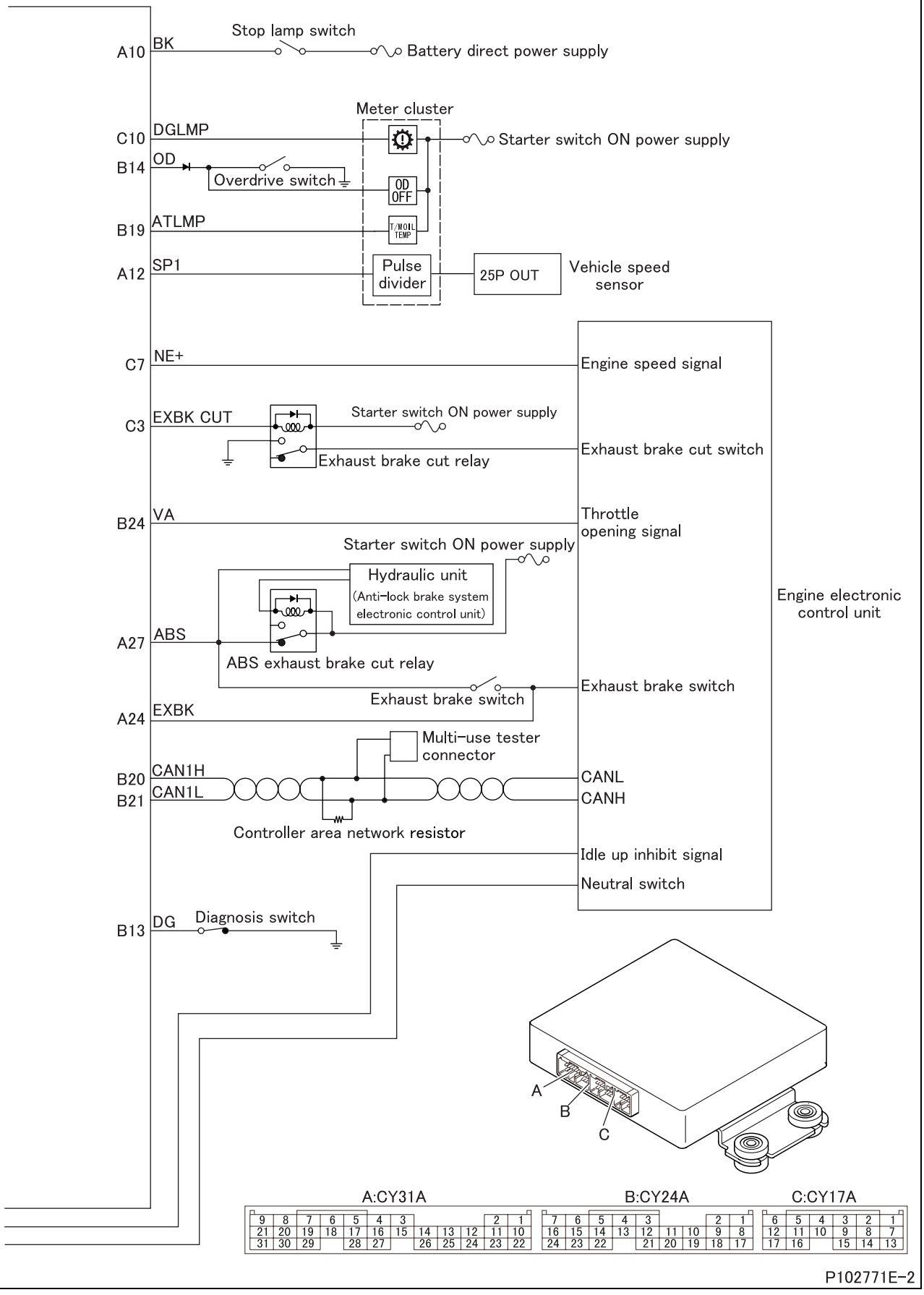
- While the starter switch is in the ON position, the sensors and other components are continuously monitored for faults. In the event that a component is found faulty, an indication is made in the meter cluster to alert the driver, the fault location is memorized in the form of a diagnosis code, and special control necessitated by the fault is initiated.
- While the special control is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.

NOTE

- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

3. Electronic Control Unit Connection Diagram

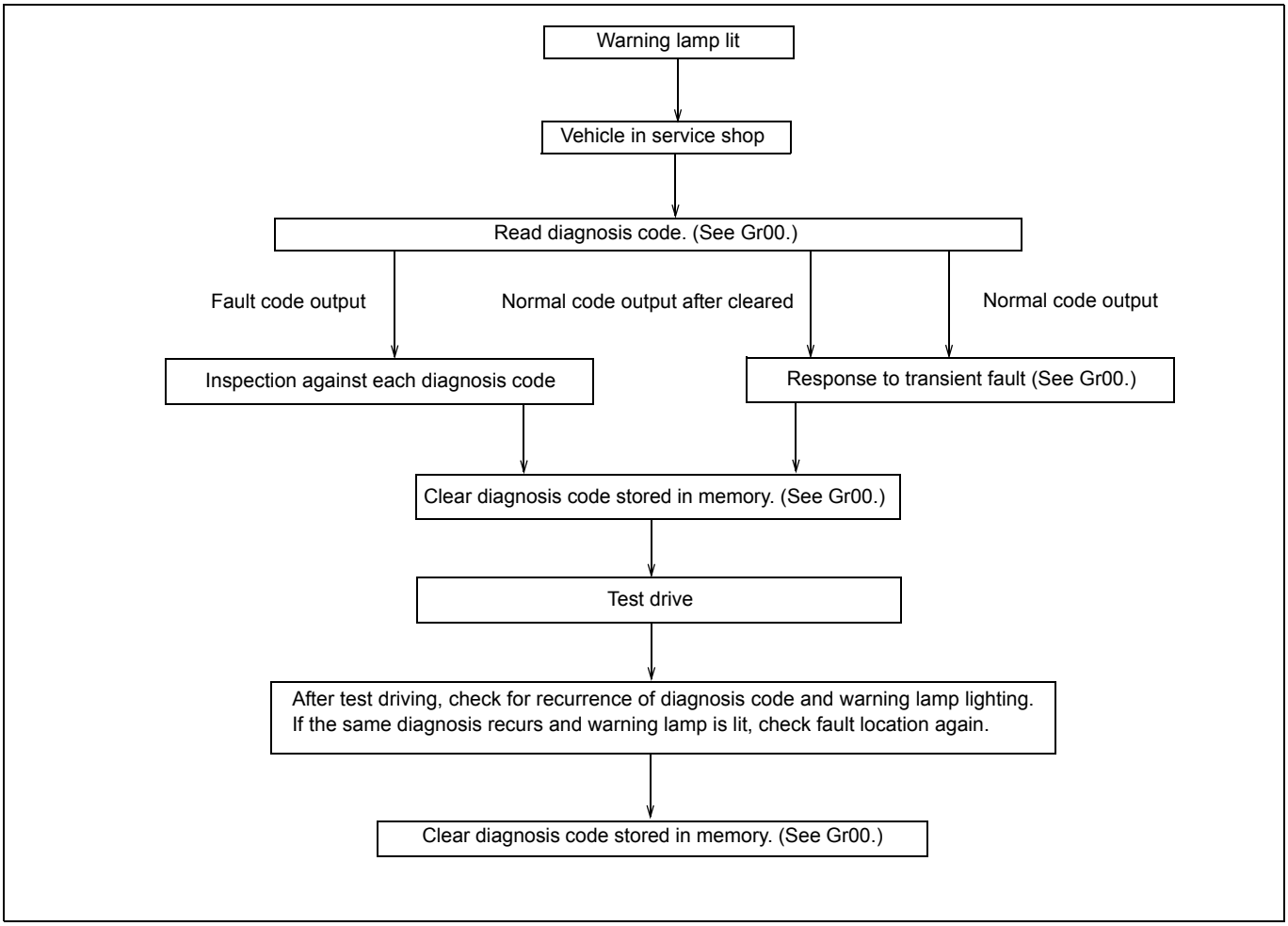



A10
BK
Stop lamp switch
Battery direct power supply
Meter cluster
C10
DGLMP
Starter switch ON power supply
B14
OD
Overdrive switch
OD OFF
B19
ATLMP
T/MOIL TEMP
A12
SP1
Pulse divider
25P OUT
Vehicle speed sensor
C7
NE+
Engine speed signal
C3
EXBK CUT
Starter switch ON power supply
Exhaust brake cut relay
Exhaust brake cut switch
B24
VA
Throttle opening signal
Starter switch ON power supply
Hydraulic unit
(Anti-lock brake system electronic control unit)
A27
ABS
ABS exhaust brake cut relay
Exhaust brake switch
Exhaust brake switch
A24
EXBK
Multi-use tester connector
B20
CAN1H
B21
CAN1L
CANL
CANH
Controller area network resistor
Idle up inhibit signal
Neutral switch
Engine electronic control unit
B13
DG
Diagnosis switch
A
B
C
A:CY31A
B:CY24A
C:CY17A
P102771E-2

TROUBLESHOOTING

1. Diagnosis Procedure

- Carry out system inspection in accordance with the flow chart given below.
  System inspection is roughly divided into two types as follows according to trouble symptom and diagnosis code.
  - Inspection against each diagnosis code stored in memory by the electronic control unit
  - Response to transient fault



2. Diagnostic Precautions

- Before measuring voltage, check the charge and specific gravity of the battery. If system inspection is performed with the battery uncharged or reduced in specific gravity, accurate measurements cannot be achieved.
- To avoid possible damage to electric parts, set the starter switch and lighting switch to LOCK or OFF before disconnecting and reconnecting battery terminals.
- Before disconnecting connectors, set the starter to LOCK or OFF, then allow at least 20 seconds. Voltage may remain in electric parts or connected circuit.
- When performing measurement with the tester, internal circuit and other electrical parts of the electronic control unit could be damaged by the test bar. To avoid it, handle the test bar carefully not to cause a short-circuit failure between connector terminals or between connector and body.
- Resistance is affected by temperature. Determine the necessity of resistance measurement by reference to given temperature specification as a guide. Otherwise, use normal temperature (10 to 35°C {50 to 95°F}) as the measuring condition.

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

- Fault codes can be monitored through the scanning tool (General Scanning Tool or Multi-Use Tester) or the flashing of the warning lamp in the meter cluster.
- There are two kinds of fault codes, i.e., fault code displayed by the General Scanning Tool or Multi-Use Tester and flash code given by the flashing of the warning lamp.
- Scanning tool (General Scanning Tool or Multi-Use Tester) can display diagnosis codes that are more specific than flash codes.
- Diagnosis codes asterisked in the list differ in fault diagnosis period according to the fault diagnosis condition. (For details on fault diagnosis condition, see “Inspection against Each Diagnosis Code”.)

Fault code		Monitor ID	Fault (outline)	Warning	Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code					
P0078	54	–	Failure of exhaust brake cut relay	O	EXH brake Cut Signal	8TRIP
P0500	12	1	Failure of vehicle speed sensor	●	Vehicle Speed Sensor	2DC
*P0501	12	2	Failure of vehicle speed sensor	●	Vehicle Speed Sensor Performance	IMD or 2DC
P0562	11	72	Open-circuit of starter switch ON power supply	●	Power Supply Voltage (Low)	IMD
P0604	91	74	Failure of electronic control unit	●	ECU Hardware (RAM)	2DC
P0605	92	75	Failure of electronic control unit	●	ECU System (Hardware)	2DC
P062F	93	76	Failure of electronic control unit	●	ECU System (EEPROM)	IMD
P0702	11	73	Open-circuit of battery power supply	●	Power Supply Low (Battery)	2DC
P0706	49	49, 50	Failure of oil pressure switch 8	●	Oil Pressure SW 8 Performance	IMD
P0707	43	19	Failure of inhibitor switch	●	Shift Position SW Low	IMD
P0708	43	20	Failure of inhibitor switch	●	Shift Position SW High	IMD
P0711	13	13, 14	Failure of oil temperature sensor (inside)	●	Oil Temp Sensor “OP” Performance	IMD
P0712	13	11	Failure of oil temperature sensor (inside)	●	Oil Temp Sensor “OP” Low	IMD
P0713	13	12	Failure of oil temperature sensor (inside)	●	Oil Temp Sensor “OP” High	IMD
P0714	13	15	Failure of oil temperature sensor (inside)	●	Oil Temp Sensor “OP” Intermittent	IMD
P0717	16	5	Failure of turbine speed sensor	●	Turbine Speed Sensor No Signal	2DC
*P0721	25	4	Failure of output speed sensor	●	Output Speed Sensor Performance	IMD or 2DC
P0722	25	3	Failure of output speed sensor	●	Output Speed Sensor No Signal	2DC
P0726	15	6	Abnormality of engine speed signal	●	Engine Speed Sensor Performance	2DC
P0730	37	7, 8	Incorrect gear ratio	●	Incorrect Gear Ratio	IMD
P0746	41	38, 39	Linear solenoid 1 binds in OFF state.	●	Linear Sol Valve 1 Stuck Off	IMD
P0747	41	40	Linear solenoid 1 binds in ON state.	●	Linear Sol Valve 1 Stuck On	IMD
P0748	26	21, 22	Linear solenoid 1 is open-circuited or short-circuited.	●	Linear Sol Valve 1 Electrical	IMD
P0751	45	52	Shift solenoid 1 binds in OFF state.	●	Shift Solenoid 1 Stuck Off	IMD
P0752	45	51	Shift solenoid 1 binds in ON state.	●	Shift Solenoid 1 Stuck On	IMD
P0756	46	56	Shift solenoid 2 binds in OFF state.	●	Shift Solenoid 2 Stuck Off	IMD

Fault code		Monitor ID	Fault (outline)	Warning	Multi-Use Tester indication	Fault diagnosis period
Diagnosis code	Flash code					
P0757	46	55	Shift solenoid 2 binds in ON state.	●	Shift Solenoid 2 Stuck On	IMD
P0761	47	60	Shift solenoid 3 binds in OFF state.	●	Shift Solenoid 3 Stuck Off	IMD
P0762	47	59	Shift solenoid 3 binds in ON state.	●	Shift Solenoid 3 Stuck On	IMD
P0766	55	64	Shift solenoid 3 binds in OFF state.	●	Shift Solenoid 4 Stuck Off	IMD
P0767	55	63	Shift solenoid 3 binds in ON state.	●	Shift Solenoid 4 Stuck On	IMD
P0776	42	43, 44	Linear solenoid 2 binds in OFF state.	●	Linear Sol Valve 2 Stuck Off	IMD
P0777	42	45	Linear solenoid 2 binds in ON state.	●	Linear Sol Valve 2 Stuck On	IMD
P0778	27	23, 24	Linear solenoid 2 is open-circuited or short-circuited.	●	Linear Sol Valve 2 Electrical	IMD
P0796	48	47	Linear solenoid 3 binds in OFF state.	●	Linear Sol Valve 3 Stuck Off	IMD
P0797	48	46	Linear solenoid 3 binds in ON state.	●	Linear Sol Valve 3 Stuck On	IMD
P083D	48	48	Failure of oil pressure switch 7	●	Oil Pressure SW 7 High	IMD
P0842	41	37	Failure of oil pressure switch 1	●	Oil Pressure SW 1 Low	IMD
P0843	41	36	Failure of oil pressure switch 1	●	Oil Pressure SW 1 High	IMD
P0847	42	42	Failure of oil pressure switch 2	●	Oil Pressure SW 2 Low	IMD
P0848	42	41	Failure of oil pressure switch 2	●	Oil Pressure SW 2 High	IMD
P0863	88	67	Abnormality in CAN communication	●	CAN Communication	IMD
P0872	45	54	Failure of oil pressure switch 3	●	Oil Pressure SW 3 Low	IMD
P0873	45	53	Failure of oil pressure switch 3	●	Oil Pressure SW 3 High	IMD
P0877	46	58	Failure of oil pressure switch 4	●	Oil Pressure SW 4 Low	IMD
P0878	46	57	Failure of oil pressure switch 4	●	Oil Pressure SW 4 High	IMD
P0973	31	29	Failure of shift solenoid 1	●	Shift Solenoid 1 - Low	IMD
P0974	31	30	Failure of shift solenoid 1	●	Shift Solenoid 1 - High	IMD
P0976	32	31	Failure of shift solenoid 2	●	Shift Solenoid 2 - Low	IMD
P0977	32	32	Failure of shift solenoid 2	●	Shift Solenoid 2 - High	IMD
P0979	33	33	Failure of shift solenoid 3	●	Shift Solenoid 3 - Low	IMD
P0980	33	34	Failure of shift solenoid 3	●	Shift Solenoid 3 - High	IMD
P0985	52	–	Failure of gain change solenoid	O	Shift Solenoid 4 - Low	IMD
P0986	52	35	Failure of gain change solenoid	●	Shift Solenoid 4 - High	IMD
P0989	47	62	Failure of oil pressure switch 5	●	Oil Pressure SW 5 Low	IMD
P0990	47	61	Failure of oil pressure switch 5	●	Oil Pressure SW 5 High	IMD
P0994	55	66	Failure of oil pressure switch 6	●	Oil Pressure SW 6 Low	IMD
P0995	55	65	Failure of oil pressure switch 6	●	Oil Pressure SW 6 High	IMD
P1604	24	10	Abnormality in accelerator pedal position signal	●	Accel Sensor	IMD
P2716	34	27, 28	PL linear solenoid is open-circuited or short-circuited.	●	Linear Sol Valve 4 Electrical	IMD
P2742	17	16	Failure of oil temperature sensor (outside)	●	Oil Temp Sensor “TC” Low	IMD
*P2743	17	17, 18	Failure of oil temperature sensor (outside)	●	Oil Temp Sensor “TC” High	IMD or 2DC
P2757	61	9	Failure of lockup clutch	●	Lockup Clutch	2DC
P2759	35	25, 26	Linear solenoid 3 is open-circuited or short-circuited.	●	Linear Sol Valve 3 Electrical	IMD
U0100	88	68, 69, 70, 71	Abnormality in CAN communication	●	CAN Communication	IMD

IMD: Immediate CAN: Controller area network
DC [Drive cycle]: “Start switch ON to start engine till starter switch OFF” constitutes 1 DC.
TRIP: Starter switch ON to OFF constitutes 1 TRIP.
●: Engine warning and automatic transmission warning lamps lit
O : Automatic transmission warning lamp only lit

3.2 Inspection against Each Fault Code in the List

[Fault code]
Diagnosis code: P0078/Flash code: 54
[Monitor ID]
None
[Fault (outline)]
Failure of exhaust brake cut relay
[Diagnosis check]
- The operating condition of exhaust brake under exhaust brake cut control is monitored.

[Code generation condition]
- Input of controller area network signal of exhaust brake operation from engine electronic control unit continues for more than 0.5 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

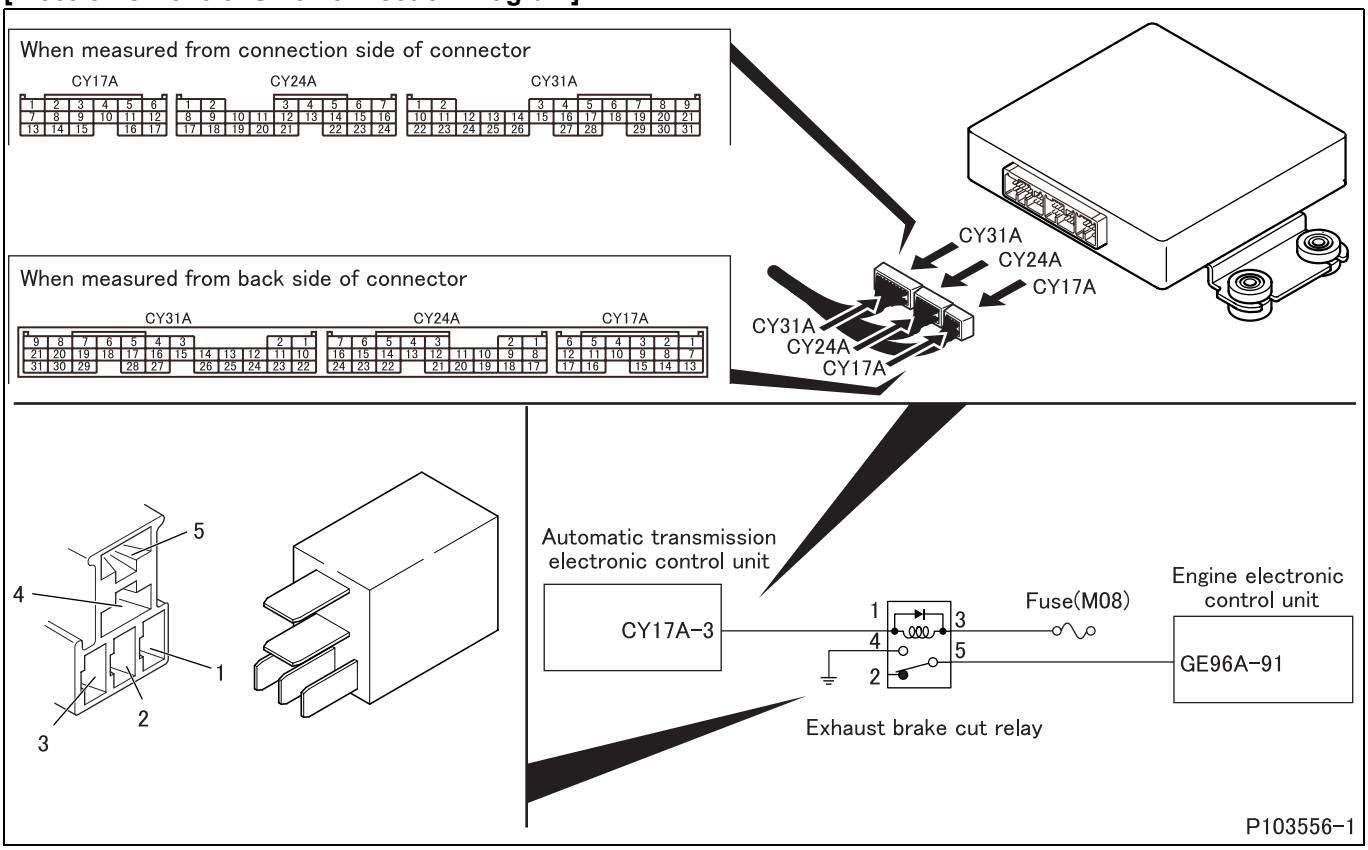
[Diagnostic requirement]
- Exhaust brake cut being requested

[Control effected by electronic control unit during fault]
- Braking force control is inhibited.

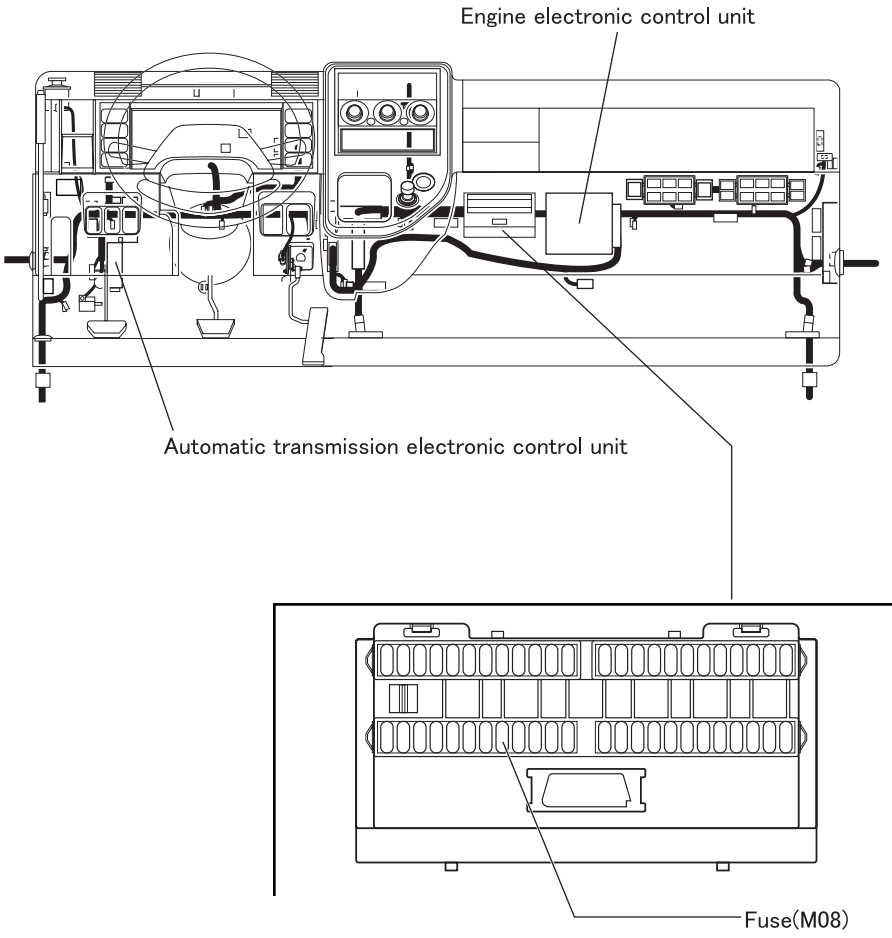
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and automatic transmission exhaust brake cut relay
- Malfunction of each connector
- Malfunction of automatic transmission exhaust brake cut relay
- Defective electronic control unit

[Recoverability]
- When diagnosis code is cleared with scanning tool (General Scanning Tool or Multi-Use Tester).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

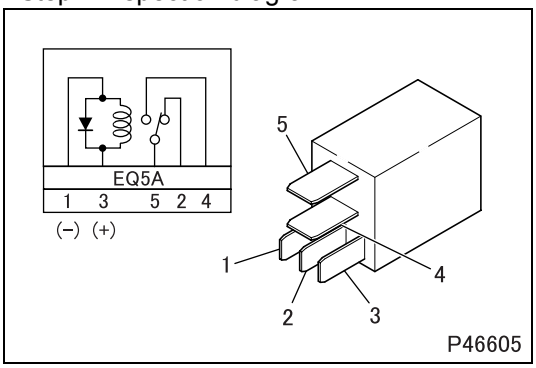
Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 54 “Exh Brake Cut SIG” of Service Data.
	Inspection condition		When vehicle is running **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • Decelerated and stopped: 12 V → 0 V • During acceleration: 12 V **<Multi-Use Tester used>** • Decelerated and stopped: OFF → ON • During acceleration: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of relay connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of relay unit
	Maintenance item		Measure continuity between terminals No. 4 and 5 when relay operates.
	Inspection condition		Apply battery voltage across connector terminals No. 3 (+) and 1 (–).
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of sensor

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between relay and electronic control unit (signal)
	Maintenance item		Check circuit between relay connector terminal No. 1 and electronic control unit connector (CY17A) terminal No. 3
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between relay and fuse
	Maintenance item		Check circuit between relay connector terminal No. 3 and electronic control unit fuse (M08)
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 54 (Exh Brake Cut SIG) of Service Data.
	Inspection condition		When vehicle is running **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • Decelerated and stopped: 12 V → 0 V • During acceleration: 12 V **<Multi-Use Tester used>** • Decelerated and stopped: OFF → ON • During acceleration: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0500/Flash code: 12
[Monitor ID]
1
[Fault (outline)]
Failure of vehicle speed sensor
[Diagnosis check]
- Vehicle speed sensor is monitored for fault during vehicle run (after at least 4 seconds of running at 5 km/h {3 mph} or more)

[Code generation condition]
- Input signal from vehicle speed sensor is missing when output speed sensor output is normal.

[Diagnosis check timing]
- Fault diagnosis is performed once at the minimum during the driving cycle.

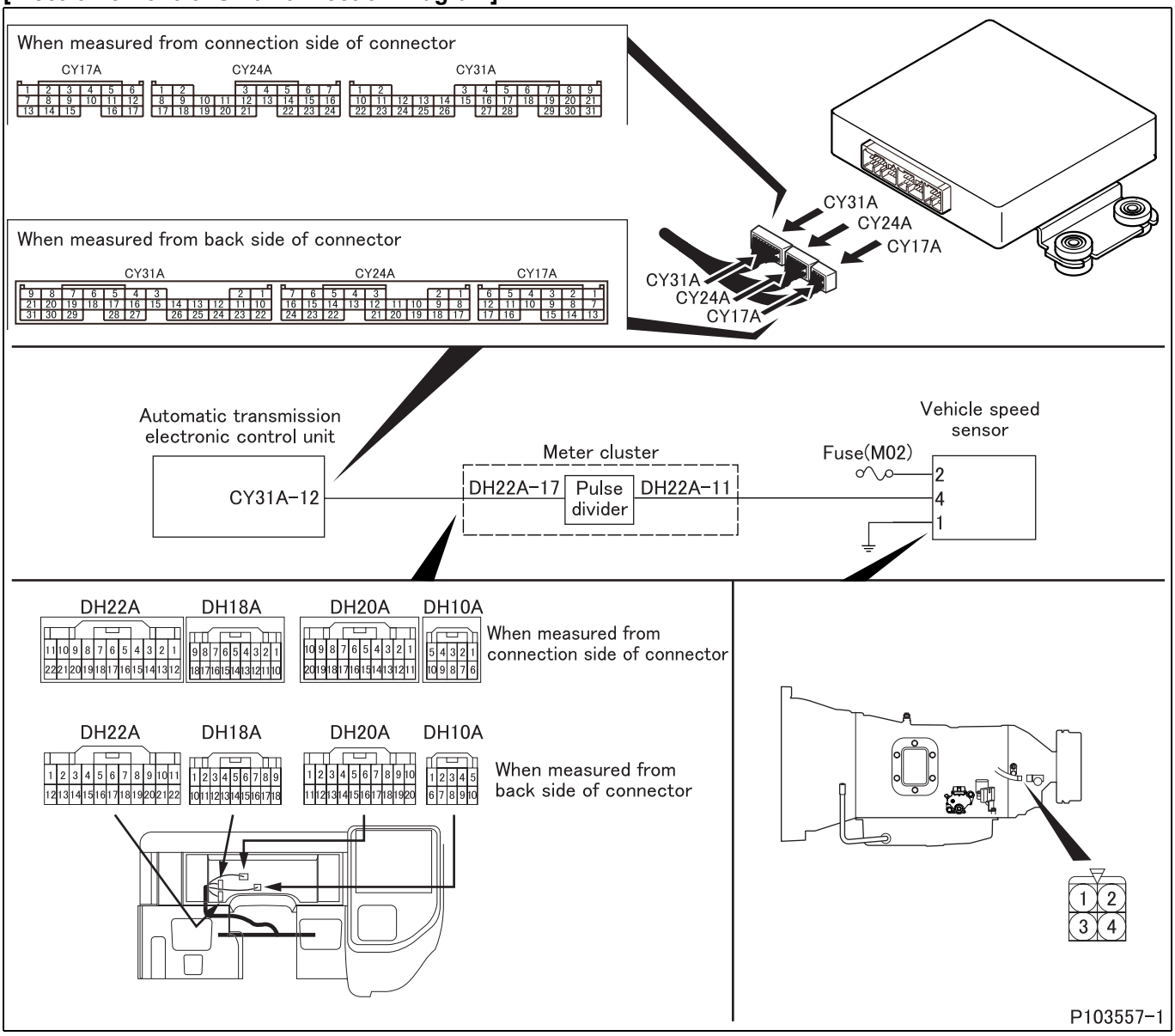
[Diagnostic requirement]
- Vehicle speed: above 5 km/h {3 mph} (not less than 4 sec.)
- Shift position: other than P or N range
- Output speed sensor related diagnosis code (P0721, P0722) does not occur.

[Control effected by electronic control unit during fault]
- Normal control is effected using output speed sensor.

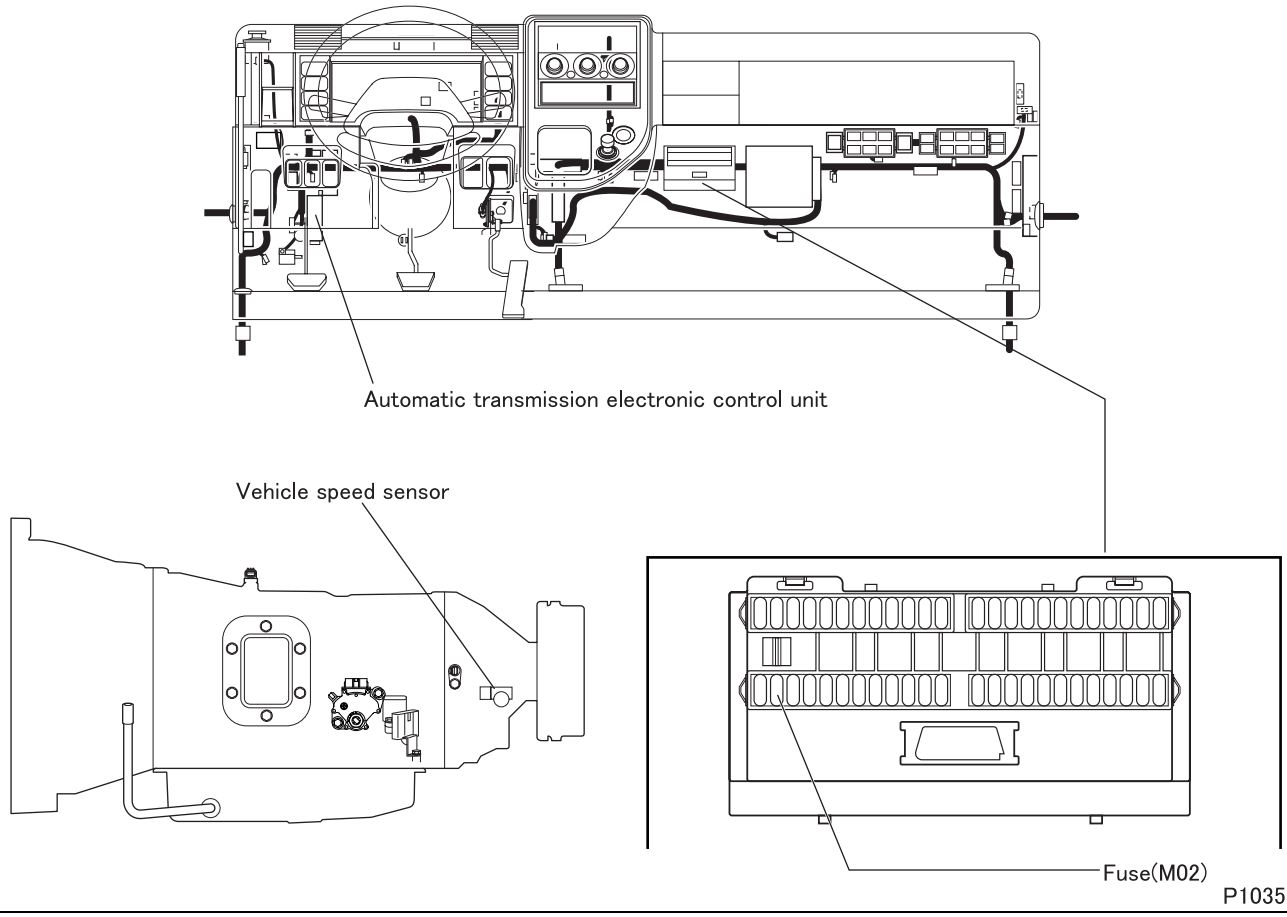
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and pulse divider in meter cluster
- Open-circuit or short-circuit of harness between pulse divider in meter cluster and vehicle speed sensor
- Malfunction of each connector
- Malfunction of pulse divider in meter cluster
- Malfunction of vehicle speed sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 12 “VEH Speed 1” of Service Data.
	Inspection condition		During vehicle run
	Requirements		Same indication as speedometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

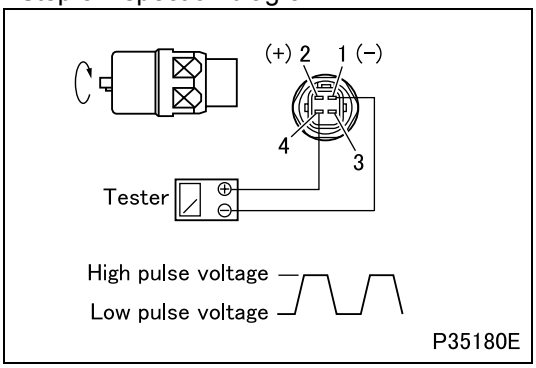
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (CY31A) terminal No. 12 (+) and (CY24A) terminal No. 8 (–).
	Inspection condition		• Measure from back side of harness connector with electronic control unit connected to harness. • Slowly turn the wheel using chassis dynamometer or the like. • Starter switch: ON
	Requirements		• Low pulse: 0.5 V or less • High pulse: Approx. 8 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and pulse divider
	Maintenance item		Check circuit between meter cluster connector (DH22A) terminal No. 17 and electronic control unit connector (CY31A) terminal No. 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of sensor unit <25 pulse output>
	Maintenance item		Measure maximum value (high pulse voltage) and minimum value (low pulse voltage) of voltage generated between sensor connector terminals No. 4 (+) and No. 1 (–).
	Inspection condition		Slowly turn sensor shaft with battery voltage applied between terminals No. 2 (+) and No. 1 (–).
	Requirements		• Low pulse: 0.5 V or less • High pulse: Approx. 8 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between sensor and fuse (power supply)
	Maintenance item		Check circuit between sensor connector No. 2 and fuse (M02).
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between sensor chassis and ground (ground)
	Maintenance item		Check circuit between sensor connector No. 1 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between sensor and pulse divider (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 4 and meter cluster connector (DH22A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by pulse divider connector
	Maintenance item		Measure value of voltage between meter cluster connector (DH22A) terminal No. 17 (+) and No. 6 (–).
	Inspection condition		• Measure from back side of connector with harness left connected • Remove sensor and slowly turn sensor shaft. • Starter switch: ON
	Requirements		• Low pulse: 0.5 V or less • High pulse: Approx. 8 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of meter cluster

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 12 (+) and (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 12 “VEH Speed 1” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** • Measure from back side of harness connector with electronic control unit connected to harness. • Slowly turn the wheel using chassis dynamometer or the like. • Starter switch: ON **<Multi-Use Tester used>** During vehicle run
	Requirements		**<Multi-Use Tester not used>** • Low pulse: 0.5 V or less • High pulse: Approx. 8 V **<Multi-Use Tester used>** Same indication as speedometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0501/Flash code: 12
[Monitor ID]
2
[Fault (outline)]
Failure of vehicle speed sensor
[Diagnosis check]
- Vehicle speed sensor in control as backup for output speed sensor is monitored for fault with vehicle in running condition.

[Code generation condition]
Vehicle speed sensor is judged faulty in either of the following cases.
- Electronic control unit determines vehicle stop after sudden input of deceleration signal from vehicle speed sensor. (Lamp indication: IMD) <A>
- Abnormality established by comparison with turbine speed sensor and output speed sensor and of output gear ratio has continued for 4 seconds. (Lamp indication: 2DC) <B>

[Diagnosis check timing]
- Fault diagnosis is performed once at the minimum during the driving cycle.

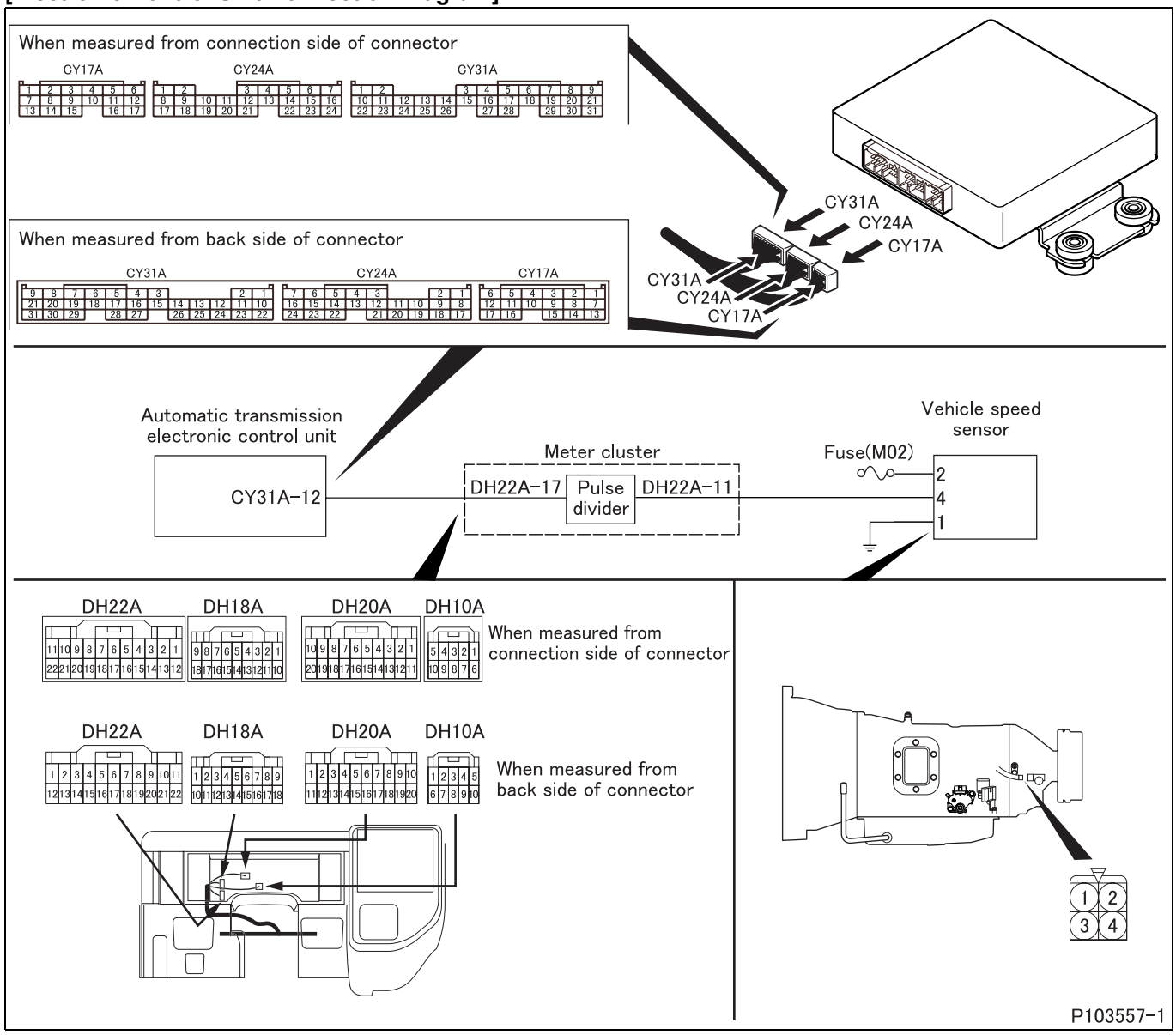
[Diagnostic requirement]
- Vehicle speed sensor related diagnosis code (P0500) does not occur.
- Output speed sensor related diagnosis code (P0721, P0722) does not occur.
- Turbine speed sensor related diagnosis code does not occur.
- Engine speed sensor related diagnosis code does not occur.
- Inhibitor switch related diagnosis code does not occur.
- Control with the fixed speed gear signals outputted under fault conditions is not effected.
- Shift position: other than P or N range
- Control at the time of gear shifting is not effected.

[Control effected by electronic control unit during fault]
- The gear last selected is active on a steady basis. <A>
- Normal control is effected using output speed sensor. <B>

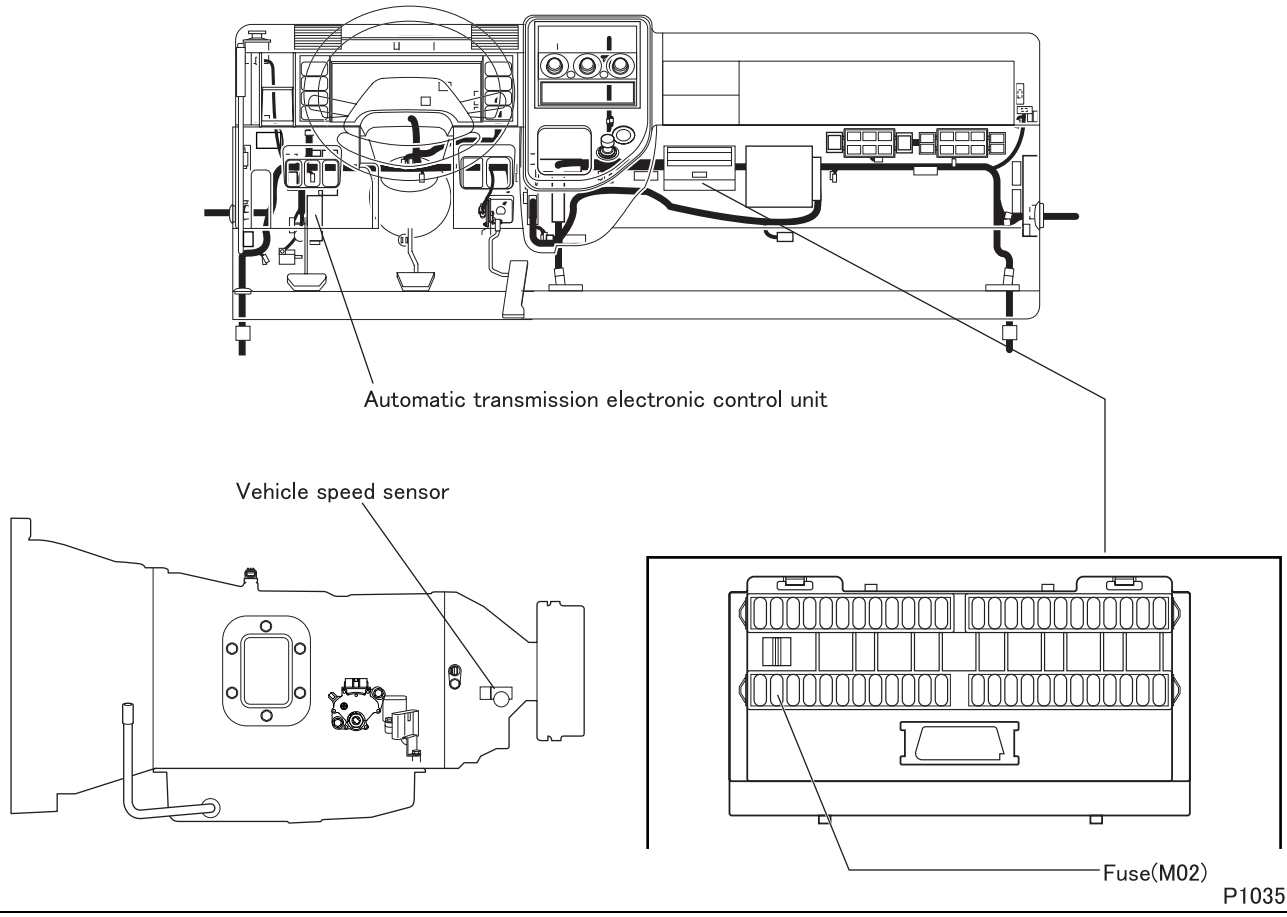
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and pulse divider in meter cluster
- Open-circuit or short-circuit of harness between pulse divider in meter cluster and vehicle speed sensor
- Malfunction of each connector
- Malfunction of pulse divider in meter cluster
- Malfunction of vehicle speed sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 12 “VEH Speed 1” of Service Data.
	Inspection condition		During vehicle run
	Requirements		Same indication as speedometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

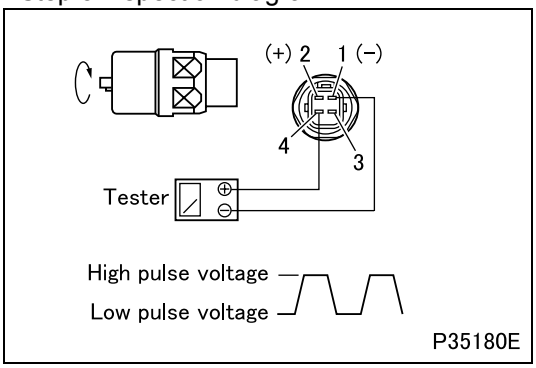
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of voltage between connector (CY31A) terminal No. 12 (+) and (CY24A) terminal No. 8 (–).
	Inspection condition		• Measure from back side of harness connector with electronic control unit connected to harness. • Slowly turn the wheel using chassis dynamometer or the like. • Starter switch: ON
	Requirements		• Low pulse: 0.5 V or less • High pulse: Approx. 8 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify connector.

Step 4	Inspection items		Inspection of harness between electronic control unit and pulse divider
	Maintenance item		Check circuit between meter cluster connector (DH22A) terminal No. 17 and electronic control unit connector (CY31A) terminal No. 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of sensor unit <25 pulse output>
	Maintenance item		Measure maximum value (high pulse voltage) and minimum value (low pulse voltage) of voltage generated between sensor connector terminals No. 4 (+) and No. 1 (–).
	Inspection condition		Slowly turn sensor shaft with battery voltage applied between terminals No. 2 (+) and No. 1 (–).
	Requirements		• Low pulse: 0.5 V or less • High pulse: Approx. 8 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between sensor and fuse (power supply)
	Maintenance item		Check circuit between sensor connector No. 2 and fuse (M02).
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between sensor chassis and ground (ground)
	Maintenance item		Check circuit between sensor connector No. 1 and chassis ground.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between sensor and pulse divider (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 4 and meter cluster connector (DH22A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by pulse divider connector
	Maintenance item		Measure value of voltage between meter cluster connector (DH22A) terminal No. 17 (+) and No. 6 (–).
	Inspection condition		• Measure from back side of connector with harness left connected • Remove sensor and slowly turn sensor shaft. • Starter switch: ON
	Requirements		• Low pulse: 0.5 V or less • High pulse: Approx. 8 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Replacement of meter cluster

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No.12 (+) and (CY24A) terminal No.8 (–). **<Multi-Use Tester used>** Measure item No. 12 “VEH Speed 1” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** • Measure from back side of harness connector with electronic control unit connected to harness. • Slowly turn the wheel using chassis dynamometer or the like. • Starter switch: ON **<Multi-Use Tester used>** During vehicle run
	Requirements		**<Multi-Use Tester not used>** • Low pulse: 0.5 V or less • High pulse: Approx. 8 V **<Multi-Use Tester used>** Same indication as speedometer is given.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0562/Flash code: 11
[Monitor ID]
72
[Fault (outline)]
Open-circuit of starter switch ON power supply
[Diagnosis check]
- Engine speed after starter switch is turned OFF is monitored for open-circuit of starter switch ON power supply.

[Code generation condition]
- Engine speed remains higher than 300 rpm for 12 seconds after starter switch is turned OFF.

[Diagnosis check timing]
- Fault diagnosis is performed once when the electronic control unit is powered off.

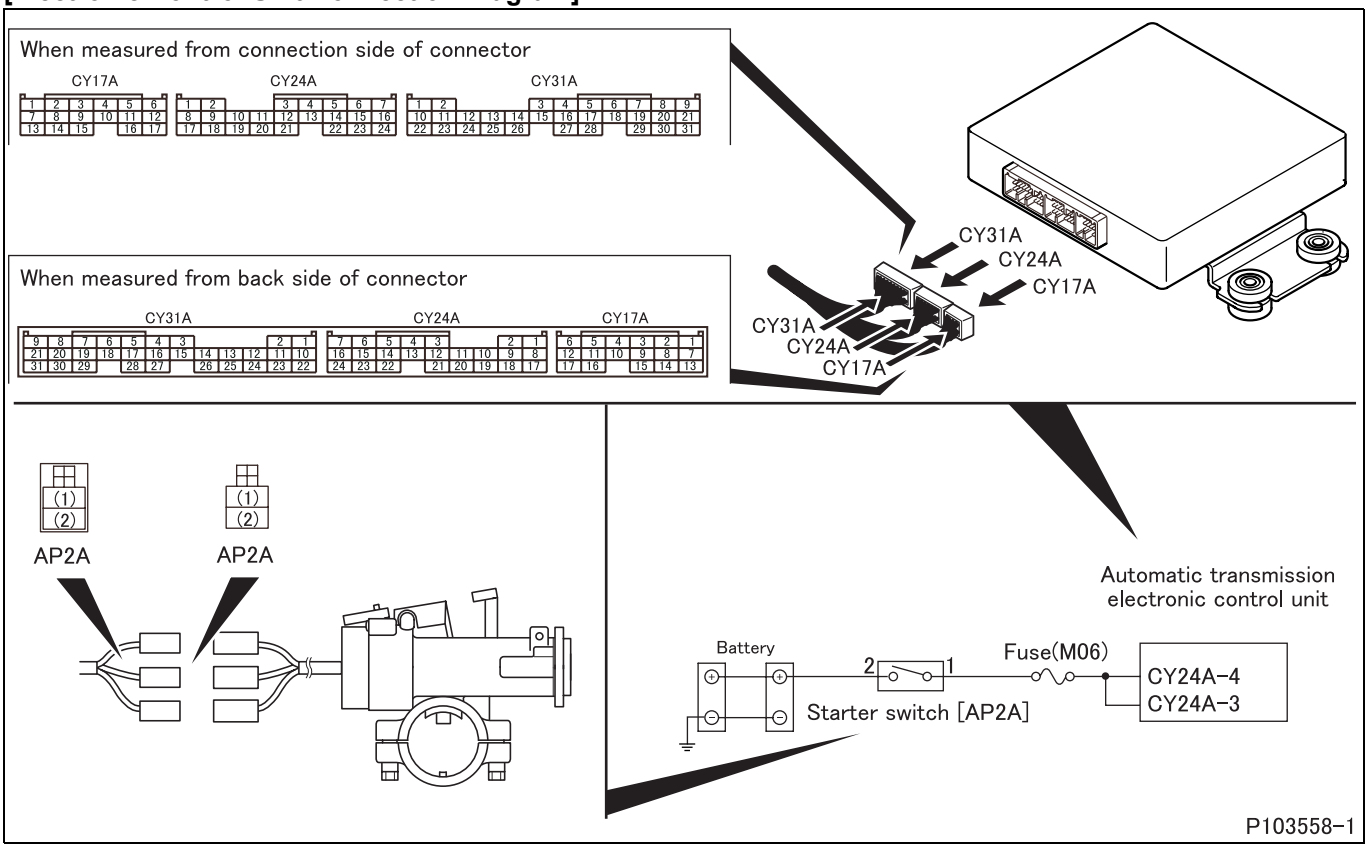
[Diagnostic requirement]
- Starter switch: OFF

[Control effected by electronic control unit during fault]
- All solenoids are turned OFF and control is effected at fixed speed gear output (3rd or 5th) corresponding to vehicle speed.

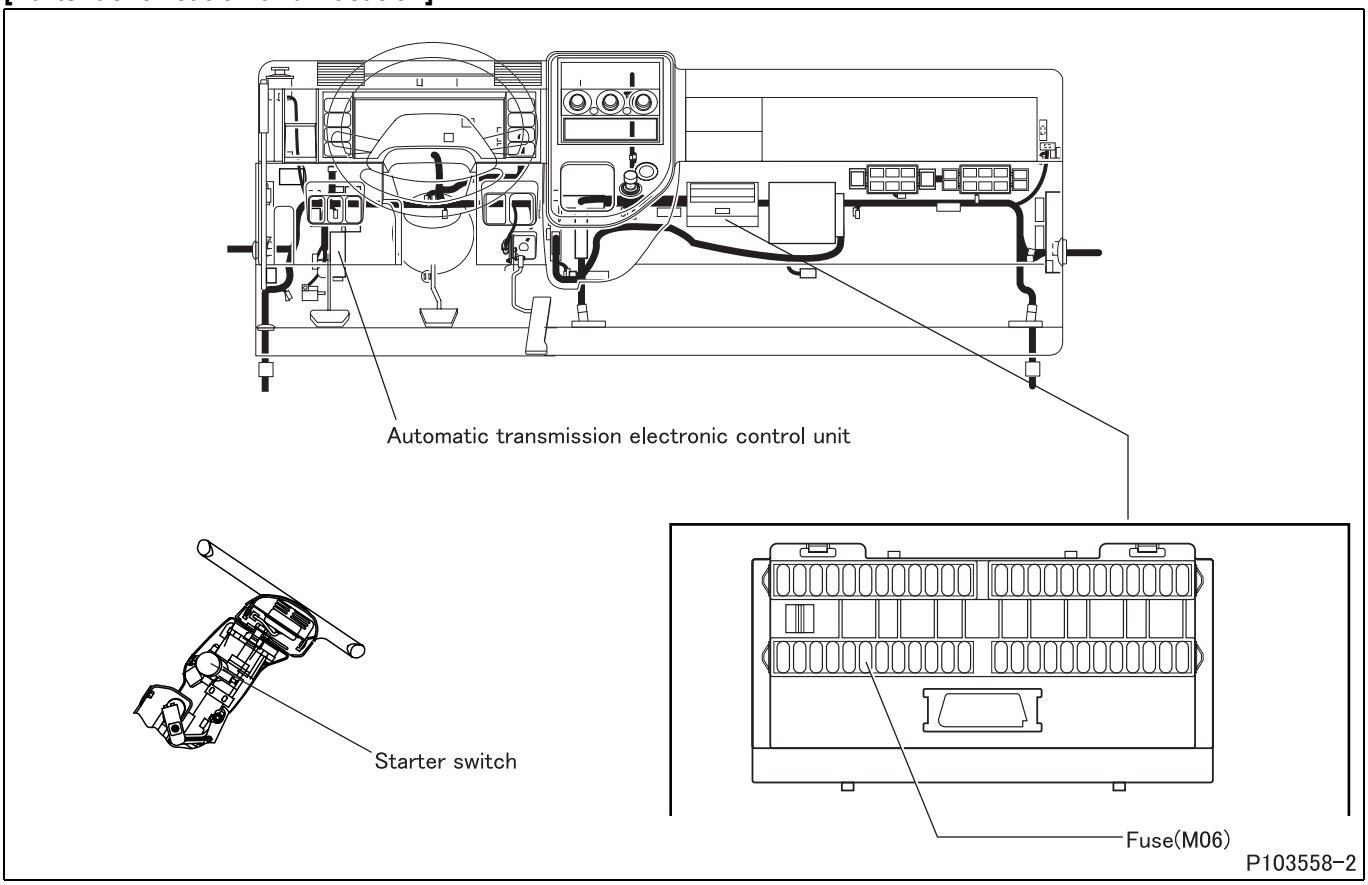
[Probable cause of trouble]
- Open-circuit of harness between electronic control unit and starter switch
- Malfunction of each connector
- Malfunction of starter switch
- Malfunction of electronic control unit

[Recoverability]
- Recovered when the starter switch is turned from OFF to ON.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 11 “IG” of Service Data.
	Inspection condition		Starter switch: ON
	Requirements		12 V (equivalent to battery voltage)
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (CY24A) terminal No. 3, 4 (+) and 8 (–).
	Inspection condition		• Measure from back side of harness connector with harness left connected • Engine stopped
	Requirements		• Starter switch ON: 12 V • Starter switch OFF: 0 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

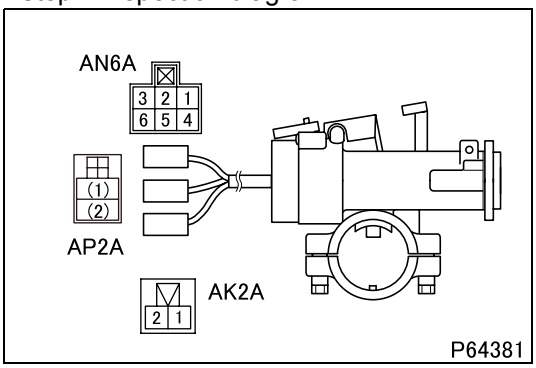
Step 4	Inspection items		Inspection of starter switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection by starter switch connector
	Maintenance item		Measure value of voltage between switch connector (AP2A) terminal No. 1 (+) and chassis ground.
	Inspection condition		• Measure from back side of connector with harness left connected • Starter switch: ON
	Requirements		12 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Go to step 7.

Step 6	Inspection items		Inspection of harness between electronic control unit and starter switch
	Maintenance item		Check circuit between starter switch connector (AP2A) terminal No.1 and electronic control unit connector (CY24A) terminal No. 3, 4
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity (Fuse (M06) not blown).
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 7	Inspection items		Inspection of starter switch unit
	Maintenance item		Measure continuity between switch connector (AP2A) terminals No. 1 and No. 2.
	Inspection condition		Starter switch: ON
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Replacement of switch

<Step 7 inspection diagram>



Step 8	Inspection items		Inspection of harness between battery and electronic control unit (power supply)
	Maintenance item		Check circuit between battery terminal (+) and electronic control unit connector (CY24A) terminal No. 3, 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity (Fuse (M06) not blown).
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection of harness between battery and electronic control unit (ground)
	Maintenance item		Check circuit between battery terminal (–) and electronic control unit connector (CY24A) terminal No. 8, 17.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 10.
		NO	Modify harness.

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY24A) terminal No. 3, 4 (+) and 8 (–). **<Multi-Use Tester used>** Measure item No. 11 “IG” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** • Measure from back side of harness connector with harness left connected • Engine stopped **<Multi-Use Tester used>** Starter switch: ON
	Requirements		**<Multi-Use Tester not used>** • Starter switch ON: 12 V • Starter switch OFF: 0 V **<Multi-Use Tester used>** 12 V (equivalent to battery voltage)
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0604/Flash code: 91
[Monitor ID]
74
[Fault (outline)]
Failure of electronic control unit
[Diagnosis check]
- Write device (RAM) in electronic control unit is monitored for fault.

[Code generation condition]
- RAM in electronic control unit malfunctions.

[Diagnosis check timing]
- Fault diagnosis is performed once when the electronic control unit is powered on.

[Diagnostic requirement]
- Performed once when electronic control unit is powered up.

[Control effected by electronic control unit during fault]
- All solenoids are turned OFF and control is effected at fixed speed gear output (3rd or 5th) corresponding to vehicle speed.

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of electronic control unit)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Fault diagnosis]
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Clear memory, resume power supply to electronic control unit and check for recurrence of the same diagnosis code.
	Maintenance item		–
	Inspection condition		–
	Requirements		No recurrence detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0605/Flash code: 92
[Monitor ID]
75
[Fault (outline)]
Failure of electronic control unit
[Diagnosis check]
- Write device (RAM) in electronic control unit is monitored for fault.

[Code generation condition]
- FlashROM in electronic control unit malfunctions.

[Diagnosis check timing]
- Fault diagnosis is performed once when the electronic control unit is powered on.

[Diagnostic requirement]
- Performed once when electronic control unit is powered up.

[Control effected by electronic control unit during fault]
- All solenoids are turned OFF and control is effected at fixed speed gear output (3rd or 5th) corresponding to vehicle speed.

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of electronic control unit)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Fault diagnosis]
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Clear memory, resume power supply to electronic control unit and check for recurrence of the same diagnosis code.
	Maintenance item		–
	Inspection condition		–
	Requirements		No recurrence detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P062F/Flash code: 93
[Monitor ID]
76
[Fault (outline)]
Failure of electronic control unit
[Diagnosis check]
- Write device (RAM) in electronic control unit is monitored for fault.

[Code generation condition]
- EEPROM in electronic control unit malfunctions.

[Diagnosis check timing]
- Fault diagnosis is performed once when the electronic control unit is powered on.

[Diagnostic requirement]
- Performed once when electronic control unit is powered up.

[Control effected by electronic control unit during fault]
- Effects no special control.

[Probable cause of trouble]
- Malfunction of electronic control unit (replacement of electronic control unit)

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Fault diagnosis]
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Clear memory, resume power supply to electronic control unit and check for recurrence of the same diagnosis code.
	Maintenance item		–
	Inspection condition		–
	Requirements		No recurrence detected
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0702/Flash code: 11
[Monitor ID]
73
[Fault (outline)]
Open-circuit of battery power supply
[Diagnosis check]
- When starter switch is turned OFF to ON, electronic control unit determines whether there was abnormality in power supply at last engine start by means of its internal write device (EEPROM).

[Code generation condition]
- Presence of abnormality at last engine start has been written in EEPROM.

[Diagnosis check timing]
- Fault diagnosis is performed once when the electronic control unit is powered on.

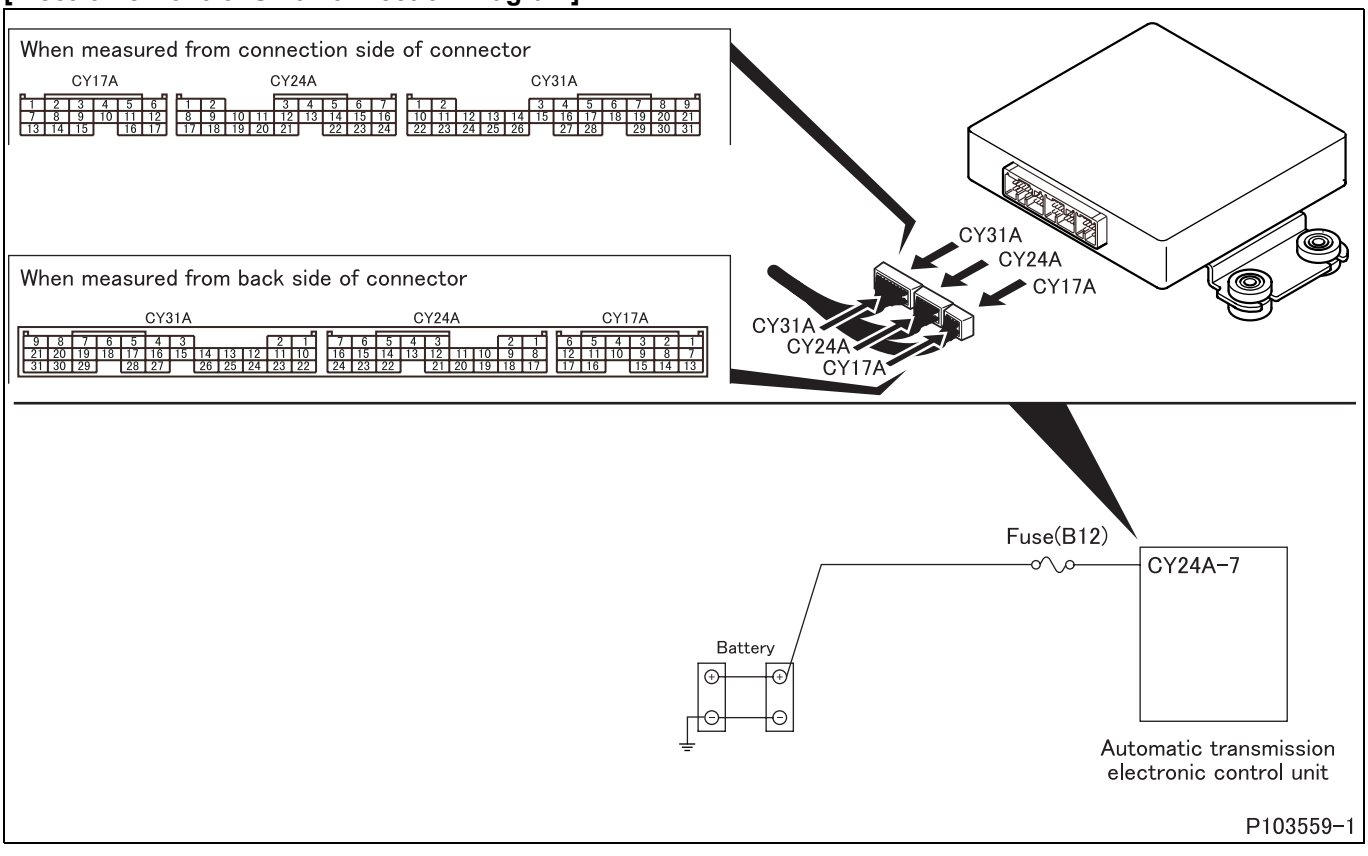
[Diagnostic requirement]
- Performed once when electronic control unit is powered up.

[Control effected by electronic control unit during fault]
- No control is effected in particular.

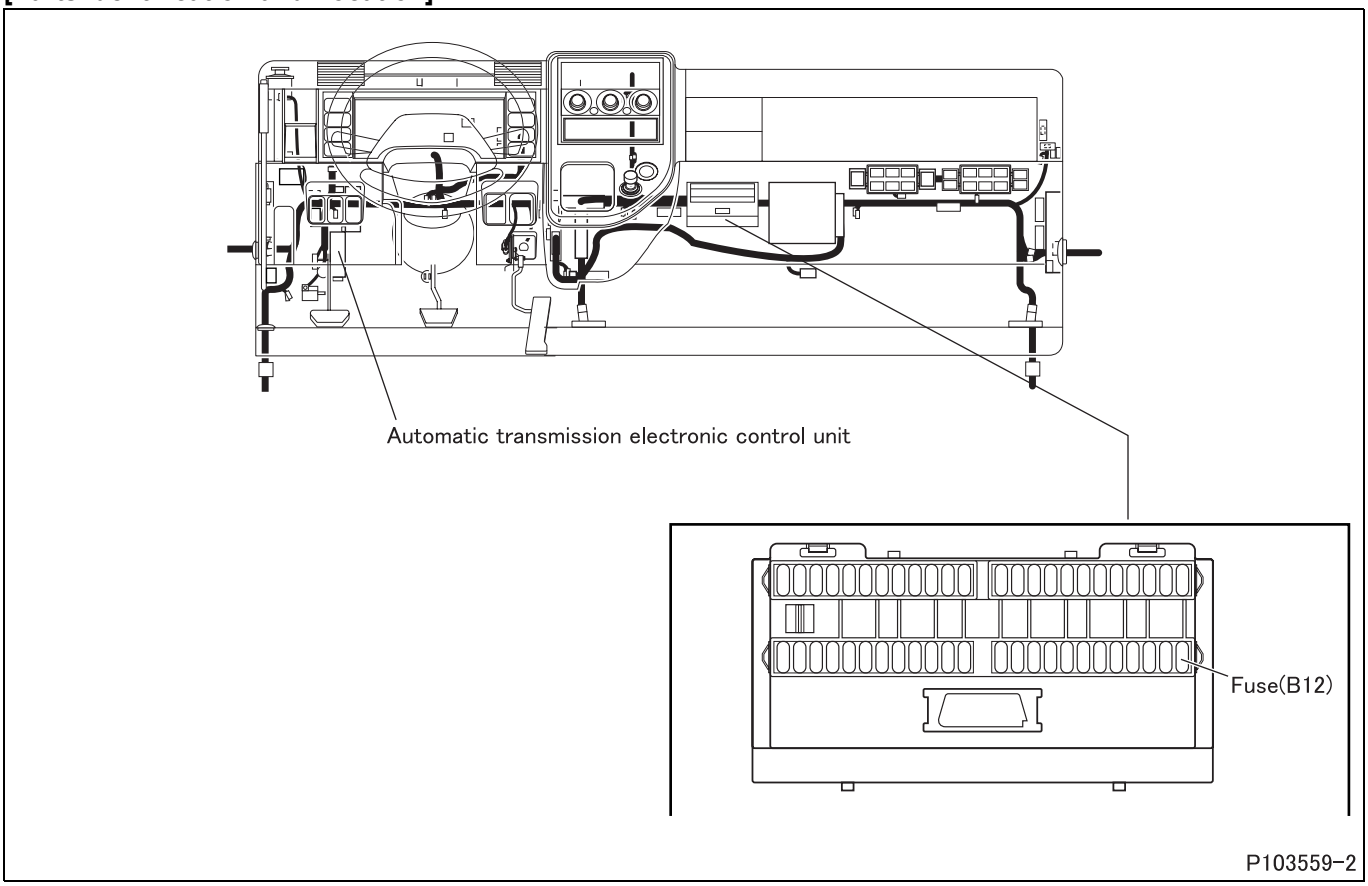
[Probable cause of trouble]
- Open-circuit of battery harness
- Malfunction of each connector
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

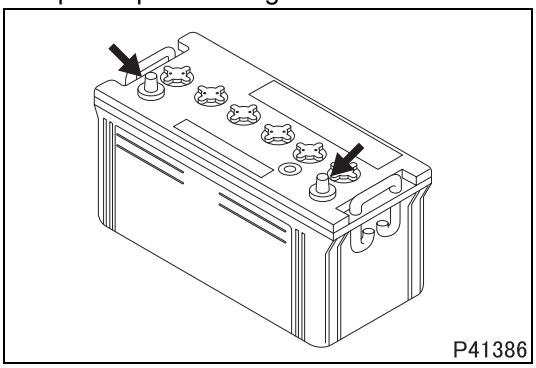
Step 1	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (CY24A) terminal No. 7 (+) and 8 (–).
	Inspection condition		• Measure from back side of harness connector with harness left connected • Engine stopped
	Requirements		12 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 2.
		NO	Go to step 3.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 3	Inspection items		Inspection of battery terminal
	Maintenance item		Inspection of battery terminal
	Inspection condition		–
	Requirements		• Connector is properly connected. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify terminal.

Step 4	Inspection items		Inspection of battery
	Maintenance item		Measure battery terminal voltage.
	Inspection condition		Engine stopped
	Requirements		Approx. 12 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify battery.

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between battery and electronic control unit (power supply)
	Maintenance item		Check circuit between battery terminal (+) and electronic control unit connector (CY24A) terminal No. 7.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity (Fuse (B12) not blown).
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between battery and electronic control unit (ground)
	Maintenance item		Check circuit between battery terminal (–) and electronic control unit connector (CY24A) terminal No. 8, 17.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by electronic control unit connector (power supply)
	Maintenance item		Measure value of voltage between connector (CY24A) terminal No. 7 (+) and 8 (–).
	Inspection condition		• Measure from back side of harness connector with harness left connected • Engine stopped
	Requirements		12 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0706/Flash code: 49
[Monitor ID]
49, 50
[Fault (outline)]
Failure of oil pressure switch 8
[Diagnosis check]
- ON/OFF status of oil pressure switch 8 at range shifts is monitored.

[Code generation condition]
- Oil pressure switch 8 remains OFF for 7 seconds for 3 times in 1 TRIP when range is shifted to D, 3 or 2. (Open-circuit) <A>
- Oil pressure switch 8 remains ON for 0.5 second when range is shifted to P, R or N. (Short-circuit) <B>

[Diagnosis check timing]
- Fault diagnosis is performed once at the minimum during the driving cycle.

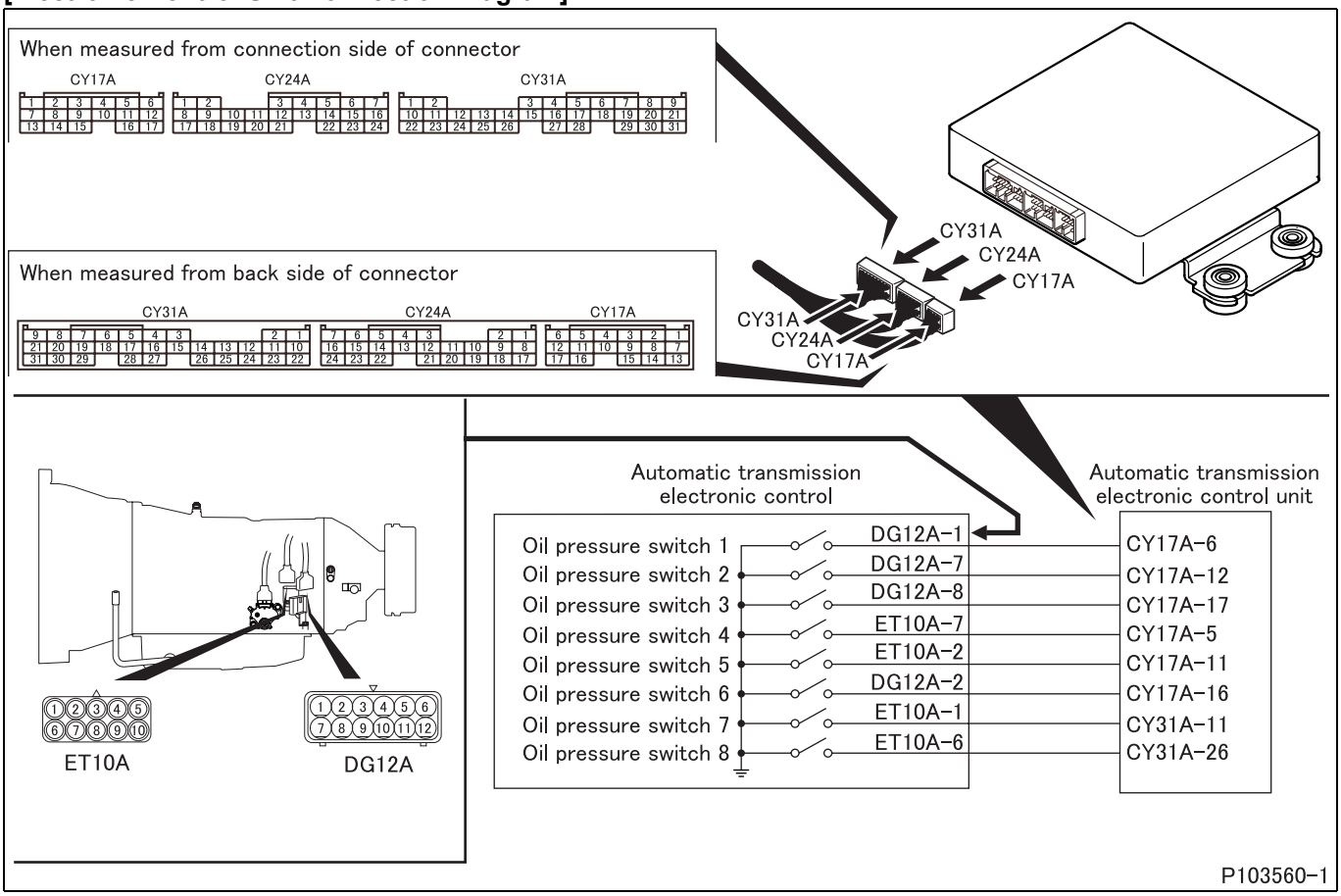
[Diagnostic requirement]
- Starter switch: ON <A>
- Engine revolution: above 550 rpm (not less than 0.1 sec.) <A>
- Continuous <B>

[Control effected by electronic control unit during fault]
- Control is effected on fixed speed gear output (3rd).

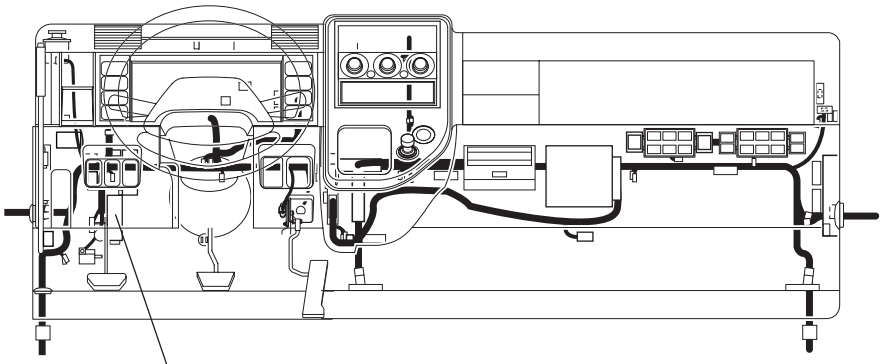
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 8
- Malfunction of each connector
- Malfunction of oil pressure switch 8
- Malfunction of electronic control unit

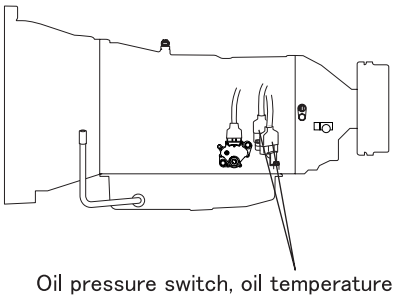
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY31A) terminal No. 26 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 68 “Oil Press SW8” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • D range: 0 V • P, R, N range: 12 V **<Multi-Use Tester used>** • D range: ON • P, R, N range: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

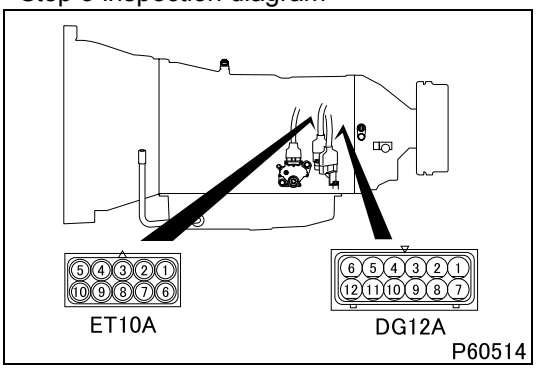
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY31A) terminal No. 26 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (ET10A) terminal No. 6 and automatic transmission case.
	Inspection condition		• Disconnect connector and measure switch side. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 6 and electronic control unit connector (CY31A) terminal No. 26
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY31A) terminal No. 26 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 68 “Oil Press SW8” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • D range: 0 V • P, R, N range: 12 V **<Multi-Use Tester used>** • D range: ON • P, R, N range: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0707/Flash code: 43
[Monitor ID]
19
[Fault (outline)]
Failure of inhibitor switch
[Diagnosis check]
- Inhibitor switch output is monitored under conditions below for open-circuit.
- Condition (1): Oil pressure switch 8 in OFF position.
- Condition (2): When range shifted

[Code generation condition]
- With oil pressure switch 8 in OFF position, all P, R and N output signals are not input from inhibitor switch for 2 consecutive seconds. <A>
- All P, R and N output signals are not input from inhibitor switch for 30 consecutive seconds. <B>
- Either R or N output signal is not input from inhibitor switch. <C>

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

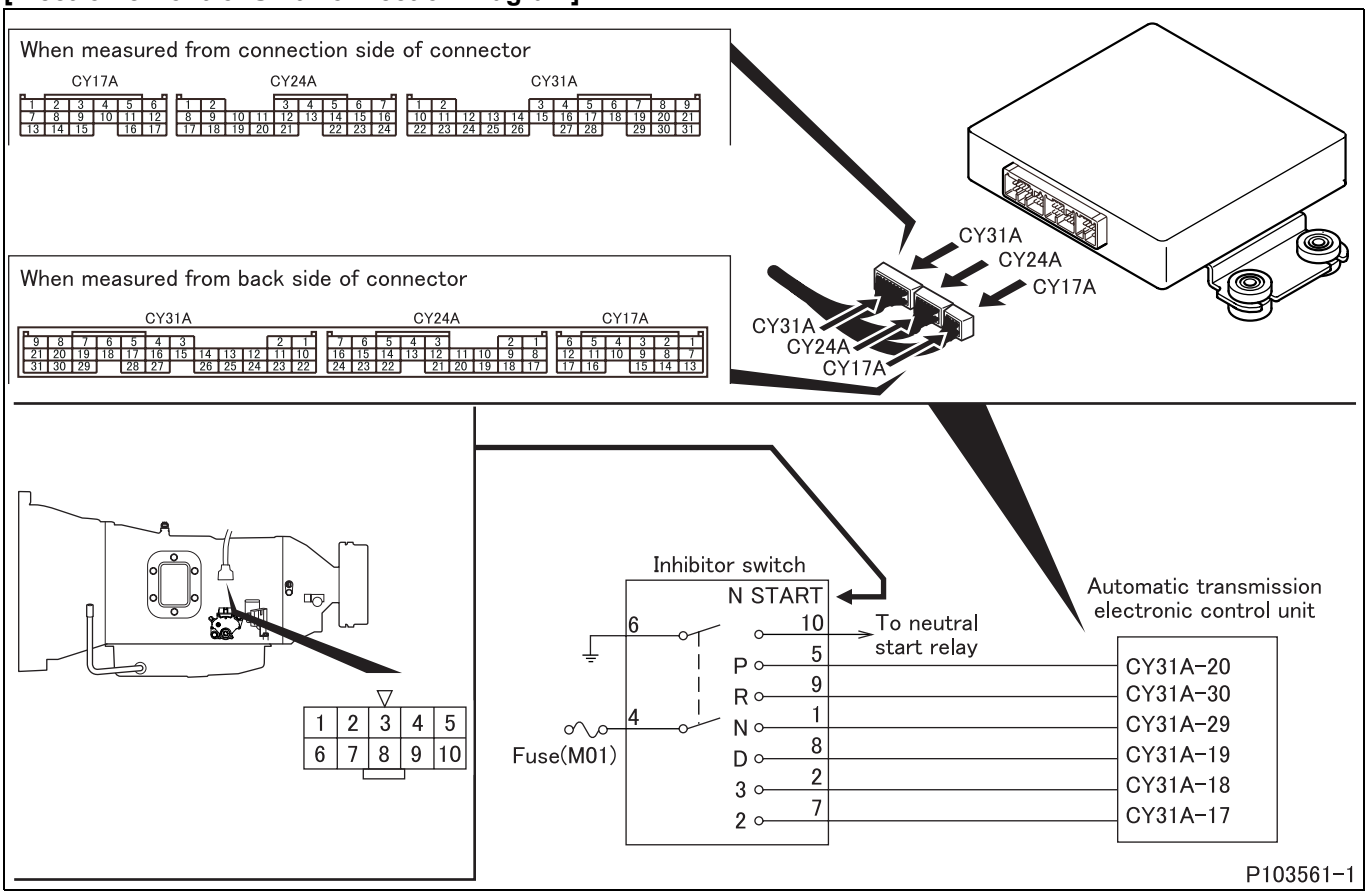
[Diagnostic requirement]
- Starter switch: ON

[Control effected by electronic control unit during fault]
- Control is effected on fixed speed gear output (3rd). <A, C>
- No control is effected in particular. <B>

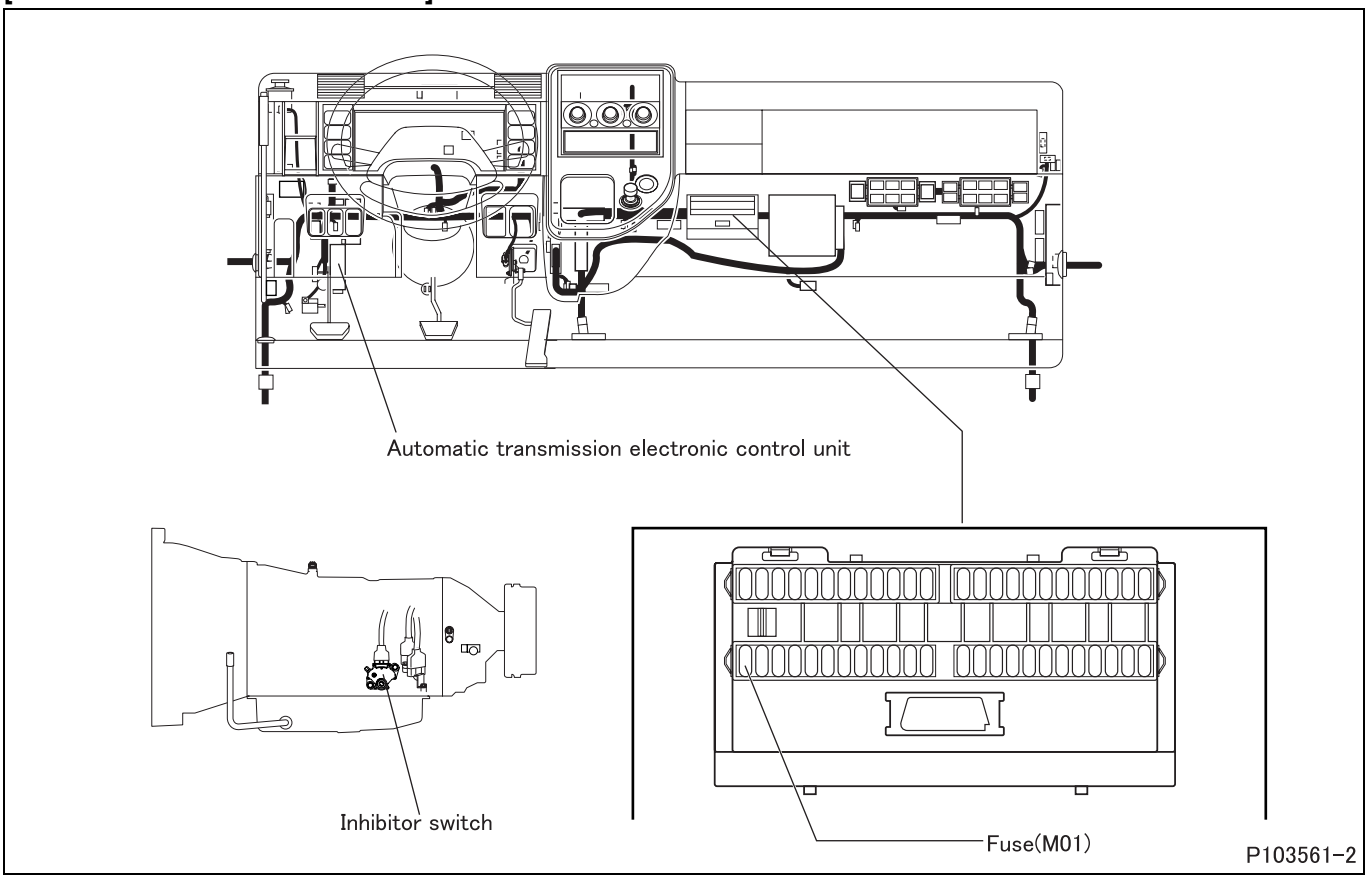
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and inhibitor switch
- Malfunction of each connector
- Malfunction of inhibitor switch
- Maladjustment of selector cable
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit). <A>
- Recovered if signal becomes normal with starter switch in ON position. <B, C>

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 19 “P Pos.SW”, No. 20 “R Pos.SW”, No. 21 “N Pos.SW”, No. 22 “D Pos.SW”, No. 24 “3 Pos.SW”, No. 55 “Selector Pos.”, No. 78 “2 Pos.SW” of Service Data.
	Inspection condition		–
	Requirements		Synchronous with shift of range selector lever position.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

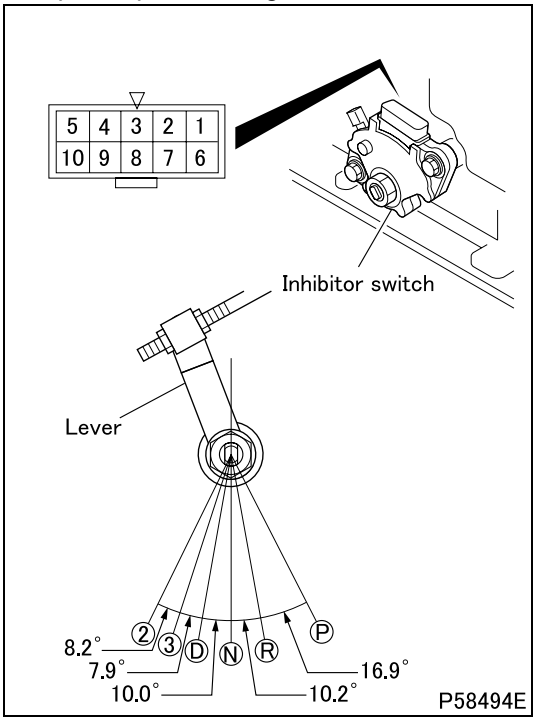
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		<Range selector in P position> Measure value of voltage between connector (CY31A) terminal No. 20 (+) and (CY24A) terminal No. 8 (–). <Range selector in R position> Measure value of voltage between connector (CY31A) terminal No. 30 (+) and (CY24A) terminal No. 8 (–). <Range selector in N position> Measure value of voltage between connector (CY31A) terminal No. 29 (+) and (CY24A) terminal No. 8 (–). <Range selector in D position> Measure value of voltage between connector (CY31A) terminal No. 19 (+) and (CY24A) terminal No. 8 (–). <Range selector in 3rd position> Measure value of voltage between connector (CY31A) terminal No. 18 (+) and (CY24A) terminal No. 8 (–). <Range selector in 2nd position> Measure value of voltage between connector (CY31A) terminal No. 17 (+) and (CY24A) terminal No. 8 (–).
	Inspection condition		• Measure from back side of harness connector with harness left connected • Starter switch: ON • Check with range selector in each position.
	Requirements		12 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 4	Inspection items		Inspection of inhibitor switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of inhibitor switch unit
	Maintenance item		**<P>** • Measure continuity between terminals No. 4 and No. 5 and between terminals No. 6 and No. 10. **<R>** • Measure continuity between terminals No. 4 and No. 9. **<N>** • Measure continuity between terminals No. 1 and No. 4 and between terminals No. 6 and No. 10. **<D>** • Measure continuity between terminals No. 4 and No. 8. **<3>** • Measure continuity between terminals No. 2 and No. 4. **<2>** • Measure continuity between terminals No. 4 and No. 7.
	Inspection condition		• Keep switch installed on vehicle. • Shift range selector lever from one range position to another and measure continuity each time. • Starter switch: ON
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of switch

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between inhibitor switch and electronic control unit (signal)
	Maintenance item		**<P>** • Check circuit between switch connector terminal No. 5 and electronic control unit connector (CY31A) terminal No. 20 **<R>** • Check circuit between switch connector terminal No. 9 and electronic control unit connector (CY31A) terminal No. 30 **<N>** • Check circuit between switch connector terminal No. 1 and electronic control unit connector (CY31A) terminal No. 29 **<D>** • Check circuit between switch connector terminal No. 8 and electronic control unit connector (CY31A) terminal No. 19 **<3>** • Check circuit between switch connector terminal No. 2 and electronic control unit connector (CY31A) terminal No. 18 **<2>** • Check circuit between switch connector terminal No. 7 and electronic control unit connector (CY31A) terminal No. 17
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between inhibitor switch and fuse (power supply)
	Maintenance item		Check circuit between switch connector terminal No. 4 and fuse (M01)
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** <Range selector in P position> Measure value of voltage between connector (CY31A) terminal No. 20 (+) and (CY24A) terminal No. 8 (–). <Range selector in R position> Measure value of voltage between connector (CY31A) terminal No. 30 (+) and (CY24A) terminal No. 8 (–). <Range selector in N position> Measure value of voltage between connector (CY31A) terminal No. 29 (+) and (CY24A) terminal No. 8 (–). <Range selector in D position> Measure value of voltage between connector (CY31A) terminal No. 19 (+) and (CY24A) terminal No. 8 (–). <Range selector in 3rd position> Measure value of voltage between connector (CY31A) terminal No. 18 (+) and (CY24A) terminal No. 8 (–). <Range selector in 2nd position> Measure value of voltage between connector (CY31A) terminal No. 17 (+) and (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 19 “P Pos.SW”, No. 20 “R Pos.SW”, No. 21 “N Pos.SW”, No. 22 “D Pos.SW”, No. 24 “3 Pos.SW”, No. 55 “Selector Pos.”, No. 78 “2 Pos.SW” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** • Measure from back side of harness connector with harness left connected • Starter switch: ON • Check with range selector in each position.
	Requirements		**<Multi-Use Tester not used>** 12 V **<Multi-Use Tester used>** Synchronous with shift of range selector lever position.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Check selector cables for incorrectly adjusted condition and adjust the cable if it is defective. If the fault is still not removed, replace the electronic control unit.

[Fault code]
Diagnosis code: P0708/Flash code: 43
[Monitor ID]
20
[Fault (outline)]
Failure of inhibitor switch
[Diagnosis check]
- Inhibitor switch output signal is monitored.

[Code generation condition]
- Two or more of inhibitor switch output signals P, R, N, D, 3 and 2 are continuously input for 0.5 second.

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

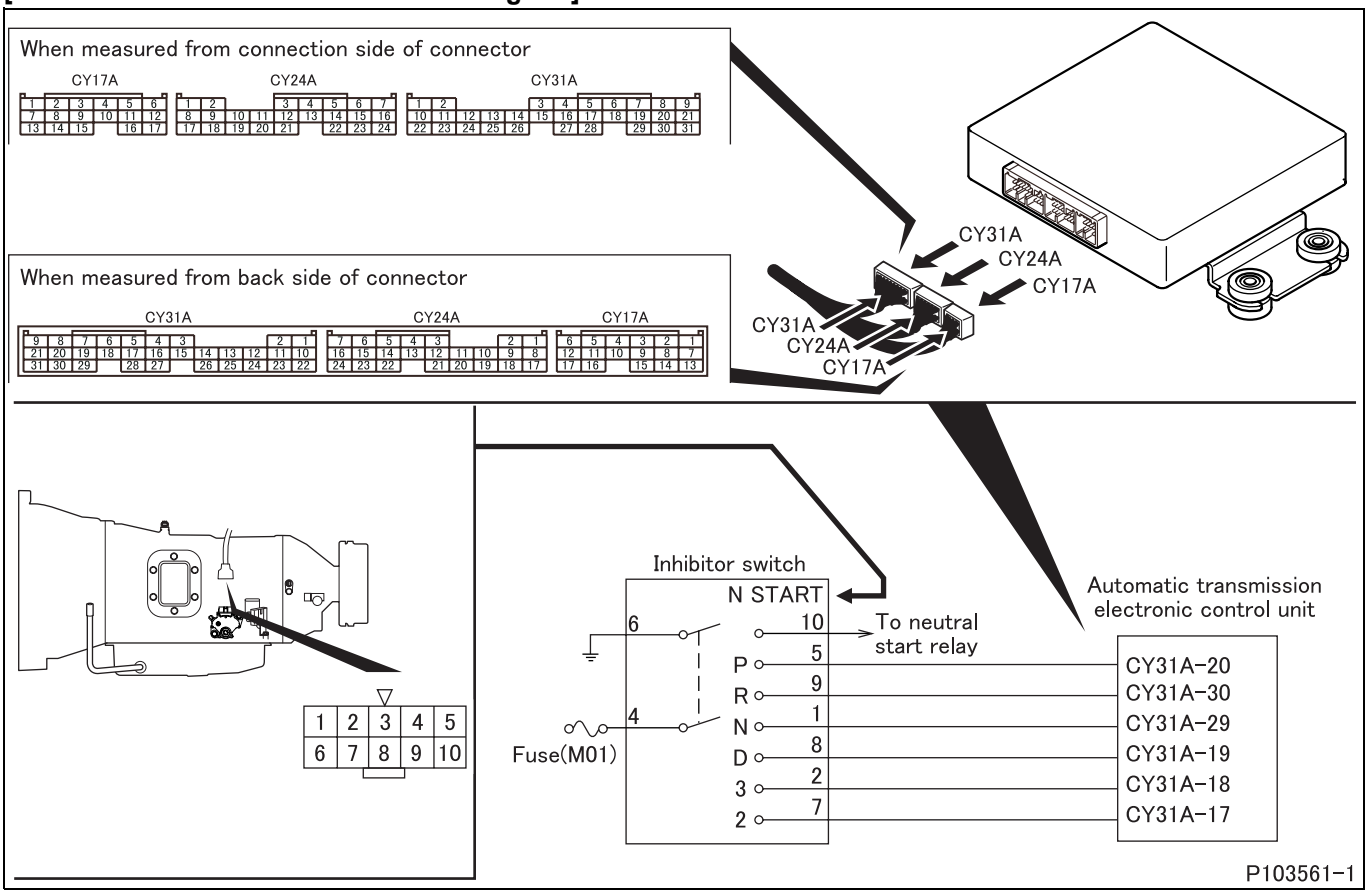
[Diagnostic requirement]
- Starter switch: ON

[Control effected by electronic control unit during fault]
- Control is effected on fixed speed gear output (3rd).

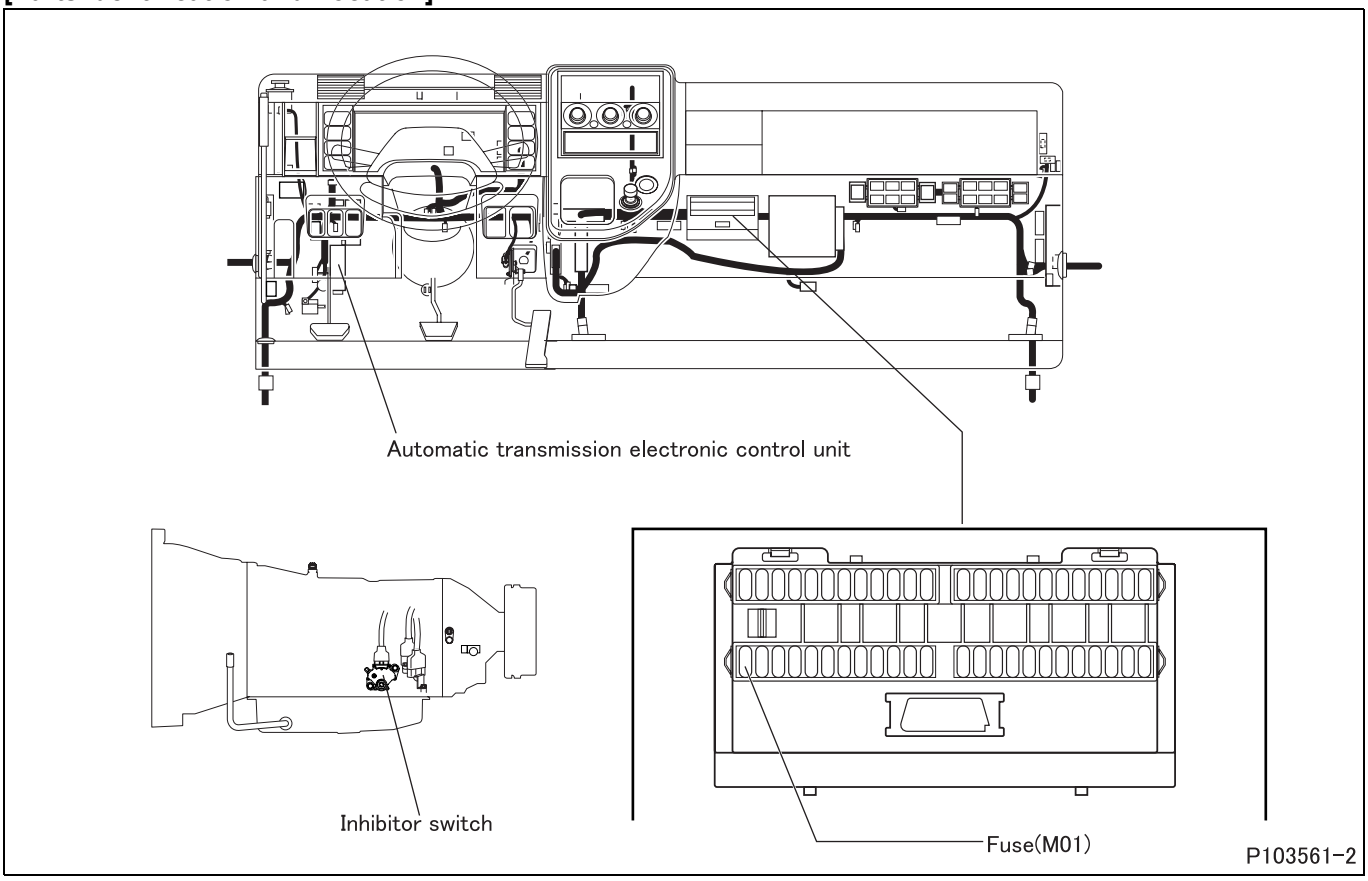
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and inhibitor switch
- Malfunction of each connector
- Malfunction of inhibitor switch
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 19 “P Pos.SW”, No. 20 “R Pos.SW”, No. 21 “N Pos.SW”, No. 22 “D Pos.SW”, No. 24 “3 Pos.SW”, No. 55 “Selector Pos.”, No. 78 “2 Pos.SW” of Service Data.
	Inspection condition		–
	Requirements		Synchronous with shift of range selector lever position.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

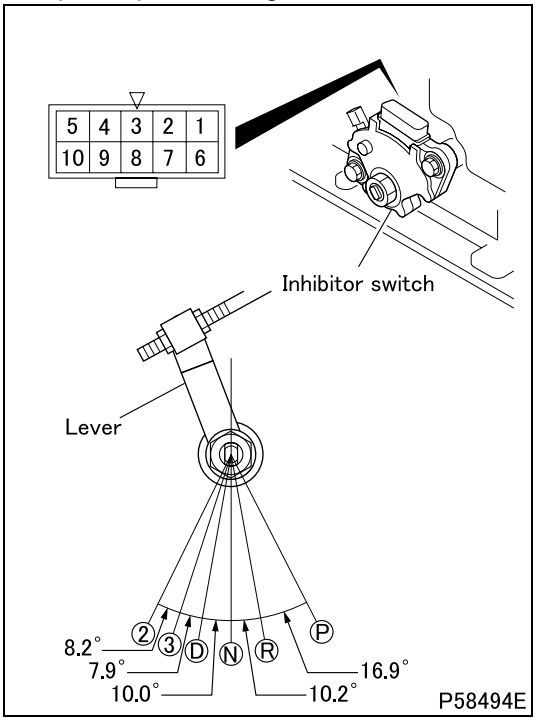
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		<Range selector in P position> Measure value of voltage between connector (CY31A) terminal No. 20 (+) and (CY24A) terminal No. 8 (–). <Range selector in R position> Measure value of voltage between connector (CY31A) terminal No. 30 (+) and (CY24A) terminal No. 8 (–). <Range selector in N position> Measure value of voltage between connector (CY31A) terminal No. 29 (+) and (CY24A) terminal No. 8 (–). <Range selector in D position> Measure value of voltage between connector (CY31A) terminal No. 19 (+) and (CY24A) terminal No. 8 (–). <Range selector in 3rd position> Measure value of voltage between connector (CY31A) terminal No. 18 (+) and (CY24A) terminal No. 8 (–). <Range selector in 2nd position> Measure value of voltage between connector (CY31A) terminal No. 17 (+) and (CY24A) terminal No. 8 (–).
	Inspection condition		• Measure from back side of harness connector with harness left connected • Starter switch: ON • Check with range selector in each position.
	Requirements		12 V
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 4	Inspection items		Inspection of inhibitor switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of inhibitor switch unit
	Maintenance item		**<P>** • Measure continuity between terminals No. 4 and No. 5 and between terminals No. 6 and No. 10. **<R>** • Measure continuity between terminals No. 4 and No. 9. **<N>** • Measure continuity between terminals No. 1 and No. 4 and between terminals No. 6 and No. 10. **<D>** • Measure continuity between terminals No. 4 and No. 8. **<3>** • Measure continuity between terminals No. 2 and No. 4. **<2>** • Measure continuity between terminals No. 4 and No. 7.
	Inspection condition		• Keep switch installed on vehicle. • Shift range selector lever from one range position to another and measure continuity each time. • Starter switch: ON
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of switch

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between inhibitor switch and electronic control unit (signal)
	Maintenance item		**<P>** • Check circuit between switch connector terminal No. 5 and electronic control unit connector (CY31A) terminal No. 20 **<R>** • Check circuit between switch connector terminal No. 9 and electronic control unit connector (CY31A) terminal No. 30 **<N>** • Check circuit between switch connector terminal No. 1 and electronic control unit connector (CY31A) terminal No. 29 **<D>** • Check circuit between switch connector terminal No. 8 and electronic control unit connector (CY31A) terminal No. 19 **<3>** • Check circuit between switch connector terminal No. 2 and electronic control unit connector (CY31A) terminal No. 18 **<2>** • Check circuit between switch connector terminal No. 7 and electronic control unit connector (CY31A) terminal No. 17
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between inhibitor switch and fuse (power supply)
	Maintenance item		Check circuit between switch connector terminal No. 4 and fuse (M01)
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** <Range selector in P position> Measure value of voltage between connector (CY31A) terminal No. 20 (+) and (CY24A) terminal No. 8 (–). <Range selector in R position> Measure value of voltage between connector (CY31A) terminal No. 30 (+) and (CY24A) terminal No. 8 (–). <Range selector in N position> Measure value of voltage between connector (CY31A) terminal No. 29 (+) and (CY24A) terminal No. 8 (–). <Range selector in D position> Measure value of voltage between connector (CY31A) terminal No. 19 (+) and (CY24A) terminal No. 8 (–). <Range selector in 3rd position> Measure value of voltage between connector (CY31A) terminal No. 18 (+) and (CY24A) terminal No. 8 (–). <Range selector in 2nd position> Measure value of voltage between connector (CY31A) terminal No. 17 (+) and (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 19 “P Pos.SW”, No. 20 “R Pos.SW”, No. 21 “N Pos.SW”, No. 22 “D Pos.SW”, No. 24 “3 Pos.SW”, No. 55 “Selector Pos.”, No. 78 “2 Pos.SW” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** • Measure from back side of harness connector with harness left connected • Starter switch: ON • Check with range selector in each position.
	Requirements		**<Multi-Use Tester not used>** 12 V **<Multi-Use Tester used>** Synchronous with shift of range selector lever position.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0711/Flash code: 13
[Monitor ID]
13, 14
[Fault (outline)]
Failure of oil temperature sensor (inside)
[Diagnosis check]
- Automatic transmission fluid temperature immediately after starter switch is turned ON is monitored. <A>
- Automatic transmission fluid temperature during engine warm-up is monitored. <B>

[Code generation condition]
- Detected temperature of oil temperature sensor (inside) is less than –10°C {14°F} even after specified time of vehicle run. <A>
- Detected temperature of oil temperature sensor (inside) does not change by any more than 2°C {36°F}. <B>

[Diagnosis check timing]
- Fault diagnosis is performed once at the minimum during the driving cycle.

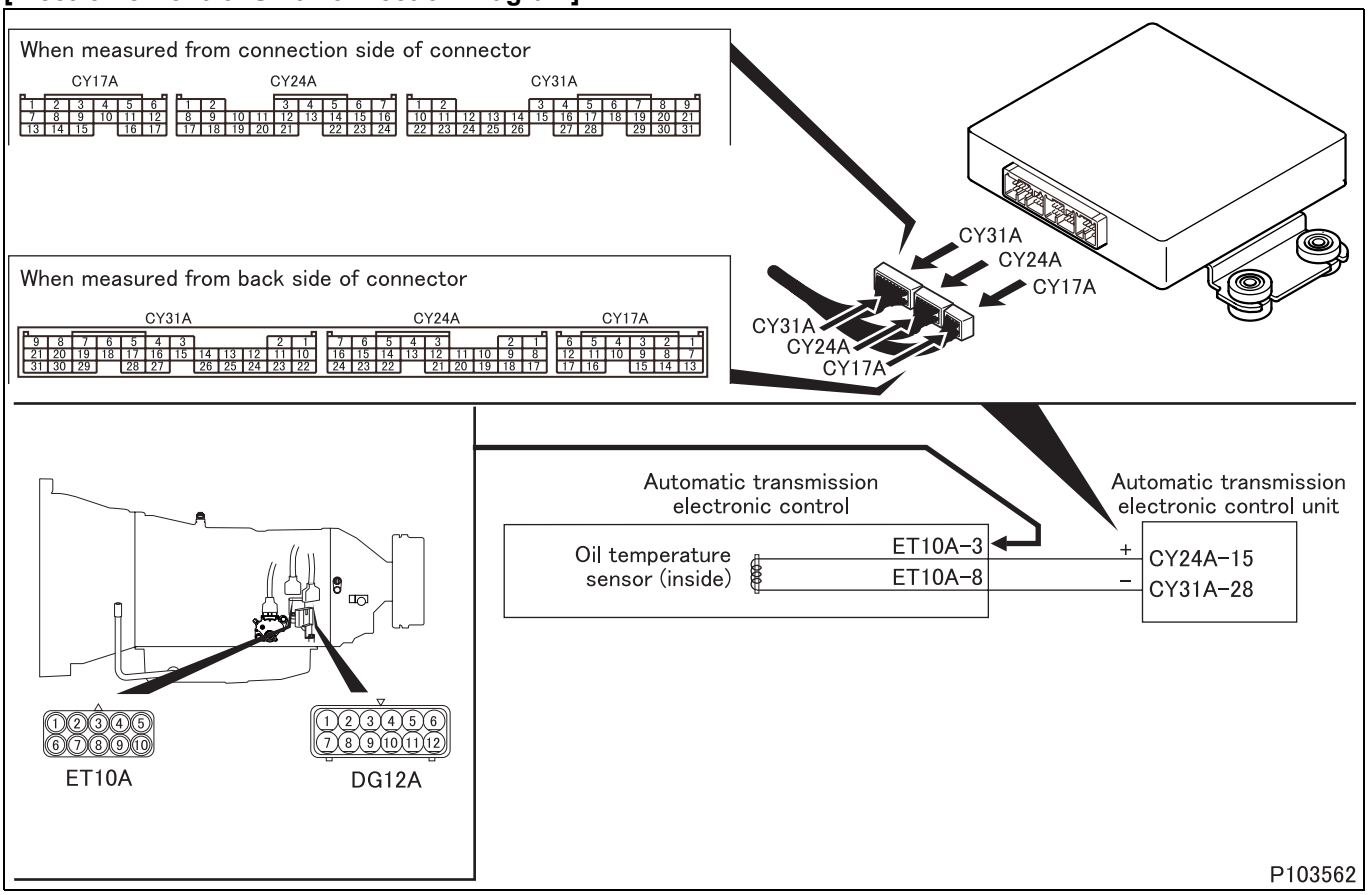
[Diagnostic requirement]
- Automatic transmission fluid temperature 1 sec. after the starter switch is turned from ON position: –50°C {–56°F} to –10°C {14°F} <A>
- Engine coolant temperature 1 sec. after the starter switch is turned from ON position: 70°C {160°F} or more <B>
- Temperature change in the engine coolant after the starter switch is turned to ON position: above 50°C {120°F} <B>
- Automatic transmission fluid temperature 1 sec. after the starter switch is turned from ON position: –50°C {–56°F} to 40°C {105°F} <B>
- Starter switch ON battery voltage: 10 V to 16 V
- Controller area network: Normal
- Elapsed time when the engine speed calculated from the output speed sensor signals exceeds 300 rpm: above 410 sec.

[Control effected by electronic control unit during fault]
- Control is effected on basis of low oil temperature (–30°C {–24°F}) immediately after starter switch is turned ON and normal oil temperature (80°C {175°F}) 5 minutes later.
- Braking force control is inhibited.

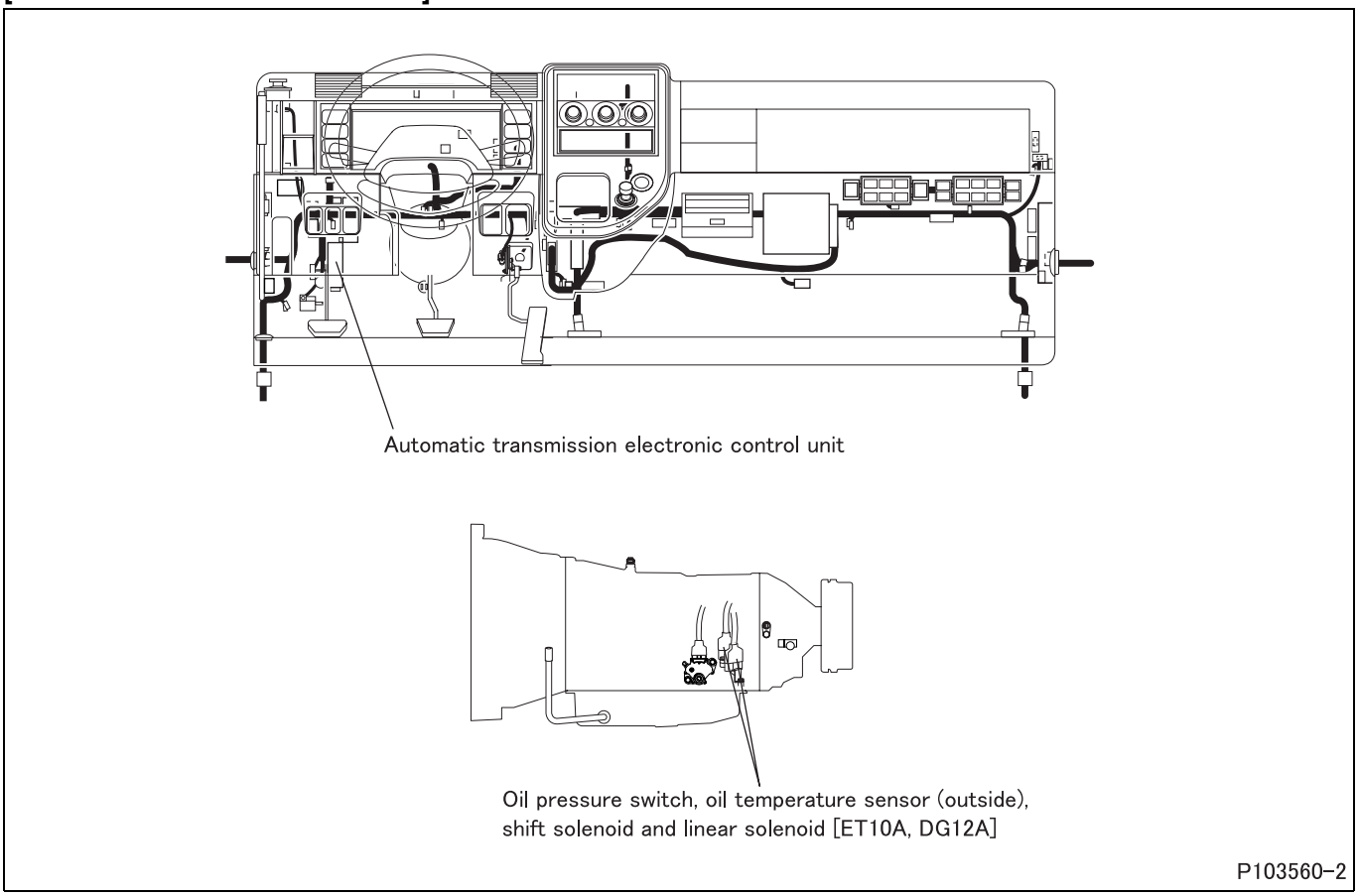
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil temperature sensor (inside)
- Malfunction of each connector
- Malfunction of oil temperature sensor (inside)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between electronic control unit connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 13 “A/T Oil Temp (OP)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

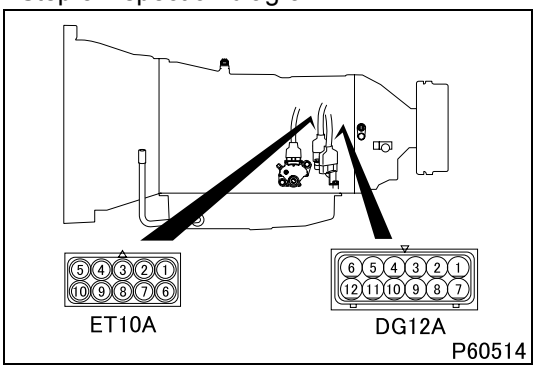
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		• –30°C {–22°F}: 44 ± 6.6 kΩ • 10°C {50°F}: 6445 ± 645 Ω • 110°C {230°F}: 247 ± 16 Ω • 145°C {295°F}: 111 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of resistance between connector (ET10A) terminal No. 3 and 8.
	Inspection condition		–
	Requirements		• –30°C {–22°F}: 44 ± 6.6 kΩ • 10°C {50°F}: 6445 ± 645 Ω • 110°C {230°F}: 247 ± 16 Ω • 145°C {295°F}: 111 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 3 and electronic control unit connector (CY24A) terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 8 and electronic control unit connector (CY31A) terminal No. 28.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between electronic control unit connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 13 “A/T Oil Temp (OP)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0712/Flash code: 13
[Monitor ID]
11
[Fault (outline)]
Failure of oil temperature sensor (inside)
[Diagnosis check]
- Automatic transmission fluid temperature is monitored by oil temperature sensor (inside).

[Code generation condition]
- Oil temperature sensor (inside) output temperature remains excessively high (over 180°C {355°F}) for 0.5 second.

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

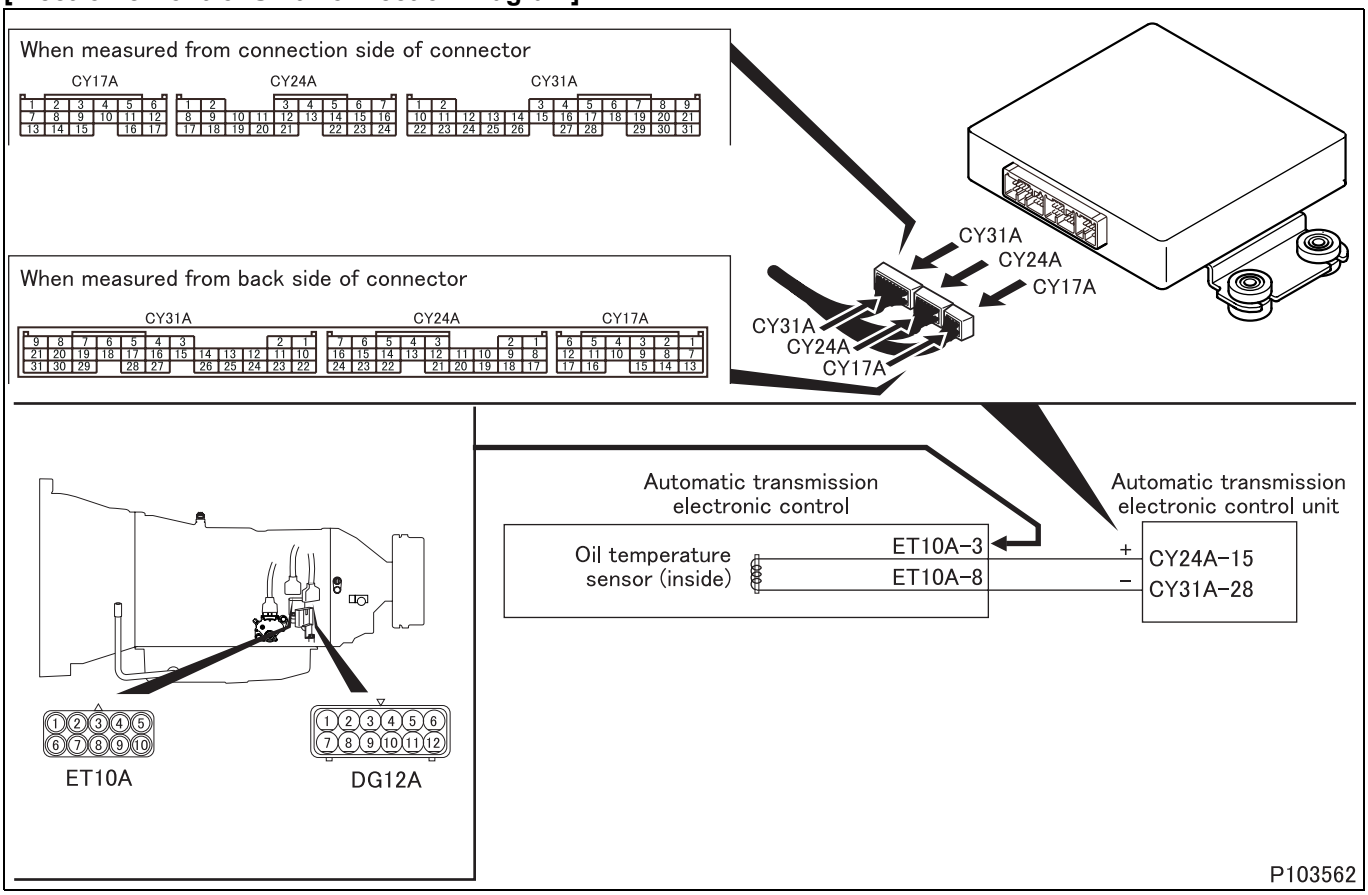
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Control is effected on basis of low oil temperature (–30°C {–24°F}) immediately after starter switch is turned ON and normal oil temperature (80°C {175°F}) 5 minutes later.
- Braking force control is inhibited.

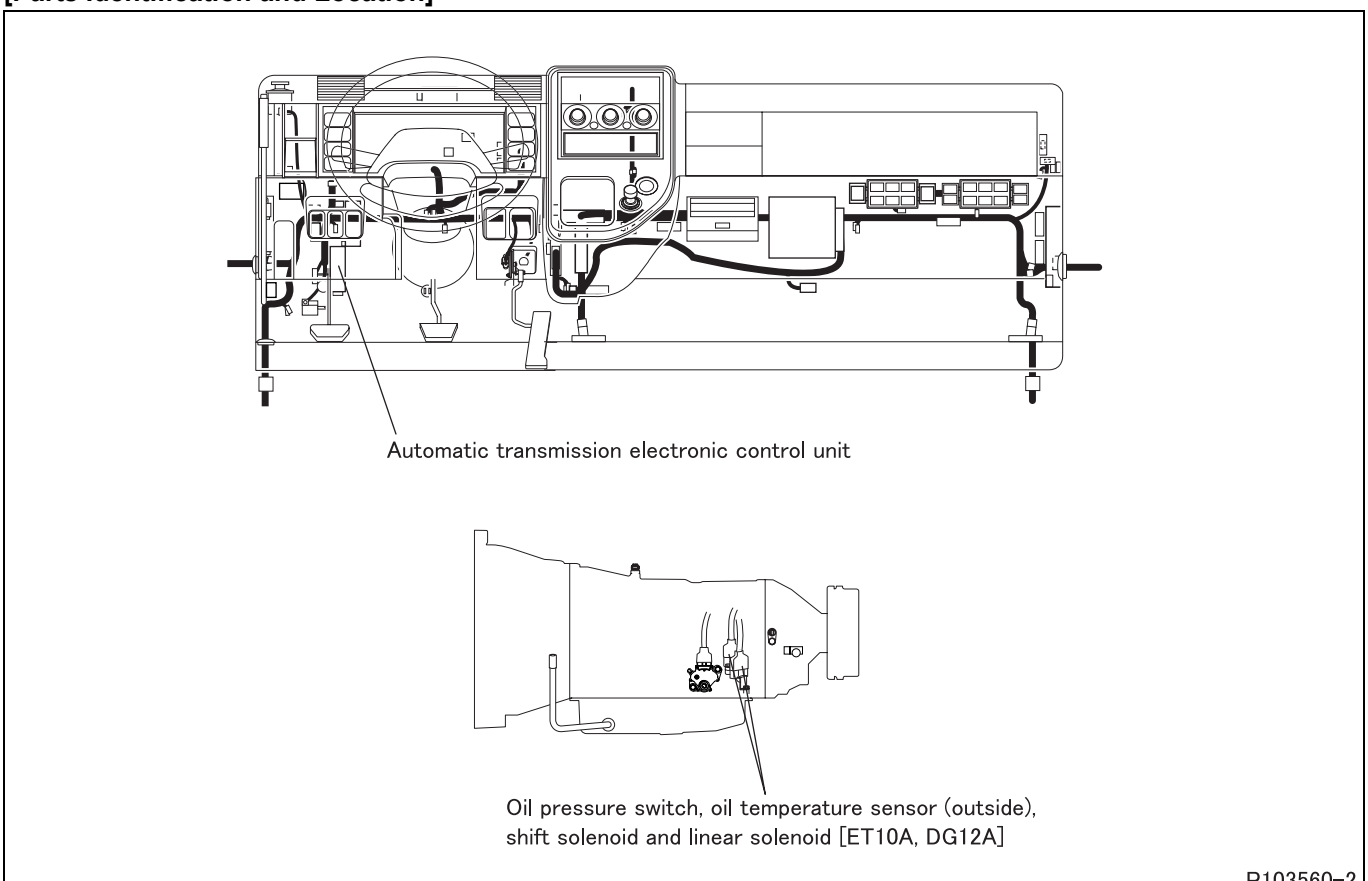
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil temperature sensor (inside)
- Malfunction of each connector
- Malfunction of oil temperature sensor (inside)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between electronic control unit connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 13 “A/T Oil Temp (OP)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

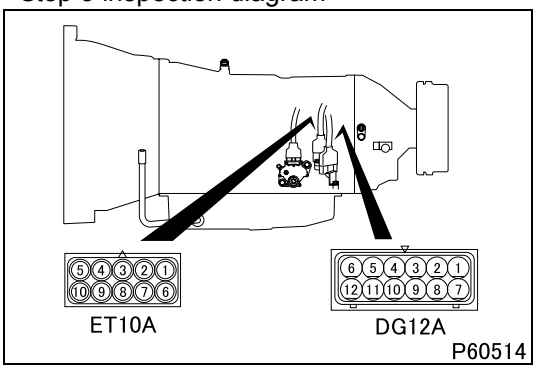
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		• –30°C {–22°F}: 44 ± 6.6 kΩ • 10°C {50°F}: 6445 ± 645 Ω • 110°C {230°F}: 247 ± 16 Ω • 145°C {295°F}: 111 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of resistance between connector (ET10A) terminal No. 3 and 8.
	Inspection condition		–
	Requirements		• –30°C {–22°F}: 44 ± 6.6 kΩ • 10°C {50°F}: 6445 ± 645 Ω • 110°C {230°F}: 247 ± 16 Ω • 145°C {295°F}: 111 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 3 and electronic control unit connector (CY24A) terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 8 and electronic control unit connector (CY31A) terminal No. 28.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between electronic control unit connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 13 “A/T Oil Temp (OP)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0713/Flash code: 13
[Monitor ID]
12
[Fault (outline)]
Failure of oil temperature sensor (inside)
[Diagnosis check]
- Automatic transmission fluid temperature is monitored by oil temperature sensor (inside).

[Code generation condition]
- Oil temperature sensor (inside) output temperature remains excessively low (below –50°C {–56°F}) for 0.5 second.

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

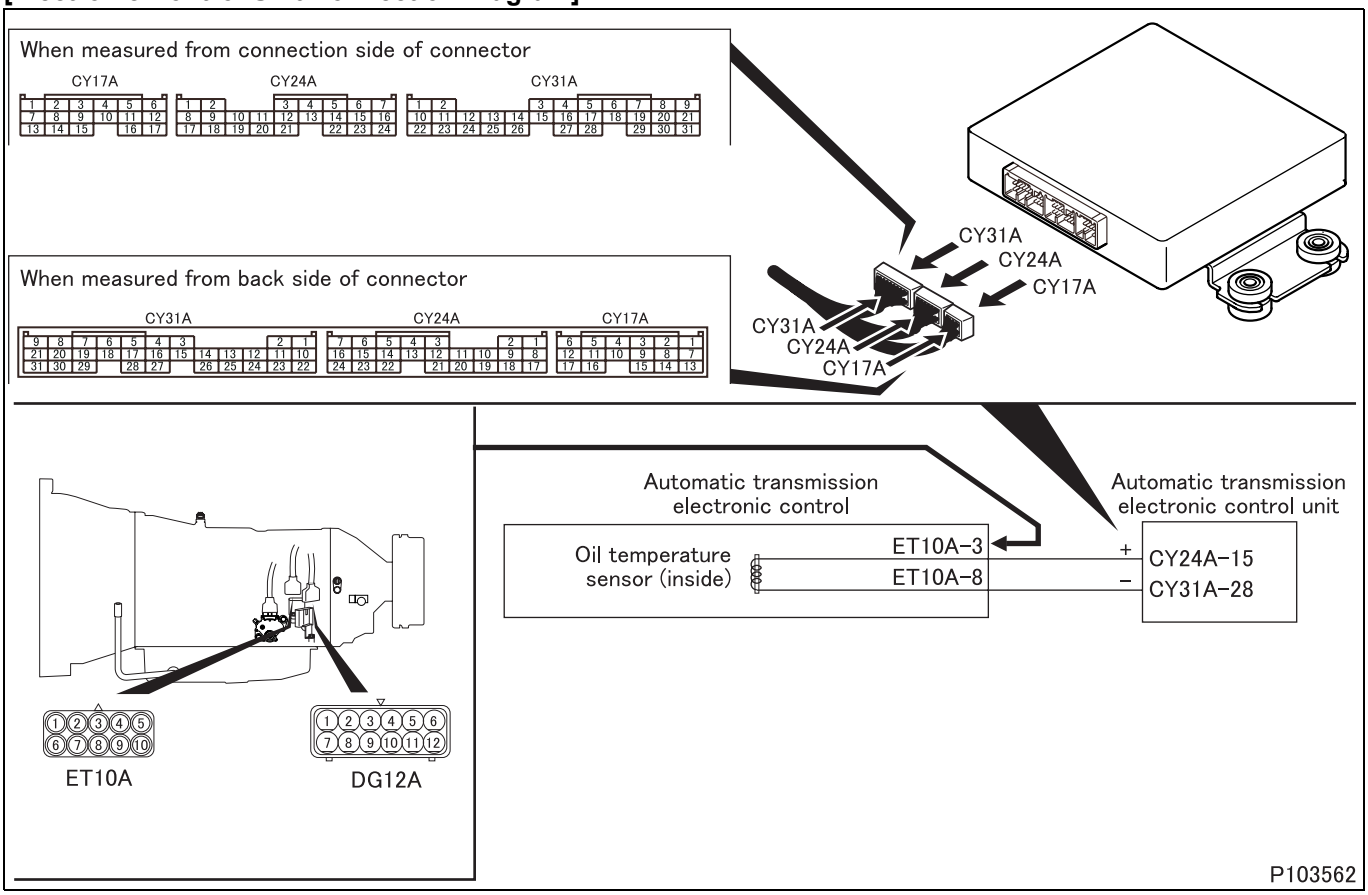
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Control is effected on basis of low oil temperature (–30°C {–24°F}) immediately after starter switch is turned ON and normal oil temperature (80°C {175°F}) 5 minutes later.
- Braking force control is inhibited.

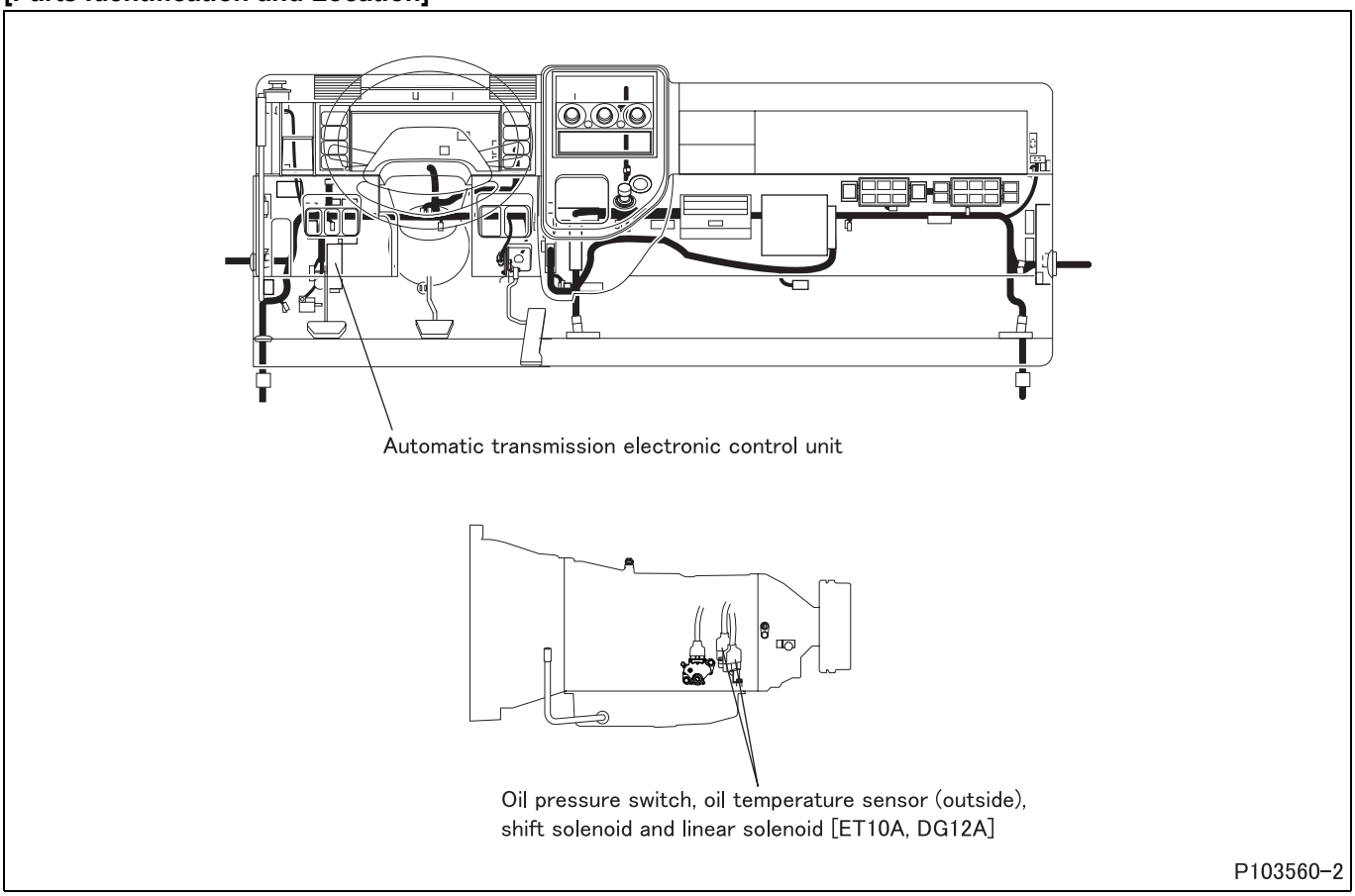
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil temperature sensor (inside)
- Malfunction of each connector
- Malfunction of oil temperature sensor (inside)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between electronic control unit connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 13 “A/T Oil Temp (OP)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

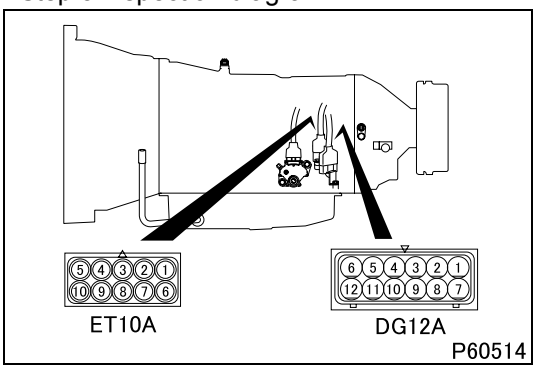
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		• –30°C {–22°F}: 44 ± 6.6 kΩ • 10°C {50°F}: 6445 ± 645 Ω • 110°C {230°F}: 247 ± 16 Ω • 145°C {295°F}: 111 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of resistance between connector (ET10A) terminal No. 3 and 8.
	Inspection condition		–
	Requirements		• –30°C {–22°F}: 44 ± 6.6 kΩ • 10°C {50°F}: 6445 ± 645 Ω • 110°C {230°F}: 247 ± 16 Ω • 145°C {295°F}: 111 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 3 and electronic control unit connector (CY24A) terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 8 and electronic control unit connector (CY31A) terminal No. 28.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between electronic control unit connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 13 “A/T Oil Temp (OP)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0714/Flash code: 13
[Monitor ID]
15
[Fault (outline)]
Failure of oil temperature sensor (inside)
[Diagnosis check]
- Automatic transmission fluid temperature is monitored by oil temperature sensor (inside).

[Code generation condition]
- Oil temperature sensor (inside) signal remains intermittent for 7 seconds.

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

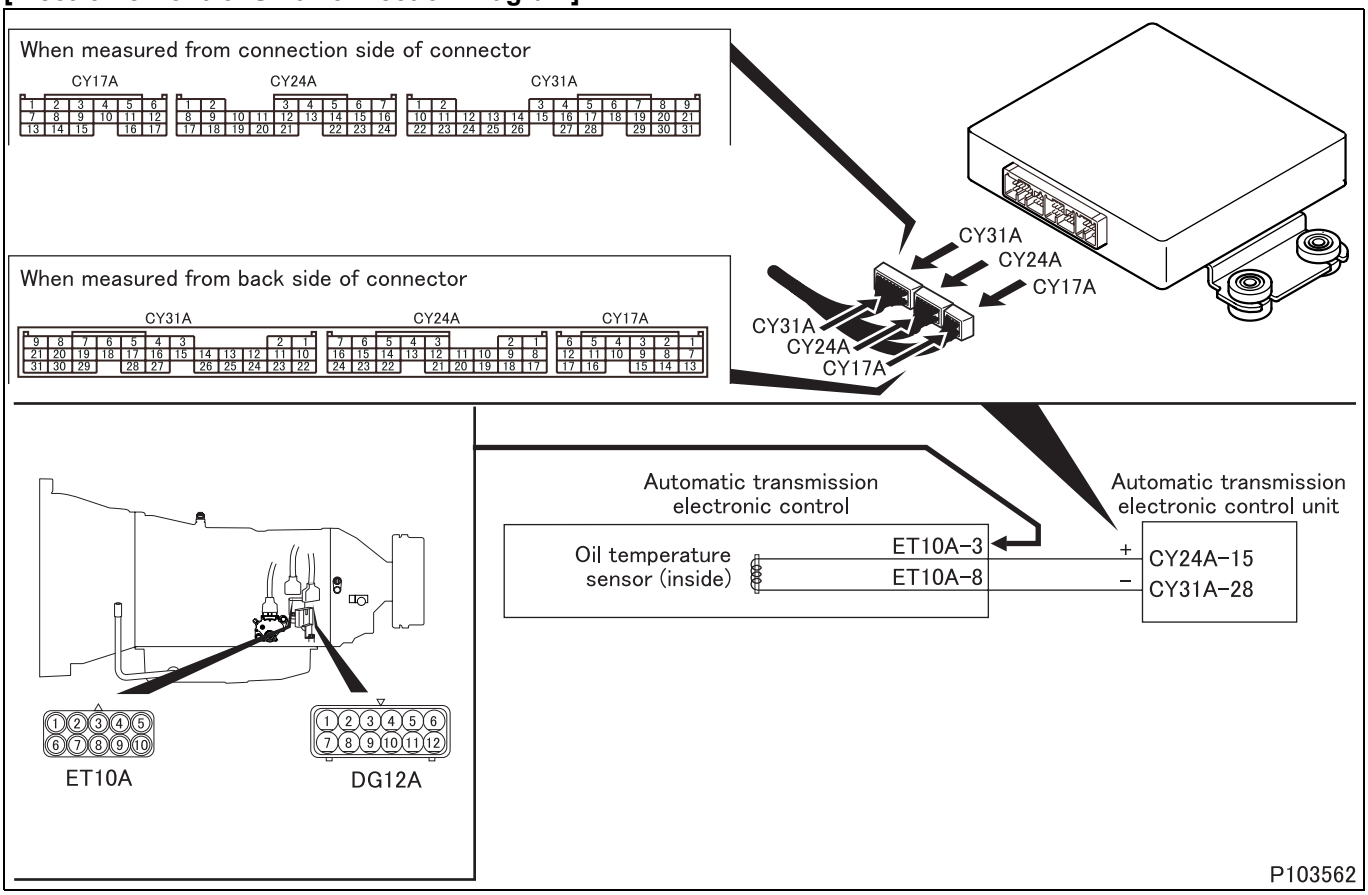
[Diagnostic requirement]
- Starter switch ON battery voltage: 10 V to 16 V

[Control effected by electronic control unit during fault]
- Control is effected on basis of low oil temperature (–30°C {–24°F}) immediately after starter switch is turned ON and normal oil temperature (80°C {175°F}) 5 minutes later.
- Braking force control is inhibited.

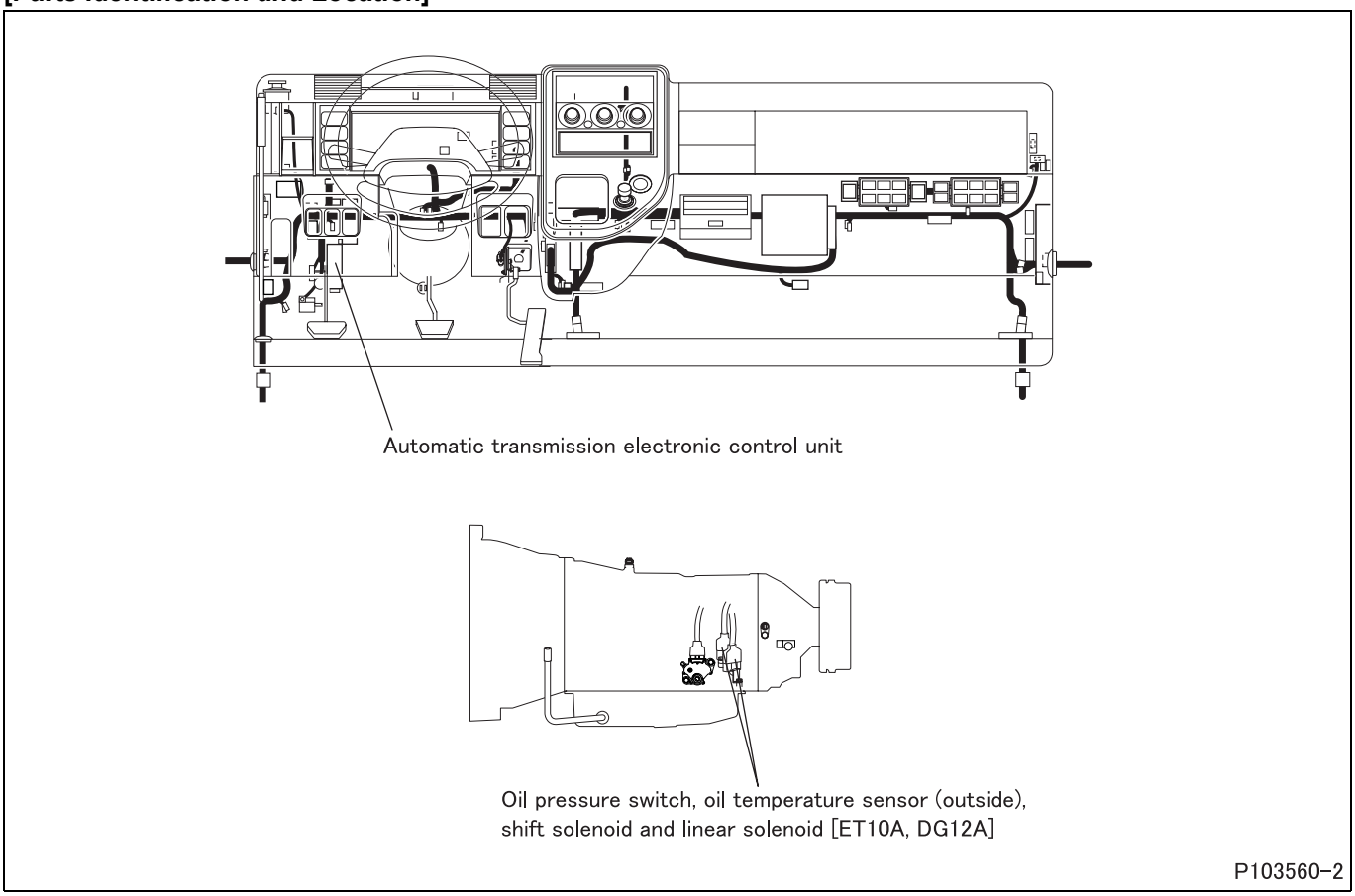
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil temperature sensor (inside)
- Malfunction of each connector
- Malfunction of oil temperature sensor (inside)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between electronic control unit connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 13 “A/T Oil Temp (OP)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

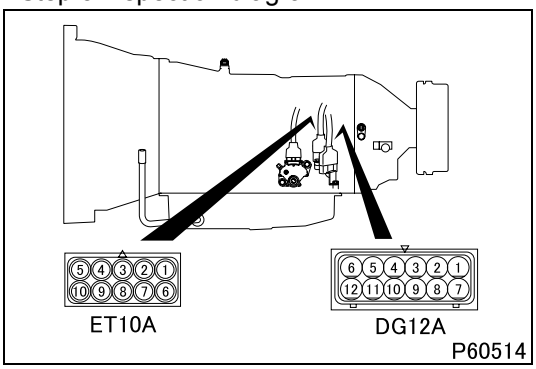
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		• –30°C {–22°F}: 44 ± 6.6 kΩ • 10°C {50°F}: 6445 ± 645 Ω • 110°C {230°F}: 247 ± 16 Ω • 145°C {295°F}: 111 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of resistance between connector (ET10A) terminal No. 3 and 8.
	Inspection condition		–
	Requirements		• –30°C {–22°F}: 44 ± 6.6 kΩ • 10°C {50°F}: 6445 ± 645 Ω • 110°C {230°F}: 247 ± 16 Ω • 145°C {295°F}: 111 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 3 and electronic control unit connector (CY24A) terminal No. 15.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 8 and electronic control unit connector (CY31A) terminal No. 28.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between electronic control unit connector (CY24A) terminal No. 15 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 13 “A/T Oil Temp (OP)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0717/Flash code: 16
[Monitor ID]
5
[Fault (outline)]
Failure of turbine speed sensor
[Diagnosis check]
- Turbine speed sensor is monitored for fault when vehicle is running without gear shifted.

[Code generation condition]
- Input signal from turbine speed sensor is missing when output speed sensor output is normal.

[Diagnosis check timing]
- Fault diagnosis is performed once at the minimum during the driving cycle.

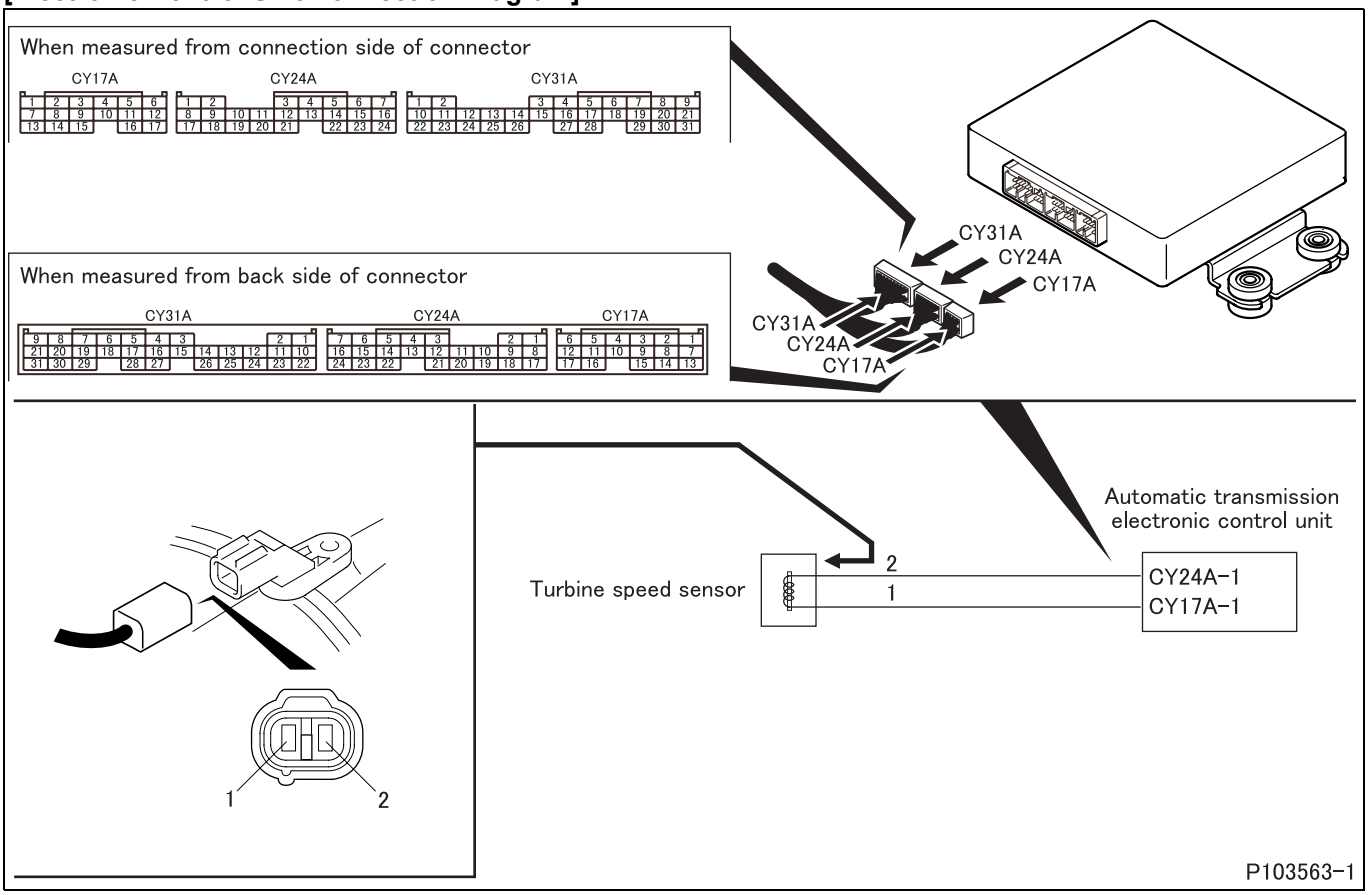
[Diagnostic requirement]
- Vehicle speed: above 5 km/h {3 mph} (not less than 4 sec.)
- Shift position: other than P or N range
- Engine revolution: 300 rpm or higher
- Control at the time of gear shifting is not effected.

[Control effected by electronic control unit during fault]
- Oil pressure control by linear solenoids 1, 2 and 3 is switched from vehicle speed feedback to controlling in accordance with elapsed time from speed change.
- Braking force control is inhibited.

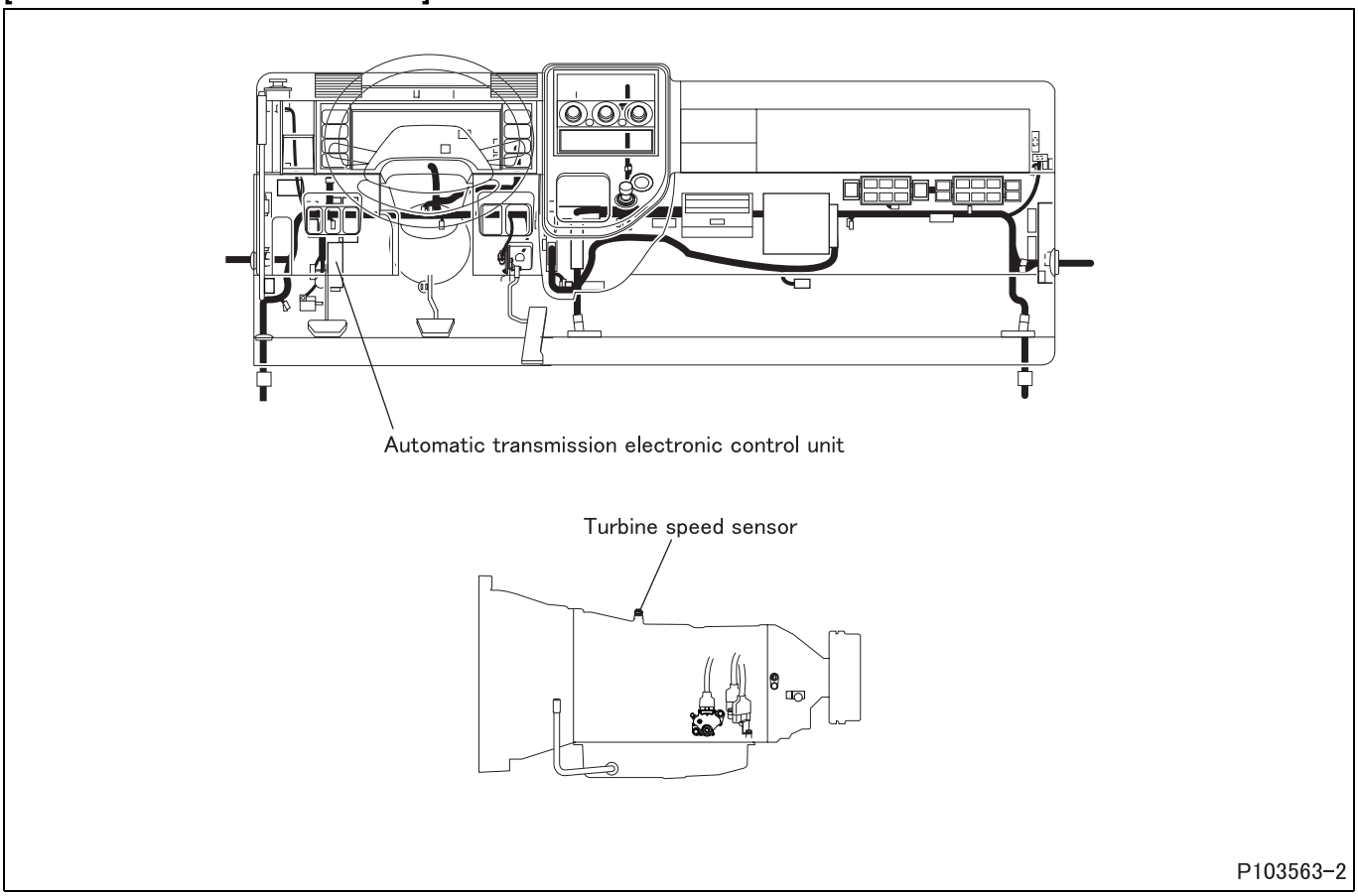
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and turbine speed sensor
- Malfunction of each connector
- Malfunction of turbine speed sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

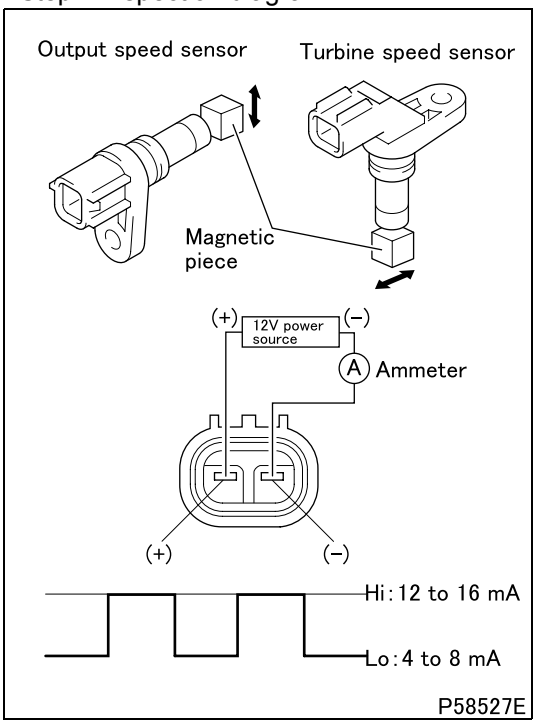
Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 16 “Turbine Speed” of Service Data.
	Inspection condition		–
	Requirements		• Vehicle standing with range selector in D position: 0 rpm • Vehicle running from above state: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor unit
	Maintenance item		Measure current between terminals.
	Inspection condition		• Wire sensor as illustrated. • Move magnetic piece at sensor tip in illustrated direction. (Distance between sensor and magnetic piece: Within 5 mm [0.20 in.])
	Requirements		• Hi: 12 to 16 mA • Low: 4 to 8 mA
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of sensor

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (CY24A) terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of harness

Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (CY17A) terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of harness

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 16 “Turbine Speed” of Service Data.
	Inspection condition		**–**
	Requirements		**<Multi-Use Tester not used>** • If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • Vehicle standing with range selector in D position: 0 rpm • Vehicle running from above state: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0721/Flash code: 25
[Monitor ID]
4
[Fault (outline)]
Failure of output speed sensor
[Diagnosis check]
- Output speed sensor is monitored for fault with vehicle in running condition.

[Code generation condition]
Vehicle speed sensor is judged faulty in either of the following cases.
- Electronic control unit determines vehicle stop after sudden input of deceleration signal from output speed sensor. (Lamp indication: IMB) <A>
- Abnormality established by comparison with turbine speed sensor and vehicle speed sensor and of output gear ratio has continued for 4 seconds. (Lamp indication: 2DC) <B>

[Diagnosis check timing]
- Fault diagnosis is performed once at the minimum during the driving cycle.

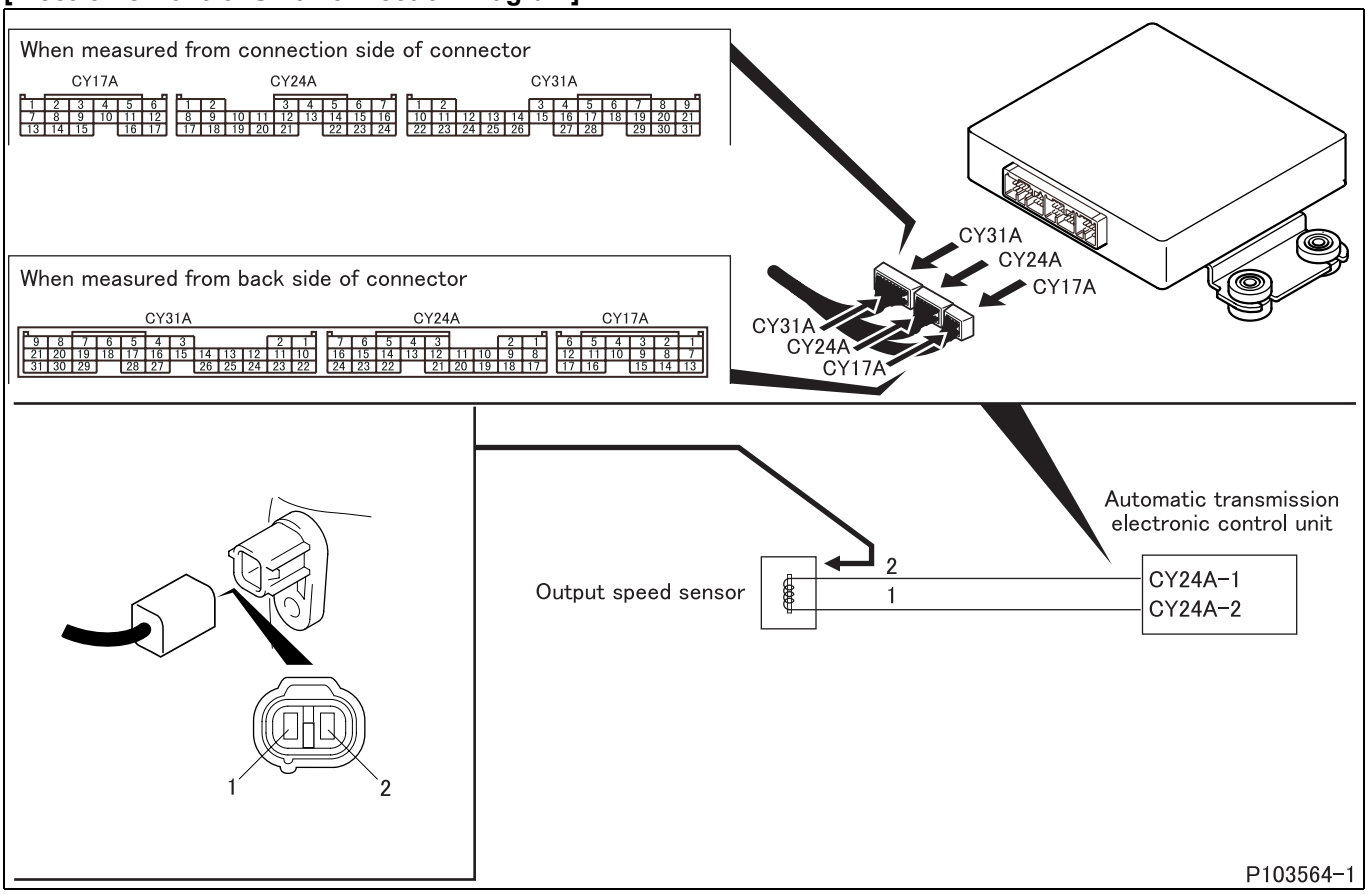
[Diagnostic requirement]
- Vehicle speed sensor related diagnosis code (P0500, P0501) does not occur.
- Output speed sensor related diagnosis code (P0722) does not occur.
- Turbine speed sensor related diagnosis code does not occur.
- Engine speed sensor related diagnosis code does not occur.
- Inhibitor switch related diagnosis code does not occur.
- Control with the fixed speed gear signals outputted under fault conditions is not effected.
- Shift position: Other than P or N range
- Control at the time of gear shifting is not effected.

[Control effected by electronic control unit during fault]
- The gear last selected is active on a steady basis.

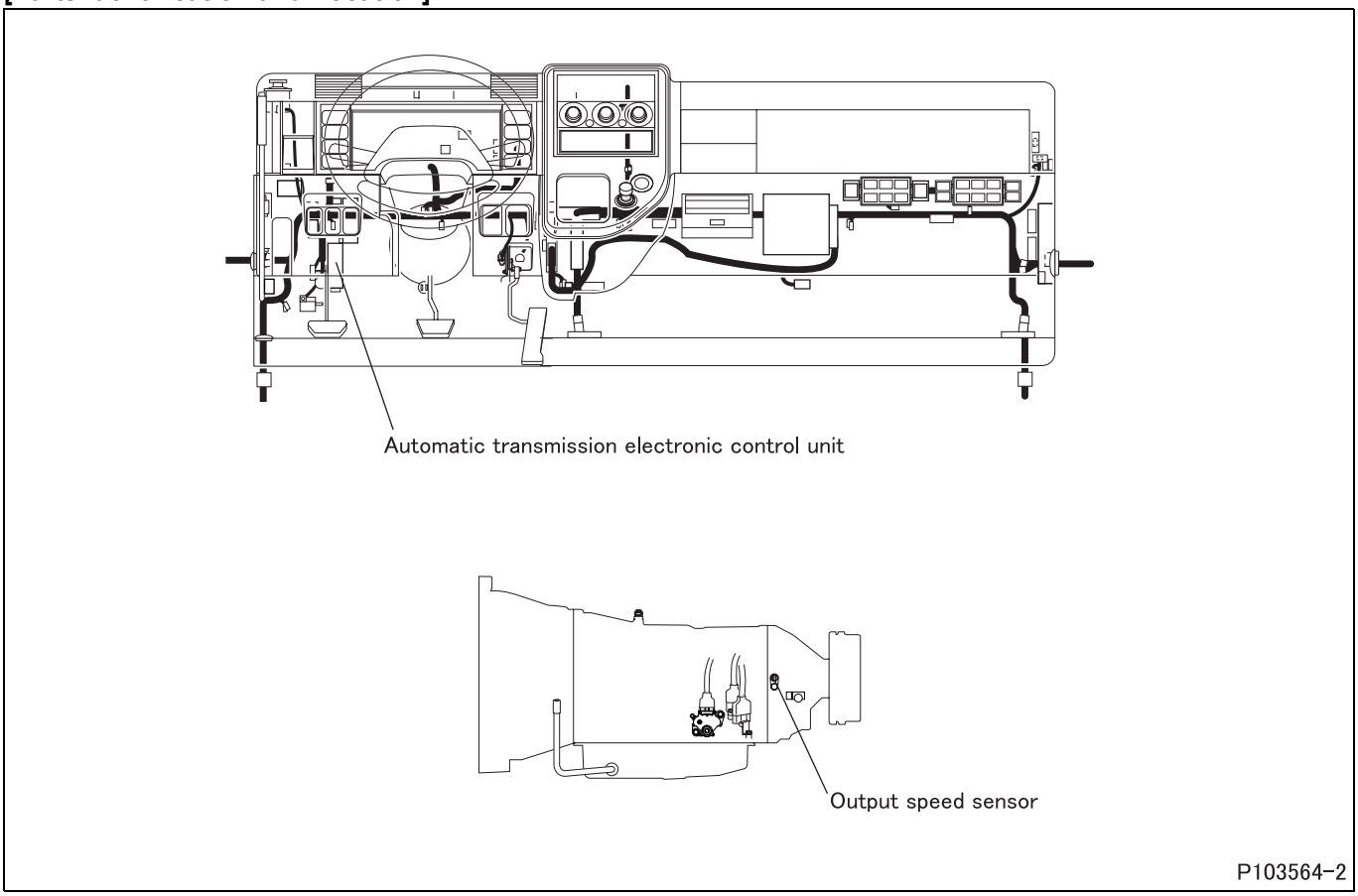
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and output speed sensor
- Malfunction of each connector
- Malfunction of output speed sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

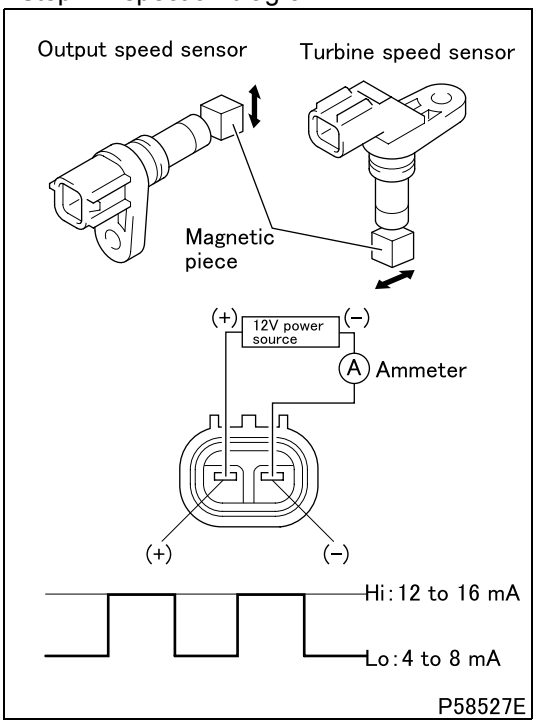
Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 25 “VEH Speed 2” of Service Data.
	Inspection condition		–
	Requirements		During vehicle run: Synchronous with speedometer.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor unit
	Maintenance item		Measure current between terminals.
	Inspection condition		• Wire sensor as illustrated. • Move magnetic piece at sensor tip in illustrated direction. (Distance between sensor and magnetic piece: Within 5 mm [0.20 in.])
	Requirements		• Hi: 12 to 16 mA • Low: 4 to 8 mA
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of sensor

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (CY24A) terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of harness

Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (CY24A) terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of harness

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 25 “VEH Speed 2” of Service Data.
	Inspection condition		**–**
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** During vehicle run: Synchronous with speedometer.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0722/Flash code: 25
[Monitor ID]
3
[Fault (outline)]
Failure of output speed sensor
[Diagnosis check]
- Output speed sensor is monitored for fault during vehicle run (after at least 4 seconds of running at 5 km/h or more)

[Code generation condition]
- Input signal from output speed sensor is missing when vehicle speed sensor output is normal.

[Diagnosis check timing]
- Fault diagnosis is performed once at the minimum during the driving cycle.

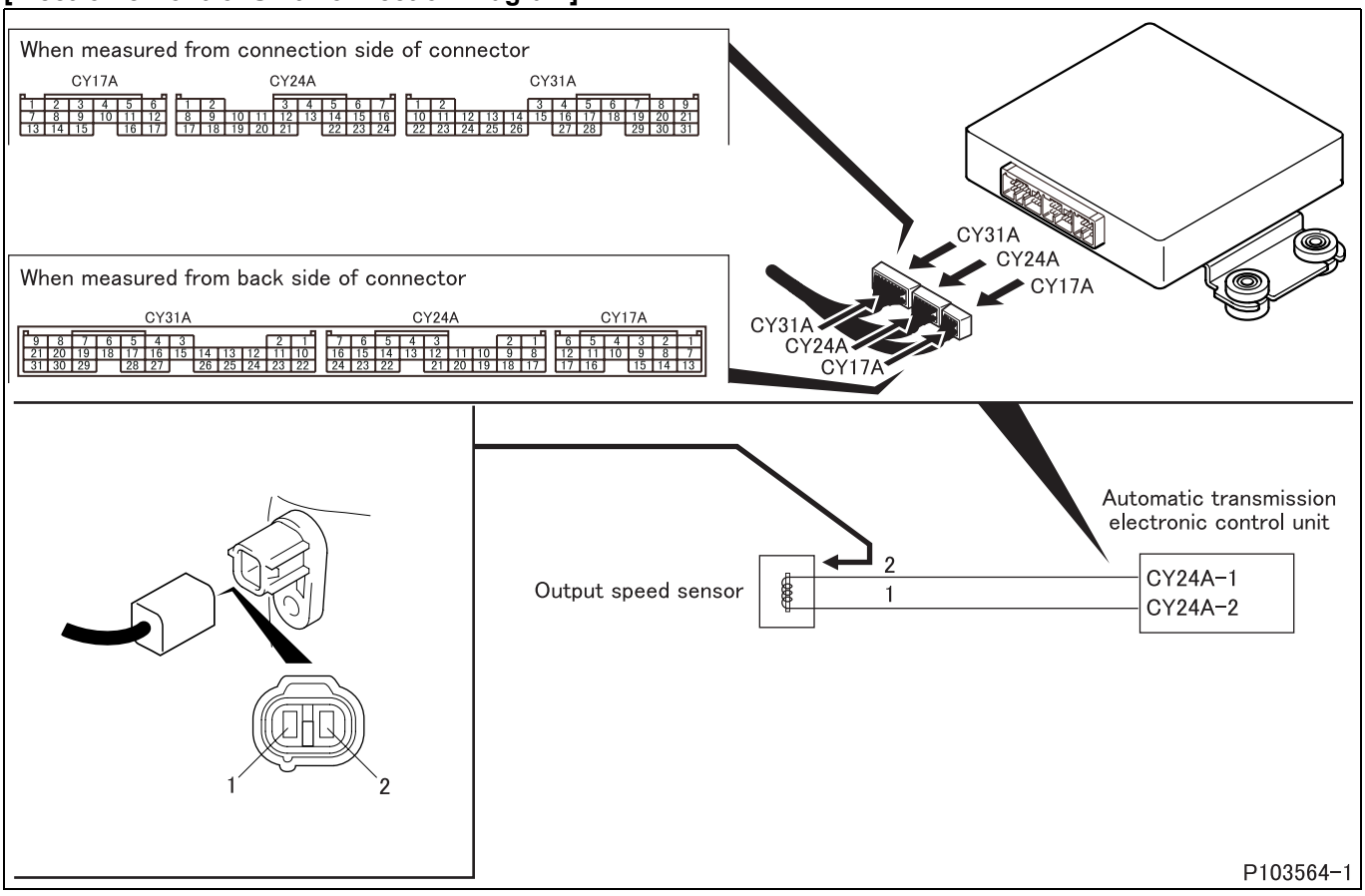
[Diagnostic requirement]
- Vehicle speed: above 5 km/h {3 mph} (not less than 4 sec.)
- Shift position: other than P or N range
- Vehicle speed sensor related diagnosis code (P0500, P0501) does not occur.

[Control effected by electronic control unit during fault]
- Control is effected using vehicle speed sensor.
- Oil pressure control by linear solenoids 1, 2 and 3 is switched from vehicle speed feedback to controlling in accordance with elapsed time from speed change.
- Braking force control is inhibited.

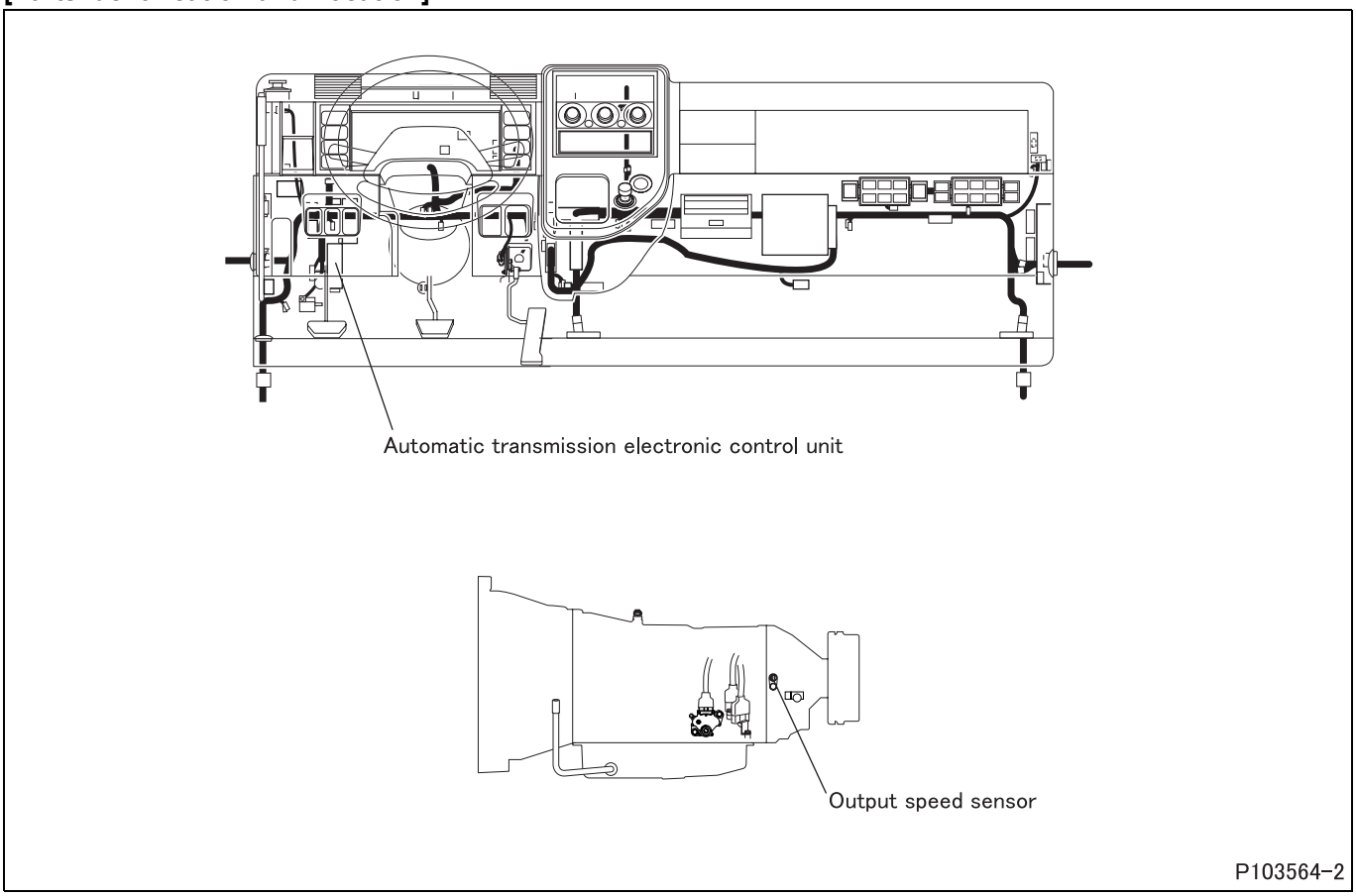
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and output speed sensor
- Malfunction of each connector
- Malfunction of output speed sensor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

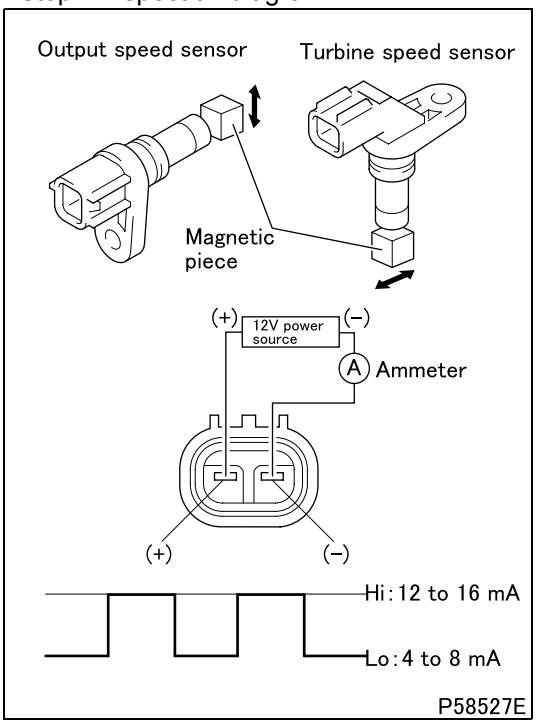
Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 25 “VEH Speed 2” of Service Data.
	Inspection condition		–
	Requirements		During vehicle run: Synchronous with speedometer.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor unit
	Maintenance item		Measure current between terminals.
	Inspection condition		• Wire sensor as illustrated. • Move magnetic piece at sensor tip in illustrated direction. (Distance between sensor and magnetic piece: Within 5 mm [0.20 in.])
	Requirements		• Hi: 12 to 16 mA • Low: 4 to 8 mA
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of sensor

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between sensor connector terminal No. 2 and electronic control unit connector (CY24A) terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of harness

Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between sensor connector terminal No. 1 and electronic control unit connector (CY24A) terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of harness

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 25 “VEH Speed 2” of Service Data.
	Inspection condition		–
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** During vehicle run: Synchronous with speedometer.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0726/Flash code: 15
[Monitor ID]
6
[Fault (outline)]
Abnormality of engine speed signal
[Diagnosis check]
- Engine speed signal from engine electronic control unit is monitored during vehicle run.

[Code generation condition]
- Engine speed signal from engine electronic control unit remains less than specified (300 rpm) for 4 seconds.

[Diagnosis check timing]
- Fault diagnosis is performed once at the minimum during the driving cycle.

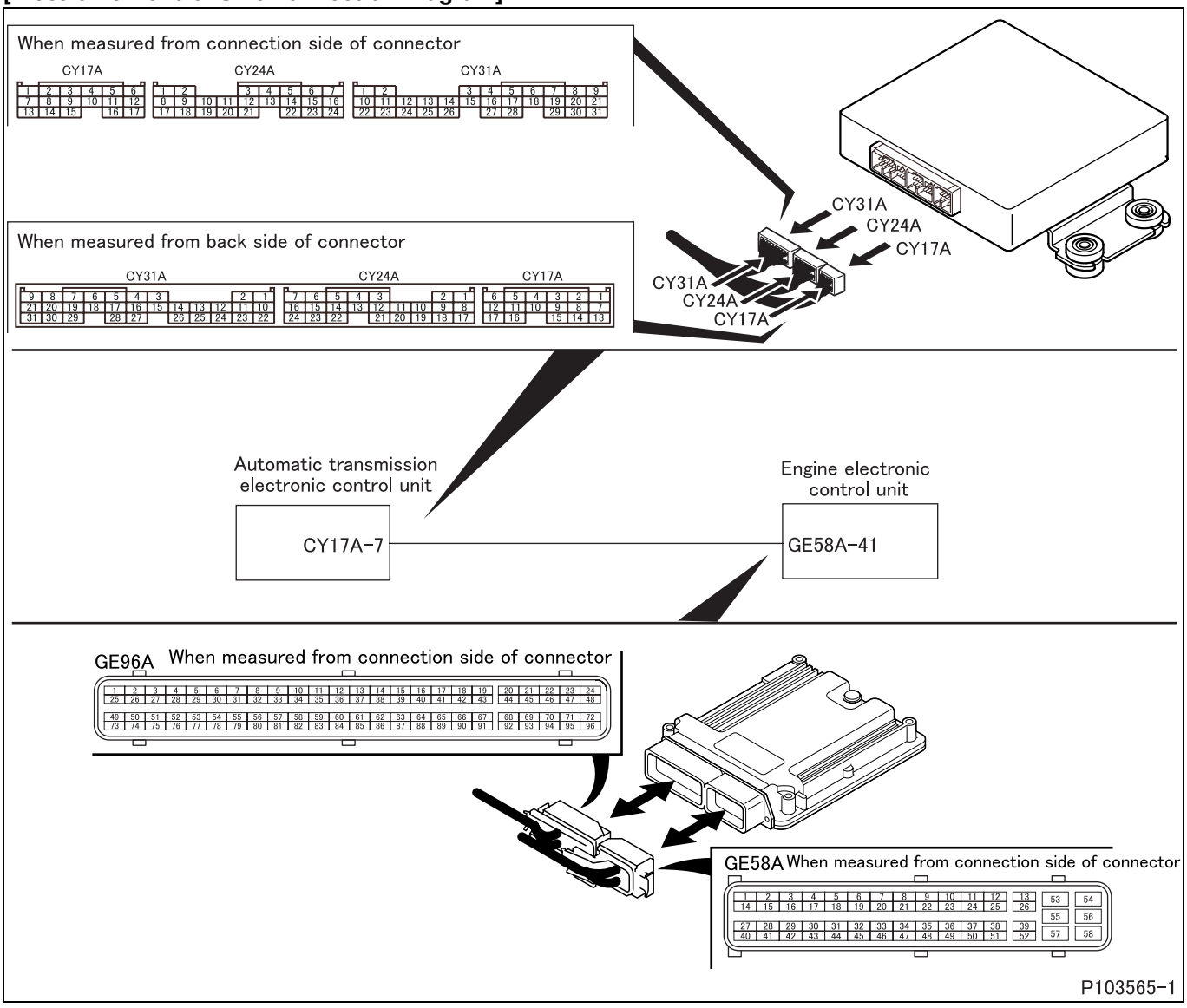
[Diagnostic requirement]
- Output shaft speed: above 1000 rpm
- Shift position: other than P or N range

[Control effected by electronic control unit during fault]
- Control is effected with engine speed at specified value (Specified values differ by type of control.)
- Braking force control is inhibited.

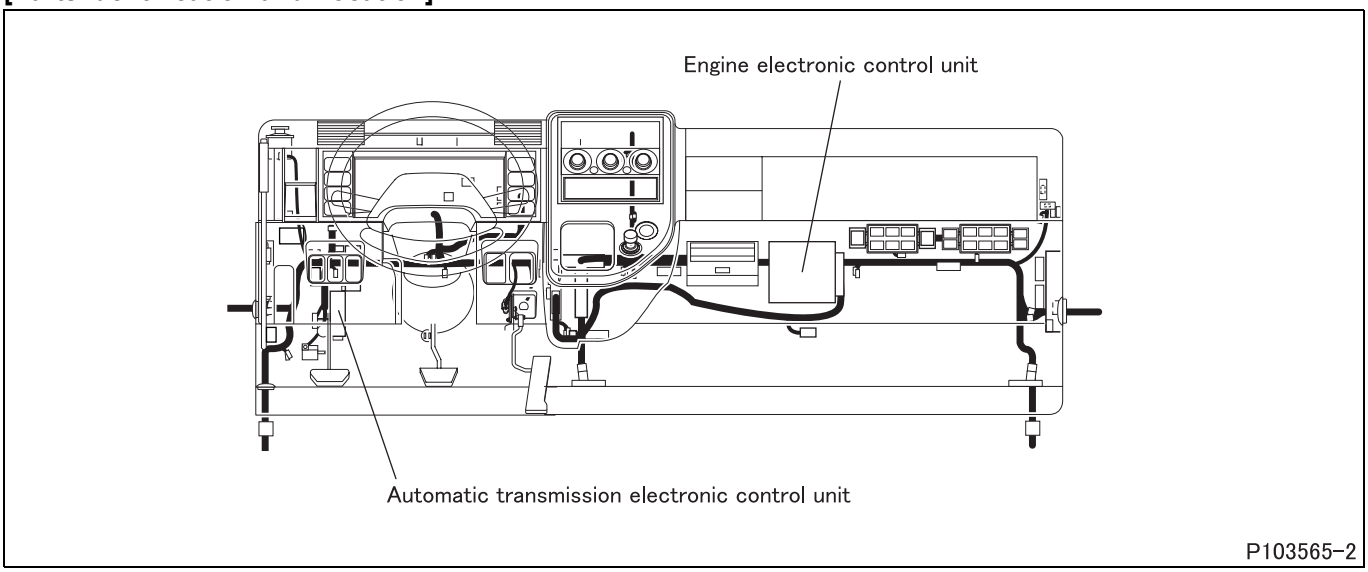
[Probable cause of trouble]
- Open-circuit or short-circuit between electronic control unit and engine electronic control unit or between engine electronic control unit and engine speed sensor
- Malfunction of each connector
- Malfunction of engine speed sensor
- Malfunction of electronic control unit
- Malfunction of engine electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 15 “Engine Speed” of Service Data.
	Inspection condition		–
	Requirements		Racing (engine in operation): Synchronous with tachometer
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of engine electronic control unit
	Maintenance item		Inspection of engine electronic control unit
	Inspection condition		–
	Requirements		Free of errors related to engine speed
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Perform troubleshooting on engine electronic control unit (See Gr13EA.).

Step 5	Inspection items		Inspection of harness between electronic control unit and engine electronic control unit
	Maintenance item		Check circuit between electronic control unit connector (CY17A) terminal No. 7 and engine electronic control unit connector (GE58A) terminal No. 41.
	Inspection condition		Disconnect each electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 15 “Engine Speed” of Service Data.
	Inspection condition		–
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. (If replacement of electronic control unit does not eliminate trouble, replace engine electronic control unit.) **<Multi-Use Tester used>** Racing (engine in operation): Synchronous with tachometer
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of harness (If replacement of electronic control unit does not eliminate trouble, replace engine electronic control unit.)

[Fault code]
Diagnosis code: P0730/Flash code: 37
[Monitor ID]
7, 8
[Fault (outline)]
Incorrect gear ratio
[Diagnosis check]
- Turbine speed sensor, output speed sensor and ongoing gear ratio are monitored to determine whether control is effected at optimal gear ratio.

[Code generation condition]
- The difference of more than 500 rpm between turbine speed and output shaft speed × gear ratio continues for 0.5 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the applicable gear speed is selected.

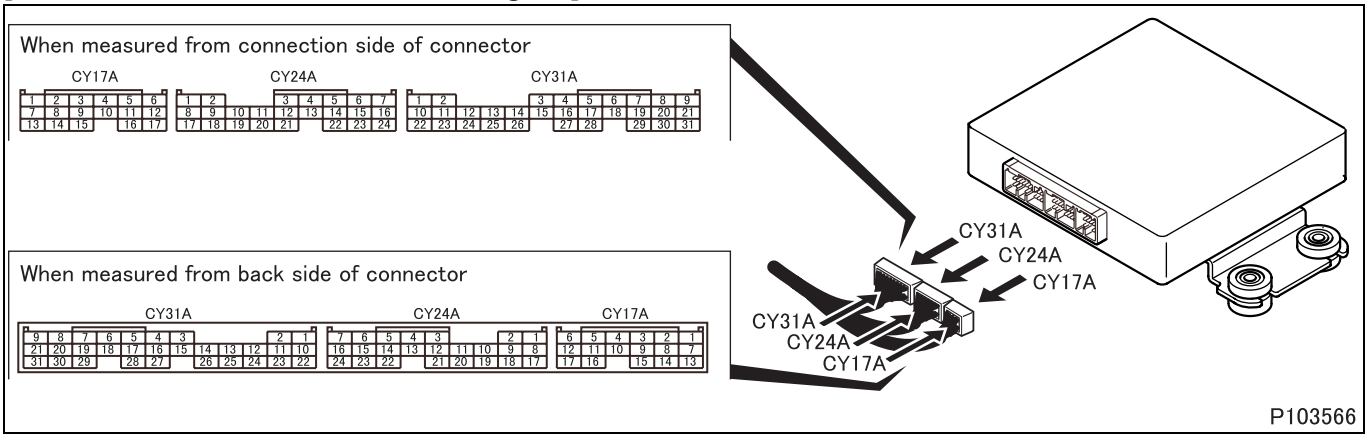
[Diagnostic requirement]
- Each solenoid, oil pressure switch, inhibitor switch, output speed sensor, or turbine speed sensor related diagnosis code does not occur.
- Automatic transmission fluid temperature: above –10°C {14°F}
- Output shaft speed: above 250 rpm
- Shift position: D, 3 or 2 range
- Shift solenoids: Disengaged
- Accelerator pedal position: 5% or more <1st>
- Turbine speed is 100 rpm slower than the engine speed <1st>

[Control effected by electronic control unit during fault]
- Control is effected on fixed speed gear output (3rd).

[Probable cause of trouble]
- Open-circuit or short-circuit between electronic control unit and turbine speed sensor/output speed sensor
- Malfunction of each connector
- Malfunction of turbine speed sensor or output speed sensor
- Malfunction of electronic control unit
- Malfunction of automatic transmission

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 16 “Turbine Speed”, No. 25 “VEH Speed 2” and No. 56 “Gear Pos.” of Service Data.
	Inspection condition		• Output shaft speed [rpm]: Item No. 25 “VEH Speed 2” [MPH] × 4.268 × final gear ratio/tire radius [m] • Turbine speed [rpm]: Item No. 16 “Turbine Speed” • Calculated gear ratio: Turbine speed/Output shaft speed • Specified gear ratio: 1st (3.742), 2nd (2.003), 3rd (1.343), 4th (1.000), 5th (0.773), 6th (0.634), Rev (3.539)
	Requirements		Specified and calculated gear ratios at corresponding gear position: Matched
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of automatic transmission
	Maintenance item		**<Multi-Use Tester not used>** Measure values of voltage between the following terminals. • Oil pressure switch 1: Electronic control unit connector (CY17A) terminal No. 6 (+) - Connector (CY24A) terminal No. 8 (–) • Oil pressure switch 2: Electronic control unit connector (CY17A) terminal No. 12 (+) - Connector (CY24A) terminal No. 8 (–) • Oil pressure switch 3: Electronic control unit connector (CY17A) terminal No. 17 (+) - Connector (CY24A) terminal No. 8 (–) • Oil pressure switch 4: Electronic control unit connector (CY17A) terminal No. 5 (+) - Connector (CY24A) terminal No. 8 (–) • Oil pressure switch 5: Electronic control unit connector (CY17A) terminal No. 11 (+) - Connector (CY24A) terminal No. 8 (–) • Oil pressure switch 6: Electronic control unit connector (CY17A) terminal No. 16 (+) - Connector (CY24A) terminal No. 8 (–) • Shift solenoid 1: Electronic control unit connector (CY31A) terminal No. 1 (+) - Connector (CY24A) terminal No. 8 (–) • Shift solenoid 2: Electronic control unit connector (CY31A) terminal No. 2 (+) - Connector (CY24A) terminal No. 8 (–) • Shift solenoid 3: Electronic control unit connector (CY31A) terminal No. 3 (+) - Connector (CY24A) terminal No. 8 (–) **<Multi-Use Tester used>** Measure item No. 31 “Shift Valve 1”, No. 32 “Shift Valve 2”, No. 33 “Shift Valve 3”, No. 56 “Gear Pos.”, No. 61 “Oil Press SW1”, No. 62 “Oil Press SW2”, No. 63 “Oil Press SW3”, No. 64 “Oil Press SW4”, No. 65 “Oil Press SW5” and No. 66 “Oil Press SW6”.
	Inspection condition		Operating status of oil pressure switches 1 through 6 and shift solenoids 1 through 3 is checked for match with respective gear positions (1st, 2nd ... 6th). **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Matched (oil pressure switch: O if 0 V; shift solenoid: O if 12 V) **<Multi-Use Tester used>** Matched
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Replacement of automatic transmission

<Step 2 operating status diagram>

	1st	2nd	3rd	4th	5th	6th
Oil pressure switch 1		○		○		○
Oil pressure switch 2	○		○		○	
Oil pressure switch 3			○	○		
Oil pressure switch 4				○	○	○
Oil pressure switch 5	○					
Oil pressure switch 6	○					
Shift solenoid 1			○	○		
Shift solenoid 2				○	○	○
Shift solenoid 3	○					

○: ON P60524E

Step 3	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 16 “Turbine Speed”, No. 25 “VEH Speed 2” and No. 56 “Gear Pos.” of Service Data.
	Inspection condition		• Output shaft speed [rpm]: Item No. 25 “VEH Speed 2” [MPH] × 4.268 × final gear ratio/tire radius [m] • Turbine speed [rpm]: Item No. 16 “Turbine Speed” • Calculated gear ratio: Turbine speed/Output shaft speed • Specified gear ratio: 1st (3.742), 2nd (2.003), 3rd (1.343), 4th (1.000), 5th (0.773), 6th (0.634), Rev (3.539)
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace automatic transmission. **<Multi-Use Tester used>** Specified and calculated gear ratios at corresponding gear position: Matched
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of automatic transmission

[Fault code]
Diagnosis code: P0746/Flash code: 41
[Monitor ID]
38, 39
[Fault (outline)]
Linear solenoid 1 binds in OFF state.
[Diagnosis check]
- Linear solenoid 1 is monitored for fault when switched from low to high pressure according to the response of oil pressure switch 1.

[Code generation condition]
- Linear solenoid 1 is judged faulty when oil pressure switch 1 remains OFF (low pressure) for 1.5 second, then N, R or P range is selected and oil pressure switch 8 remains OFF for 0.5 second (check if stuck ON).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

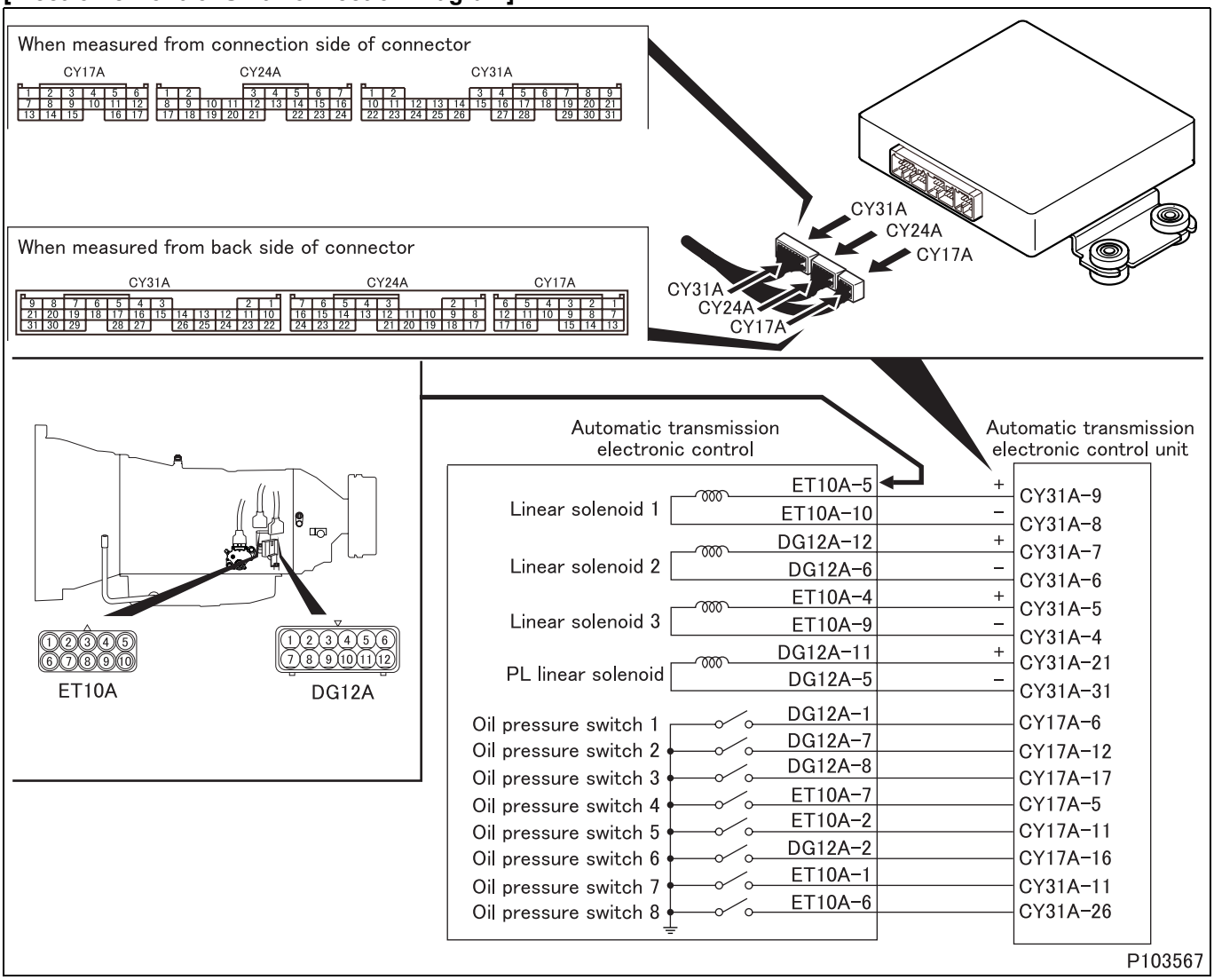
[Diagnostic requirement]
- Oil pressure switch 8: ON
- Shift position: D, 3 or 2 range
- Automatic transmission fluid temperature: above –10°C {14°F} <used for a part of judgment>

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

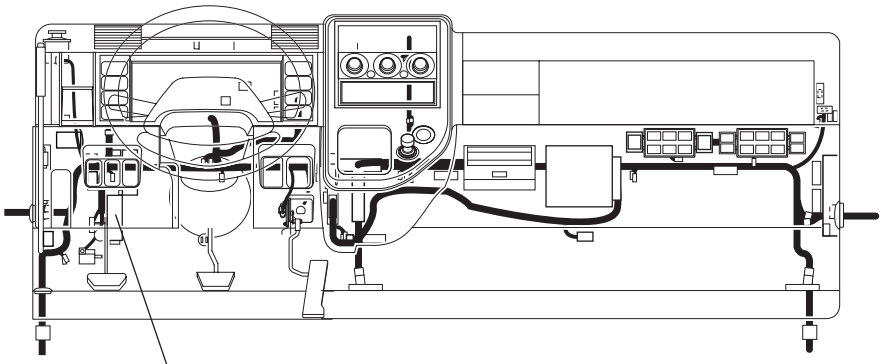
[Probable cause of trouble]
- Open-circuit or short-circuit between electronic control unit and linear solenoid 1/oil pressure switch 1
- Malfunction of each connector
- Malfunction of linear solenoid 1/oil pressure switch 1
- Malfunction of electronic control unit

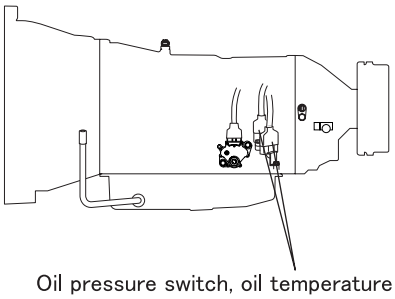
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 26 “Linear Sol Press 1” of Service Data.
	Inspection condition		Vehicle run
	Requirements		• During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Rises • During speed change (2nd to 3rd, 4th to 5th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY17A) terminal No. 6 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 61 “Oil Press SW 1” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 2nd, 4th, 6th gears: 0 V • In 1st, 3rd, 5th gears: 12 V **<Multi-Use Tester used>** • In 2nd, 4th, 6th gears: ON • In 1st, 3rd, 5th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

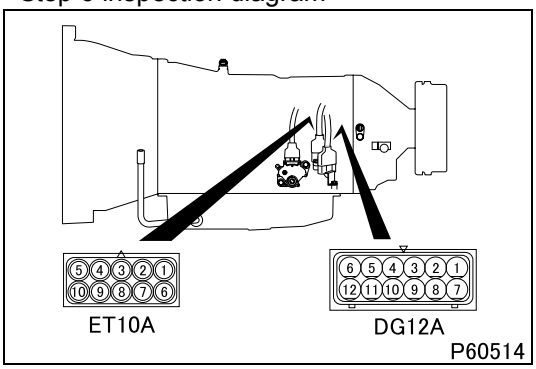
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 9 and 8.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (ET10A) terminal No. 5 and 10.
	Inspection condition		• Disconnect connector and measure solenoid side. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 5 and electronic control unit connector (CY31A) terminal No. 9.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between solenoid and electronic control unit (ground)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 10 and electronic control unit connector (CY31A) terminal No. 8.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 26 “Linear Sol Press 1” of Service Data.
	Inspection condition		Vehicle run
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Rises • During speed change (2nd to 3rd, 4th to 5th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 10.

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY17A) terminal No. 6 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 61 “Oil Press SW 1” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 2nd, 4th, 6th gears: 0 V • In 1st, 3rd, 5th gears: 12 V **<Multi-Use Tester used>** • In 2nd, 4th, 6th gears: ON • In 1st, 3rd, 5th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 1 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0747/Flash code: 41
[Monitor ID]
40
[Fault (outline)]
Linear solenoid 1 binds in ON state.
[Diagnosis check]
- Linear solenoid 1 is monitored for fault when switched from high to low pressure according to the response of oil pressure switch 1.

[Code generation condition]
- Oil pressure switch 1 remains ON (high pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

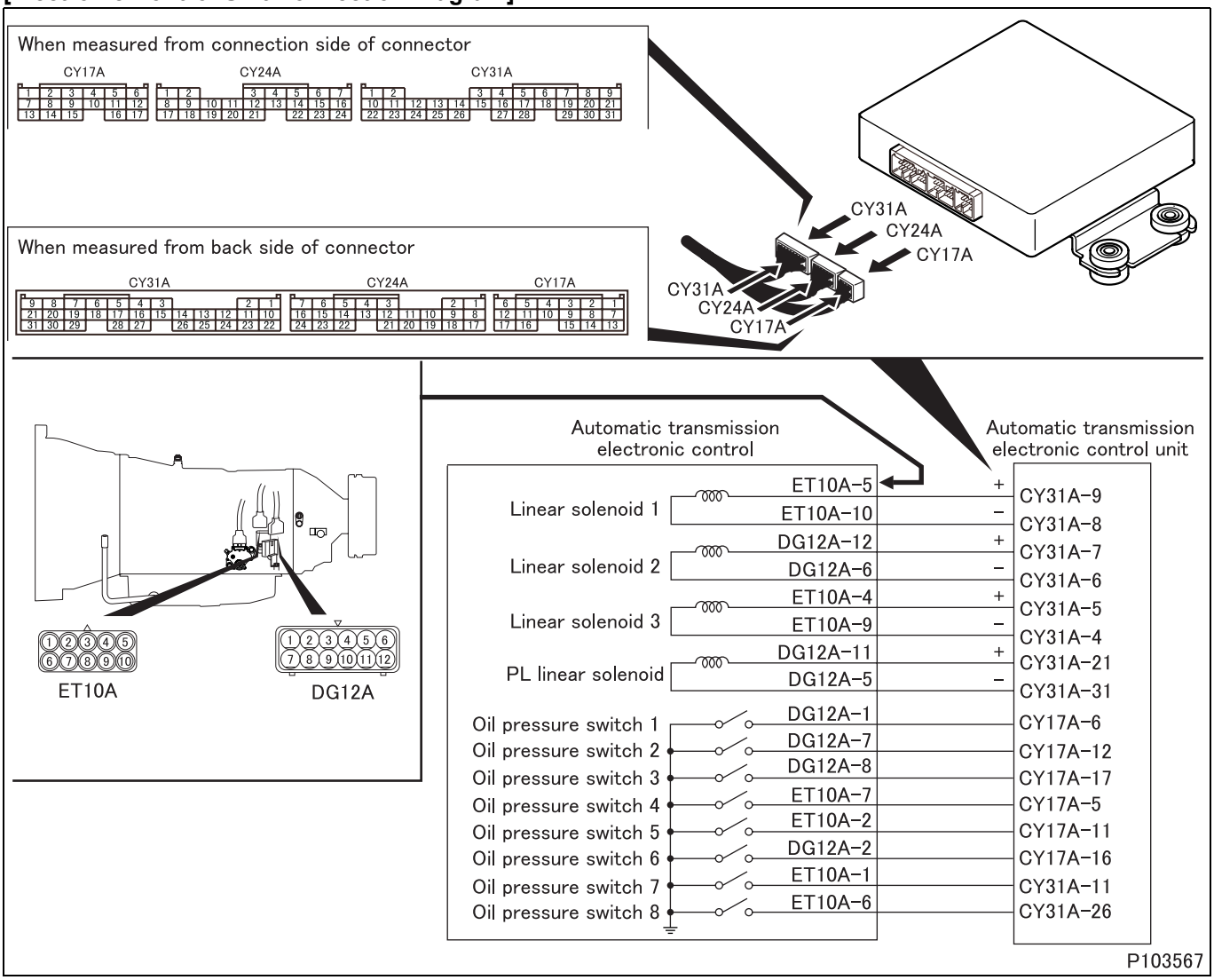
[Diagnostic requirement]
- After linear solenoid 1 switched from high to low pressure

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (4th).

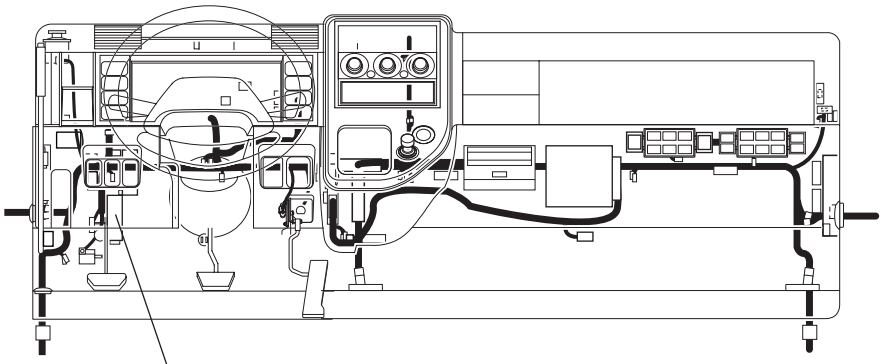
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and linear solenoid 1 or oil pressure switch 1
- Malfunction of each connector
- Malfunction of linear solenoid 1 or oil pressure switch 1
- Malfunction of electronic control unit

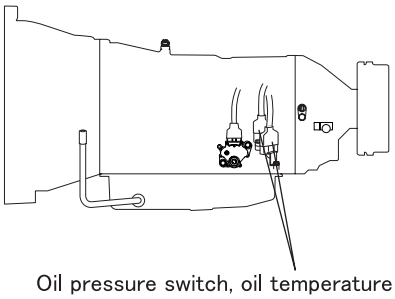
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 26 “Linear Sol Press 1” of Service Data.
	Inspection condition		Vehicle run
	Requirements		• During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Rises • During speed change (2nd to 3rd, 4th to 5th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY17A) terminal No. 6 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 61 “Oil Press SW 1” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 2nd, 4th, 6th gears: 0 V • In 1st, 3rd, 5th gears: 12 V **<Multi-Use Tester used>** • In 2nd, 4th, 6th gears: ON • In 1st, 3rd, 5th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

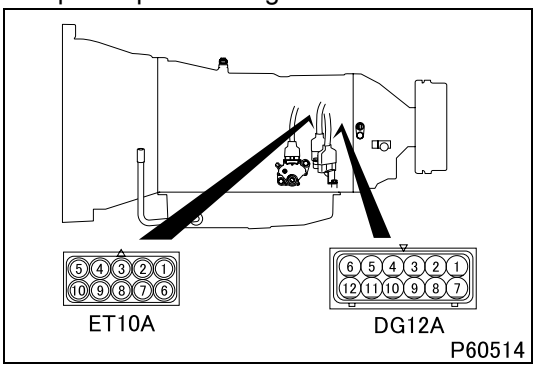
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 9 and 8.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (ET10A) terminal No. 5 and 10.
	Inspection condition		• Disconnect connector and measure solenoid side. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 5 and electronic control unit connector (CY31A) terminal No. 9.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between solenoid and electronic control unit (ground)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 10 and electronic control unit connector (CY31A) terminal No. 8.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 26 “Linear Sol Press 1” of Service Data.
	Inspection condition		Vehicle run
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Rises. • During speed change (2nd to 3rd, 4th to 5th): Declines.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 10.

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY17A) terminal No. 6 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 61 “Oil Press SW 1” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 2nd, 4th, 6th gears: 0 V • In 1st, 3rd, 5th gears: 12 V **<Multi-Use Tester used>** • In 2nd, 4th, 6th gears: ON • In 1st, 3rd, 5th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 1 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0748/Flash code: 26
[Monitor ID]
21, 22
[Fault (outline)]
Linear solenoid 1 is open-circuited or short-circuited.
[Diagnosis check]
- Resistance and current value in linear solenoid 1 is monitored for fault.

[Code generation condition]
Linear solenoid is judged faulty in either of the following cases.
- Resistance across the linear solenoid 1 remains higher than the specification (100 kΩ) for 0.065 second (open-circuited or circuit shorted to power supply).
- Current flowing in the linear solenoid 1 remains higher than the specification (4A) for 0.065 second (circuit shorted to ground).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

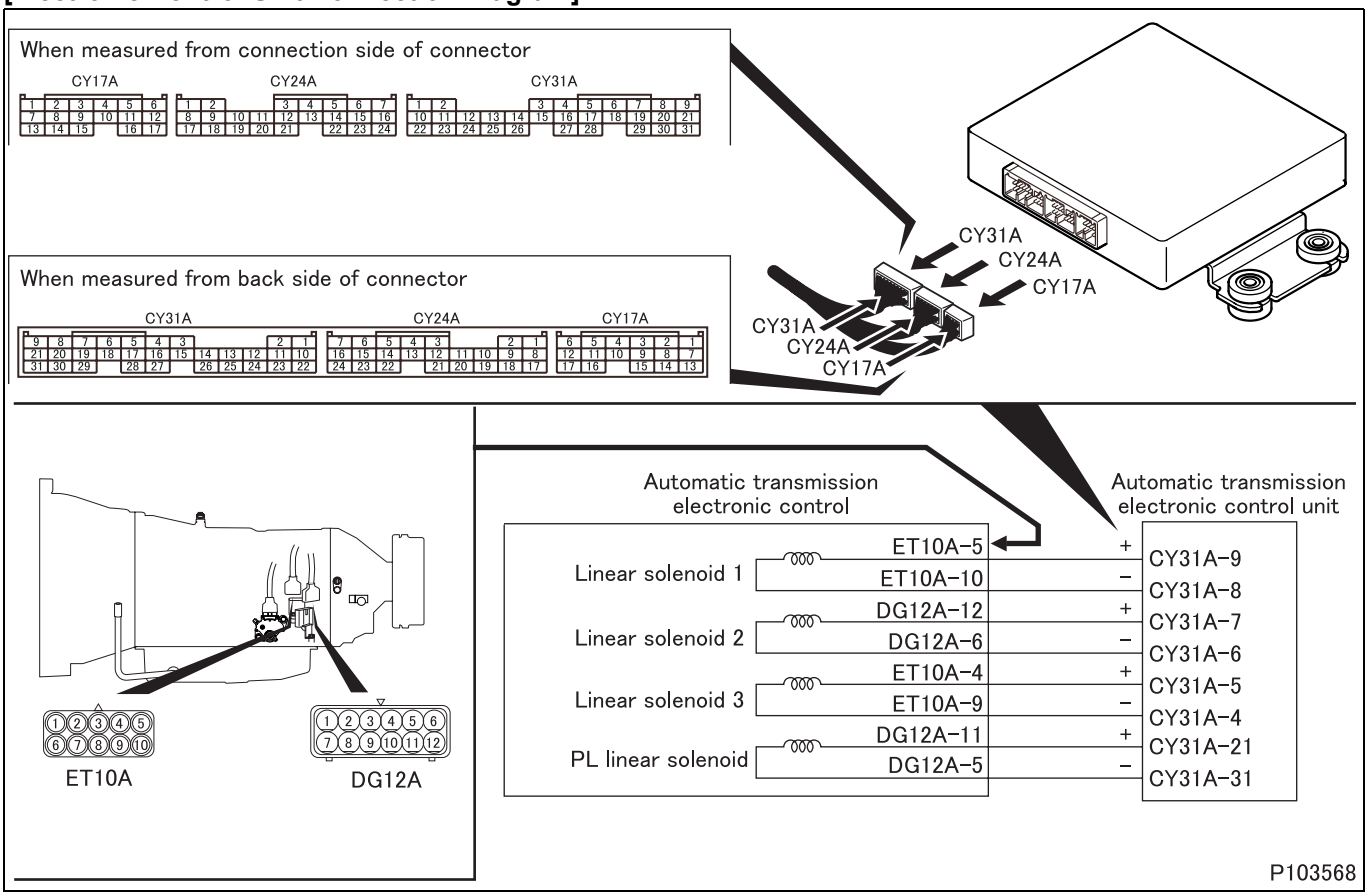
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd for open-circuit, 4th for short-circuit).

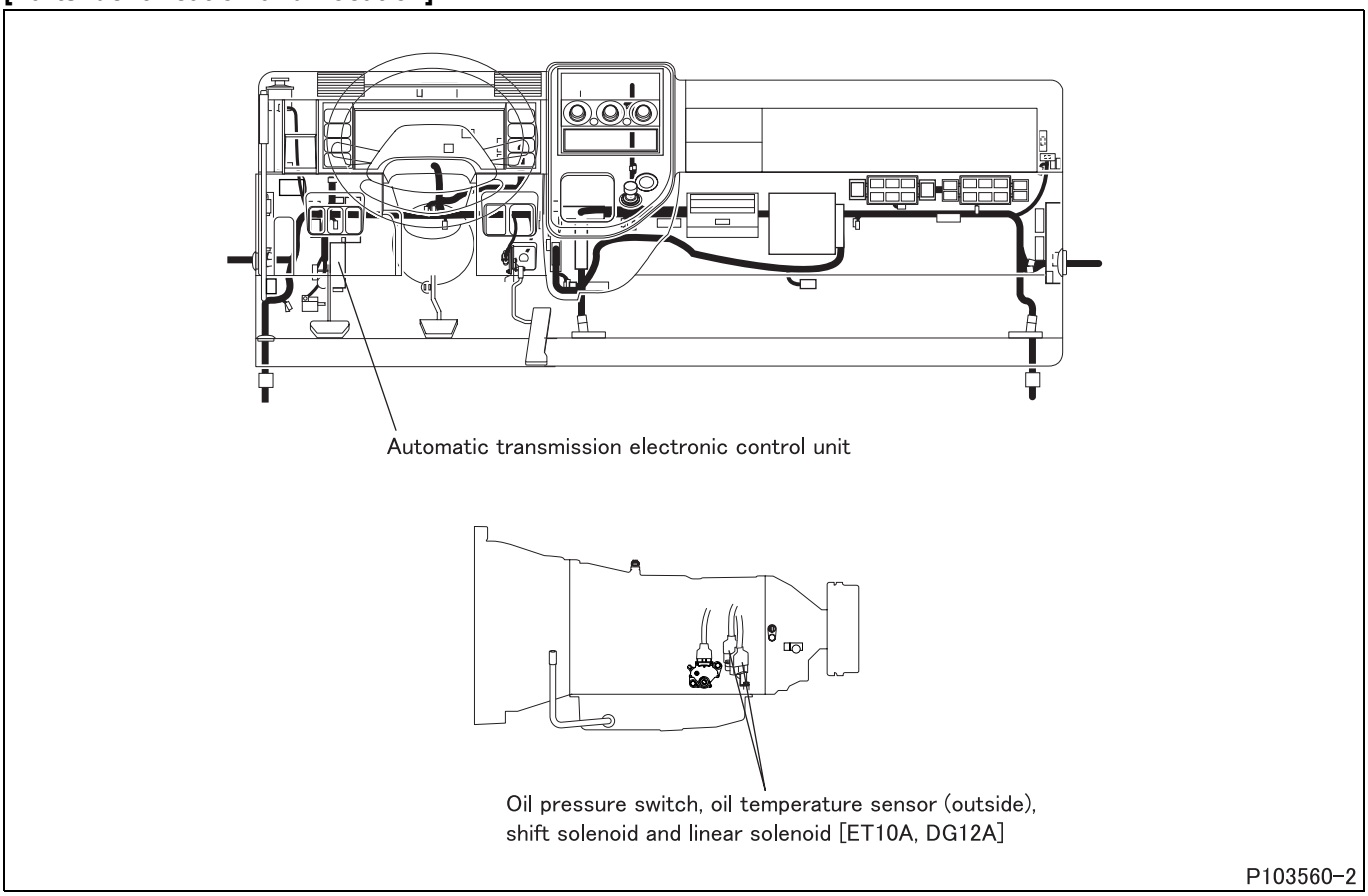
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and linear solenoid 1
- Malfunction of each connector
- Malfunction of linear solenoid 1
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 26 “Linear Sol Press 1” of Service Data.
	Inspection condition		Vehicle run
	Requirements		• During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Rises • During speed change (2nd to 3rd, 4th to 5th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

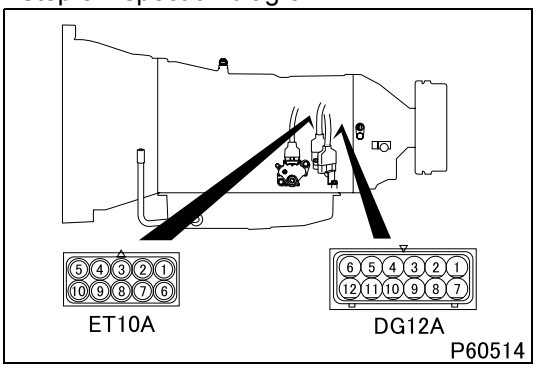
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 9 and 8.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (ET10A) terminal No. 5 and 10.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 5 and electronic control unit connector (CY31A) terminal No. 9.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (ground)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 10 and electronic control unit connector (CY31A) terminal No. 8.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 26 “Linear Sol Press 1” of Service Data.
	Inspection condition		Vehicle run
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Rises • During speed change (2nd to 3rd, 4th to 5th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0751/Flash code: 45
[Monitor ID]
52
[Fault (outline)]
Shift solenoid 1 binds in OFF state.
[Diagnosis check]
- Shift solenoid 1 is monitored for fault when switched from pressure OFF to pressure ON according to the response of oil pressure switch 3

[Code generation condition]
- Oil pressure switch 3 remains OFF (low pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

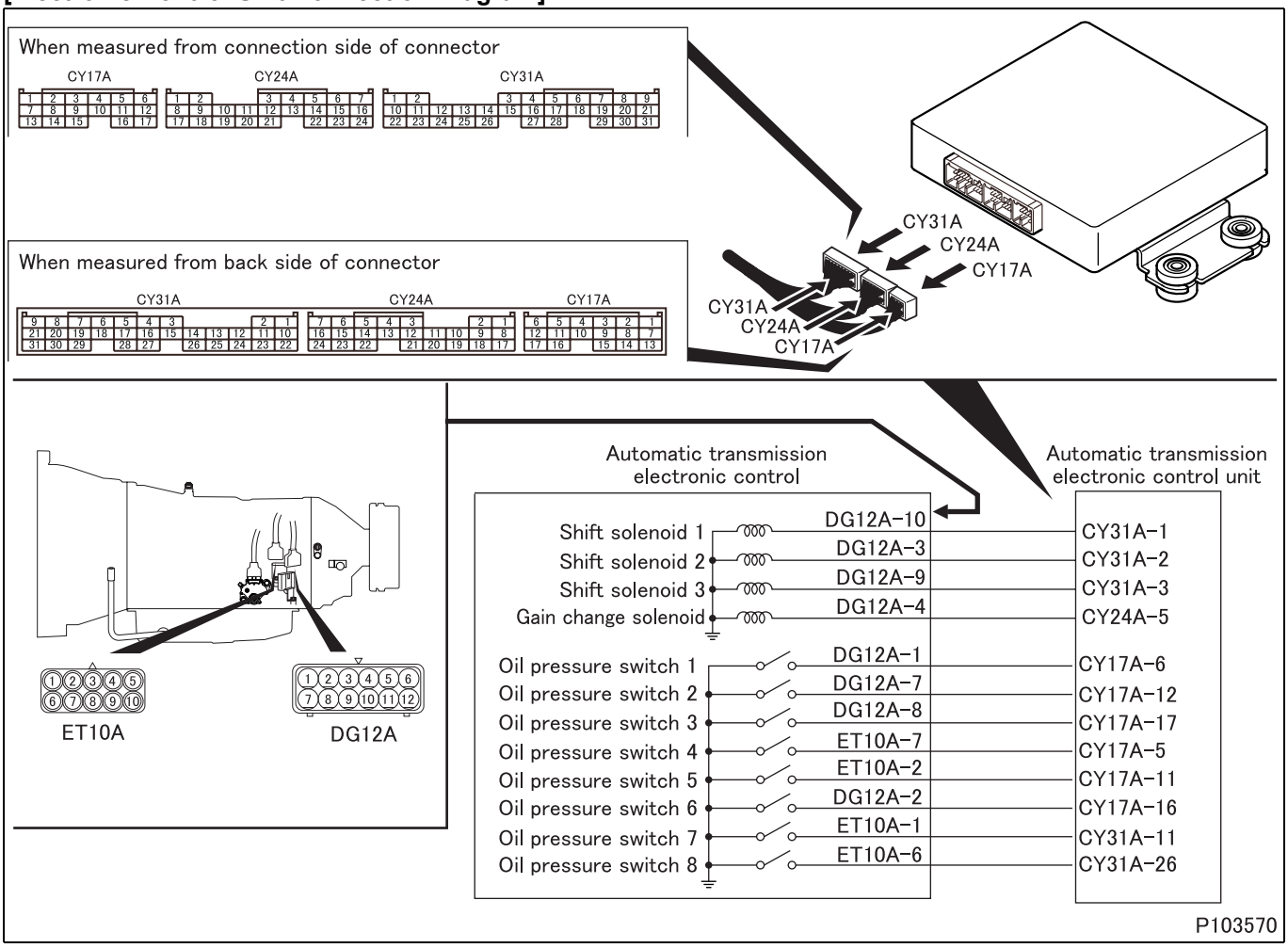
[Diagnostic requirement]
- After shift solenoid 1 switched from pressure OFF to ON

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

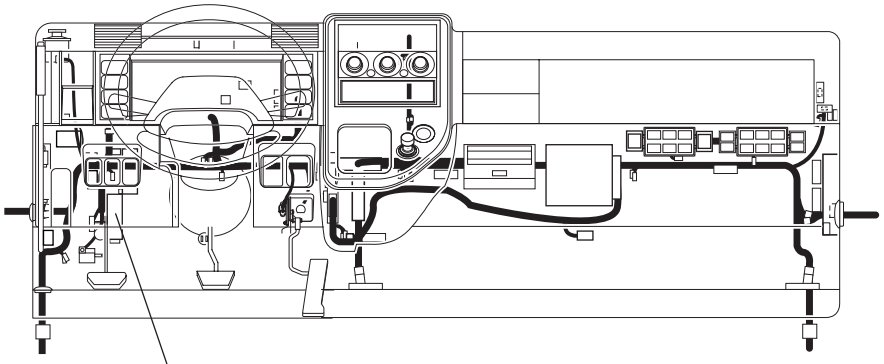
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and shift solenoid 1 or oil pressure switch 3
- Malfunction of each connector
- Malfunction of shift solenoid 1 or oil pressure switch 3
- Malfunction of electronic control unit

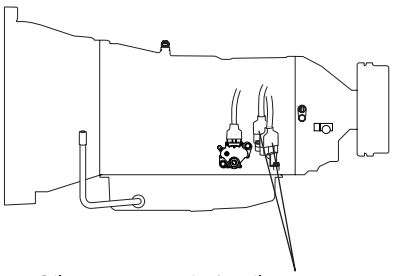
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY31A) terminal No. 1 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 31 “Shift Valve 1” and No. 71 “Shift Valve Press 1” of Service Data.
	Inspection condition		Vehicle run **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 31 “Shift Valve 1”> • In 3rd, 4th gears: ON • In any gears except above: OFF <No. 71 “Shift Valve Press 1”> • In 3rd, 4th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY17A) terminal No. 17 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 63 “Oil Press SW 3” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 0 V • In 1st, 2nd, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 3rd, 4th gears: ON • In 1st, 2nd, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

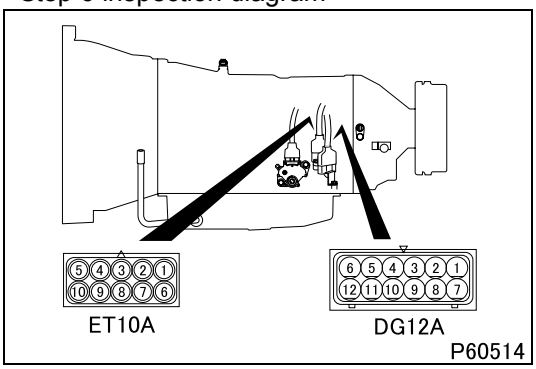
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 1 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 10 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 10 and electronic control unit connector (CY31A) terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY31A) terminal No. 1 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 31 “Shift Valve 1” and No. 71 “Shift Valve Press 1” of Service Data.
	Inspection condition		Vehicle run **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 31 “Shift Valve 1”> • In 3rd, 4th gears: ON • In any gears except above: OFF <No. 71 “Shift Valve Press 1”> • In 3rd, 4th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY17A) terminal No. 17 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 63 “Oil Press SW 3” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 0 V • In 1st, 2nd, 5th, 6th gear: 12 V **<Multi-Use Tester used>** • In 3rd, 4th gears: ON • In 1st, 2nd, 5th, 6th gear: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 3 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0752/Flash code: 45
[Monitor ID]
51
[Fault (outline)]
Shift solenoid 1 binds in ON state.
[Diagnosis check]
- Shift solenoid 1 is monitored for fault when switched from pressure ON to pressure OFF according to the response of oil pressure switch 3

[Code generation condition]
- Oil pressure switch 3 remains ON (high pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

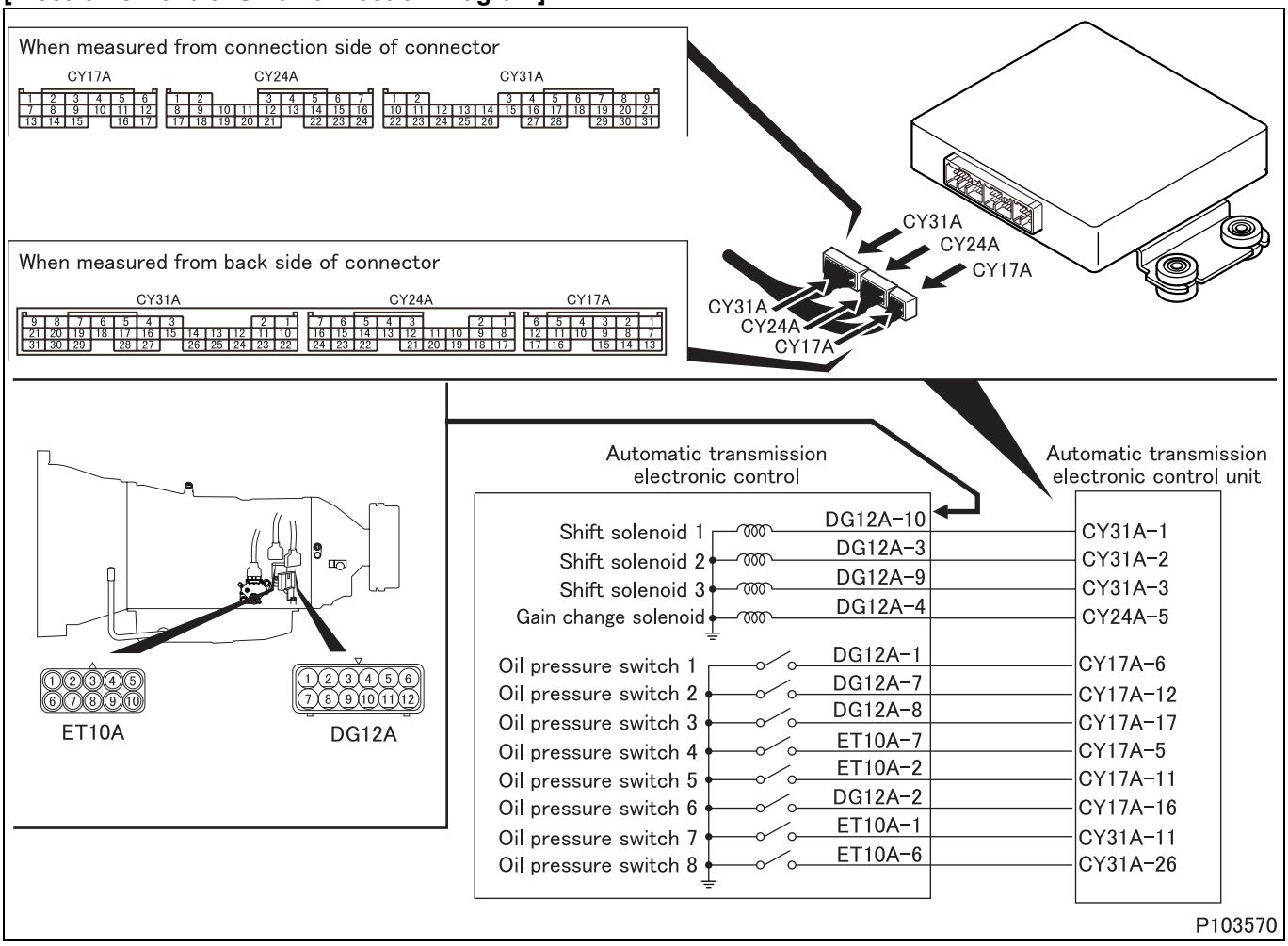
[Diagnostic requirement]
- After shift solenoid 1 switched from pressure ON to OFF

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

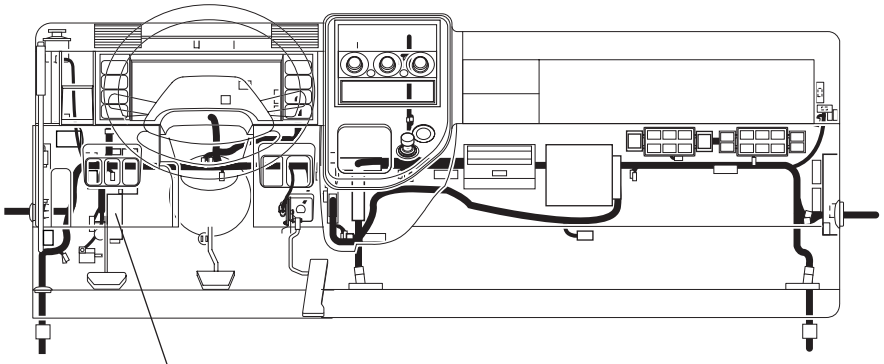
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and shift solenoid 1 or oil pressure switch 3
- Malfunction of each connector
- Malfunction of shift solenoid 1 or oil pressure switch 3
- Malfunction of electronic control unit

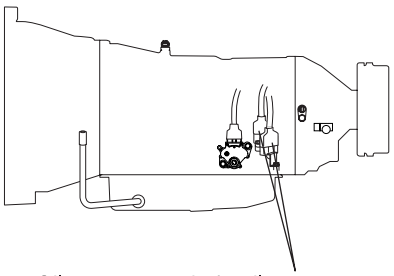
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY31A) terminal No. 1 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 31 “Shift Valve 1” and No. 71 “Shift Valve Press 1” of Service Data.
	Inspection condition		Vehicle run **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 31 “Shift Valve 1”> • In 3rd, 4th gears: ON • In any gears except above: OFF <No. 71 “Shift Valve Press 1”> • In 3rd, 4th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY17A) terminal No. 17 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 63 “Oil Press SW 3” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 0 V • In 1st, 2nd, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 3rd, 4th gears: ON • In 1st, 2nd, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

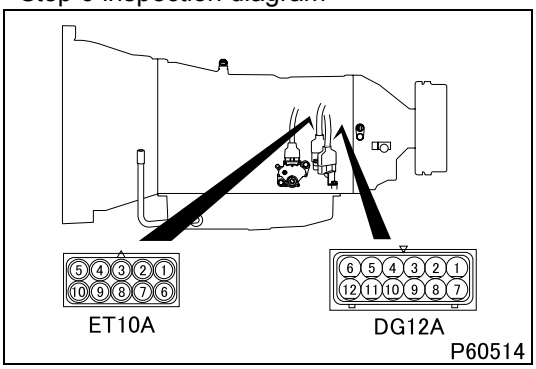
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 1 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 10 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 10 and electronic control unit connector (CY31A) terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY31A) terminal No.1 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 31 “Shift Valve 1” and No. 71 “Shift Valve Press 1” of Service Data.
	Inspection condition		Vehicle run **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 31 “Shift Valve 1”> • In 3rd, 4th gears: ON • In any gears except above: OFF <No. 71 “Shift Valve Press 1”> • In 3rd, 4th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY17A) terminal No. 17 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 63 “Oil Press SW 3” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 0 V • In 1st, 2nd, 5th, 6th gear: 12 V **<Multi-Use Tester used>** • In 3rd, 4th gears: ON • In 1st, 2nd, 5th, 6th gear: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 3 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0756/Flash code: 46
[Monitor ID]
56
[Fault (outline)]
Shift solenoid 2 binds in OFF state.
[Diagnosis check]
- Shift solenoid 2 is monitored for fault when switched from pressure OFF to pressure ON according to the response of oil pressure switch 4

[Code generation condition]
- Oil pressure switch 4 remains OFF (low pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

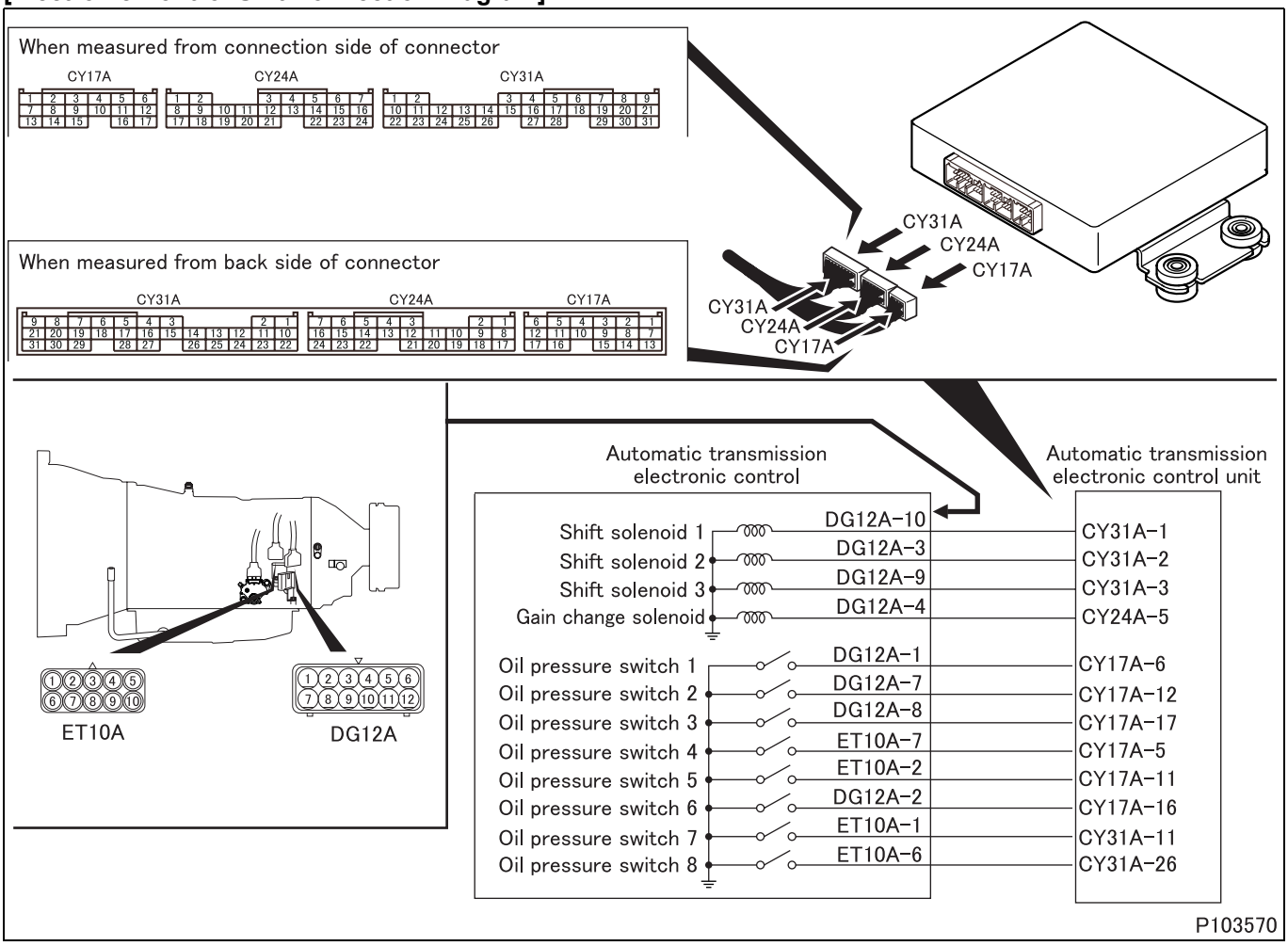
[Diagnostic requirement]
- After shift solenoid 2 switched from pressure OFF to ON

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

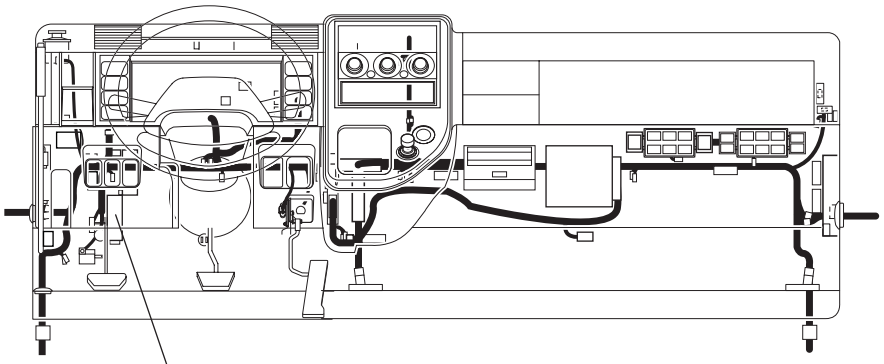
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and shift solenoid 2 or oil pressure switch 4
- Malfunction of each connector
- Malfunction of shift solenoid 2 or oil pressure switch 4
- Malfunction of electronic control unit

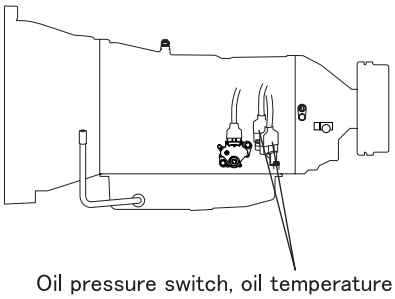
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY31A) terminal No.2 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 32 “Shift Valve 2” and No. 72 “Shift Valve Press 2” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, and 6th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 32 “Shift Valve 2”> • In 4th, 5th, and 6th gears: ON • In any gears except above: OFF <No. 72 “Shift Valve Press 2”> • In 4th, 5th, and 6th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 64 “Oil Press SW 4” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 0 V • In 1st, 2nd, 3rd gears: 12 V **<Multi-Use Tester used>** • In 4th, 5th, 6th gears: ON • In 1st, 2nd, 3rd gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

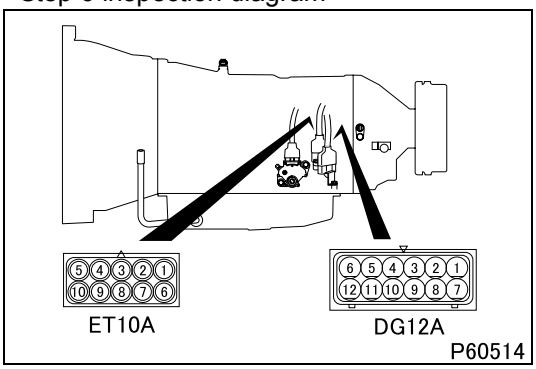
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 2 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 3 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 3 and electronic control unit connector (CY31A) terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY31A) terminal No.1 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 32 “Shift Valve 2” and No. 72 “Shift Valve Press 2” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, and 6th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 32 “Shift Valve 2”> • In 4th, 5th, and 6th gears: ON • In any gears except above: OFF <No. 72 “Shift Valve Press 2”> • In 4th, 5th, and 6th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 64 “Oil Press SW 4” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 0 V • In 1st, 2nd, 3rd gears: 12 V **<Multi-Use Tester used>** • In 4th, 5th, 6th gears: ON • In 1st, 2nd, 3rd gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 4 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0757/Flash code: 46
[Monitor ID]
55
[Fault (outline)]
Shift solenoid 2 binds in ON state.
[Diagnosis check]
- Shift solenoid 2 is monitored for fault when switched from pressure ON to pressure OFF according to the response of oil pressure switch 4

[Code generation condition]
- Oil pressure switch 4 remains ON (high pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

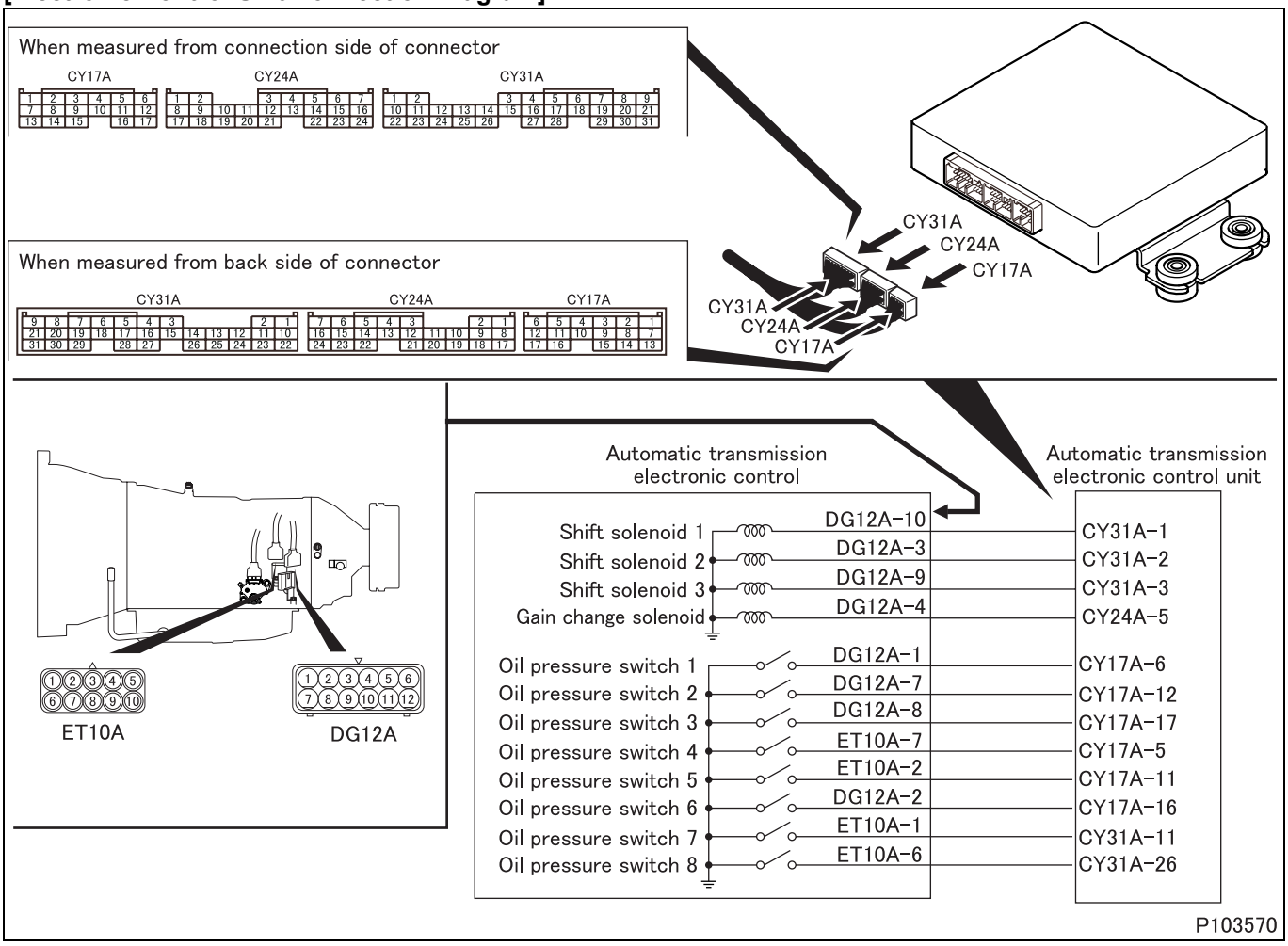
[Diagnostic requirement]
- After shift solenoid 2 switched from pressure ON to OFF

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (5th).

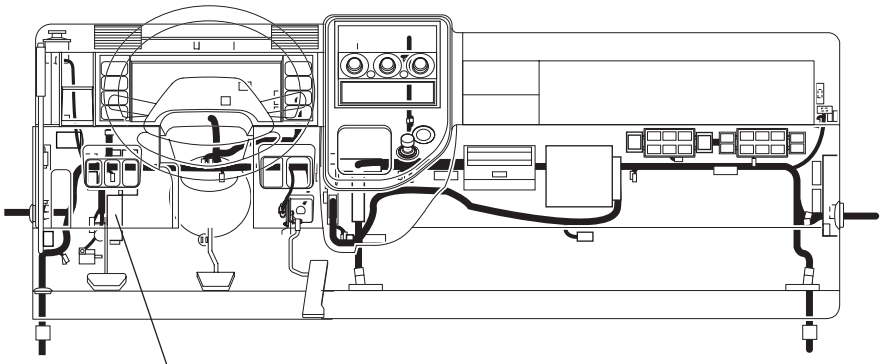
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and shift solenoid 2 or oil pressure switch 4
- Malfunction of each connector
- Malfunction of shift solenoid 2 or oil pressure switch 4
- Malfunction of electronic control unit

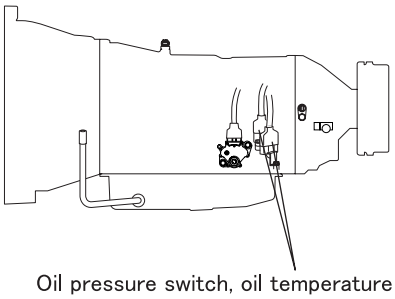
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY31A) terminal No. 2 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 32 “Shift Valve 2” and No. 72 “Shift Valve Press 2” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, and 6th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 32 “Shift Valve 2”> • In 4th, 5th, and 6th gears: ON • In any gears except above: OFF <No. 72 “Shift Valve Press 2”> • In 4th, 5th, and 6th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 64 “Oil Press SW 4” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 0 V • In 1st, 2nd, 3rd gears: 12 V **<Multi-Use Tester used>** • In 4th, 5th, 6th gears: ON • In 1st, 2nd, 3rd gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

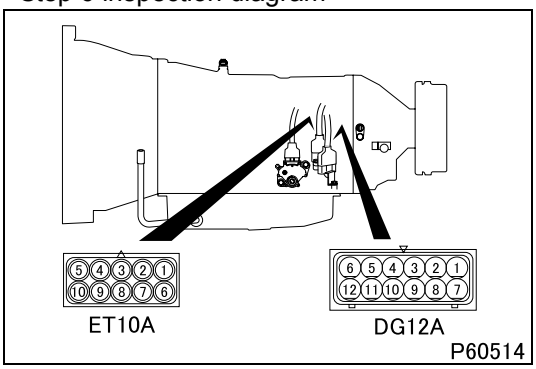
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 2 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 3 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 3 and electronic control unit connector (CY31A) terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between electronic control unit connector (CY31A) terminal No.1 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 32 “Shift Valve 2” and No. 72 “Shift Valve Press 2” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, and 6th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 32 “Shift Valve 2”> • In 4th, 5th, and 6th gears: ON • In any gears except above: OFF <No. 72 “Shift Valve Press 2”> • In 4th, 5th, and 6th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 64 “Oil Press SW 4” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 0 V • In 1st, 2nd, 3rd gears: 12 V **<Multi-Use Tester used>** • In 4th, 5th, 6th gears: ON • In 1st, 2nd, 3rd gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 4 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0761/Flash code: 47
[Monitor ID]
60
[Fault (outline)]
Shift solenoid 3 binds in OFF state.
[Diagnosis check]
- Shift solenoid 3 (shift solenoid valve 3) is monitored for fault when switched from pressure OFF to pressure ON according to the response of oil pressure switch 5

[Code generation condition]
- Oil pressure switch 5 remains OFF.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

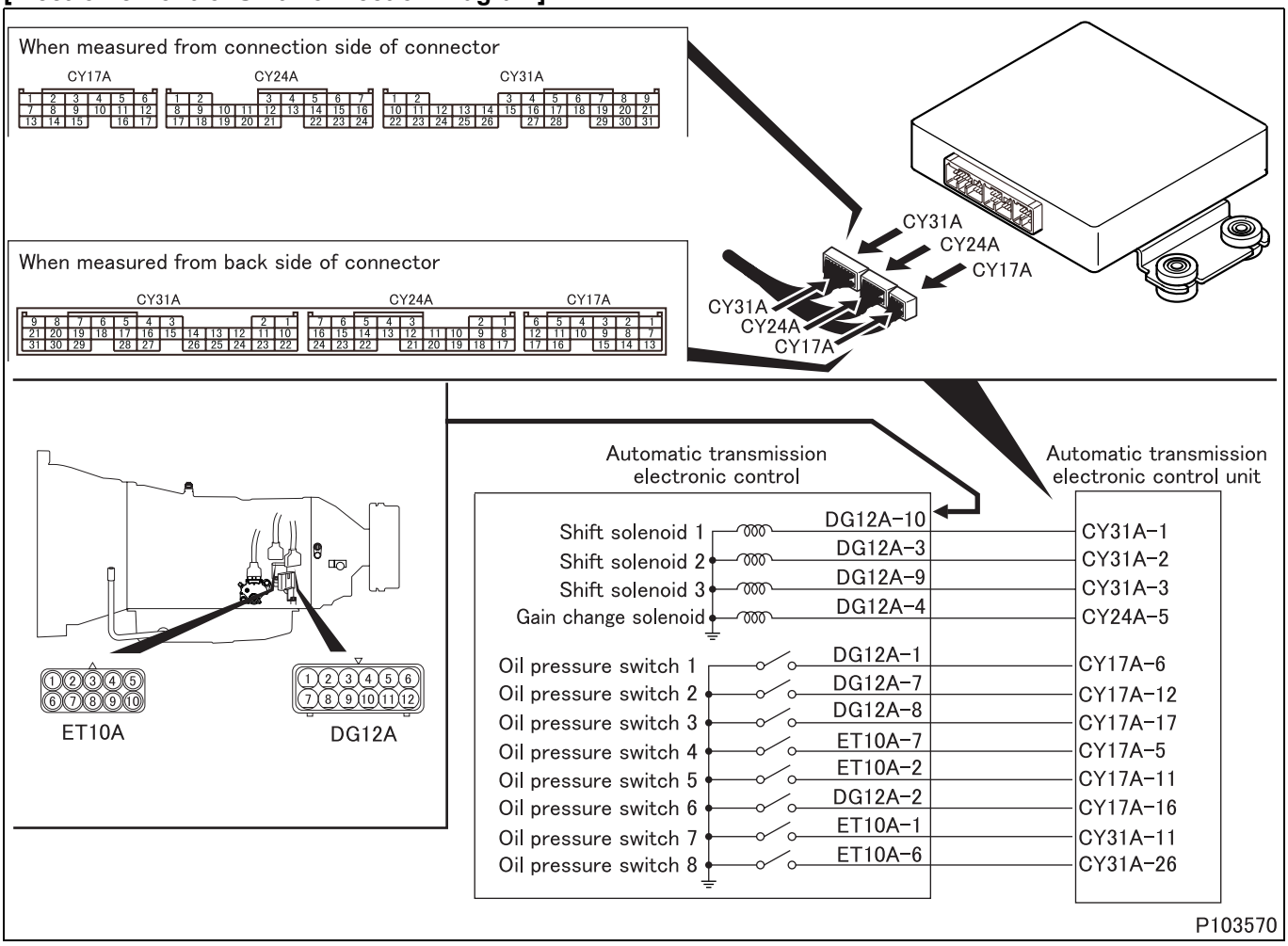
[Diagnostic requirement]
- After shift solenoid 3 (shift solenoid valve 3) switched from pressure OFF to ON

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

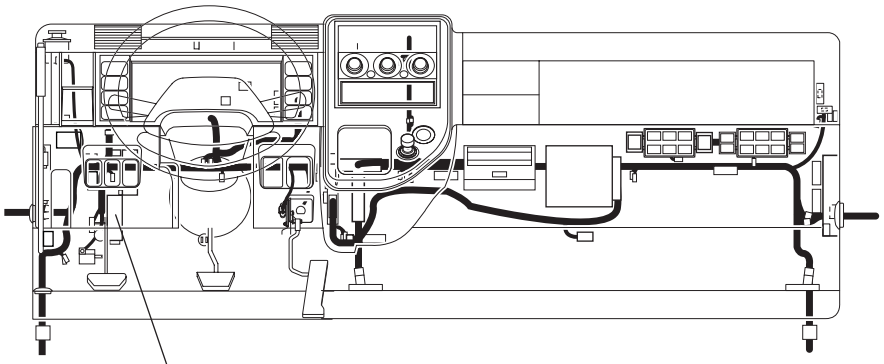
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and shift solenoid 3 or oil pressure switch 5
- Malfunction of each connector
- Malfunction of shift solenoid 3 or oil pressure switch 5
- Malfunction of electronic control unit

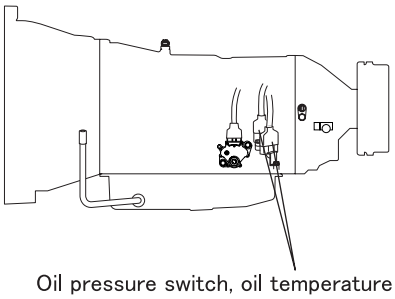
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 65 “Oil Press SW 5” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

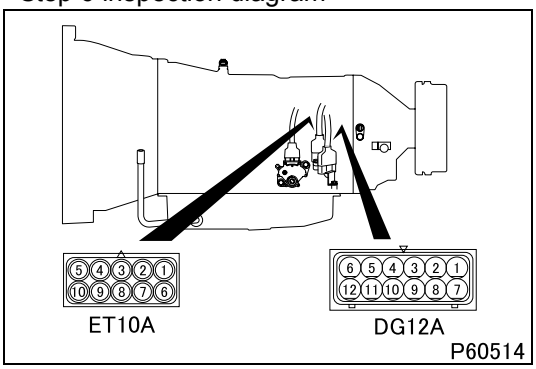
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 3 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 9 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 9 and electronic control unit connector (CY31A) terminal No. 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 65 “Oil Press SW 5” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 5 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0762/Flash code: 47
[Monitor ID]
59
[Fault (outline)]
Shift solenoid 3 binds in ON state.
[Diagnosis check]
- Shift solenoid 3 (shift solenoid valve 3) is monitored for fault when switched from pressure ON to pressure OFF according to the response of oil pressure switch 5

[Code generation condition]
- Oil pressure switch 5 remains ON (high pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

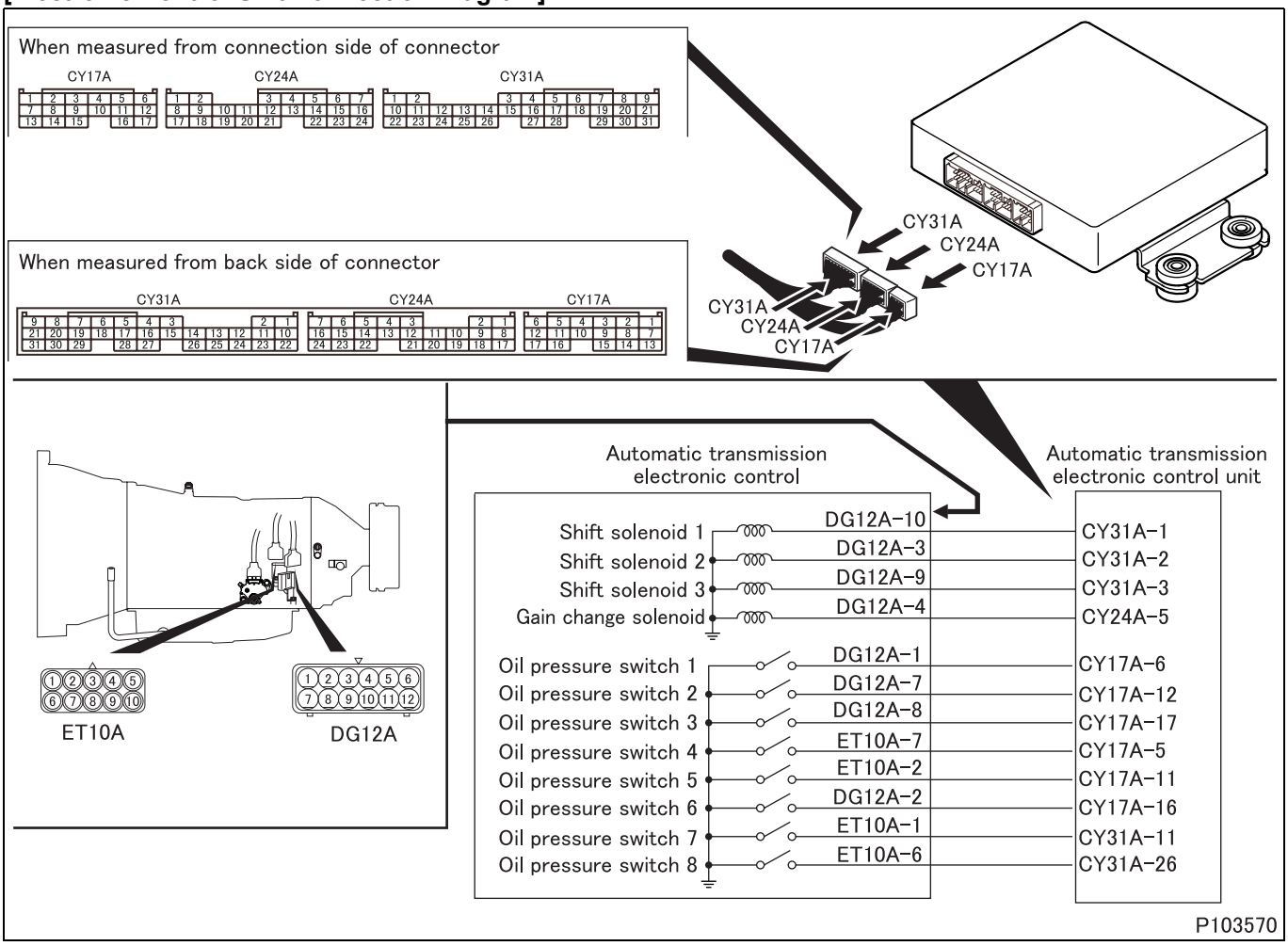
[Diagnostic requirement]
- After shift solenoid 3 (shift solenoid valve 3) switched from pressure ON to OFF

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

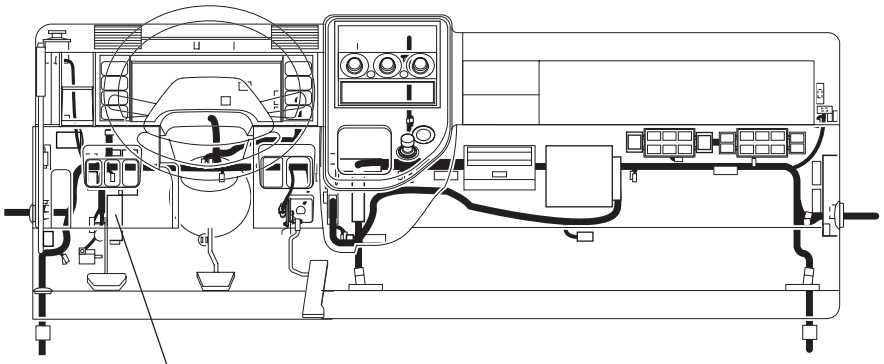
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and shift solenoid 3 or oil pressure switch 5
- Malfunction of each connector
- Malfunction of shift solenoid 3 or oil pressure switch 5
- Malfunction of electronic control unit

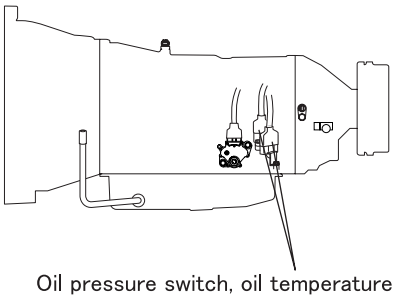
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 65 “Oil Press SW 5” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

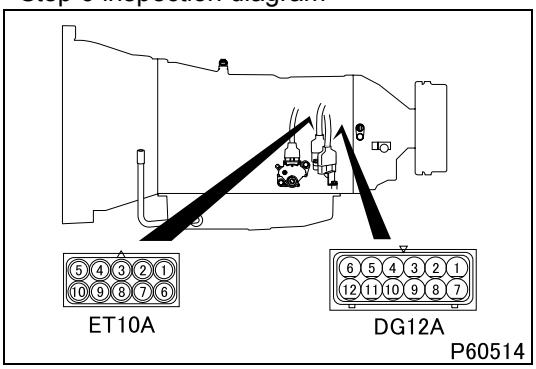
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 3 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 9 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 9 and electronic control unit connector (CY31A) terminal No. 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 65 “Oil Press SW 5” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 5 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0766/Flash code: 55
[Monitor ID]
64
[Fault (outline)]
Shift solenoid 3 binds in OFF state.
[Diagnosis check]
- Shift solenoid 3 (shift solenoid valve 4) is monitored for fault when switched from pressure OFF to pressure ON according to the response of oil pressure switch 6

[Code generation condition]
- Oil pressure switch 6 remains OFF (low pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

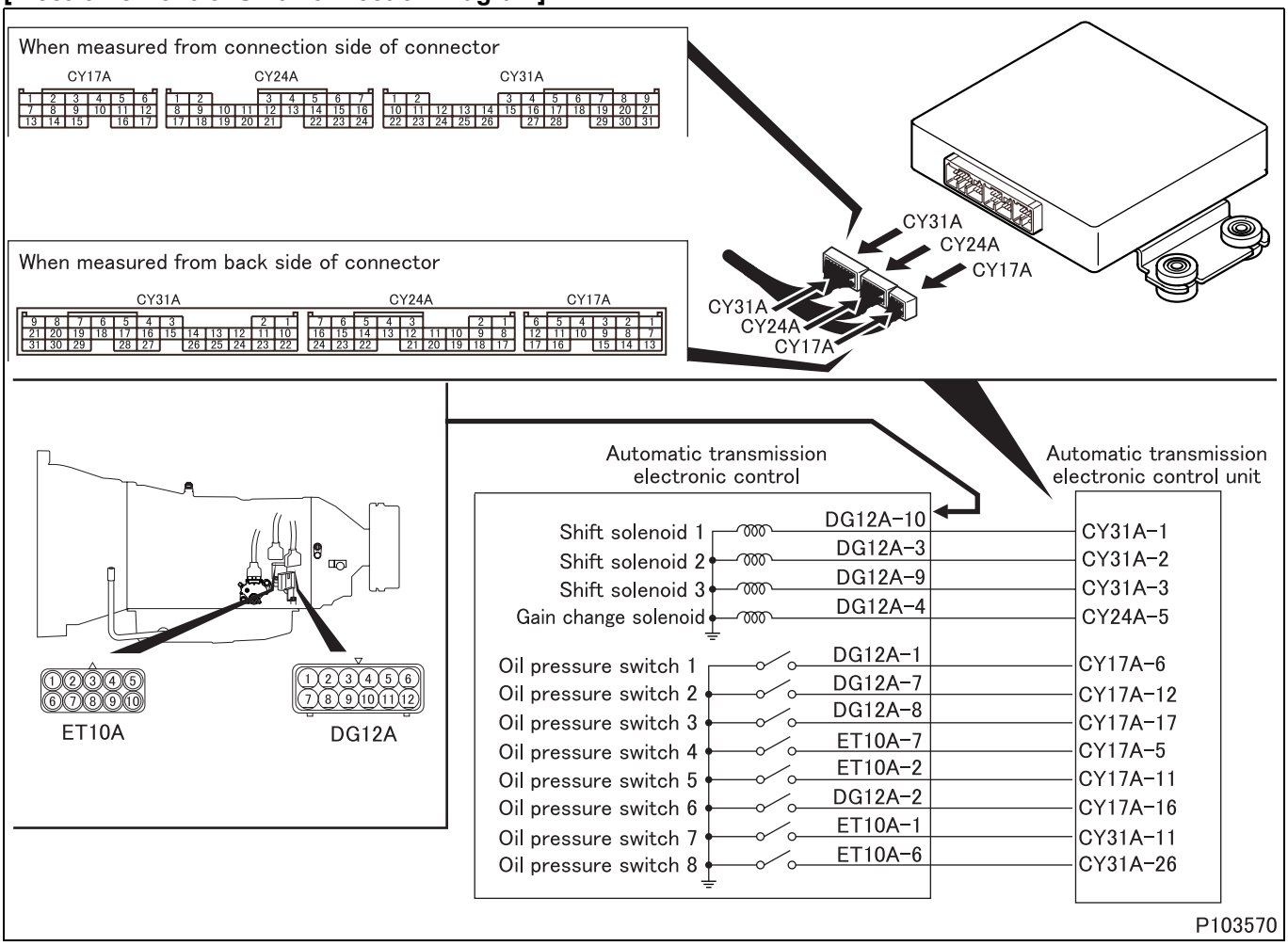
[Diagnostic requirement]
- After shift solenoid 3 (shift solenoid valve 4) switched from pressure OFF to ON

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

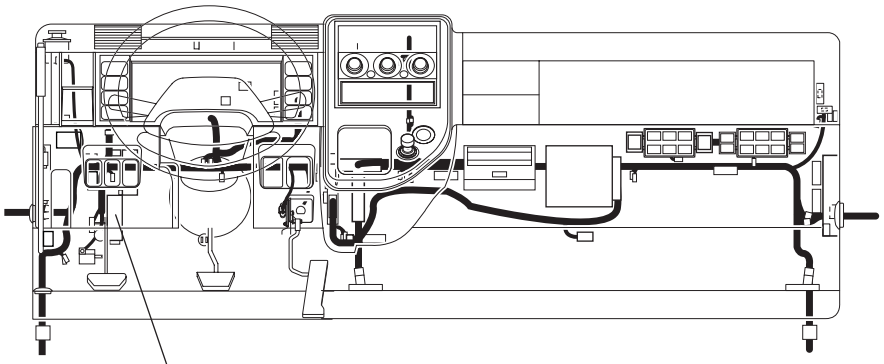
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and shift solenoid 3 or oil pressure switch 6
- Malfunction of each connector
- Malfunction of shift solenoid 3 or oil pressure switch 6
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

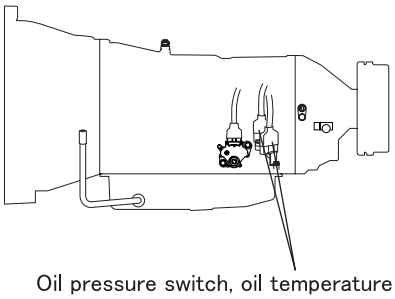
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Automatic transmission electronic control unit



Oil pressure switch, oil temperature sensor (outside), shift solenoid and linear solenoid [ET10A, DG12A]

P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 16 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 66 “Oil Press SW 6” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

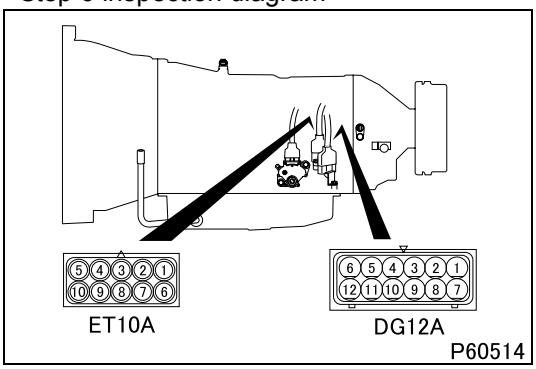
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 5 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 4 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 4 and electronic control unit connector (CY24A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 16 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 66 “Oil Press SW 6” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 6 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0767/Flash code: 55
[Monitor ID]
63
[Fault (outline)]
Shift solenoid 3 binds in ON state.
[Diagnosis check]
- Shift solenoid 3 (shift solenoid valve 4) is monitored for fault when switched from pressure ON to pressure OFF according to the response of oil pressure switch 6

[Code generation condition]
- Oil pressure switch 6 remains ON (high pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

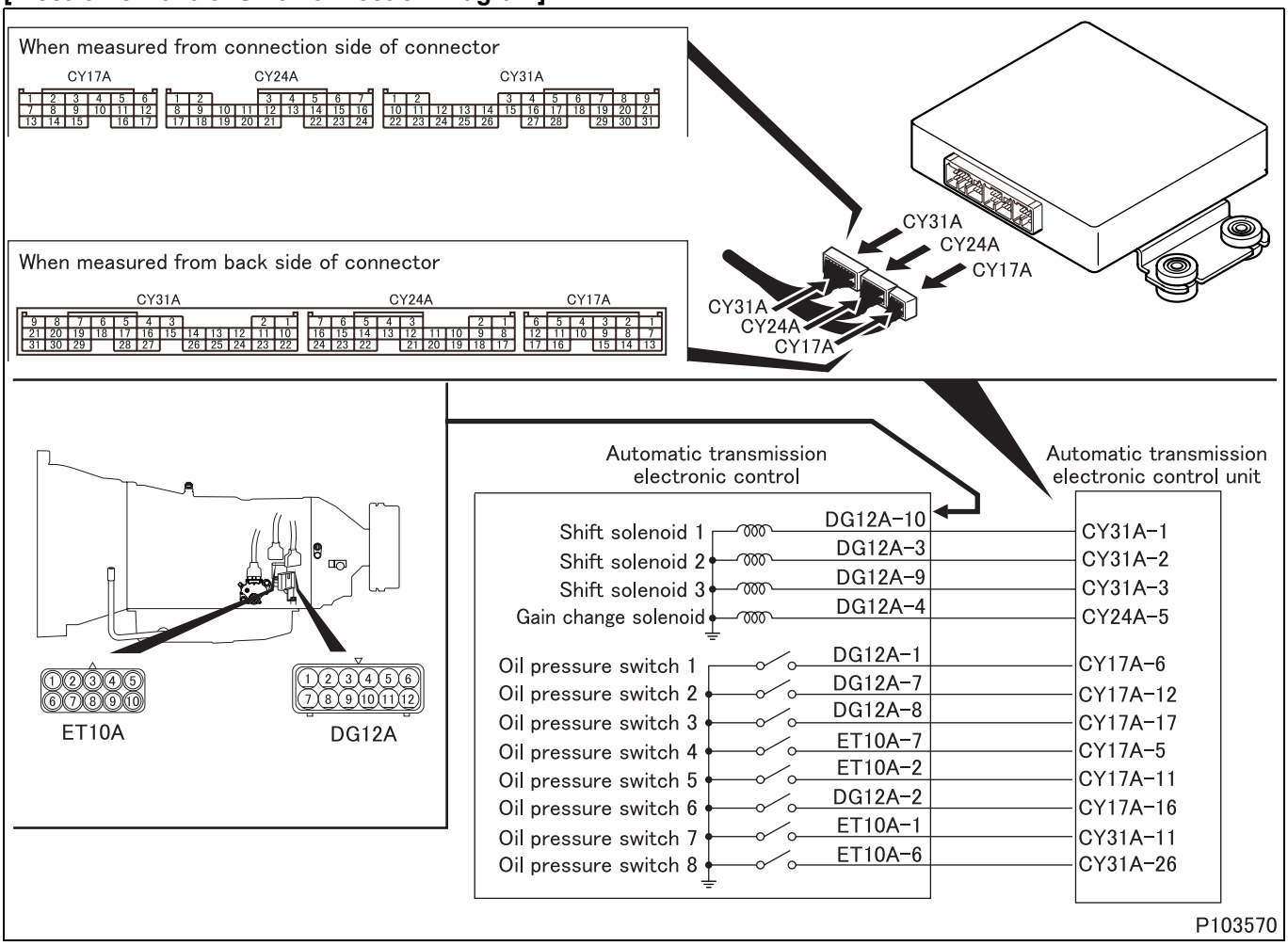
[Diagnostic requirement]
- After shift solenoid 3 (shift solenoid valve 4) switched from pressure ON to OFF

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

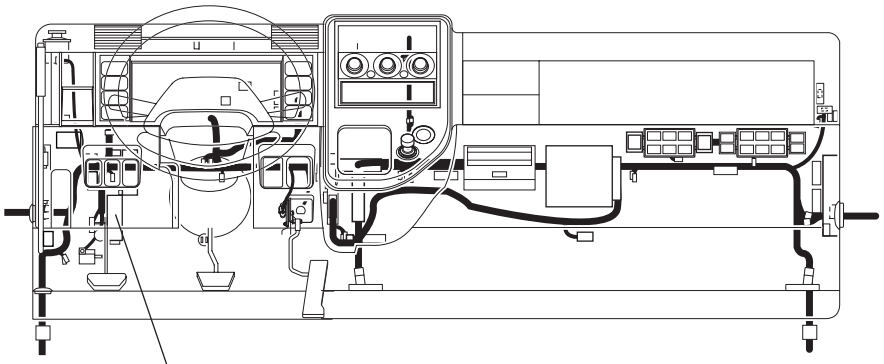
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and shift solenoid 3 or oil pressure switch 6
- Malfunction of each connector
- Malfunction of shift solenoid 3 or oil pressure switch 6
- Malfunction of electronic control unit

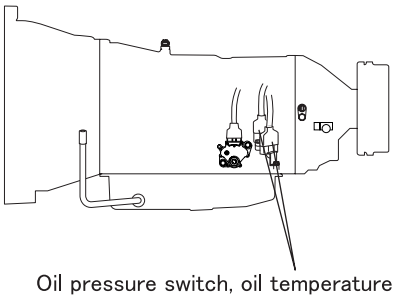
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 16 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 66 “Oil Press SW 6” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

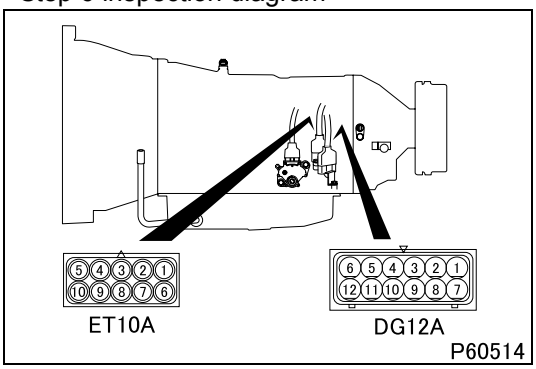
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 5 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 4 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 4 and electronic control unit connector (CY24A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 9.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 16 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 66 “Oil Press SW 6” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 6 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0776/Flash code: 42
[Monitor ID]
43, 44
[Fault (outline)]
Linear solenoid 2 binds in OFF state.
[Diagnosis check]
- Linear solenoid 2 is monitored for fault when switched from low to high pressure according to the response of oil pressure switch 2

[Code generation condition]
- Oil pressure switch 2 remains OFF (low pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

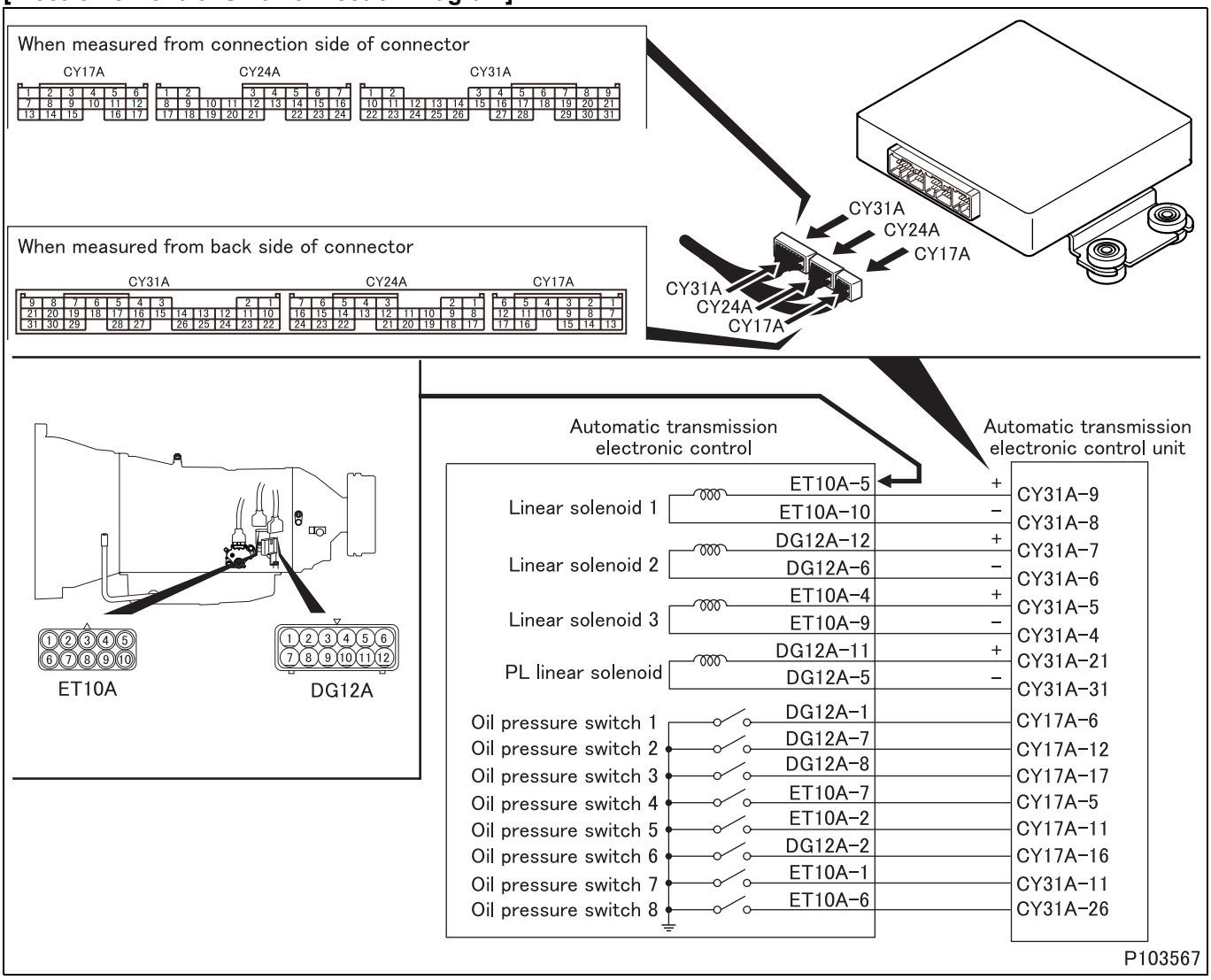
[Diagnostic requirement]
- After linear solenoid 2 switched from low to high pressure
- Automatic transmission fluid temperature: above –10°C {14°F} <used for a part of judgment>

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (4th).

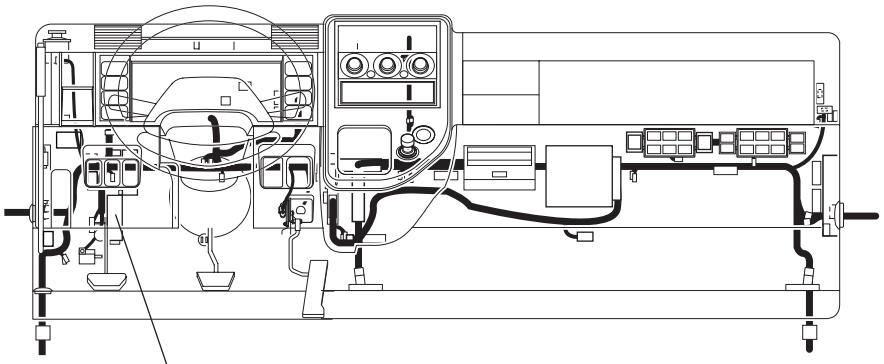
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and linear solenoid 2 or oil pressure switch 2
- Malfunction of each connector
- Malfunction of linear solenoid 2 or oil pressure switch 2
- Malfunction of electronic control unit

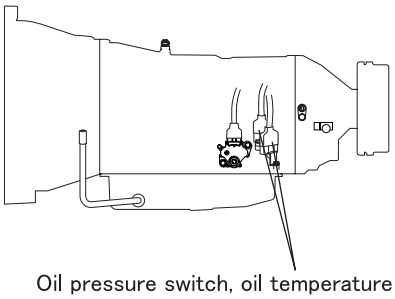
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 27 “Linear Sol Press 2” of Service Data.
	Inspection condition		Vehicle run
	Requirements		• During speed change (2nd to 3rd, 4th to 5th): Rises • During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between connector (CY17A) terminal No. 12 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 62 “Oil Press SW 2” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st, 3rd, 5th gears: 0 V • In 2nd, 4th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st, 3rd, 5th gears: ON • In 2nd, 4th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

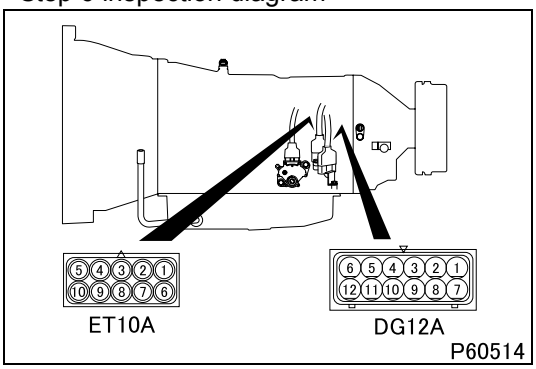
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 6 and 7.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 6 and 12.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 12 and electronic control unit connector (CY31A) terminal No. 7.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between solenoid and electronic control unit (ground)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 6 and electronic control unit connector (CY31A) terminal No. 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 27 “Linear Sol Press 2” of Service Data.
	Inspection condition		Vehicle run
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • During speed change (2nd to 3rd, 4th to 5th): Rises • During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 10.

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between connector (CY17A) terminal No. 12 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 62 “Oil Press SW 2” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st, 3rd, 5th gears: 0 V • In 2nd, 4th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st, 3rd, 5th gears: ON • In 2nd, 4th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Inspection of oil pressure switch 2 is performed.

[Fault code]
Diagnosis code: P0777/Flash code: 42
[Monitor ID]
45
[Fault (outline)]
Linear solenoid 2 binds in ON state.
[Diagnosis check]
- Linear solenoid 2 is monitored for fault when switched from high to low pressure according to the response of oil pressure switch 2

[Code generation condition]
- Oil pressure switch 2 remains ON (high pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

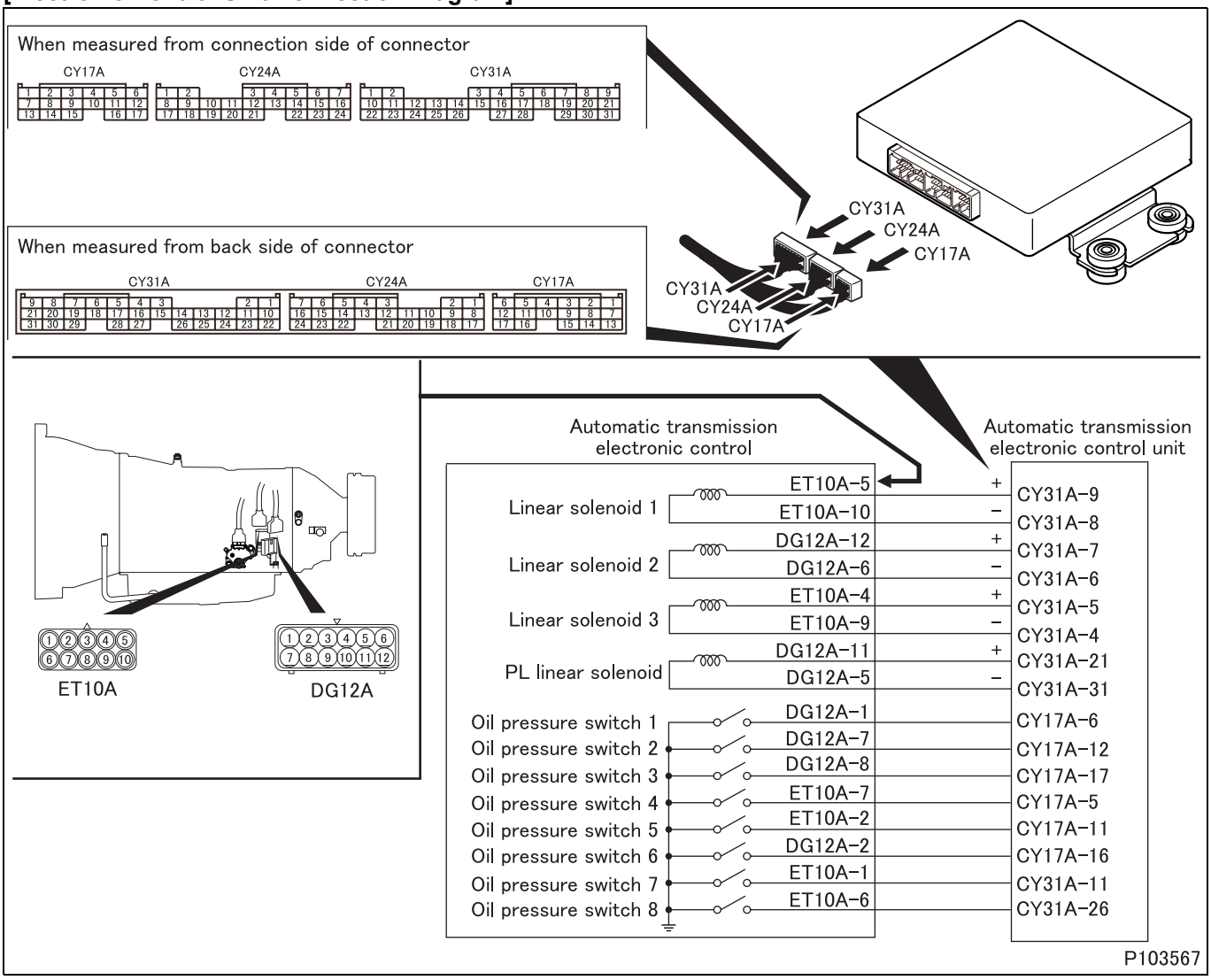
[Diagnostic requirement]
- After linear solenoid 2 switched from high to low pressure

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

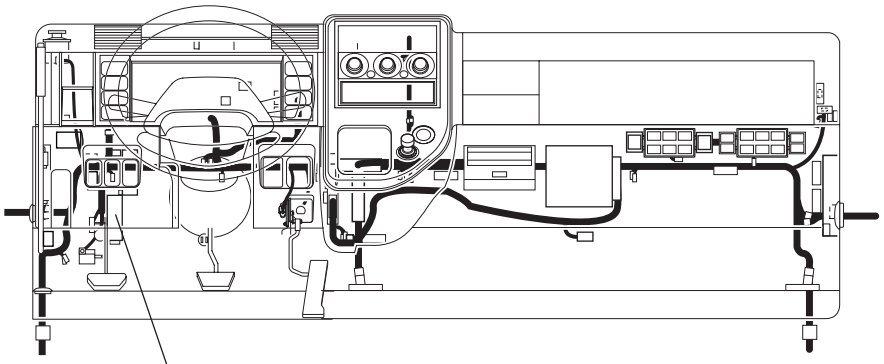
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and linear solenoid 2 or oil pressure switch 2
- Malfunction of each connector
- Malfunction of linear solenoid 2 or oil pressure switch 2
- Malfunction of electronic control unit

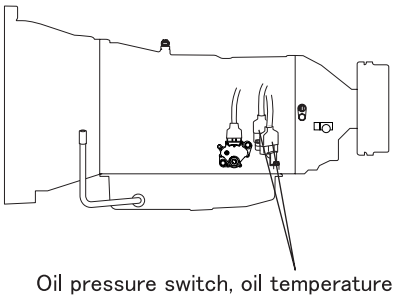
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 27 “Linear Sol Press 2” of Service Data.
	Inspection condition		Vehicle run
	Requirements		• During speed change (2nd to 3rd, 4th to 5th): Rises • During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between connector (CY17A) terminal No. 12 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 62 “Oil Press SW 2” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st, 3rd, 5th gears: 0 V • In 2nd, 4th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st, 3rd, 5th gears: ON • In 2nd, 4th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

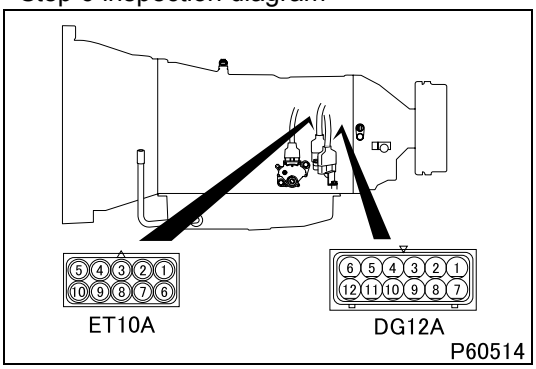
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 6 and 7.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 6 and 12.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 12 and electronic control unit connector (CY31A) terminal No. 7.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between solenoid and electronic control unit (ground)
	Maintenance item		Check circuit between connector (DG12A) terminal No.6 and electronic control unit connector (CY31A) terminal No. 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 27 “Linear Sol Press 2” of Service Data.
	Inspection condition		Vehicle run
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • During speed change (2nd to 3rd, 4th to 5th): Rises • During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 10.

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between connector (CY17A) terminal No. 12 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 62 “Oil Press SW 2” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st, 3rd, 5th gears: 0 V • In 2nd, 4th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st, 3rd, 5th gears: ON • In 2nd, 4th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Inspection of oil pressure switch 2 is performed.

[Fault code]
Diagnosis code: P0778/Flash code: 27
[Monitor ID]
23, 24
[Fault (outline)]
Linear solenoid 2 is open-circuited or short-circuited.
[Diagnosis check]
- Resistance and current value in linear solenoid 2 is monitored for fault.

[Code generation condition]
Linear solenoid is judged faulty in either of the following cases.
- Resistance across the linear solenoid 2 remains higher than the specification (100 Ω) for 0.065 second (open-circuited or circuit shorted to power supply).
- Current flowing in the linear solenoid 2 remains higher than the specification (4A) for 0.065 second (circuit shorted to ground).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

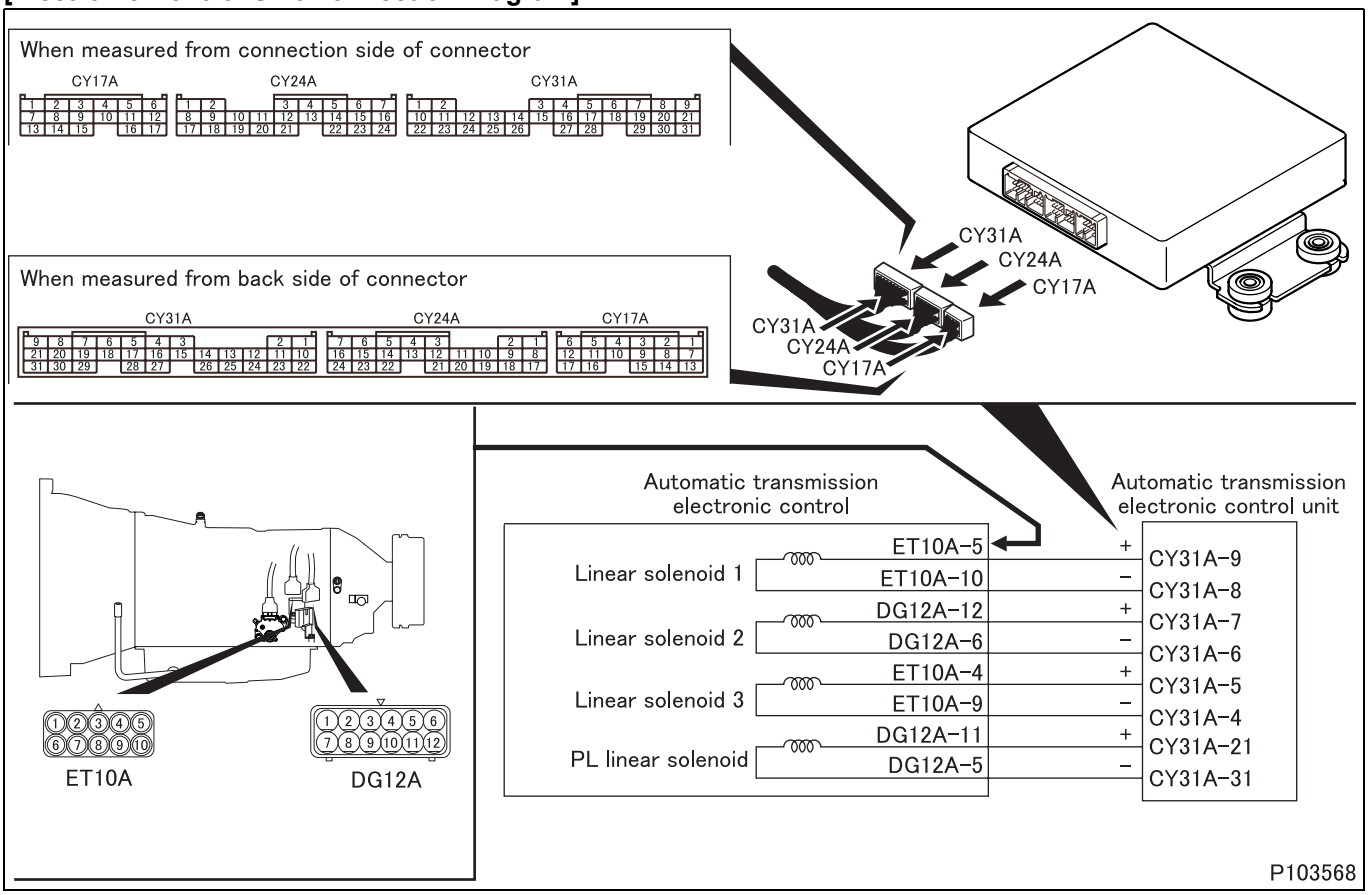
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (4th for open-circuit, 3rd for short-circuit).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and linear solenoid 2
- Malfunction of each connector
- Malfunction of linear solenoid 2
- Malfunction of electronic control unit

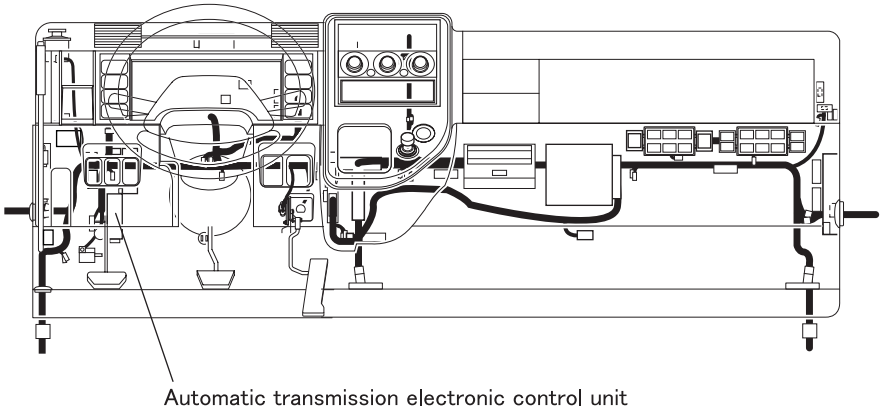
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

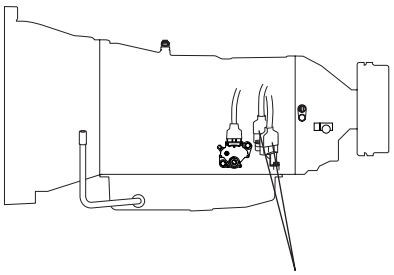
[Electronic Control Unit Connection Diagram]



P103568

[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 27 “Linear Sol Press 2” of Service Data.
	Inspection condition		Vehicle run
	Requirements		• During speed change (2nd to 3rd, 4th to 5th): Rises • During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

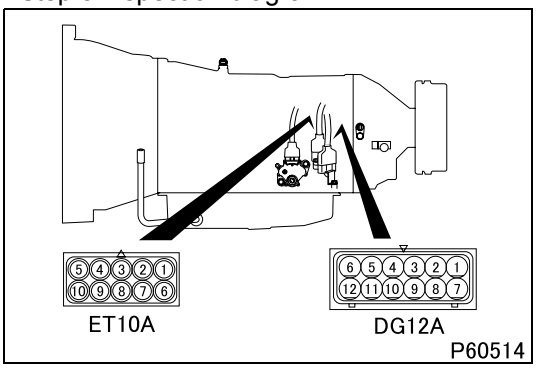
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 6 and 7.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 6 and 12.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 12 and electronic control unit connector (CY31A) terminal No. 7.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (ground)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 6 and electronic control unit connector (CY31A) terminal No. 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 27 “Linear Sol Press 2” of Service Data.
	Inspection condition		Vehicle run
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • During speed change (2nd to 3rd, 4th to 5th): Rises • During speed change (1st to 2nd, 3rd to 4th, 5th to 6th): Declines
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0796/Flash code: 48
[Monitor ID]
47
[Fault (outline)]
Linear solenoid 3 is binds in OFF state.
[Diagnosis check]
- When the garage control (selector lever is shifted from N to D or R range) is terminated, the linear solenoid 3 is monitored for flow of the maximum oil pressure according to the response of oil pressure switch 7 and its condition is decided by the electronic control unit.

[Code generation condition]
- Oil pressure switch 7 remains OFF (low pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

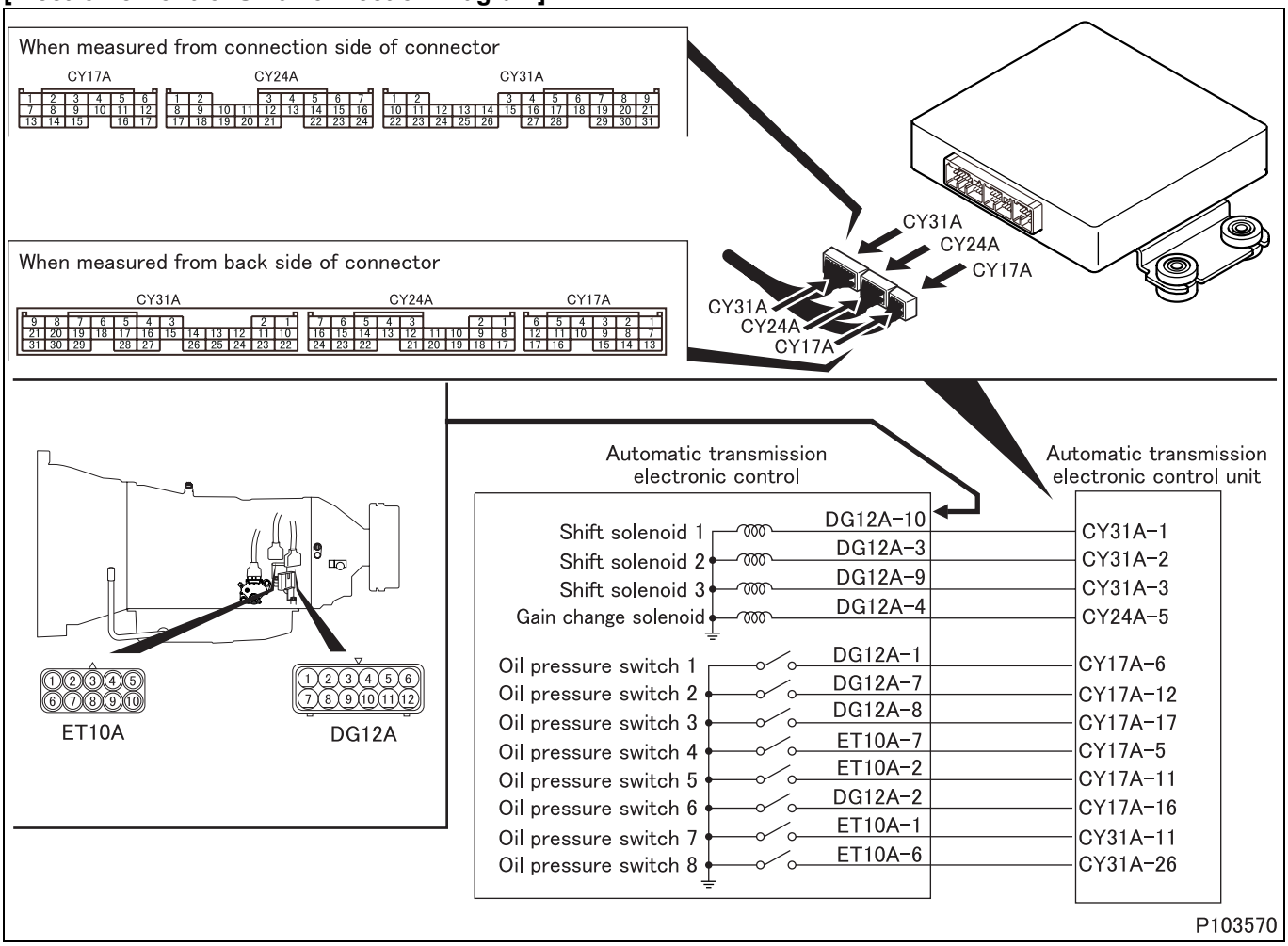
[Diagnostic requirement]
- Garage control: termination

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

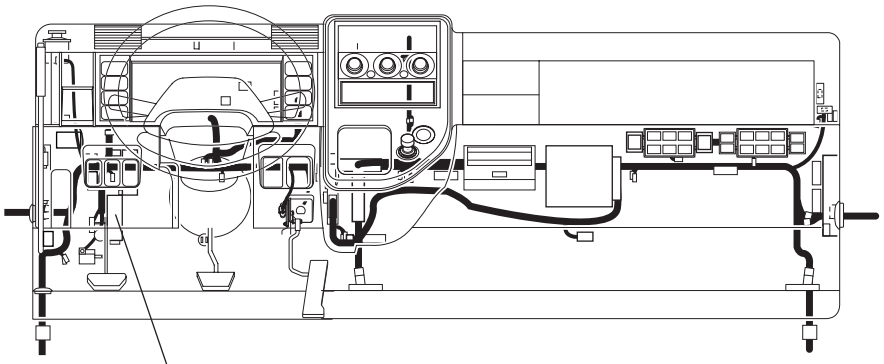
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and linear solenoid 3 or oil pressure switch 7
- Malfunction of each connector
- Malfunction of linear solenoid 3 or oil pressure switch 7
- Malfunction of electronic control unit

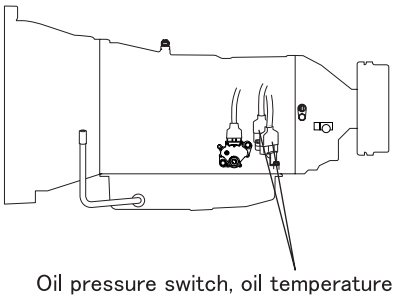
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 35 “Linear Sol Press 3” of Service Data.
	Inspection condition		Engine in operation <When shifting from N to D> With the brake pedal pressed down, shift the range selector lever (from N to D). <In lock-up state> • Item No. 13 “A/T Oil Temp (OP)” indicates 25°C {77°F} or higher. • Lock-up speed (2nd gear, accelerator pedal fully pressed down): 15 to 17 km/h {9.3 to 10.6 mph}
	Requirements		• When shifting from N to D: Varies • In lock-up state: 100 lbf/in^2
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No.11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 67 “Oil Press SW 7” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** When shifting N to D: 12 V → 0 V → 12 V **<Multi-Use Tester used>** When shifting N to D: OFF → ON → OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

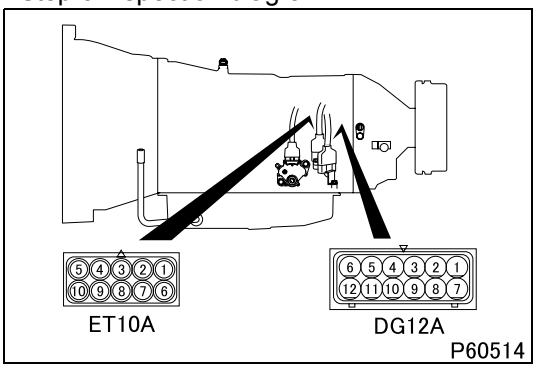
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 5 and 4.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (ET10A) terminal No. 4 and 9.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 4 and electronic control unit connector (CY31A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between solenoid and electronic control unit (ground)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 9 and electronic control unit connector (CY31A) terminal No. 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 35 “Linear Sol Press 3” of Service Data.
	Inspection condition		Engine in operation <When shifting from N to D> With the brake pedal pressed down, shift the range selector lever (from N to D). <In lock-up state> • Item No. 13 “A/T Oil Temp (OP)” indicates 25°C {77°F} or higher. • Lock-up speed (2nd gear, accelerator pedal fully pressed down): 15 to 17 km/h {9.3 to 10.6 mph}
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • When shifting from N to D: Varies • In lock-up state: 100 lbf/in^2
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 10.

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No.11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 67 “Oil Press SW 7” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** When shifting N to D: 12 V → 0 V → 12 V **<Multi-Use Tester used>** When shifting N to D: OFF → ON → OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 7 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0797/Flash code: 48
[Monitor ID]
46
[Fault (outline)]
Linear solenoid 3 is binds in ON state.
[Diagnosis check]
- Linear solenoid 3 is monitored for fault when switched from high to low pressure with the oil pressure switch 6 turned ON (gain change solenoid ON) according to the response of oil pressure switch 7

[Code generation condition]
- Oil pressure switch 7 remains ON (high pressure).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

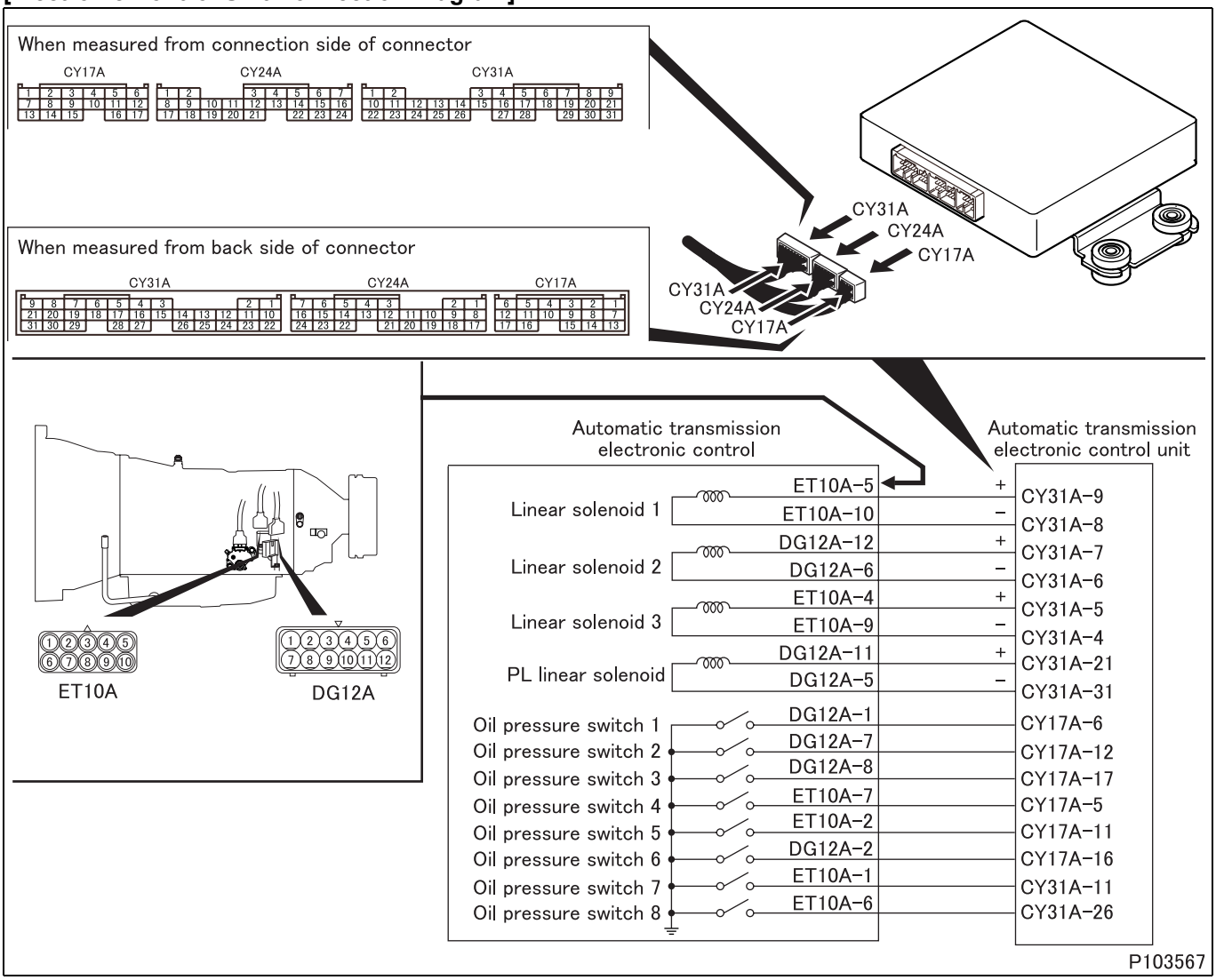
[Diagnostic requirement]
- Oil pressure switch 6: ON

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

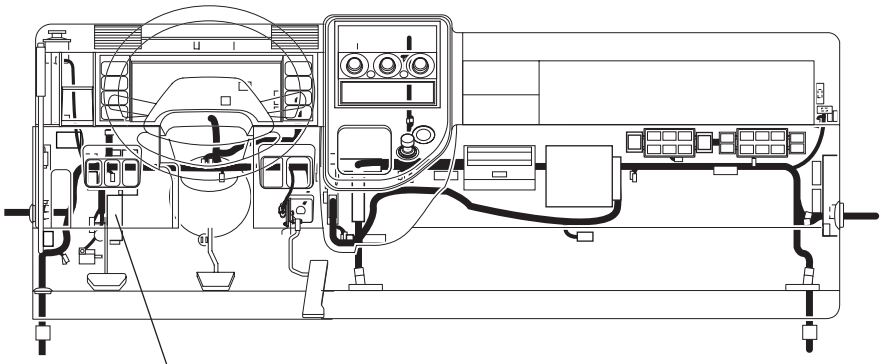
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and linear solenoid 3 or oil pressure switch 7
- Malfunction of each connector
- Malfunction of linear solenoid 3 or oil pressure switch 7
- Malfunction of electronic control unit

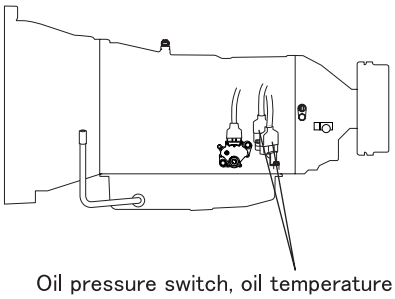
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 35 “Linear Sol Press 3” of Service Data.
	Inspection condition		Engine in operation <When shifting from N to D> With the brake pedal pressed down, shift the range selector lever (from N to D). <In lock-up state> • Item No. 13 “A/T Oil Temp (OP)” indicates 25°C {77°F} or higher. • Lock-up speed (2nd gear, accelerator pedal fully pressed down): 15 to 17 km/h {9.3 to 10.6 mph}
	Requirements		• When shifting from N to D: Varies • In lock-up state: 100 lbf/in^2
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 67 “Oil Press SW 7” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** When shifting N to D: 12 V → 0 V → 12 V **<Multi-Use Tester used>** When shifting N to D: OFF → ON → OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 3.

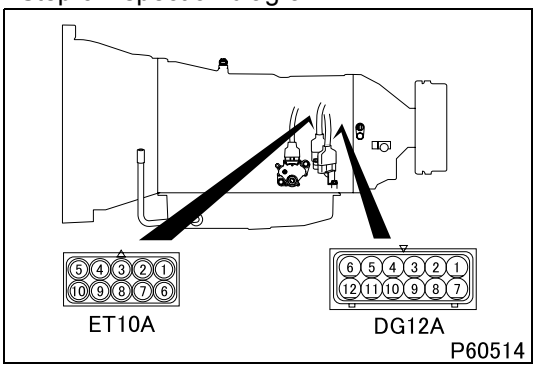
Step 3	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 5 and 4.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Go to step 5.

Step 4	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify connector.

Step 6	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (ET10A) terminal No. 4 and 9.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 6 inspection diagram>



Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 4 and electronic control unit connector (CY31A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection of harness between solenoid and electronic control unit (ground)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 9 and electronic control unit connector (CY31A) terminal No. 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 9.
		NO	Modify harness.

Step 9	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 35 “Linear Sol Press 3” of Service Data.
	Inspection condition		Engine in operation <When shifting from N to D> With the brake pedal pressed down, shift the range selector lever (from N to D). <In lock-up state> • Item No. 13 “A/T Oil Temp (OP)” indicates 25°C {77°F} or higher. • Lock-up speed (2nd gear, accelerator pedal fully pressed down): 15 to 17 km/h {9.3 to 10.6 mph}
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • When shifting from N to D: Varies • In lock-up state: 100 lbf/in^2
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

Step 10	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No.11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 67 “Oil Press SW 7” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** When shifting N to D: 12 V → 0 V → 12 V **<Multi-Use Tester used>** When shifting N to D: OFF → ON → OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of oil pressure switch 7 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P083D/Flash code: 48
[Monitor ID]
48
[Fault (outline)]
Failure of oil pressure switch 7
[Diagnosis check]
- With the oil pressure switch 6 turned ON (gain change solenoid ON), oil pressure switch 7 is monitored for fault when the linear solenoid 3 is deenergized (low pressure).

[Code generation condition]
- Oil pressure switch 7 remains ON (high pressure) for 0.18 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

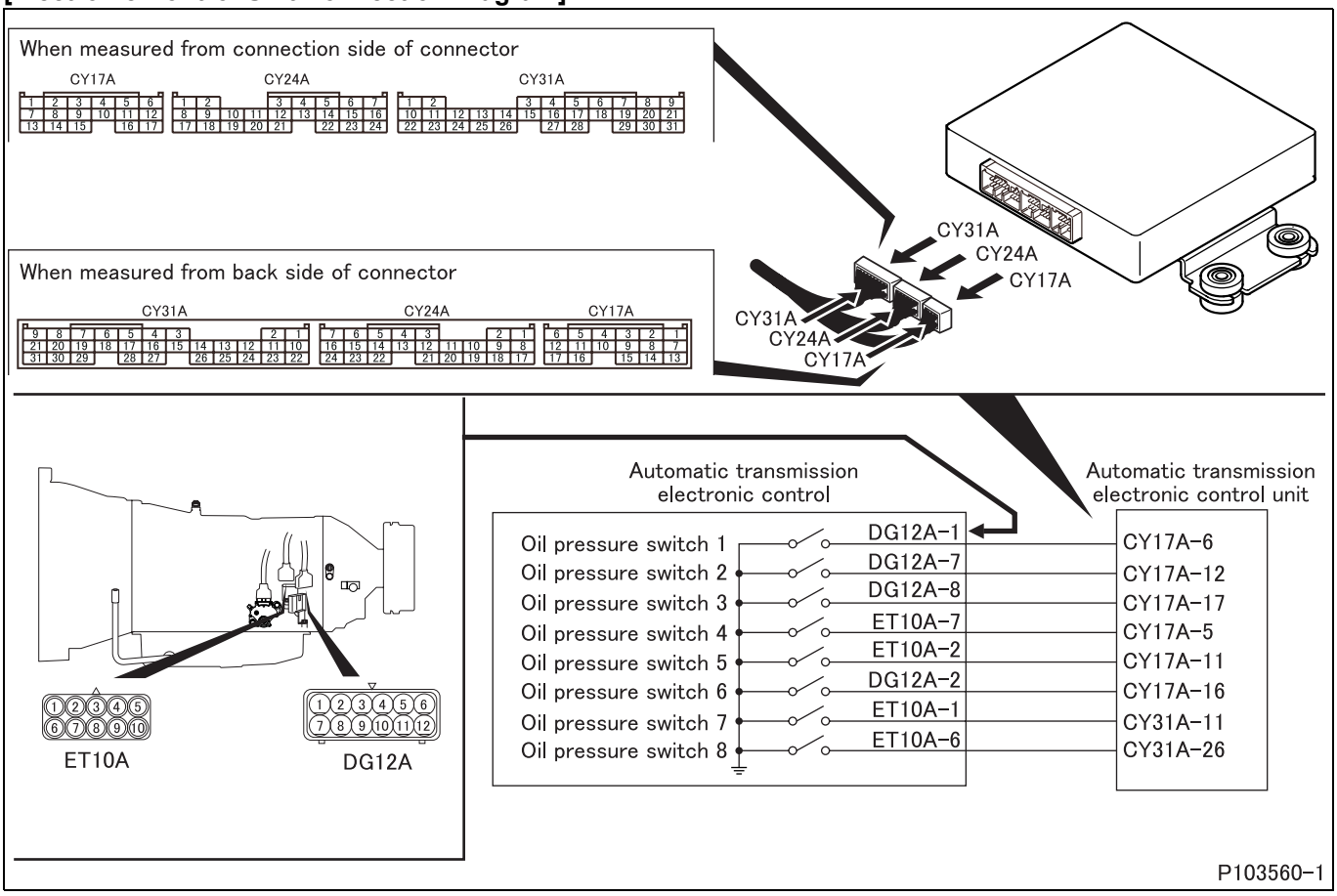
[Diagnostic requirement]
- Oil pressure switch 6: ON
- Linear solenoid 3 is low pressure

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 7 or linear solenoid 3
- Malfunction of each connector
- Malfunction of oil pressure switch 7 or linear solenoid 3
- Malfunction of electronic control unit

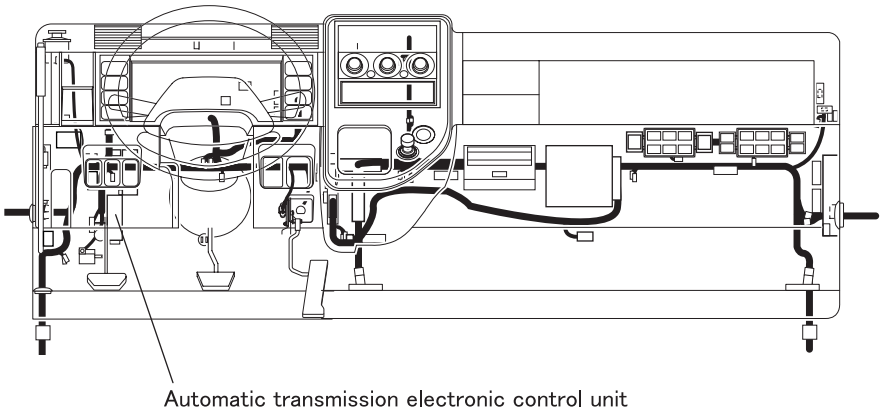
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

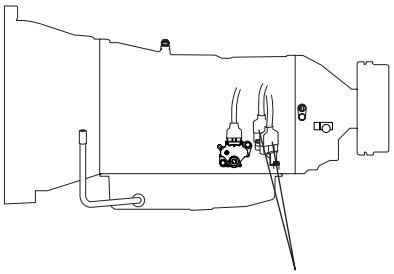
[Electronic Control Unit Connection Diagram]



P103560-1

[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 67 “Oil Press SW 7” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** When shifting from N to D: 12 V → 0 V → 12 V **<Multi-Use Tester used>** When shifting from N to D: OFF → ON → OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

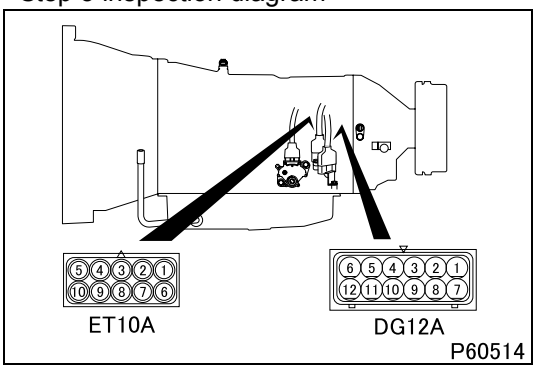
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY31A) terminal No. 11 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (ET10A) terminal No. 1 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 1 and electronic control unit connector (CY31A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 67 “Oil Press SW 7” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** When shifting from N to D: 12 V → 0 V → 12 V **<Multi-Use Tester used>** When shifting from N to D: OFF → ON → OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of linear solenoid 3 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0842/Flash code: 41
[Monitor ID]
37
[Fault (outline)]
Failure of oil pressure switch 1
[Diagnosis check]
- Oil pressure switch 1 is monitored for fault when the linear solenoid 1 is energized (high pressure).

[Code generation condition]
- Oil pressure switch 1 is judged faulty when the oil pressure switch 1 remains OFF (low pressure) for 2 seconds, then N, R or P range is selected and the oil pressure switch 8 remains OFF for 0.5 second (check if stuck ON).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

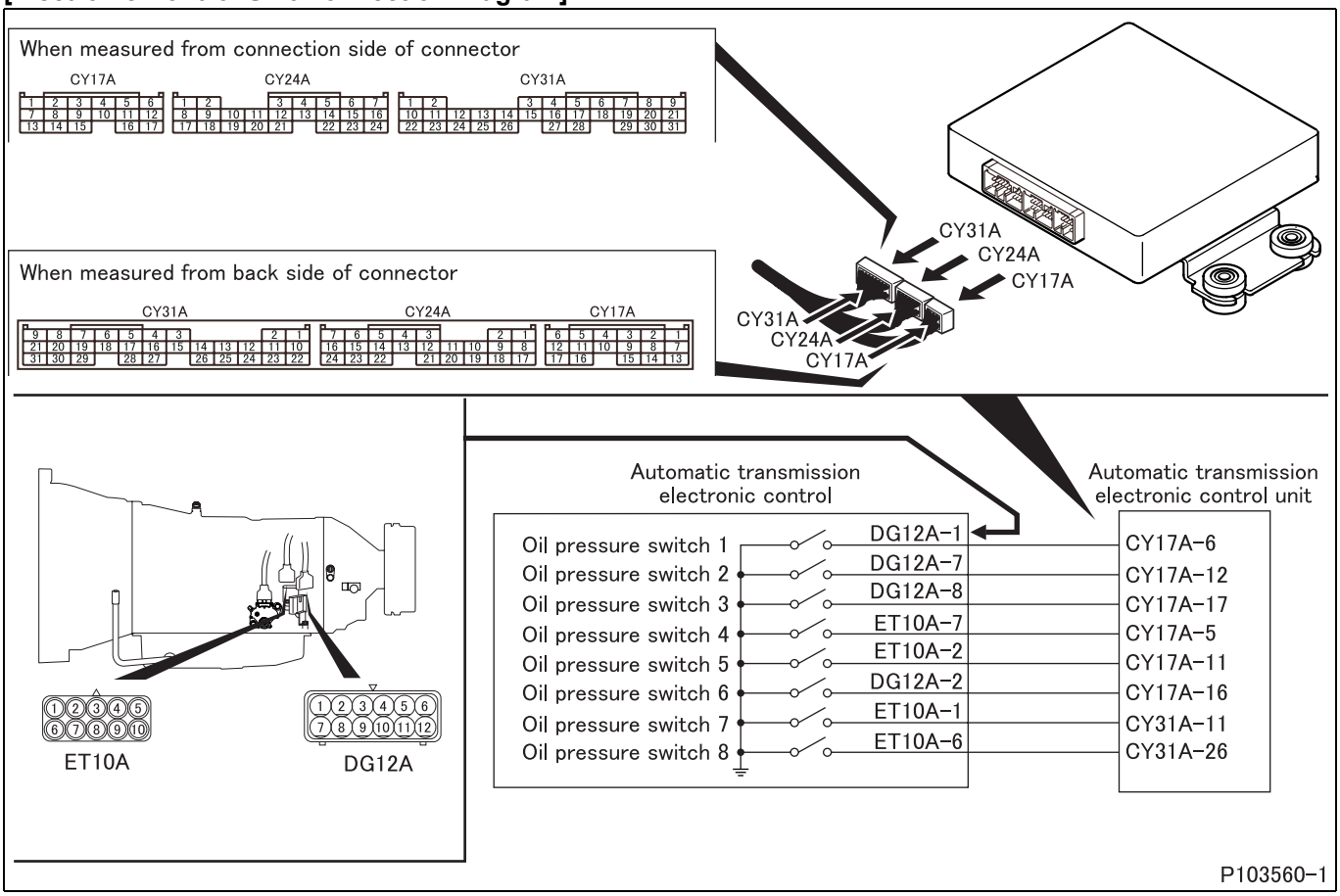
[Diagnostic requirement]
- Oil pressure switch 8: ON
- Shift position: D, 3 or 2 range
- Linear solenoid 1 is high pressure

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

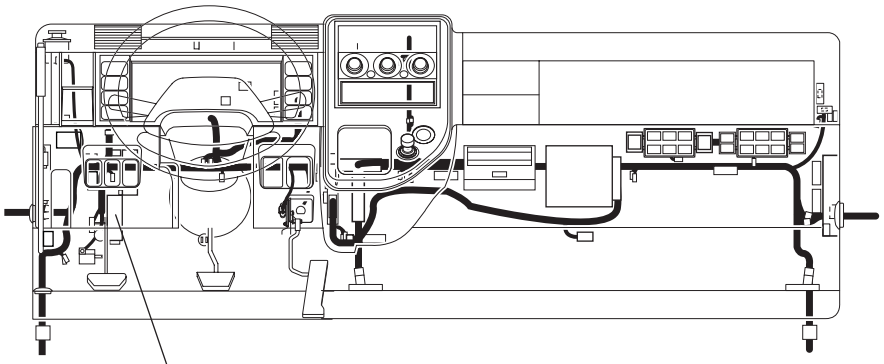
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 1 or linear solenoid 1
- Malfunction of each connector
- Malfunction of oil pressure switch 1 or linear solenoid 1
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

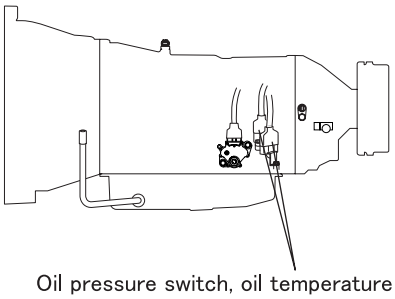
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Automatic transmission electronic control unit



Oil pressure switch, oil temperature sensor (outside), shift solenoid and linear solenoid [ET10A, DG12A]

P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 6 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 61 “Oil Press SW 1” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 2nd, 4th, 6th gears: 0 V • In 1st, 3rd, 5th gears: 12 V **<Multi-Use Tester used>** • In 2nd, 4th, 6th gears: ON • In 1st, 3rd, 5th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

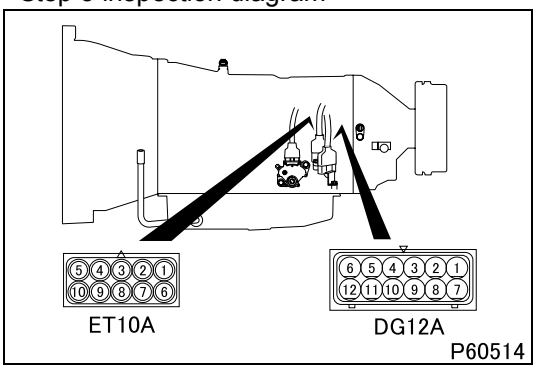
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 6 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (DG12A) terminal No. 1 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 1 and electronic control unit connector (CY17A) terminal No. 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 6 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 61 “Oil Press SW 1” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 2nd, 4th, 6th gears: 0 V • In 1st, 3rd, 5th gears: 12 V **<Multi-Use Tester used>** • In 2nd, 4th, 6th gears: ON • In 1st, 3rd, 5th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of linear solenoid 1 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0843/Flash code: 41
[Monitor ID]
36
[Fault (outline)]
Failure of oil pressure switch 1
[Diagnosis check]
- Oil pressure switch 1 is monitored for fault when the linear solenoid 1 is deenergized (low pressure).

[Code generation condition]
- Oil pressure switch 1 remains ON (high pressure) for 0.1 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

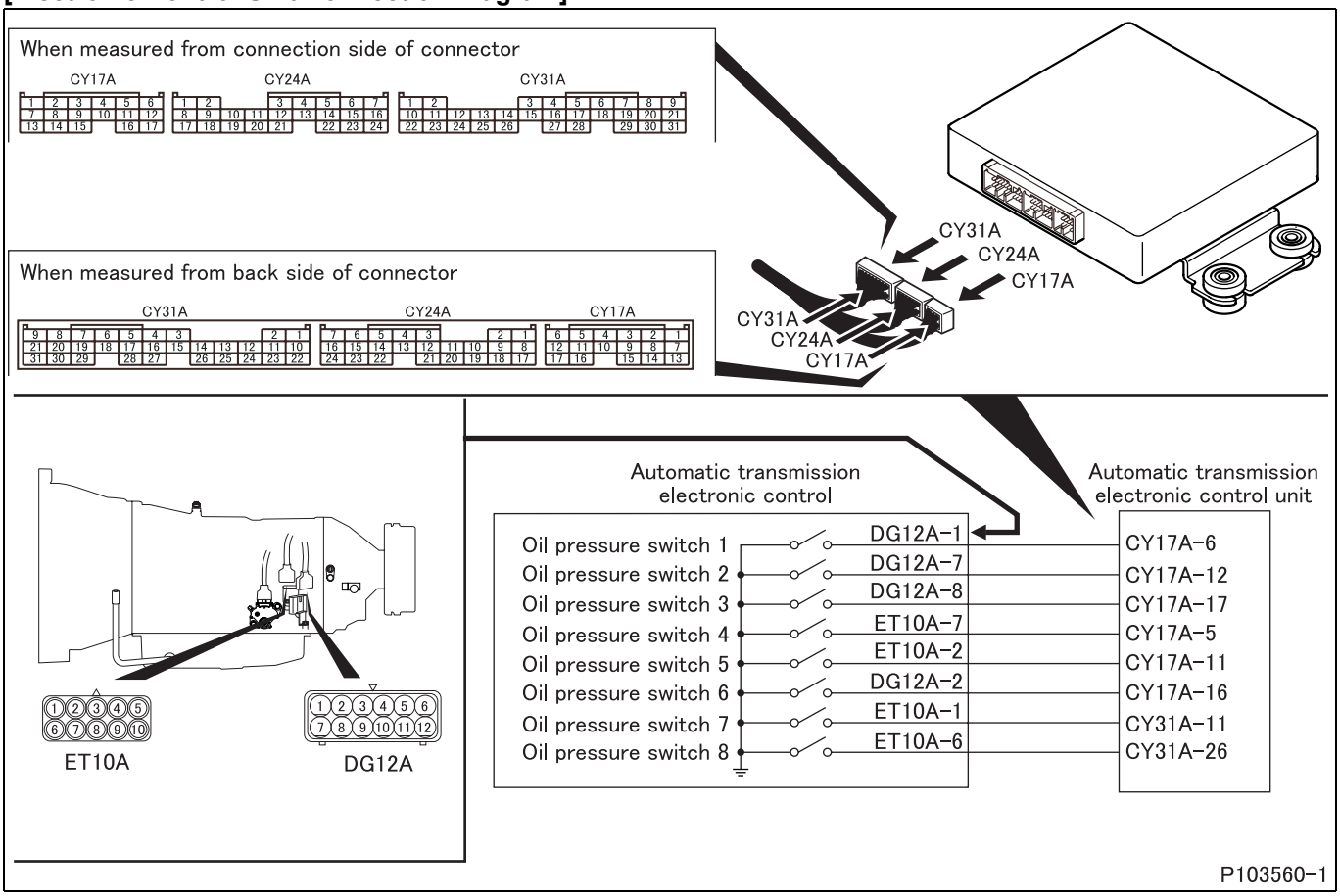
[Diagnostic requirement]
- Linear solenoid 1 is low pressure

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (4th).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 1 or linear solenoid 1
- Malfunction of each connector
- Malfunction of oil pressure switch 1 or linear solenoid 1
- Malfunction of electronic control unit

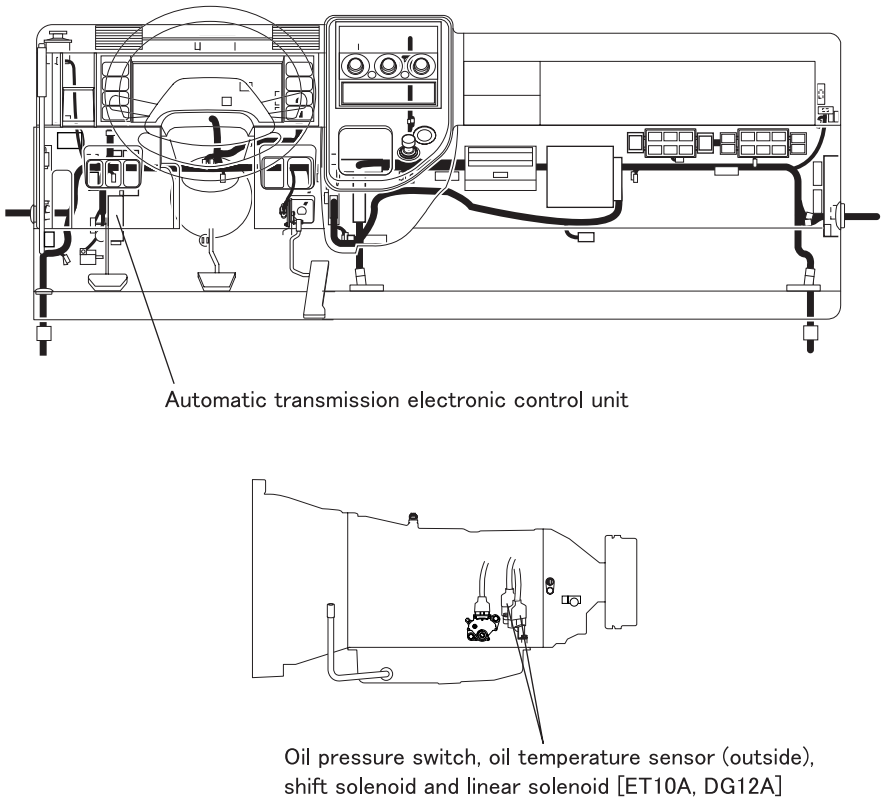
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



P103560-1

[Parts Identification and Location]



P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 6 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 61 “Oil Press SW 1” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 2nd, 4th, 6th gears: 0 V • In 1st, 3rd, 5th gears: 12 V **<Multi-Use Tester used>** • In 2nd, 4th, 6th gears: ON • In 1st, 3rd, 5th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

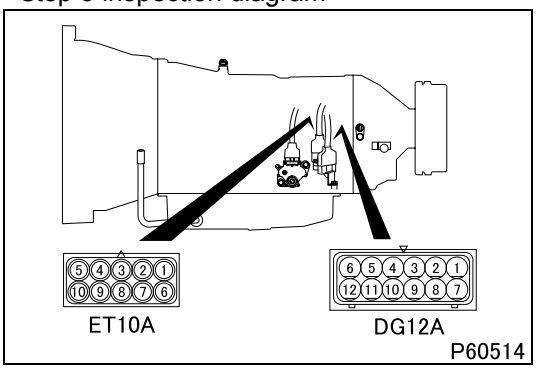
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 6 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (DG12A) terminal No. 1 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 1 and electronic control unit connector (CY17A) terminal No. 6.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 6 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 61 “Oil Press SW 1” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 2nd, 4th, 6th gears: 0 V • In 1st, 3rd, 5th gears: 12 V **<Multi-Use Tester used>** • In 2nd, 4th, 6th gears: ON • In 1st, 3rd, 5th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of linear solenoid 1 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0847/Flash code: 42
[Monitor ID]
42
[Fault (outline)]
Failure of oil pressure switch 2
[Diagnosis check]
- Oil pressure switch 2 is monitored for fault when the linear solenoid 2 is energized (high pressure).

[Code generation condition]
- Oil pressure switch 2 remains OFF (low pressure) for 2 seconds.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

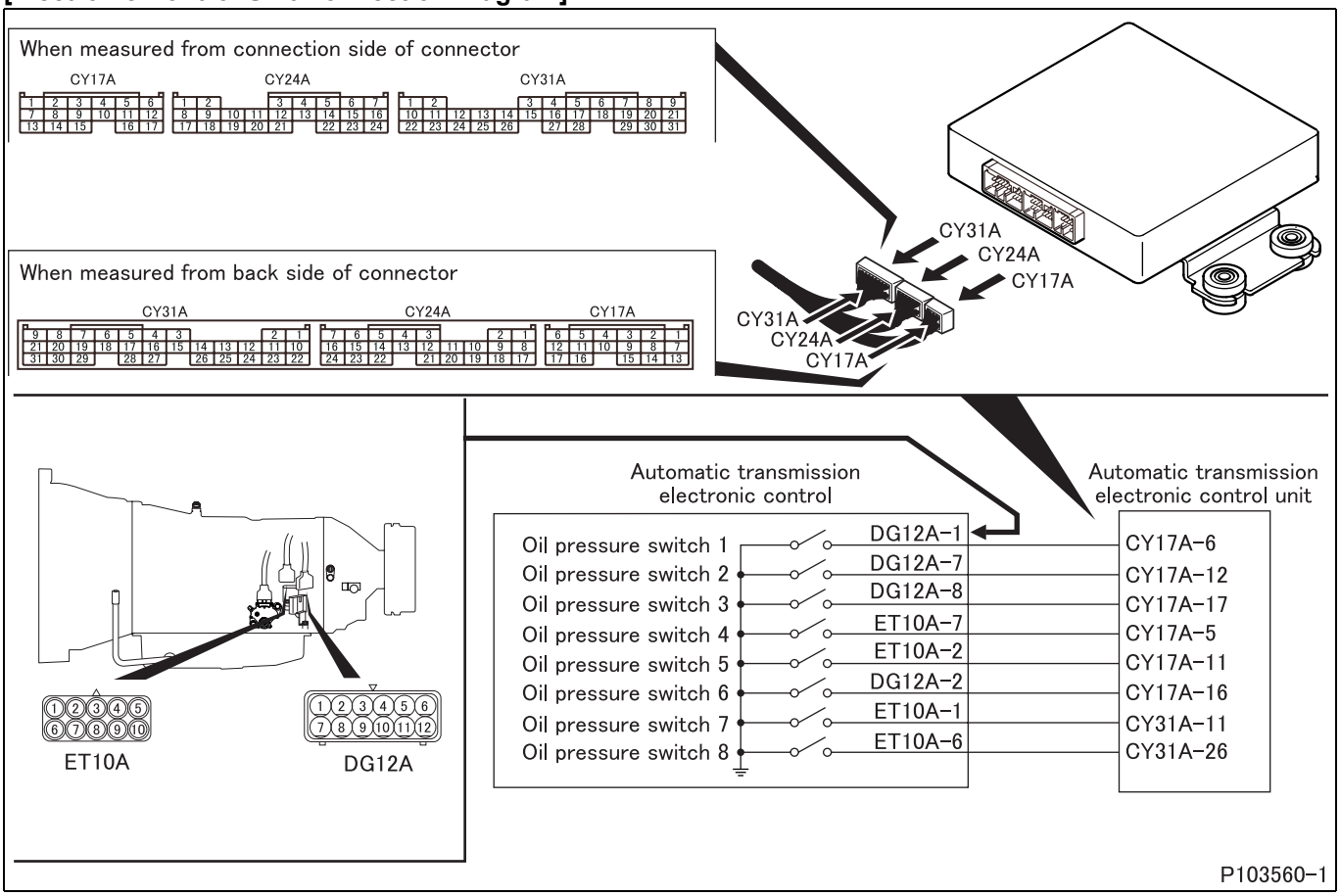
[Diagnostic requirement]
- Linear solenoid 2 is high pressure

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (4th).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 2 or linear solenoid 2
- Malfunction of each connector
- Malfunction of oil pressure switch 2 or linear solenoid 2
- Malfunction of electronic control unit

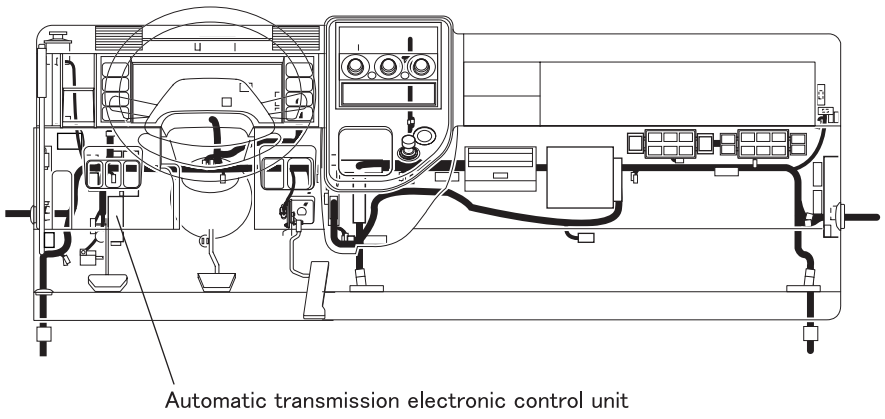
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

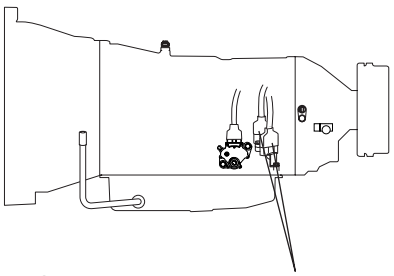
[Electronic Control Unit Connection Diagram]



P103560-1

[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 12 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 62 “Oil Press SW 2” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st, 3rd, 5th gears: 0 V • In 2nd, 4th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st, 3rd, 5th gears: ON • In 2nd, 4th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

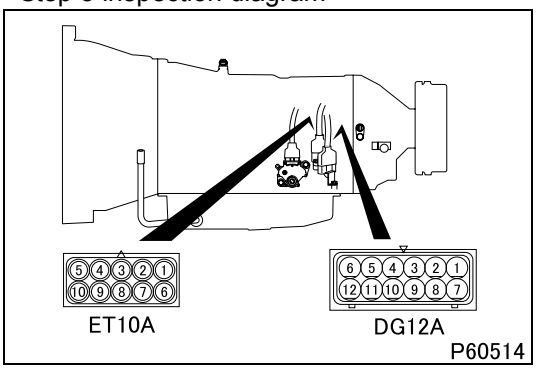
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 12 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (DG12A) terminal No. 7 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 7 and electronic control unit connector (CY17A) terminal No. 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 12 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 62 “Oil Press SW 2” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st, 3rd, 5th gears: 0 V • In 2nd, 4th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st, 3rd, 5th gears: ON • In 2nd, 4th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of linear solenoid 2 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0848/Flash code: 42
[Monitor ID]
41
[Fault (outline)]
Failure of oil pressure switch 2
[Diagnosis check]
- Oil pressure switch 2 is monitored for fault when the linear solenoid 2 is deenergized (low pressure).

[Code generation condition]
- Oil pressure switch 2 remains ON (high pressure) for 0.1 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

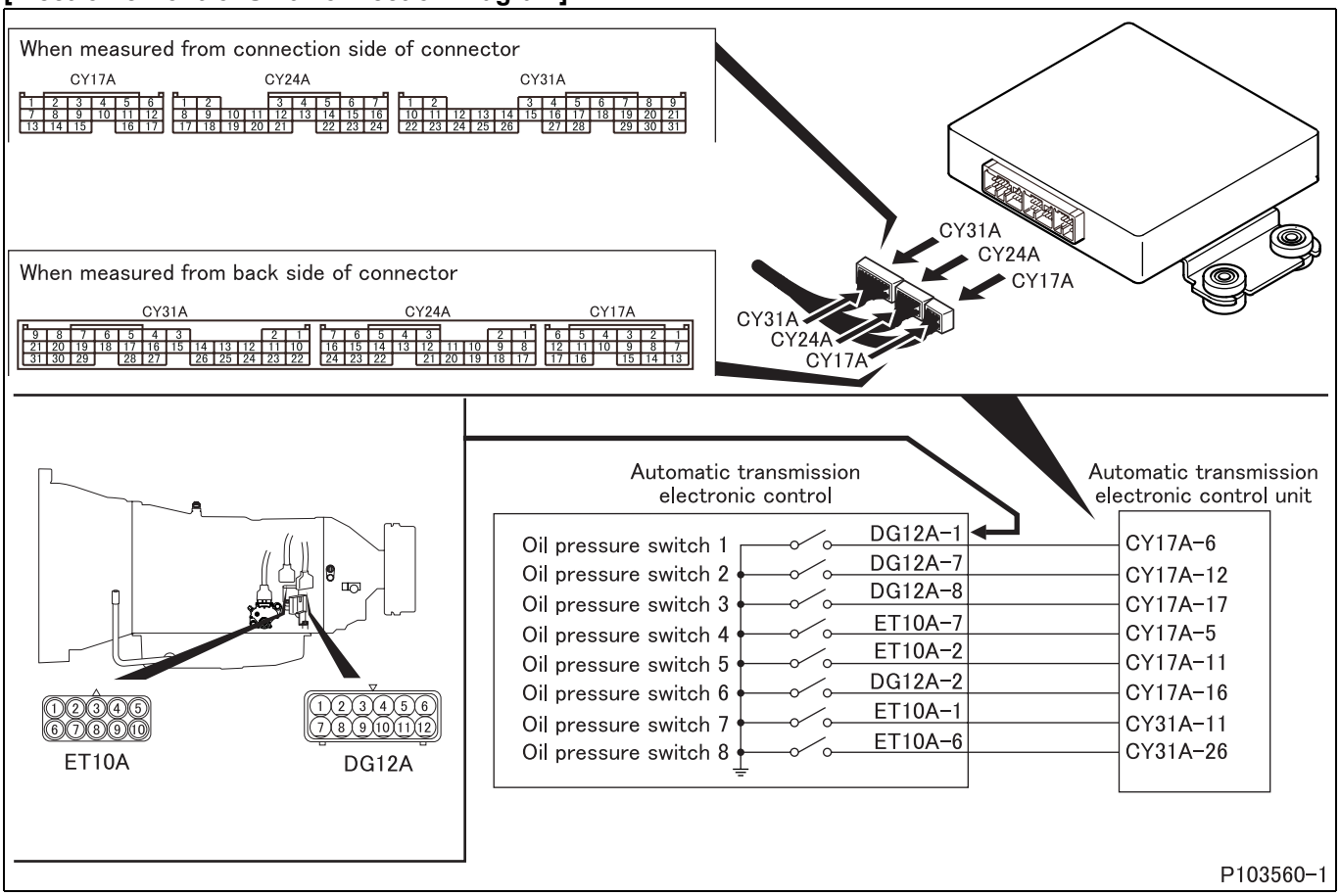
[Diagnostic requirement]
- Linear solenoid 2 is low pressure

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 2 or linear solenoid 2
- Malfunction of each connector
- Malfunction of oil pressure switch 2 or linear solenoid 2
- Malfunction of electronic control unit

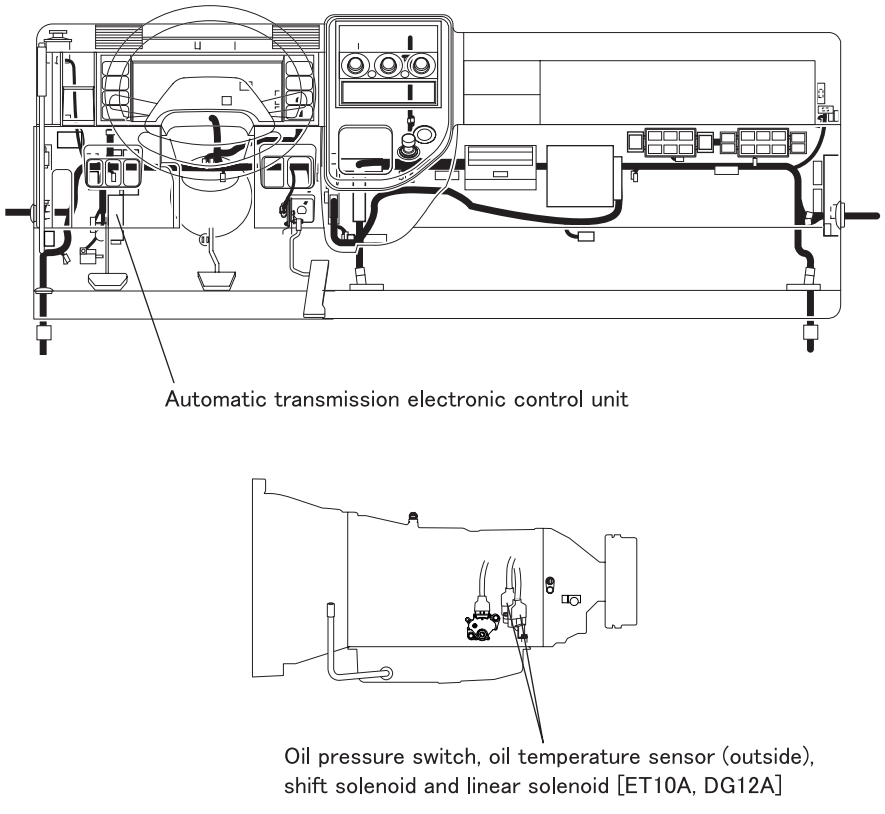
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



P103560-1

[Parts Identification and Location]



P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 12 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 62 “Oil Press SW 2” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st, 3rd, 5th gears: 0 V • In 2nd, 4th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st, 3rd, 5th gears: ON • In 2nd, 4th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

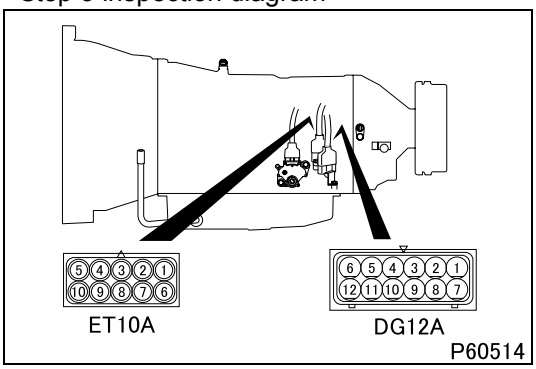
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 12 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (DG12A) terminal No. 7 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 7 and electronic control unit connector (CY17A) terminal No. 12.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 12 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 62 “Oil Press SW 2” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st, 3rd, 5th gears: 0 V • In 2nd, 4th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st, 3rd, 5th gears: ON • In 2nd, 4th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of linear solenoid 2 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0863/Flash code: 88
[Monitor ID]
67
[Fault (outline)]
Abnormality in controller area network communication
[Diagnosis check]
- Controller area network communication is monitored for abnormality according to the controller area network signal to be received 5 seconds after the starter switch is turned ON.

[Code generation condition]
- No controller area network signals are received for 1 second.

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

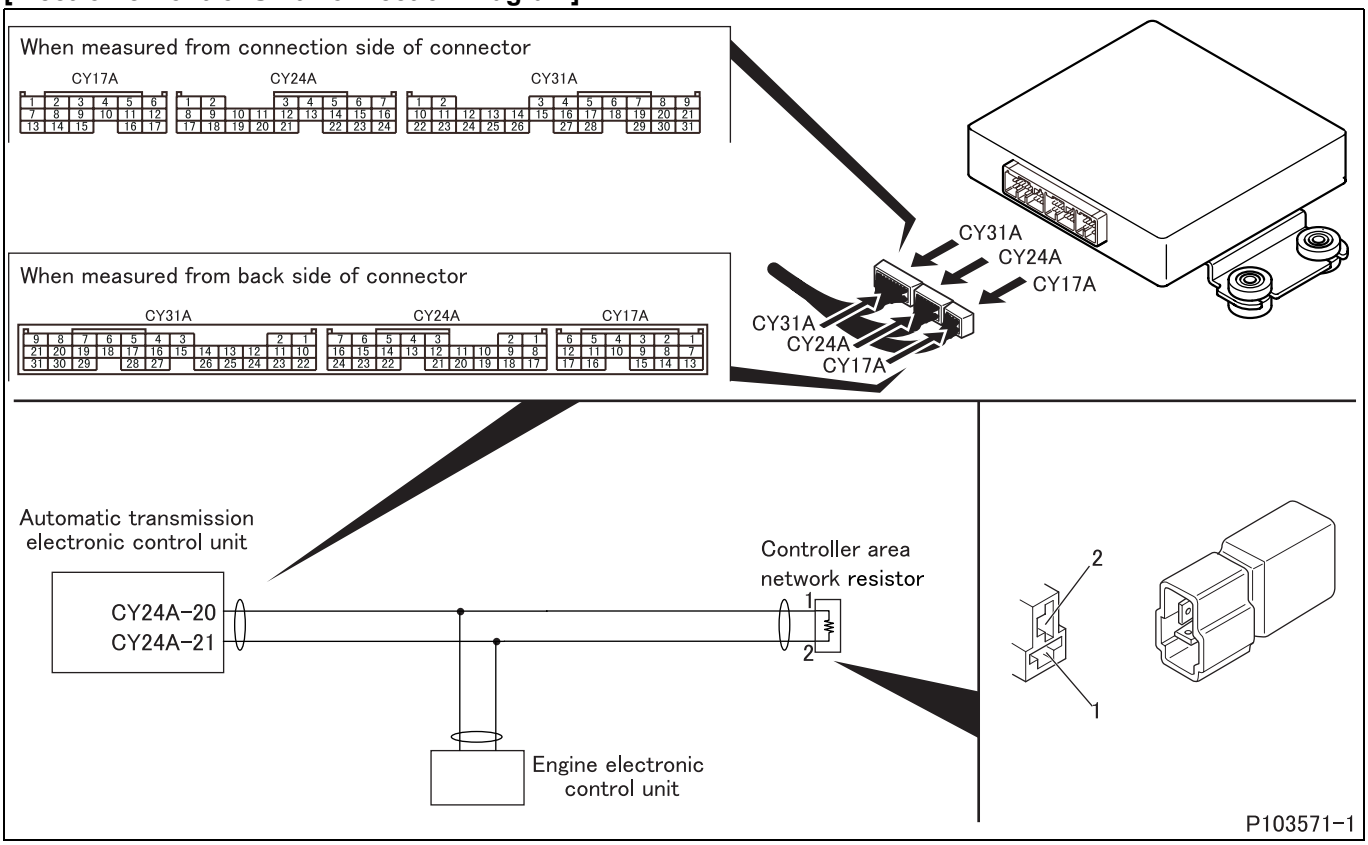
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Change point control and lock-up control are effected with accelerator pedal position at 0% (shift-up and lock-up vehicle speeds are switched to low side).
- Line pressure control is effected with accelerator pedal position at 100% (speed change shock occurs).
- Garage control is effected at 0% during idling and 50% otherwise (speed change shock occurs).

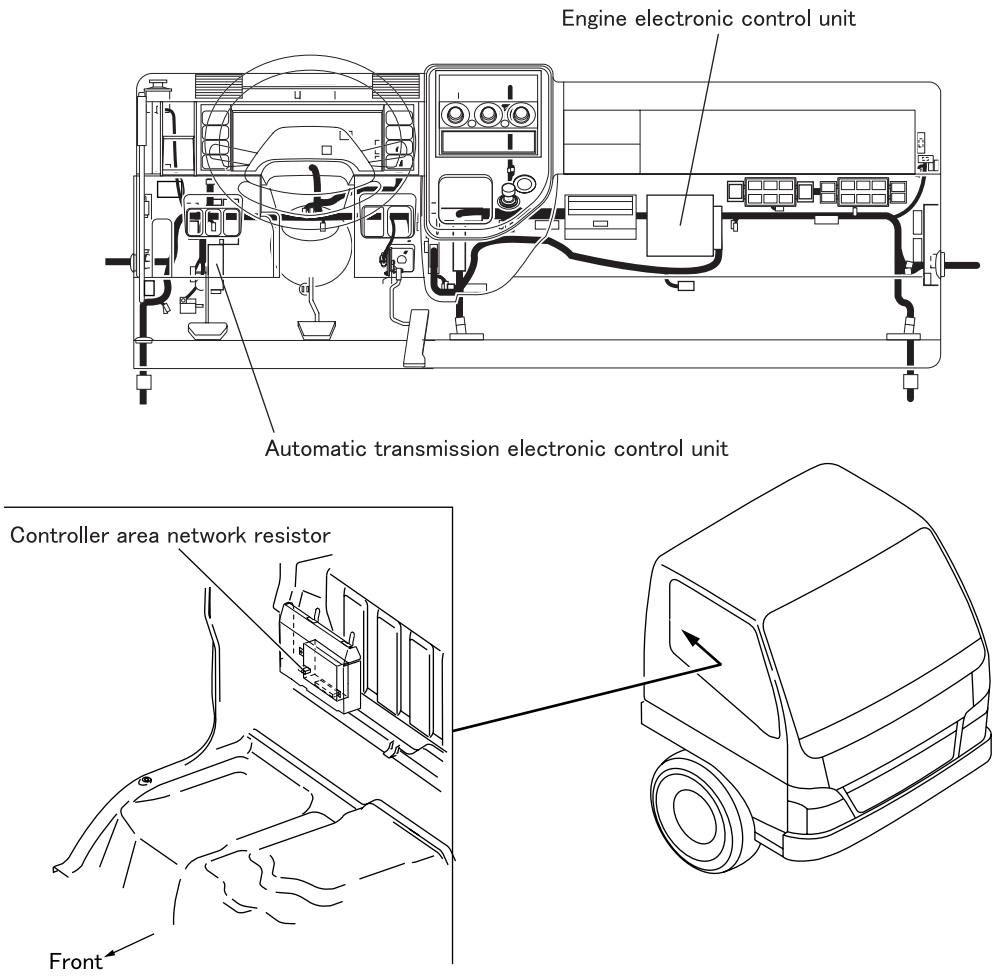
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and controller area network resistor
- Malfunction of each connector
- Malfunction of controller area network resistor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



P103571-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

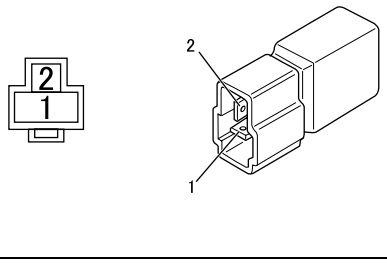
Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 20 and 21.
	Inspection condition		• Disconnect the engine electronic control unit and automatic transmission electronic control unit connectors, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminals No. 1 and 2.
	Inspection condition		–
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of controller area network resistor

<Step 4 inspection diagram>



Step 5	Inspection items		Inspection of harness between electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and electronic control unit connector (CY24A) terminal No. 20.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and electronic control unit connector (CY24A) terminal No. 21.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by Multi-Use Tester diagnosis code
	Maintenance item		Check for occurrence of the diagnosis code No. P0863 “CAN Communication”.
	Inspection condition		Starter switch: ON
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Perform troubleshooting for the controller area network communication system in the engine electronic control. If the fault is not still removed, replace the automatic transmission electronic control unit.

[Fault code]
Diagnosis code: P0872/Flash code: 45
[Monitor ID]
54
[Fault (outline)]
Failure of oil pressure switch 3
[Diagnosis check]
- Oil pressure switch 3 is monitored for fault when the shift solenoid 1 is energized (high pressure).

[Code generation condition]
- Oil pressure switch 3 remains OFF (low pressure) for 0.1 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

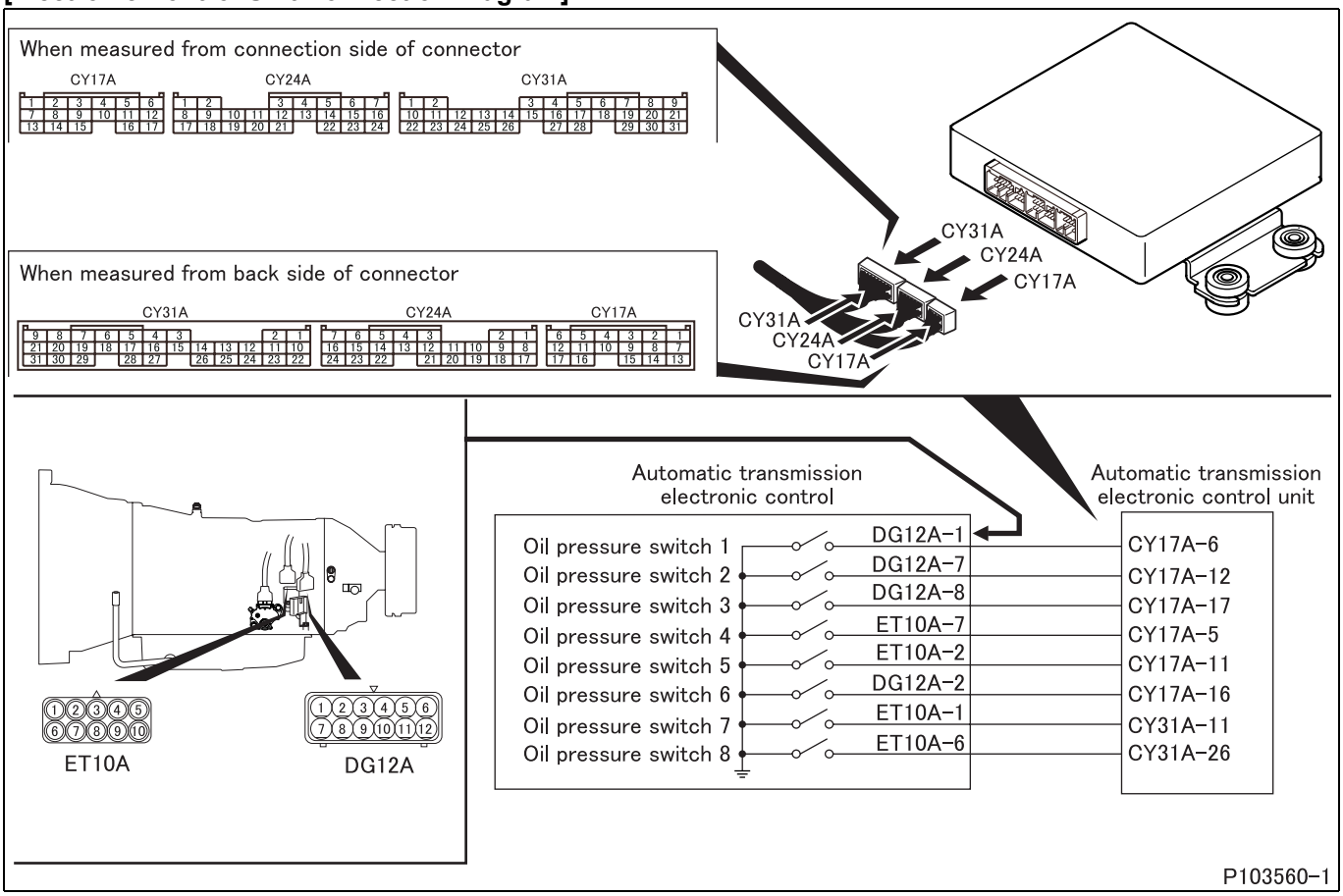
[Diagnostic requirement]
- Shift solenoid 1 is ON

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 3 or shift solenoid 1
- Malfunction of each connector
- Malfunction of oil pressure switch 3 or shift solenoid 1
- Malfunction of electronic control unit

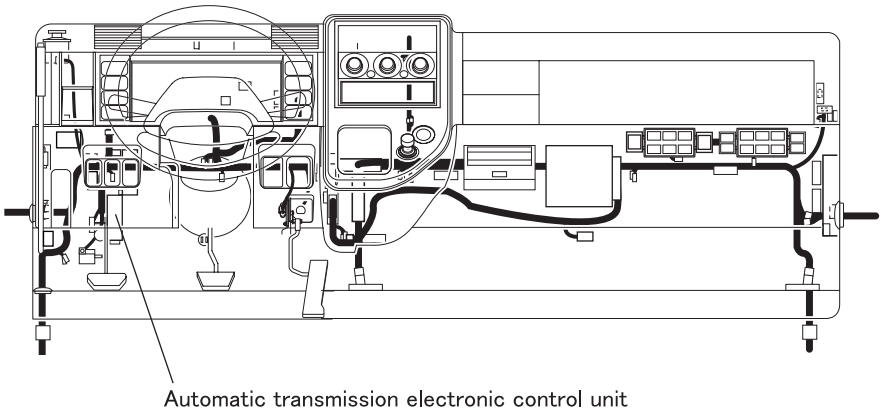
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



P103560-1

[Parts Identification and Location]



P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 17 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 63 “Oil Press SW 3” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 0 V • In 1st, 2nd, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 3rd, 4th gears: ON • In 1st, 2nd, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

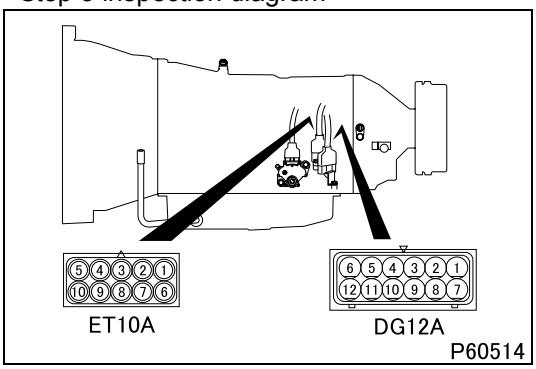
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 17 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (DG12A) terminal No. 8 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 8 and electronic control unit connector (CY17A) terminal No. 17.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 17 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 63 “Oil Press SW 3” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 0 V • In 1st, 2nd, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 3rd, 4th gears: ON • In 1st, 2nd, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of shift solenoid 1 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0873/Flash code: 45
[Monitor ID]
53
[Fault (outline)]
Failure of oil pressure switch 3
[Diagnosis check]
- Oil pressure switch 3 is monitored for fault when the shift solenoid 1 is deenergized (low pressure).

[Code generation condition]
- Oil pressure switch 3 remains ON (high pressure) for 0.1 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

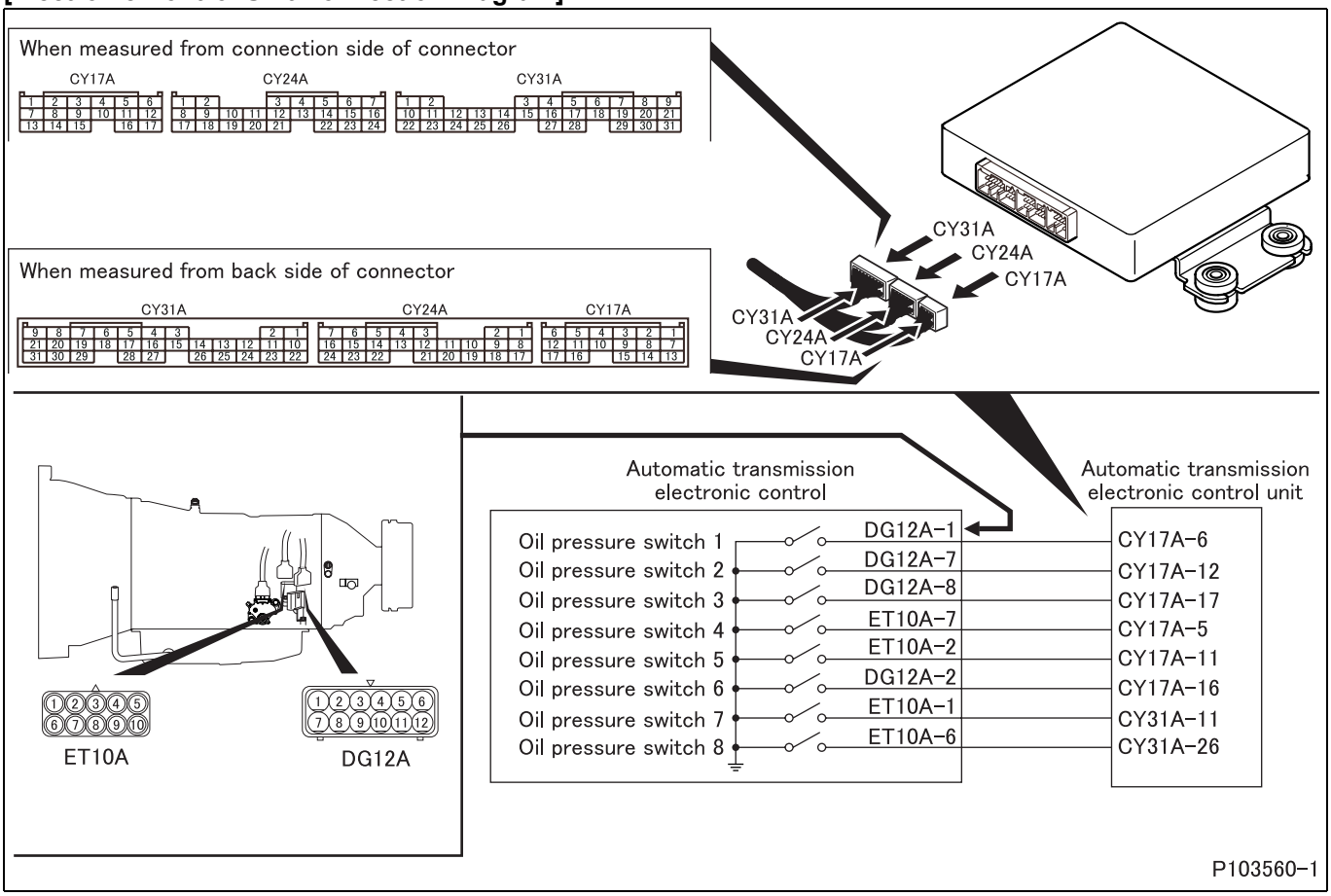
[Diagnostic requirement]
- Shift solenoid 1 is OFF

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

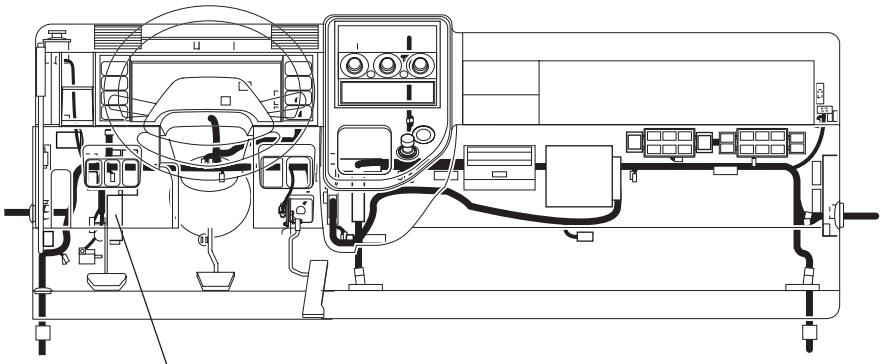
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 3 or shift solenoid 1
- Malfunction of each connector
- Malfunction of oil pressure switch 3 or shift solenoid 1
- Malfunction of electronic control unit

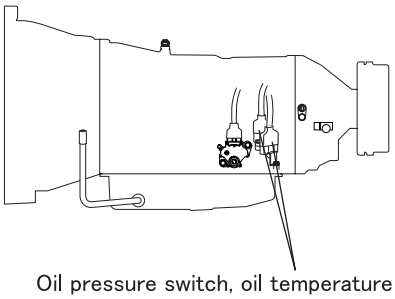
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 17 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 63 “Oil Press SW 3” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 0 V • In 1st, 2nd, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 3rd, 4th gears: ON • In 1st, 2nd, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

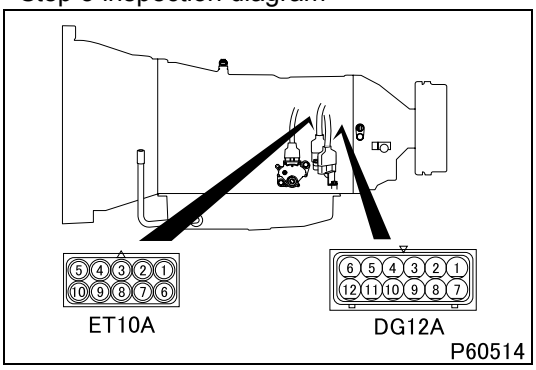
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 17 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (DG12A) terminal No. 8 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 8 and electronic control unit connector (CY17A) terminal No. 17.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 17 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 63 “Oil Press SW 3” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 0 V • In 1st, 2nd, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 3rd, 4th gears: ON • In 1st, 2nd, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of shift solenoid 1 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0877/Flash code: 46
[Monitor ID]
58
[Fault (outline)]
Failure of oil pressure switch 4
[Diagnosis check]
- Oil pressure switch 4 is monitored for fault when the shift solenoid 2 is energized (high pressure).

[Code generation condition]
- Oil pressure switch 4 remains OFF (low pressure) for 0.1 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

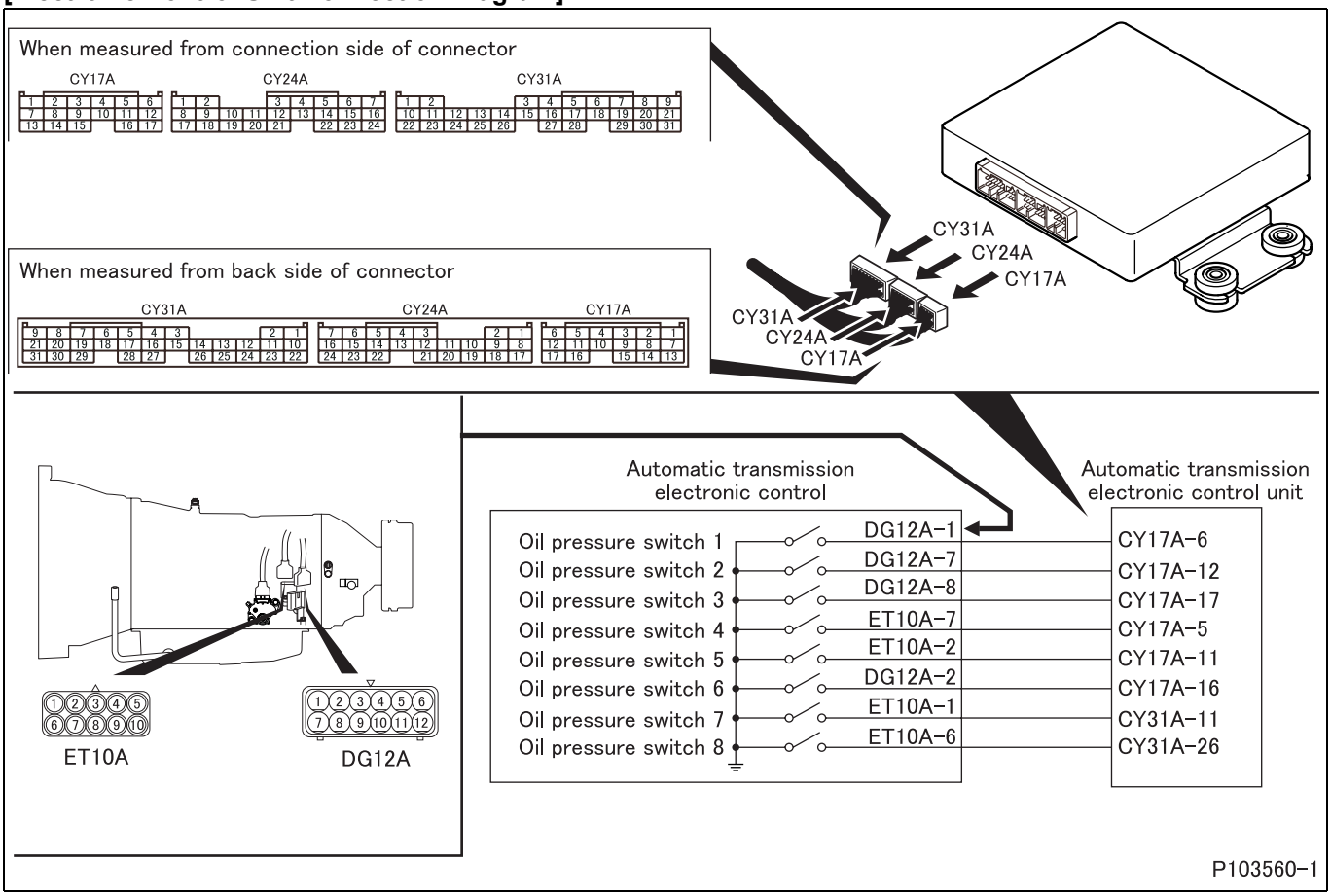
[Diagnostic requirement]
- Shift solenoid 2 is ON

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

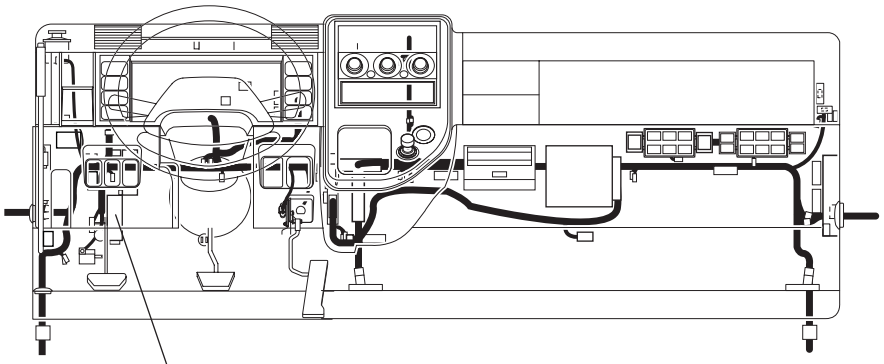
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 4 or shift solenoid 2
- Malfunction of each connector
- Malfunction of oil pressure switch 4 or shift solenoid 2
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

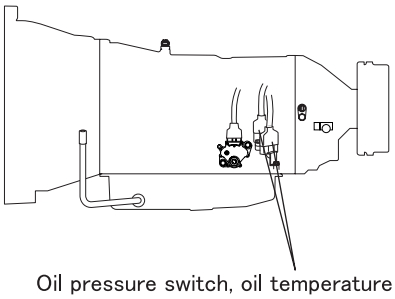
[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



Automatic transmission electronic control unit



Oil pressure switch, oil temperature sensor (outside), shift solenoid and linear solenoid [ET10A, DG12A]

P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 64 “Oil Press SW 4” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 0 V • In 1st, 2nd, 3rd gears: 12 V **<Multi-Use Tester used>** • In 4th, 5th, 6th gears: ON • In 1st, 2nd, 3rd gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

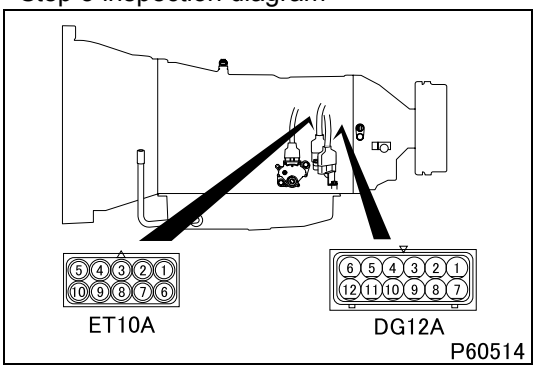
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 5 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (ET10A) terminal No. 7 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 7 and electronic control unit connector (CY17A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 64 “Oil Press SW 4” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 0 V • In 1st, 2nd, 3rd gears: 12 V **<Multi-Use Tester used>** • In 4th, 5th, 6th gears: ON • In 1st, 2nd, 3rd gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of shift solenoid 2 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0878/Flash code: 46
[Monitor ID]
57
[Fault (outline)]
Failure of oil pressure switch 4
[Diagnosis check]
- Oil pressure switch 4 is monitored for fault when the shift solenoid 2 is deenergized (low pressure).

[Code generation condition]
- Oil pressure switch 4 remains ON (high pressure) for 0.1 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

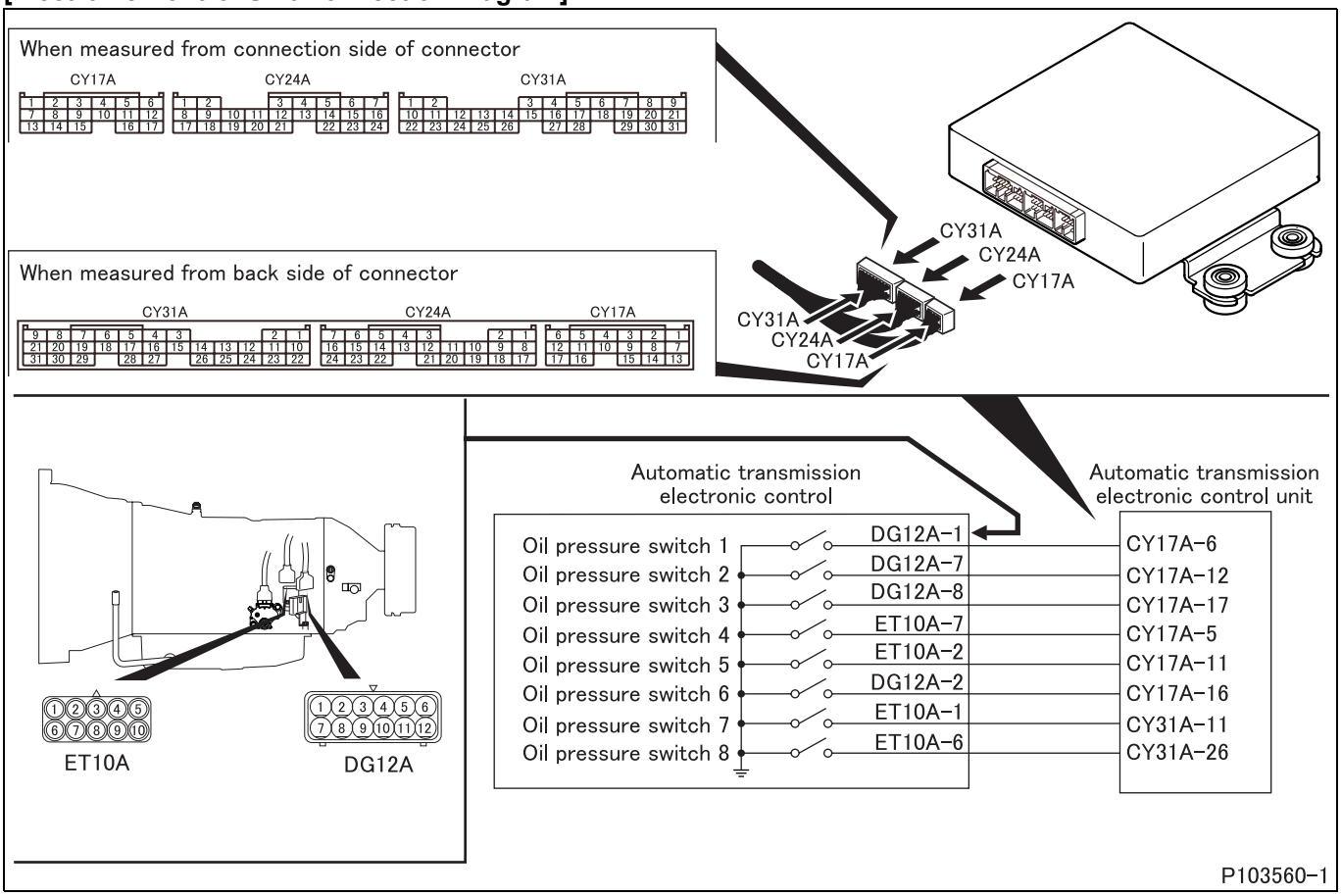
[Diagnostic requirement]
- Shift solenoid 2 is OFF

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (5th).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 4 or shift solenoid 2
- Malfunction of each connector
- Malfunction of oil pressure switch 4 or shift solenoid 2
- Malfunction of electronic control unit

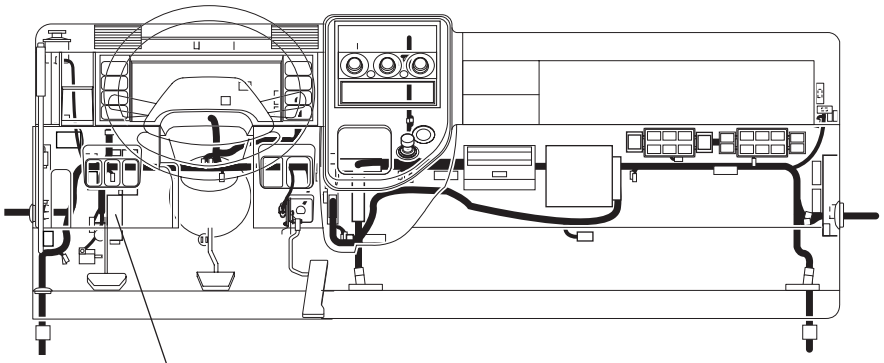
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

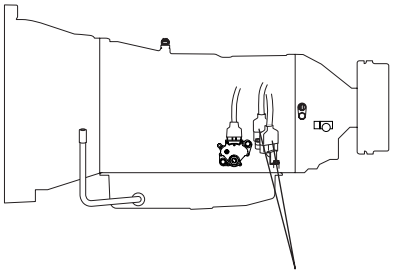
[Electronic Control Unit Connection Diagram]



P103560-1

[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 64 “Oil Press SW 4” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 0 V • In 1st, 2nd, 3rd gears: 12 V **<Multi-Use Tester used>** • In 4th, 5th, 6th gears: ON • In 1st, 2nd, 3rd gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

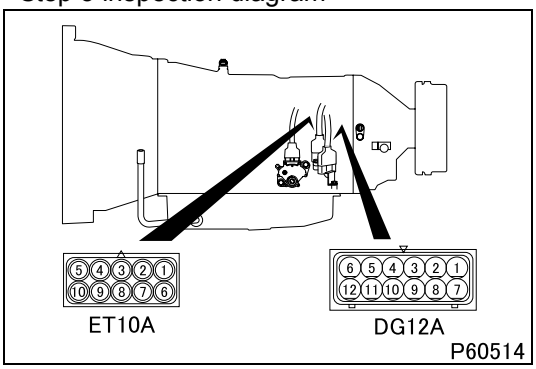
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 5 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (ET10A) terminal No. 7 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 7 and electronic control unit connector (CY17A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 64 “Oil Press SW 4” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 0 V • In 1st, 2nd, 3rd gears: 12 V **<Multi-Use Tester used>** • In 4th, 5th, 6th gears: ON • In 1st, 2nd, 3rd gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of shift solenoid 2 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0973/Flash code: 31
[Monitor ID]
29
[Fault (outline)]
Failure of shift solenoid 1
[Diagnosis check]
- Current in the shift solenoid 1 is monitored for fault.

[Code generation condition]
- Current in the shift solenoid 1 remains at or above the specified value (4A) for 0.1 second (short-circuit in ground side).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

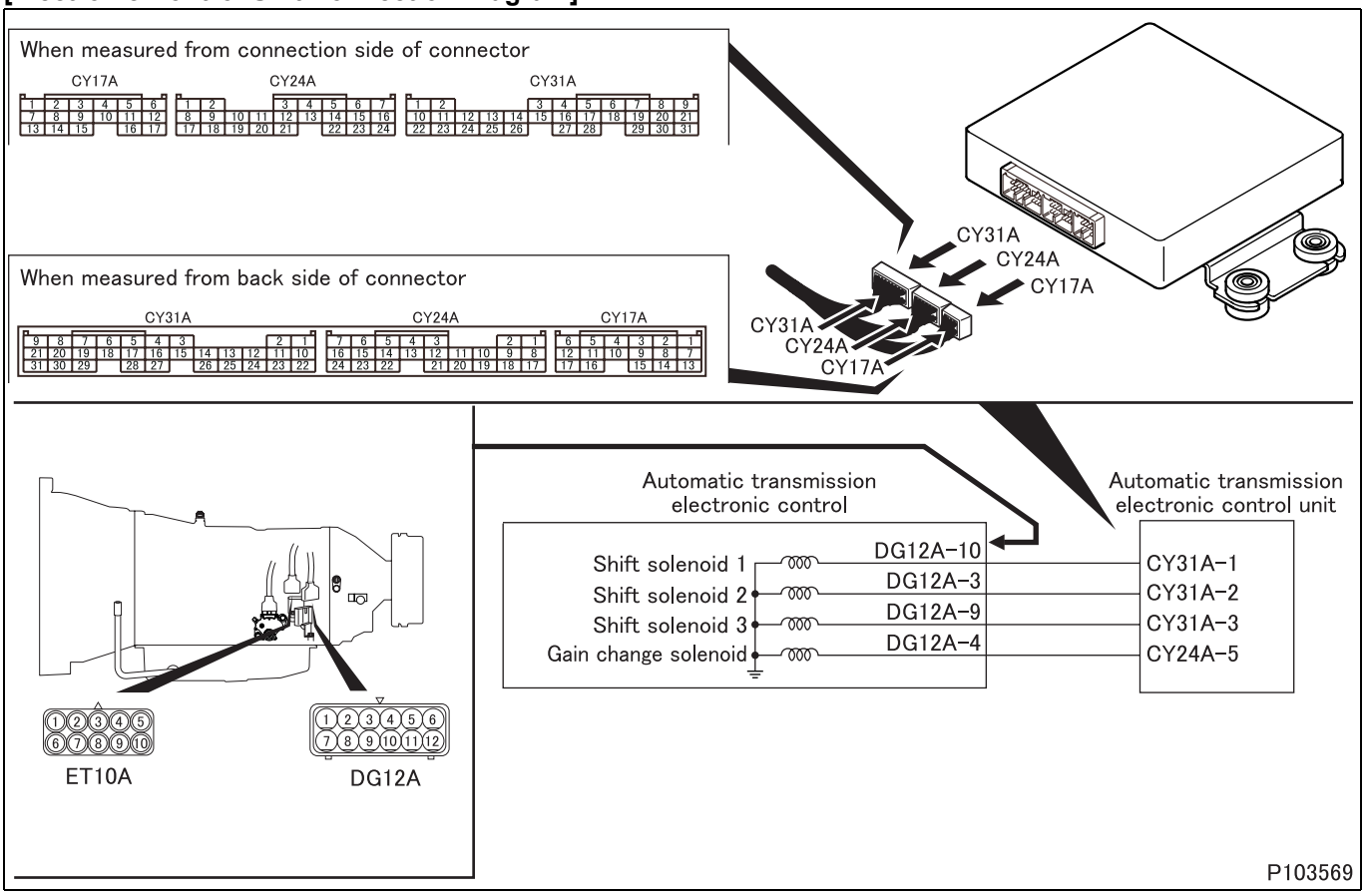
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and shift solenoid 1
- Malfunction of each connector
- Malfunction of shift solenoid 1
- Malfunction of electronic control unit

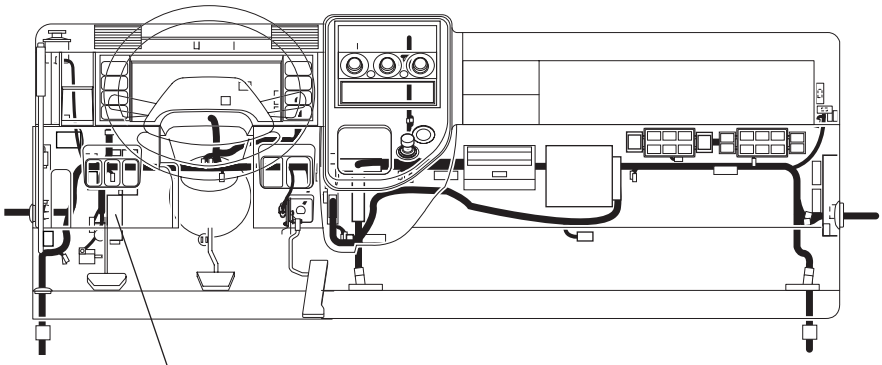
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

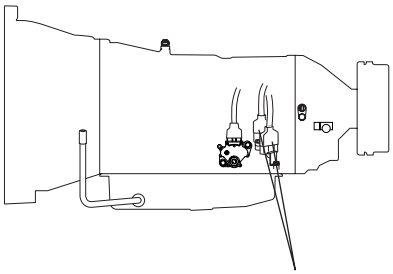
[Electronic Control Unit Connection Diagram]



P103569

[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 1 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 31 “Shift Valve 1” and No. 71 “Shift Valve Press 1” of Service Data.
	Inspection condition		Vehicle run **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 31 “Shift Valve 1”> • In 3rd, 4th gears: ON • In any gears except above: OFF <No. 71 “Shift Valve Press 1”> • In 3rd, 4th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

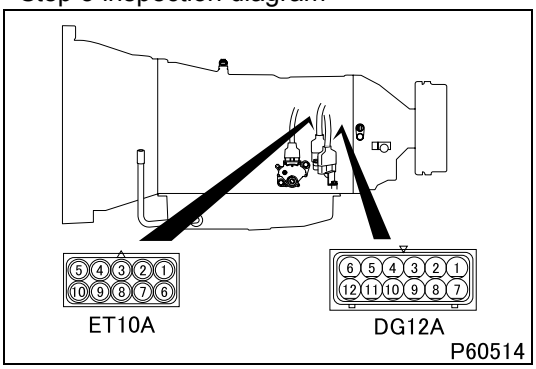
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 1 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 10 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 10 and electronic control unit connector (CY31A) terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 1 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 31 “Shift Valve 1” and No. 71 “Shift Valve Press 1” of Service Data.
	Inspection condition		Vehicle run **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 31 “Shift Valve 1”> • In 3rd, 4th gears: ON • In any gears except above: OFF <No. 71 “Shift Valve Press 1”> • In 3rd, 4th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0974/Flash code: 31
[Monitor ID]
30
[Fault (outline)]
Failure of shift solenoid 1
[Diagnosis check]
- Resistance in the shift solenoid 1 is monitored for fault.

[Code generation condition]
- Resistance in the shift solenoid 1 remains at or above the specified value (100 kΩ) for 0.1 second (open-circuit or short-circuit in power supply side).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

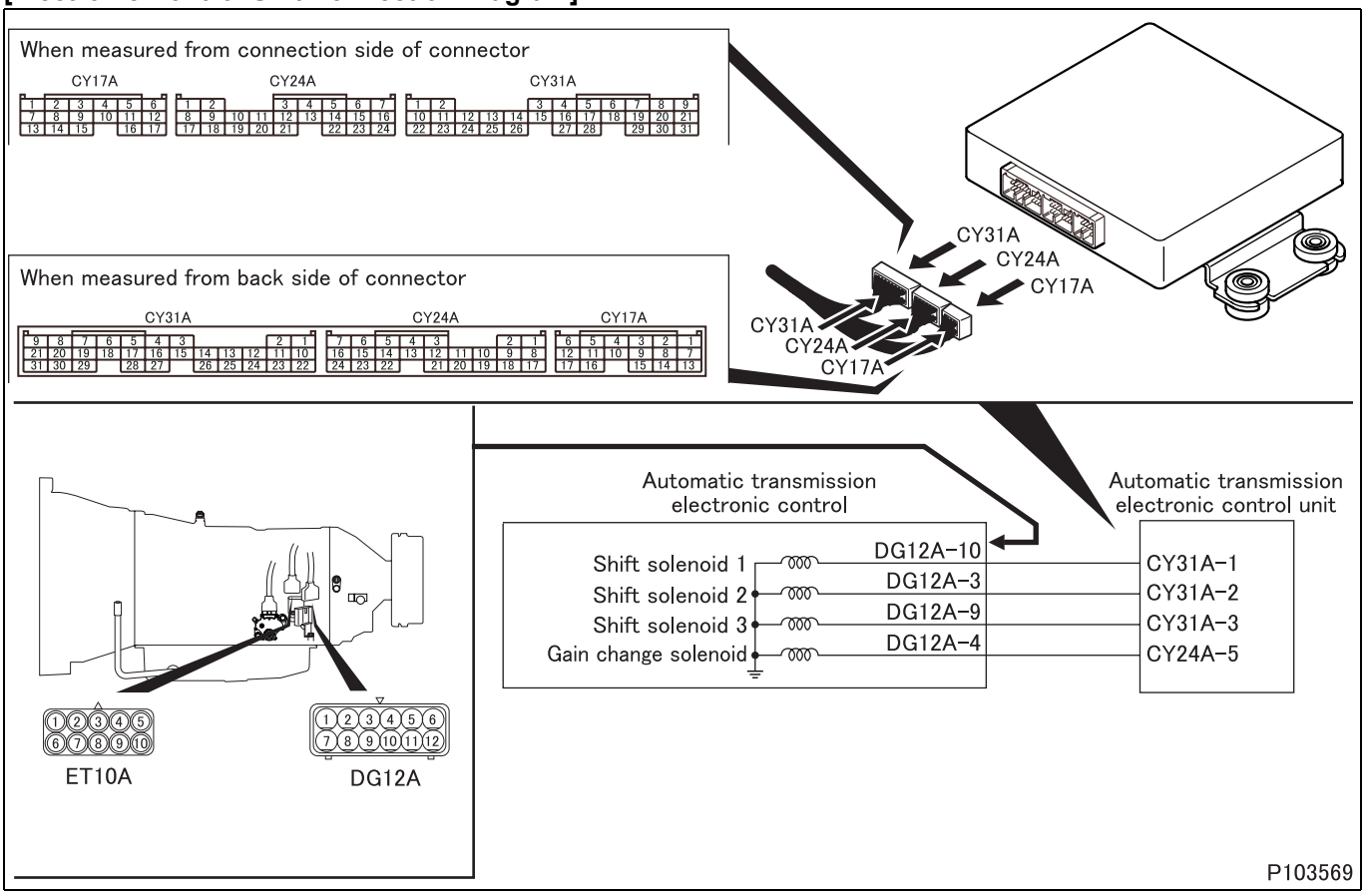
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and shift solenoid 1
- Malfunction of each connector
- Malfunction of shift solenoid 1
- Malfunction of electronic control unit

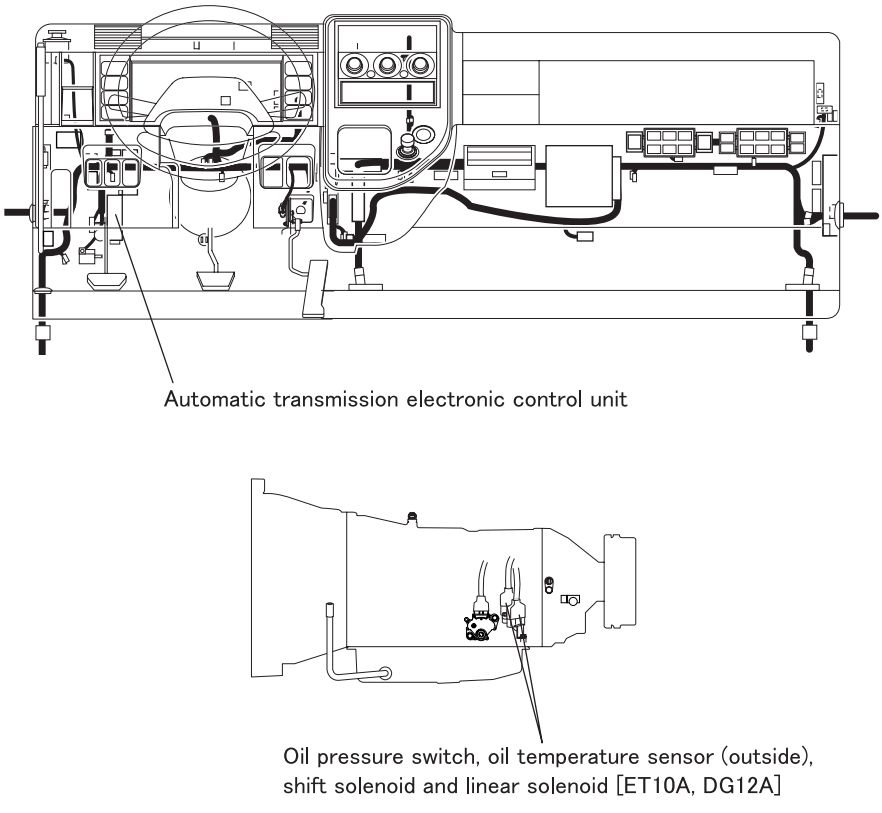
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



P103569

[Parts Identification and Location]



P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 1 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 31 “Shift Valve 1” and No. 71 “Shift Valve Press 1” of Service Data.
	Inspection condition		Vehicle run **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 31 “Shift Valve 1”> • In 3rd, 4th gears: ON • In any gears except above: OFF <No. 71 “Shift Valve Press 1”> • In 3rd, 4th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

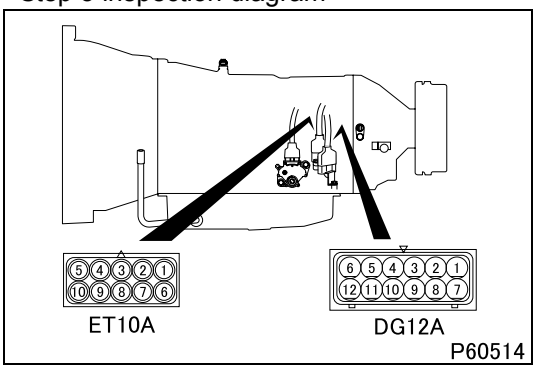
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 1 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 10 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 10 and electronic control unit connector (CY31A) terminal No. 1.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 1 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 31 “Shift Valve 1” and No. 71 “Shift Valve Press 1” of Service Data.
	Inspection condition		Vehicle run **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 3rd, 4th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 31 “Shift Valve 1”> • In 3rd, 4th gears: ON • In any gears except above: OFF <No. 71 “Shift Valve Press 1”> • In 3rd, 4th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0976/Flash code: 32
[Monitor ID]
31
[Fault (outline)]
Failure of shift solenoid 2
[Diagnosis check]
- Current in the shift solenoid 2 is monitored for fault.

[Code generation condition]
- Current in the shift solenoid 2 remains at or above the specified value (4A) for 0.1 second (short-circuit in ground side).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

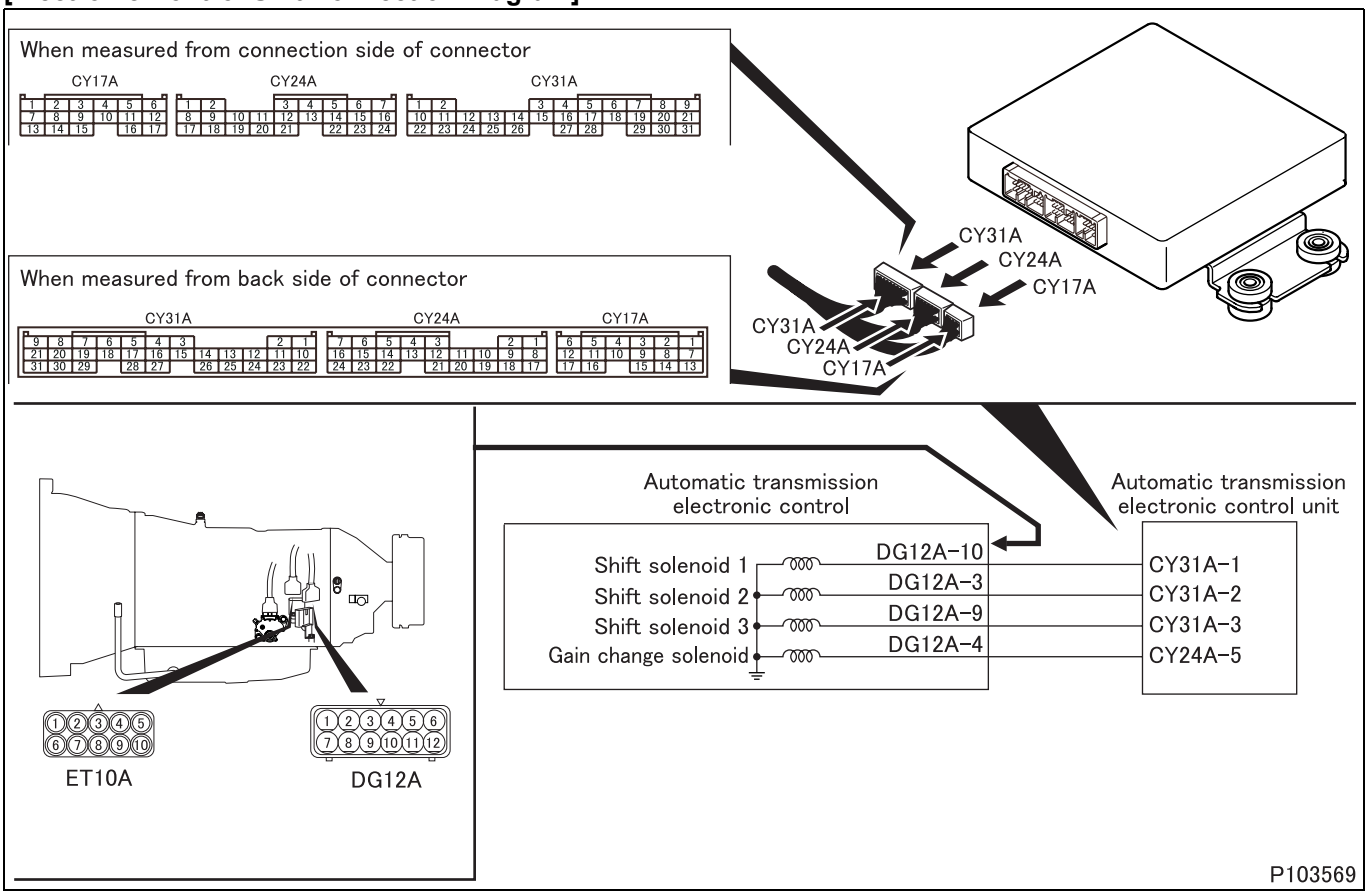
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (5th).

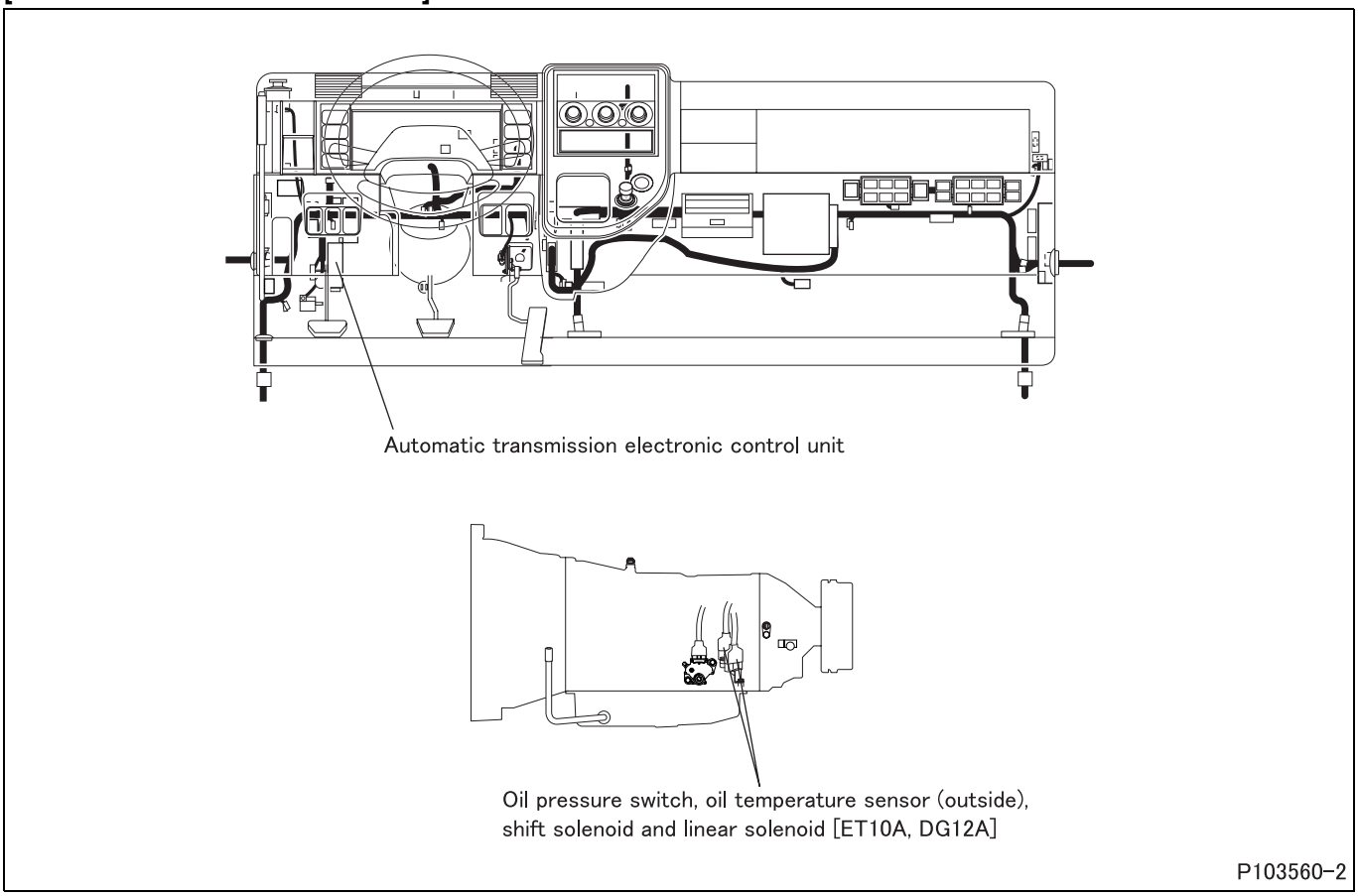
[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and shift solenoid 2
- Malfunction of each connector
- Malfunction of shift solenoid 2
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 2 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 32 “Shift Valve 2” and No. 72 “Shift Valve Press 2” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 32 “Shift Valve 2”> • In 4th, 5th, 6th gears: ON • In any gears except above: OFF <No. 72 “Shift Valve Press 2”> • In 4th, 5th, 6th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

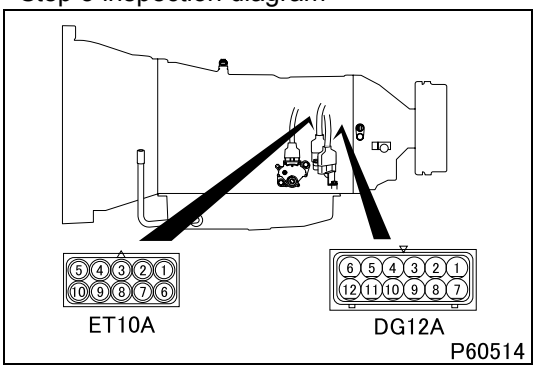
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 2 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 3 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 3 and electronic control unit connector (CY31A) terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 2 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 32 “Shift Valve 2” and No. 72 “Shift Valve Press 2” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 32 “Shift Valve 2”> • In 4th, 5th, 6th gears: ON • In any gears except above: OFF <No. 72 “Shift Valve Press 2”> • In 4th, 5th, 6th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0977/Flash code: 32
[Monitor ID]
32
[Fault (outline)]
Failure of shift solenoid 2
[Diagnosis check]
- Resistance in the shift solenoid 2 is monitored for fault.

[Code generation condition]
- Resistance in the shift solenoid 2 remains at or above the specified value (100 kΩ) for 0.1 second (open-circuit or short-circuit in power supply side).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

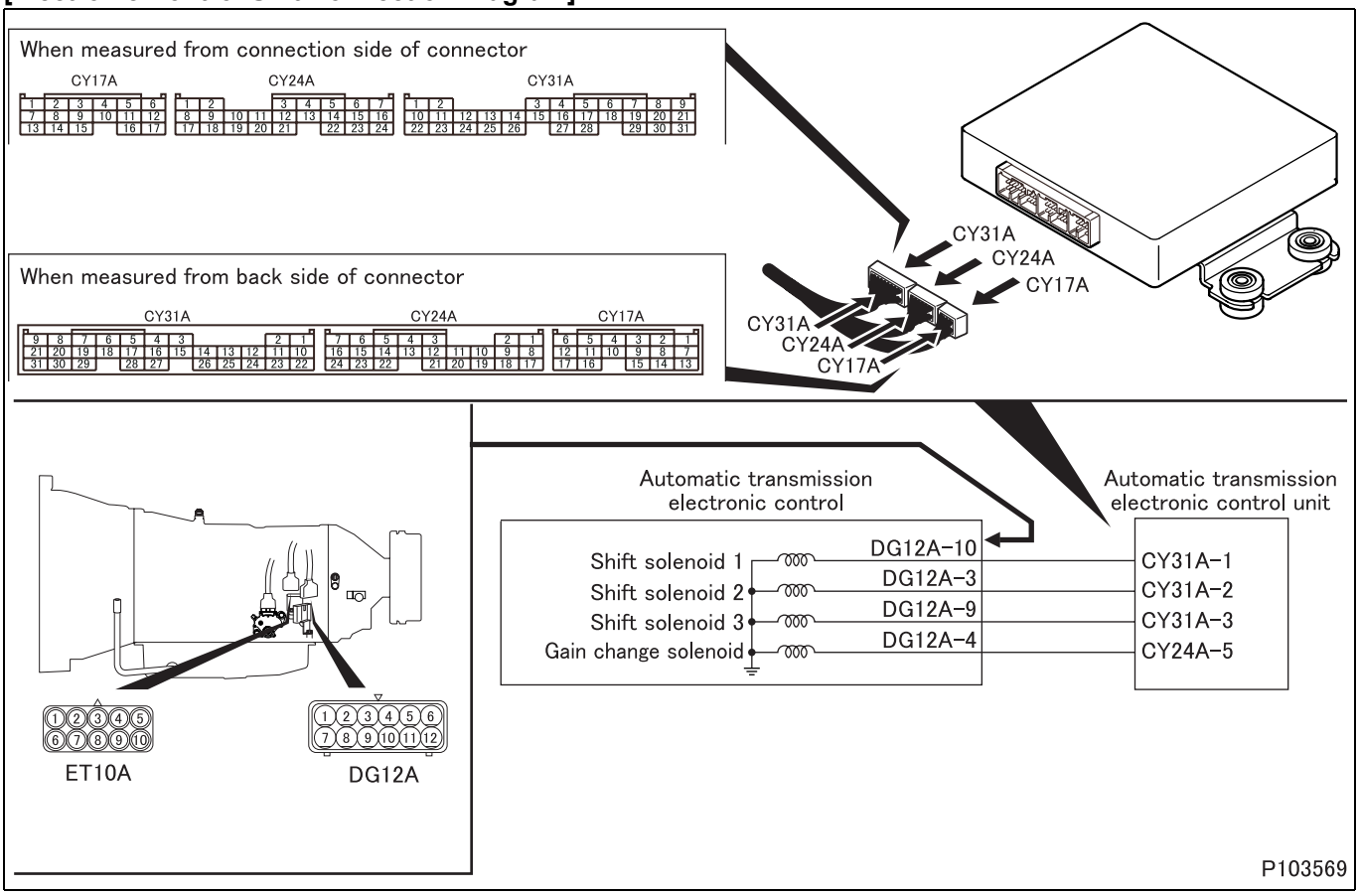
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Faulty solenoid is turned OFF
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (5th).

[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and shift solenoid 2
- Malfunction of each connector
- Malfunction of shift solenoid 2
- Malfunction of electronic control unit

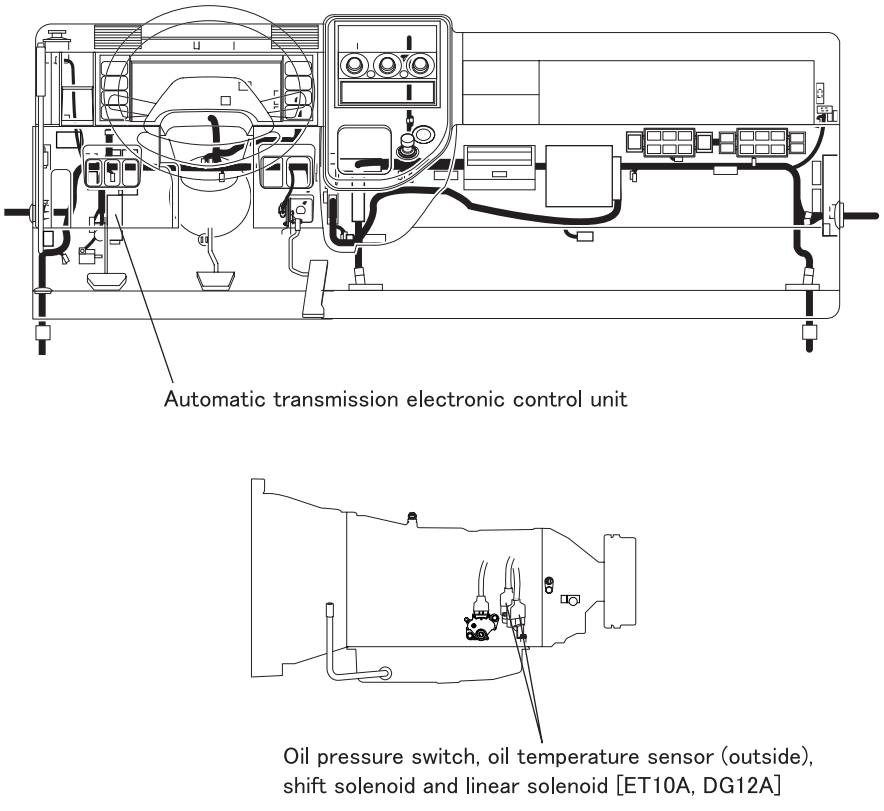
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



P103569

[Parts Identification and Location]



P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 2 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 32 “Shift Valve 2” and No. 72 “Shift Valve Press 2” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 32 “Shift Valve 2”> • In 4th, 5th, 6th gears: ON • In any gears except above: OFF <No. 72 “Shift Valve Press 2”> • In 4th, 5th, 6th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

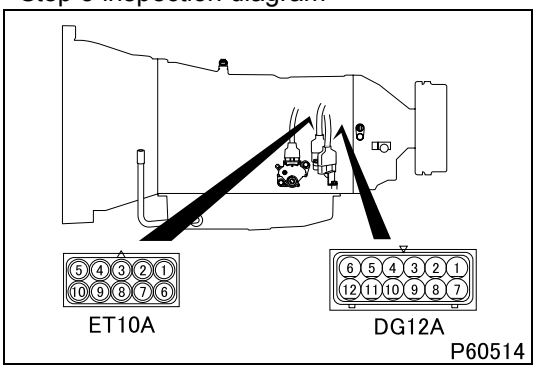
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 2 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 3 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 3 and electronic control unit connector (CY31A) terminal No. 2.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 2 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 32 “Shift Valve 2” and No. 72 “Shift Valve Press 2” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 4th, 5th, 6th gears: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 32 “Shift Valve 2”> • In 4th, 5th, 6th gears: ON • In any gears except above: OFF <No. 72 “Shift Valve Press 2”> • In 4th, 5th, 6th gears: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0979/Flash code: 33
[Monitor ID]
33
[Fault (outline)]
Failure of shift solenoid 3
[Diagnosis check]
- Current in the shift solenoid 3 is monitored for fault.

[Code generation condition]
- Current in the shift solenoid 3 remains at or above the specified value (4A) for 0.1 second (short-circuit in ground side).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

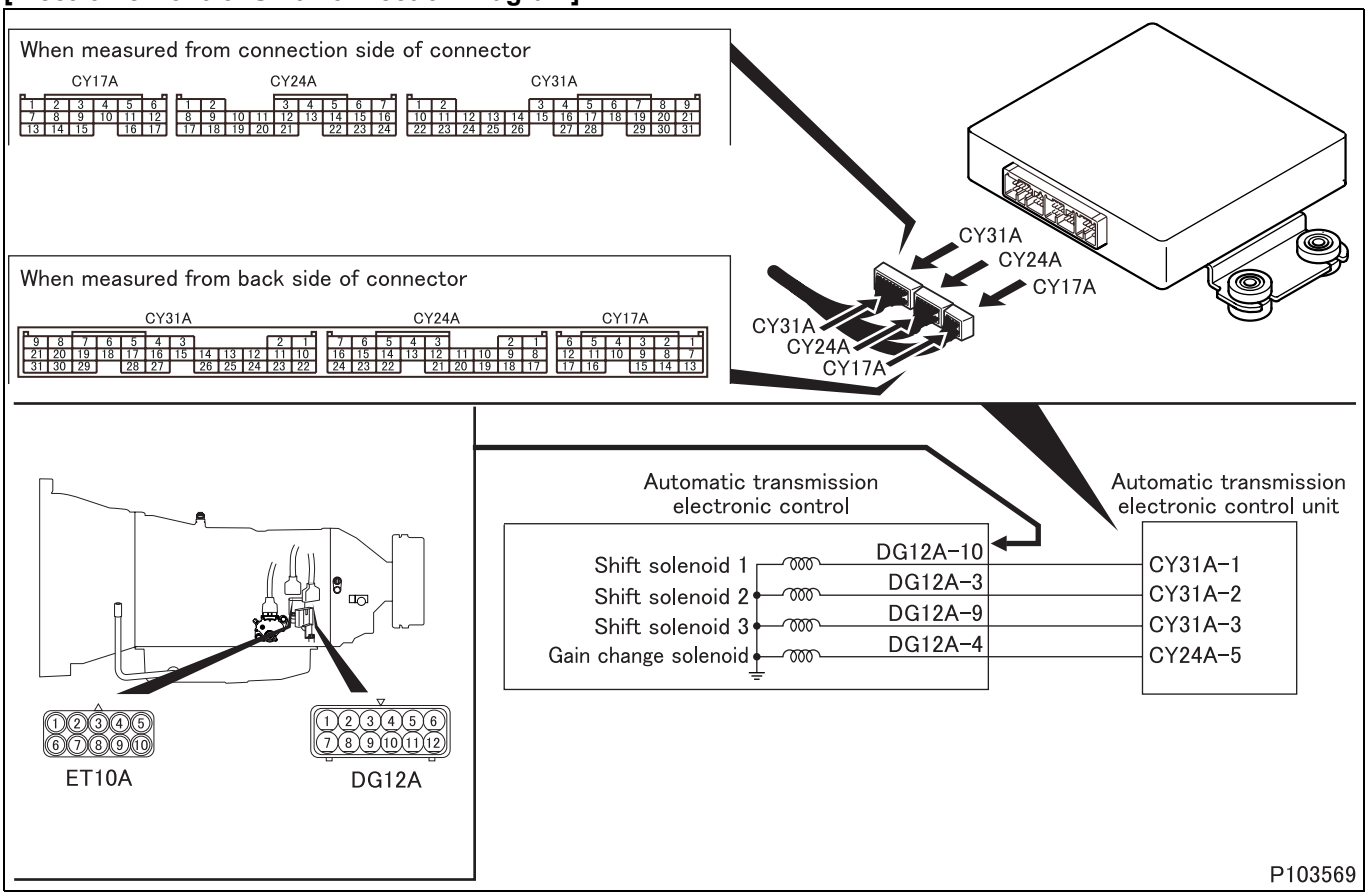
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd).

[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and shift solenoid 3
- Malfunction of each connector
- Malfunction of shift solenoid 3
- Malfunction of electronic control unit

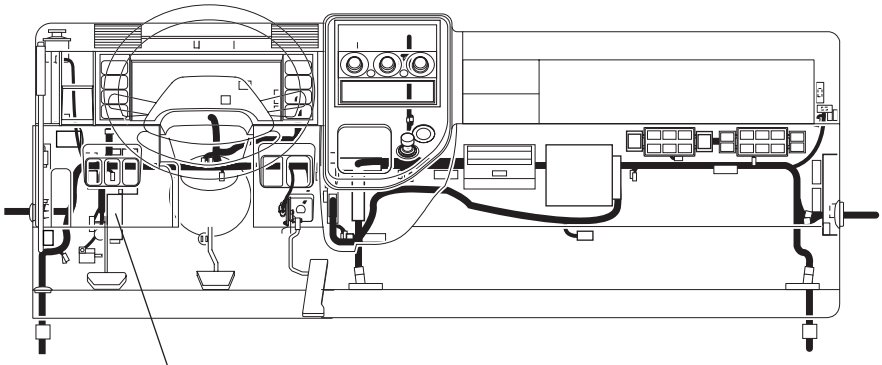
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

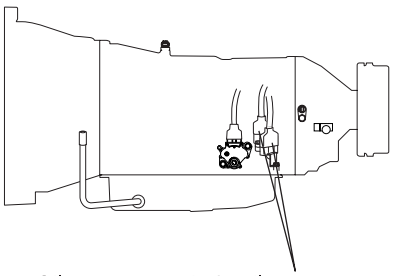
[Electronic Control Unit Connection Diagram]



P103569

[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

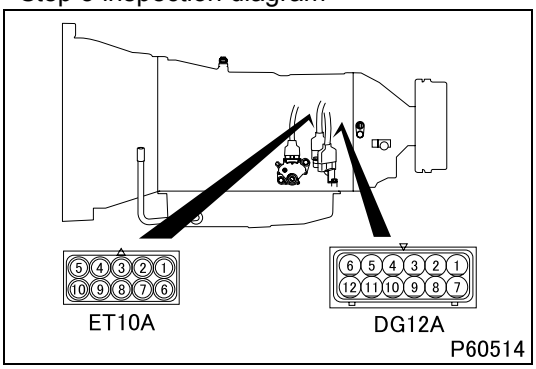
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 3 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 9 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 9 and electronic control unit connector (CY31A) terminal No. 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No. 33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0980/Flash code: 33
[Monitor ID]
34
[Fault (outline)]
Failure of shift solenoid 3
[Diagnosis check]
- Resistance in the shift solenoid 3 is monitored for fault.

[Code generation condition]
- Resistance in the shift solenoid 3 remains at or above the specified value (100 kΩ) for 0.1 second (open-circuit or short-circuit in power supply side).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

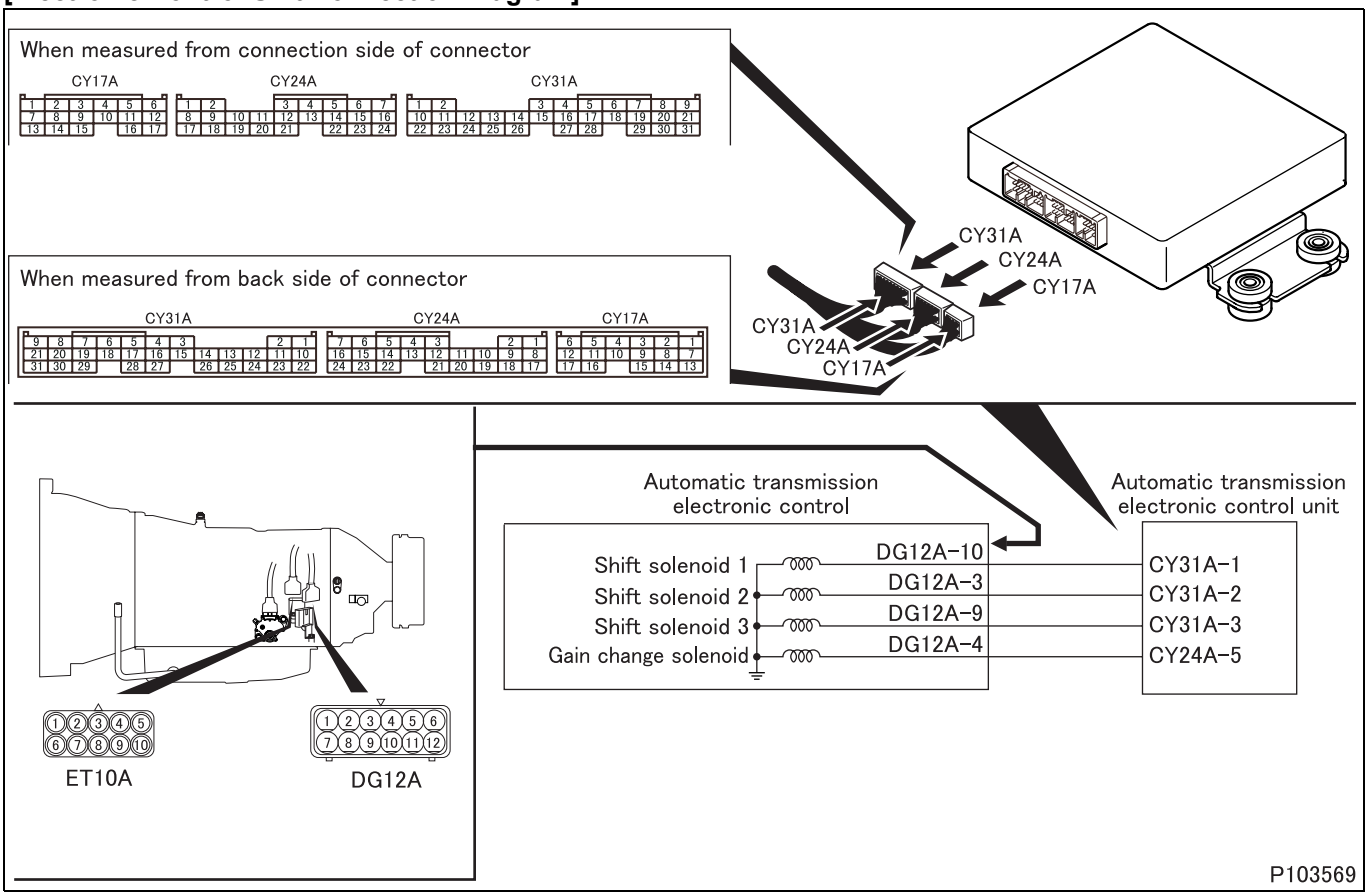
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and shift solenoid 3
- Malfunction of each connector
- Malfunction of shift solenoid 3
- Malfunction of electronic control unit

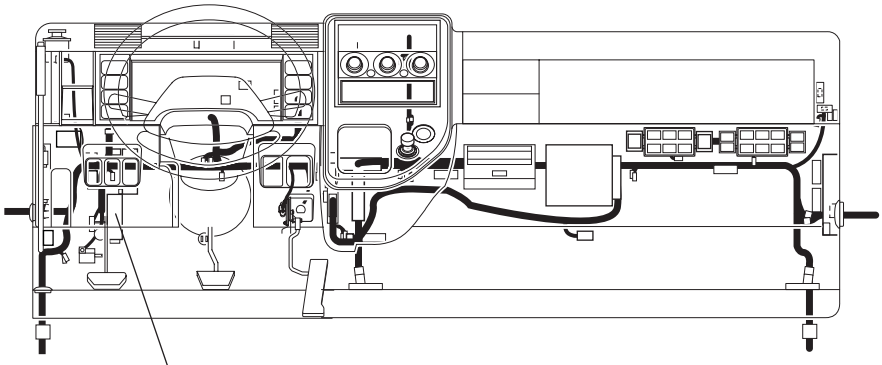
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

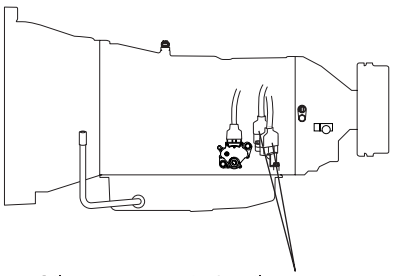
[Electronic Control Unit Connection Diagram]



P103569

[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No.33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

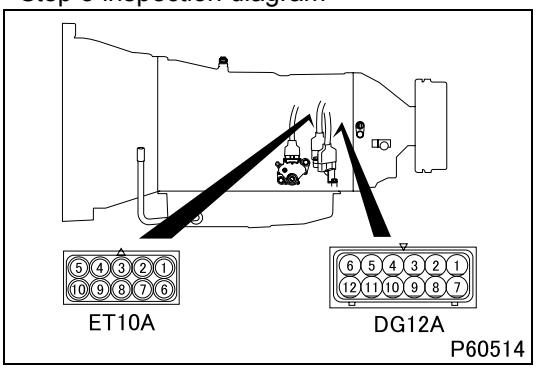
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminal No. 3 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 9 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 9 and electronic control unit connector (CY31A) terminal No. 3.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY31A) terminal No. 3 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 33 “Shift Valve 3” and No. 73 “Shift Valve Press 3” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 12 V • In any gears except above: 0 V **<Multi-Use Tester used>** <No.33 “Shift Valve 3”> • In 1st gear: ON • In any gears except above: OFF <No. 73 “Shift Valve Press 3”> • In 1st gear: HIGH • In any gears except above: LOW
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0985/Flash code: 52
[Monitor ID]
None
[Fault (outline)]
Failure of gain change solenoid
[Diagnosis check]
- Current in the gain change solenoid is monitored for fault.

[Code generation condition]
- Current in the gain change solenoid remains at or above the specified value (4A) for 0.1 second (short-circuit in ground side).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

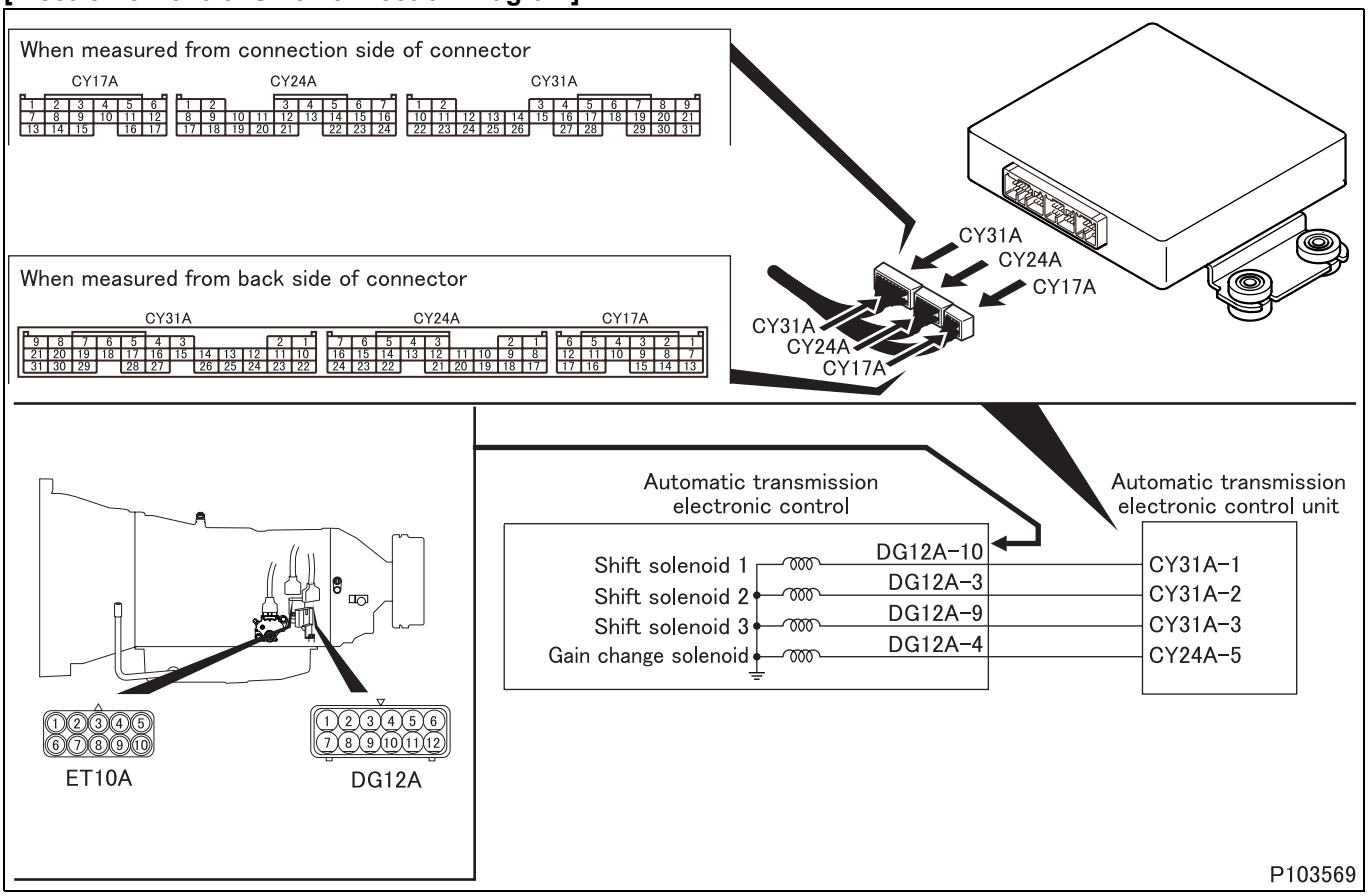
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Effects no special control (gearshifting performance is reduced).

[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and gain change solenoid
- Malfunction of each connector
- Malfunction of gain change solenoid
- Malfunction of electronic control unit

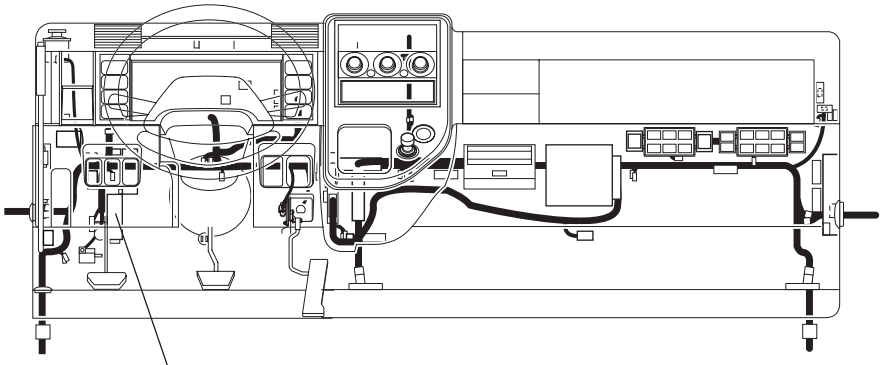
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

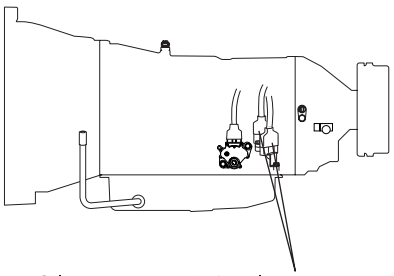
[Electronic Control Unit Connection Diagram]



P103569

[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY24A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 52 “Shift Valve 4” and No. 74 “Shift Valve Press 4” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In R range (high accelerator pedal position): 12 V • In R range (low accelerator pedal position): 0 V **<Multi-Use Tester used>** <No. 52 “Shift Valve 4”> • In R range (high accelerator pedal position): OFF • In R range (low accelerator pedal position): ON <No. 74 “Shift Valve Press 4”> • In R range (high accelerator pedal position): HIGH • In R range (low accelerator pedal position): LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

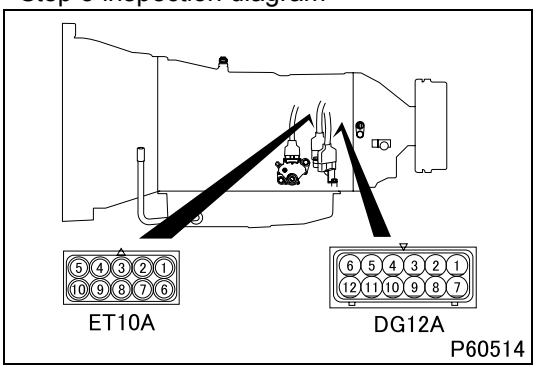
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 5 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 4 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 4 and electronic control unit connector (CY24A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY24A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 52 “Shift Valve 4” and No. 74 “Shift Valve Press 4” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In R range (high accelerator pedal position): 12 V • In R range (low accelerator pedal position): 0 V **<Multi-Use Tester used>** <No. 52 “Shift Valve 4”> • In R range (high accelerator pedal position): OFF • In R range (low accelerator pedal position): ON <No. 74 “Shift Valve Press 4”> • In R range (high accelerator pedal position): HIGH • In R range (low accelerator pedal position): LOW
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0986/Flash code: 52
[Monitor ID]
35
[Fault (outline)]
Failure of gain change solenoid
[Diagnosis check]
- Resistance in the gain change solenoid is monitored for fault.

[Code generation condition]
- Resistance in the gain change solenoid remains at or above the specified value (100 kΩ) for 0.1 second (open-circuit or short-circuit in power supply side).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

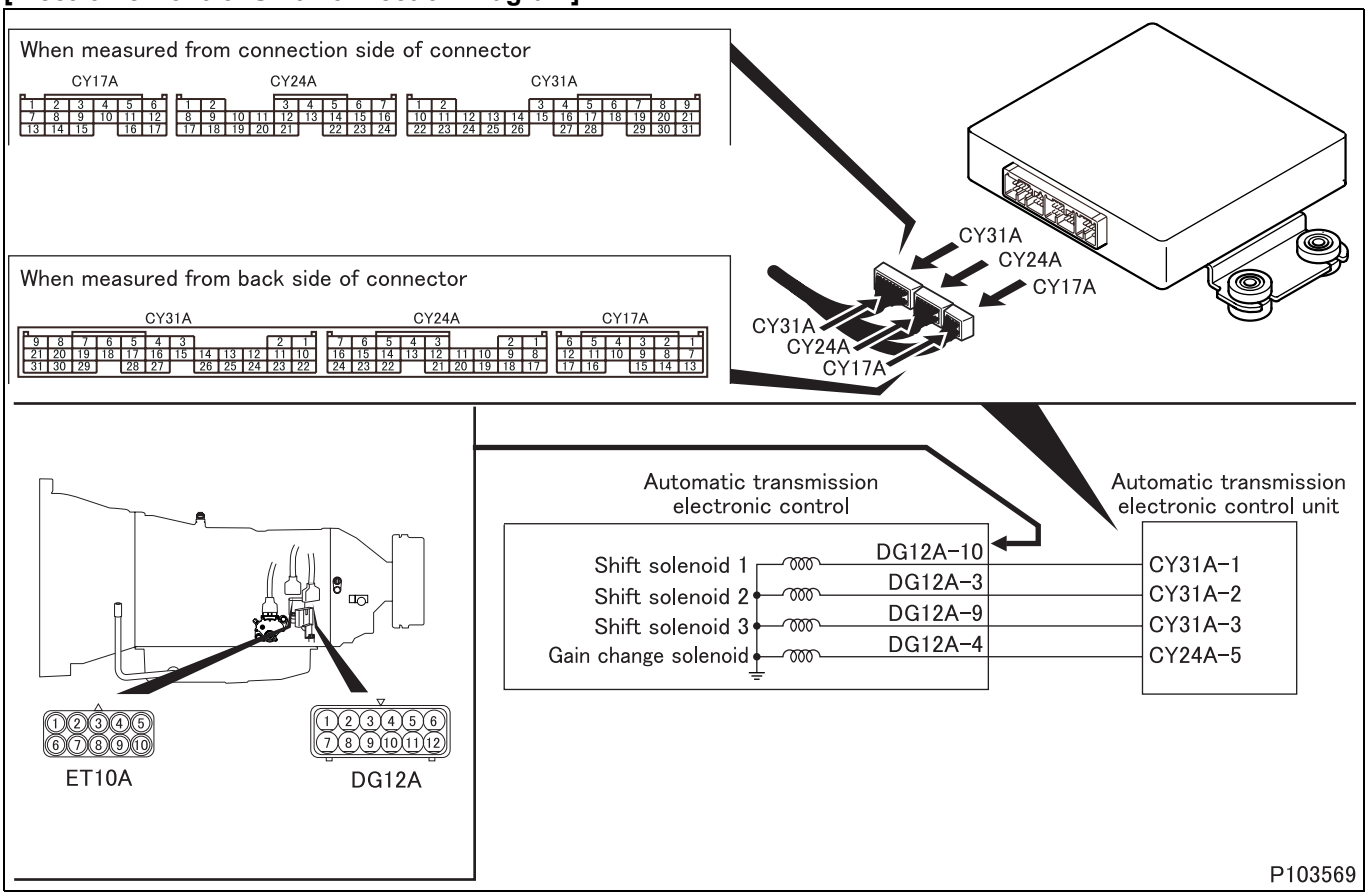
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Requested to send output signals to the engine electronic control unit during engine starting.

[Probable cause of trouble]
- Short-circuit of harness between electronic control unit and gain change solenoid
- Malfunction of each connector
- Malfunction of gain change solenoid
- Malfunction of electronic control unit

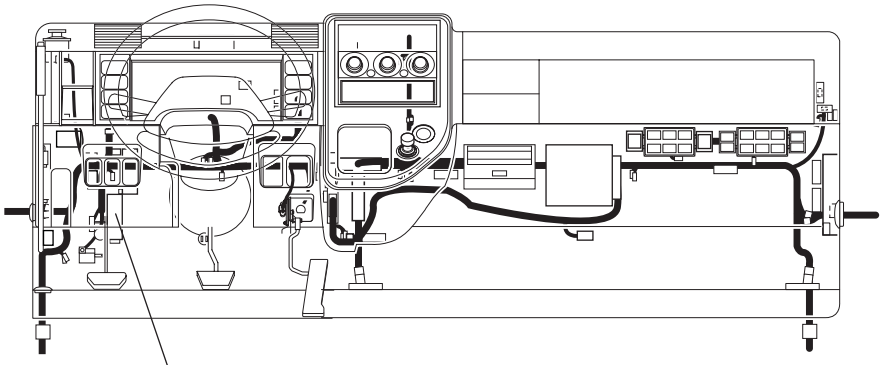
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

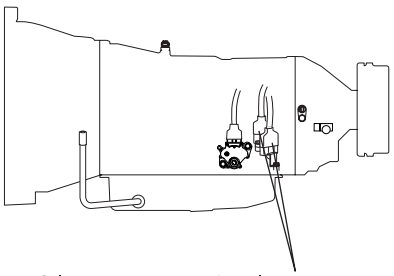
[Electronic Control Unit Connection Diagram]



P103569

[Parts Identification and Location]





P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY24A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 52 “Shift Valve 4” and No. 74 “Shift Valve Press 4” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In R range (high accelerator pedal position): 12 V • In R range (low accelerator pedal position): 0 V **<Multi-Use Tester used>** <No. 52 “Shift Valve 4”> • In R range (high accelerator pedal position): OFF • In R range (low accelerator pedal position): ON <No. 74 “Shift Valve Press 4”> • In R range (high accelerator pedal position): HIGH • In R range (low accelerator pedal position): LOW
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

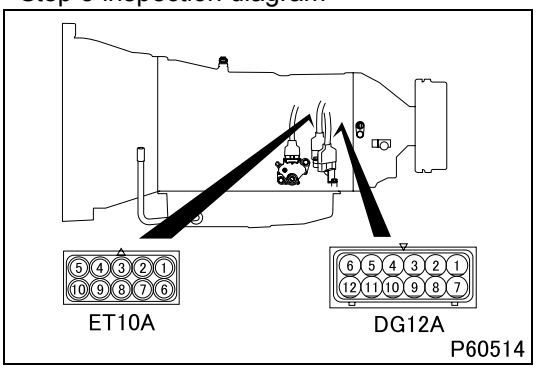
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 5 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminal No. 4 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		13 ± 2 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 4 and electronic control unit connector (CY24A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY24A) terminal No. 5 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure items No. 52 “Shift Valve 4” and No. 74 “Shift Valve Press 4” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In R range (high accelerator pedal position): 12 V • In R range (low accelerator pedal position): 0 V **<Multi-Use Tester used>** <No. 52 “Shift Valve 4”> • In R range (high accelerator pedal position): OFF • In R range (low accelerator pedal position): ON <No. 74 “Shift Valve Press 4”> • In R range (high accelerator pedal position): HIGH • In R range (low accelerator pedal position): LOW
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P0989/Flash code: 47
[Monitor ID]
62
[Fault (outline)]
Failure of oil pressure switch 5
[Diagnosis check]
- Oil pressure switch 5 is monitored for fault when the shift solenoid 3 is energized (high pressure).

[Code generation condition]
- Oil pressure switch 5 remains OFF (low pressure) for 0.1 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

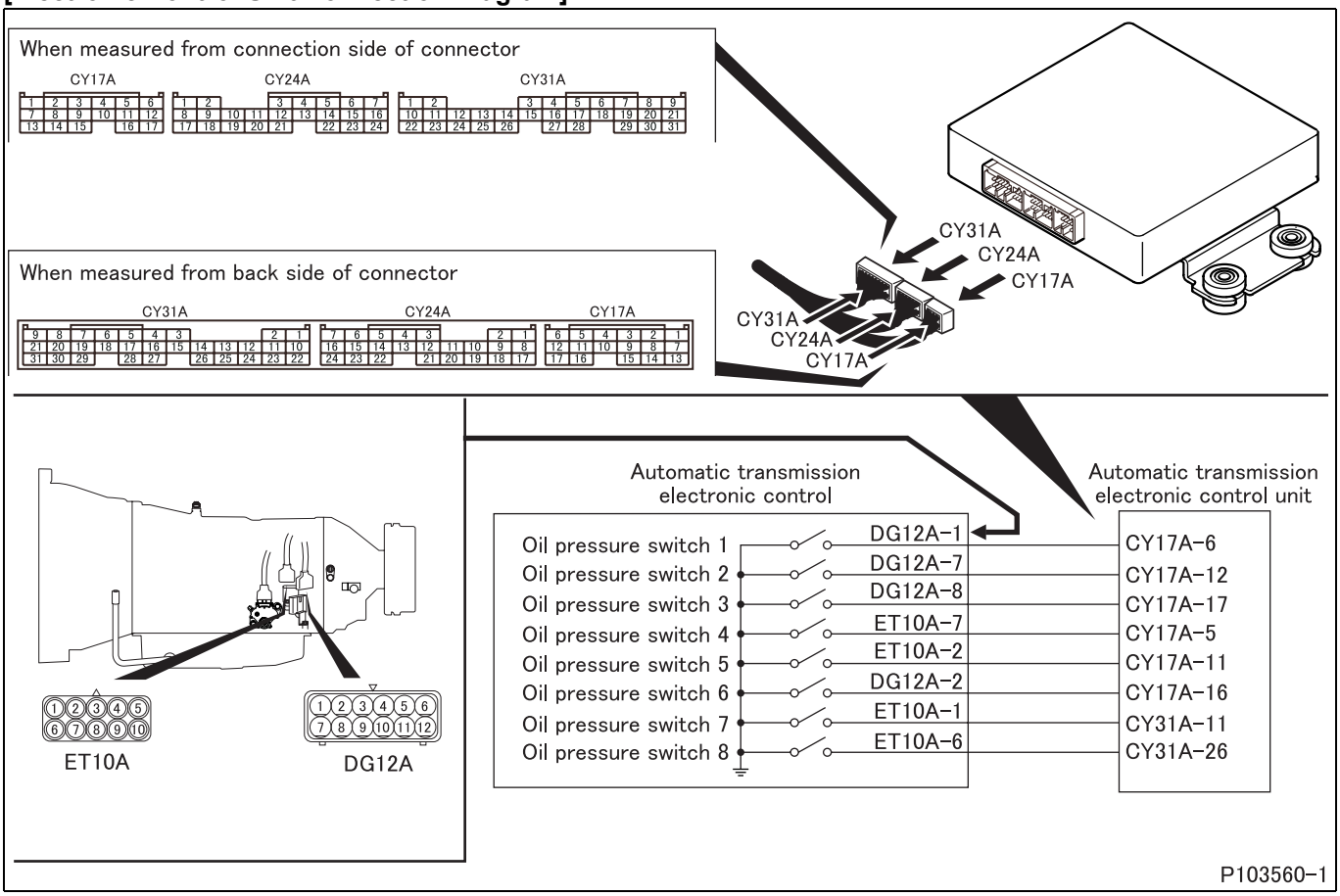
[Diagnostic requirement]
- Shift solenoid 3 is ON

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 5 or shift solenoid 3
- Malfunction of each connector
- Malfunction of oil pressure switch 5 or shift solenoid 3
- Malfunction of electronic control unit

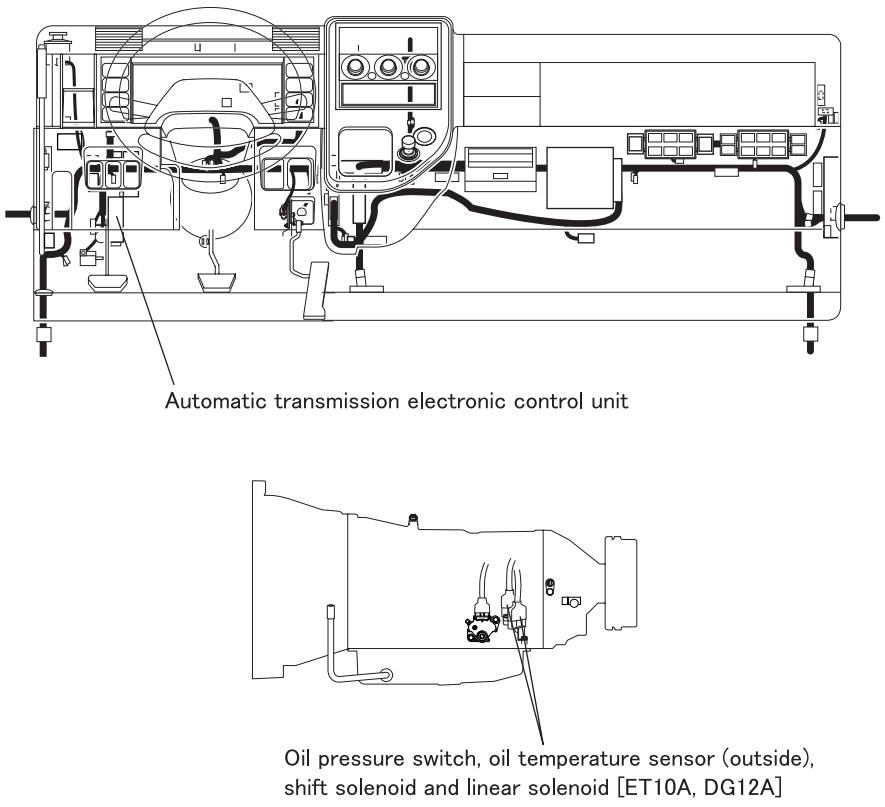
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



P103560-1

[Parts Identification and Location]



P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 65 “Oil Press SW 5” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

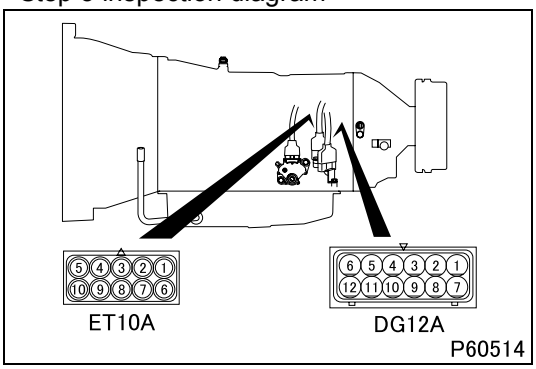
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 11 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (ET10A) terminal No. 2 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 2 and electronic control unit connector (CY17A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 65 “Oil Press SW 5” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of shift solenoid 3 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0990/Flash code: 47
[Monitor ID]
61
[Fault (outline)]
Failure of oil pressure switch 5
[Diagnosis check]
- Oil pressure switch 5 is monitored for fault when the shift solenoid 3 is deenergized (low pressure).

[Code generation condition]
- Oil pressure switch 5 remains ON (high pressure) for 0.1 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

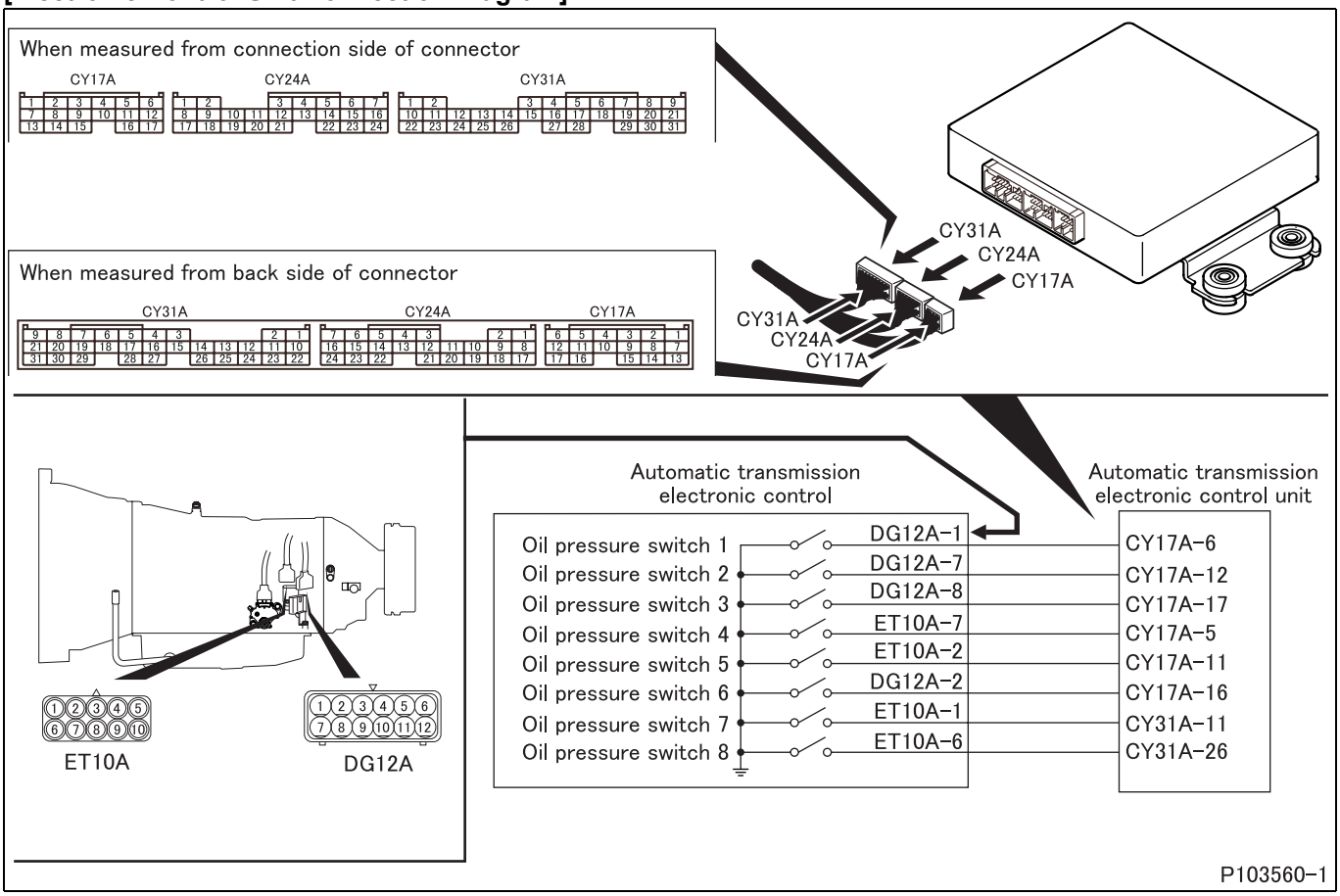
[Diagnostic requirement]
- Shift solenoid 3 is OFF

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 5 or shift solenoid 3
- Malfunction of each connector
- Malfunction of oil pressure switch 5 or shift solenoid 3
- Malfunction of electronic control unit

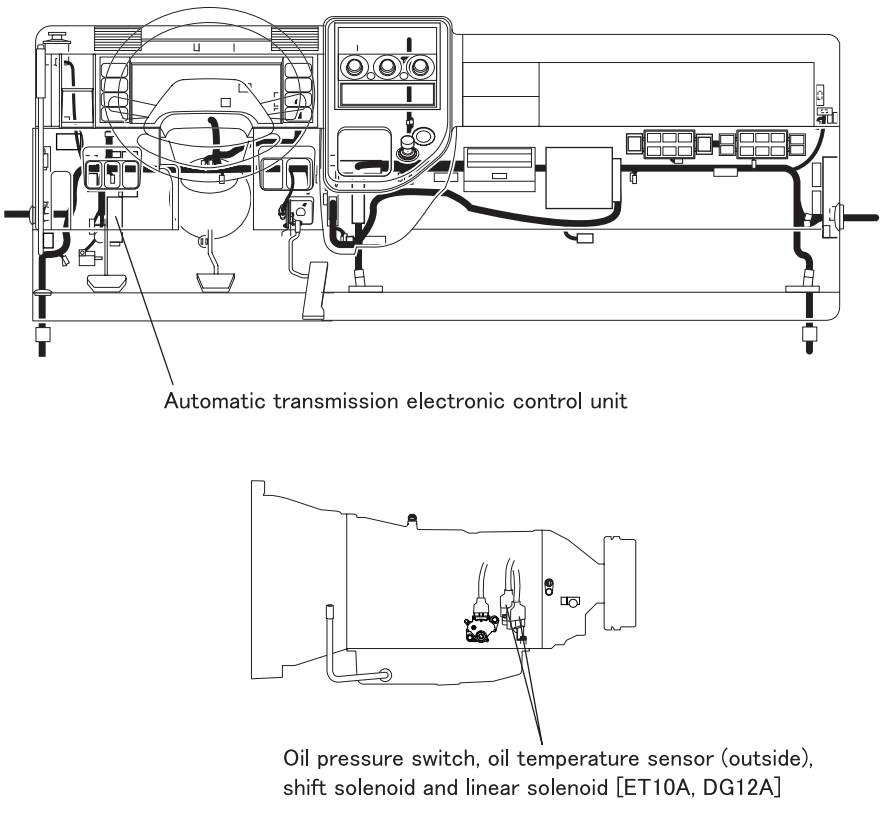
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



P103560-1

[Parts Identification and Location]



P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 65 “Oil Press SW 5” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

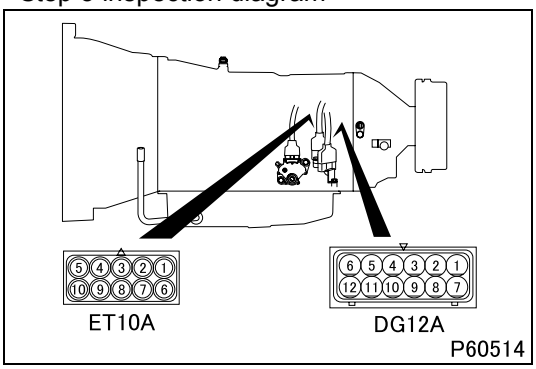
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 11 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (ET10A) terminal No. 2 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 2 and electronic control unit connector (CY17A) terminal No. 11.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 11 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 65 “Oil Press SW 5” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of shift solenoid 3 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0994/Flash code: 55
[Monitor ID]
66
[Fault (outline)]
Failure of oil pressure switch 6
[Diagnosis check]
- Oil pressure switch 6 is monitored for fault when the shift solenoid 3 is energized (high pressure).

[Code generation condition]
- Oil pressure switch 6 remains OFF (low pressure) for 0.1 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

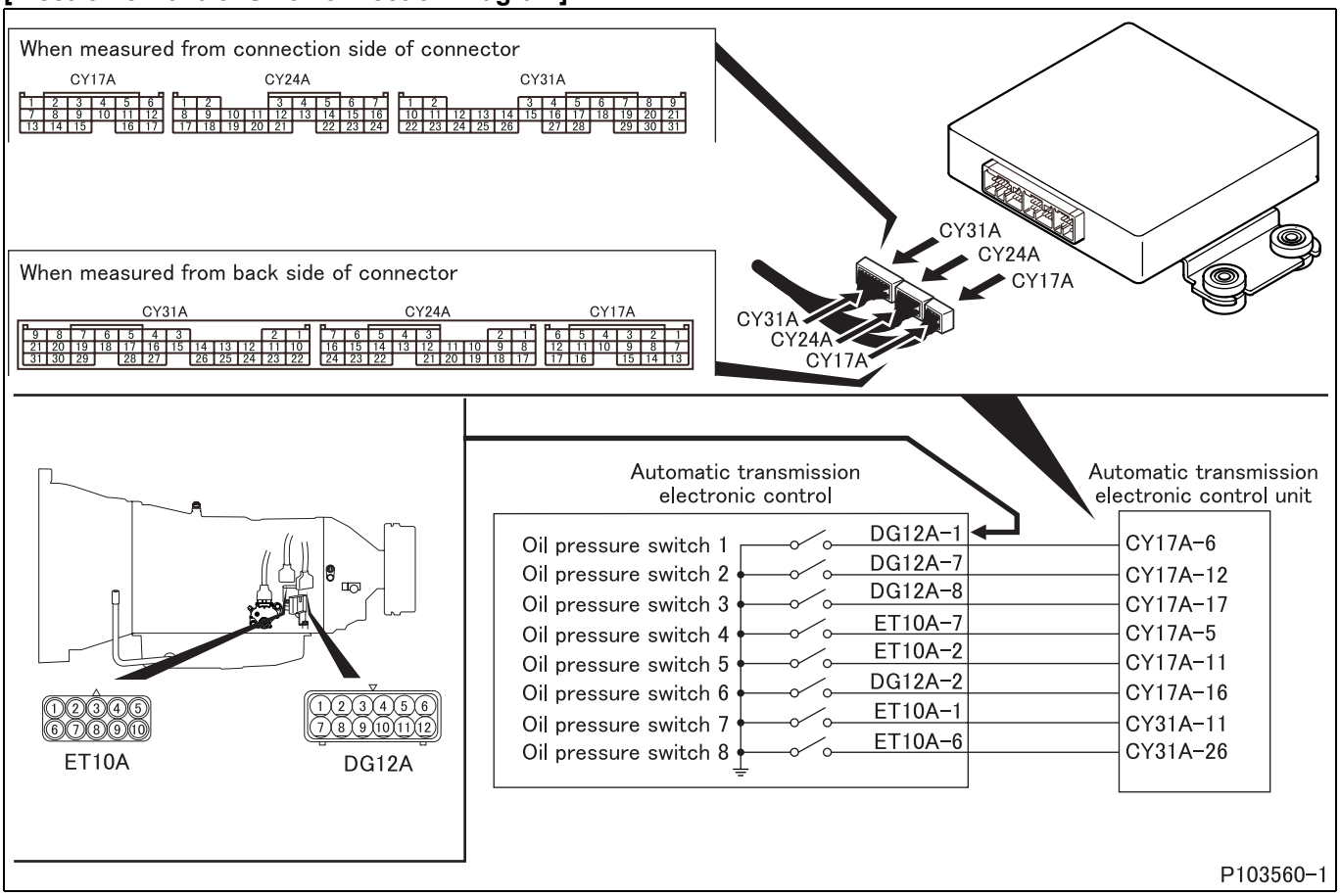
[Diagnostic requirement]
- Shift solenoid 3 is ON

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 6 or shift solenoid 3
- Malfunction of each connector
- Malfunction of oil pressure switch 6 or shift solenoid 3
- Malfunction of electronic control unit

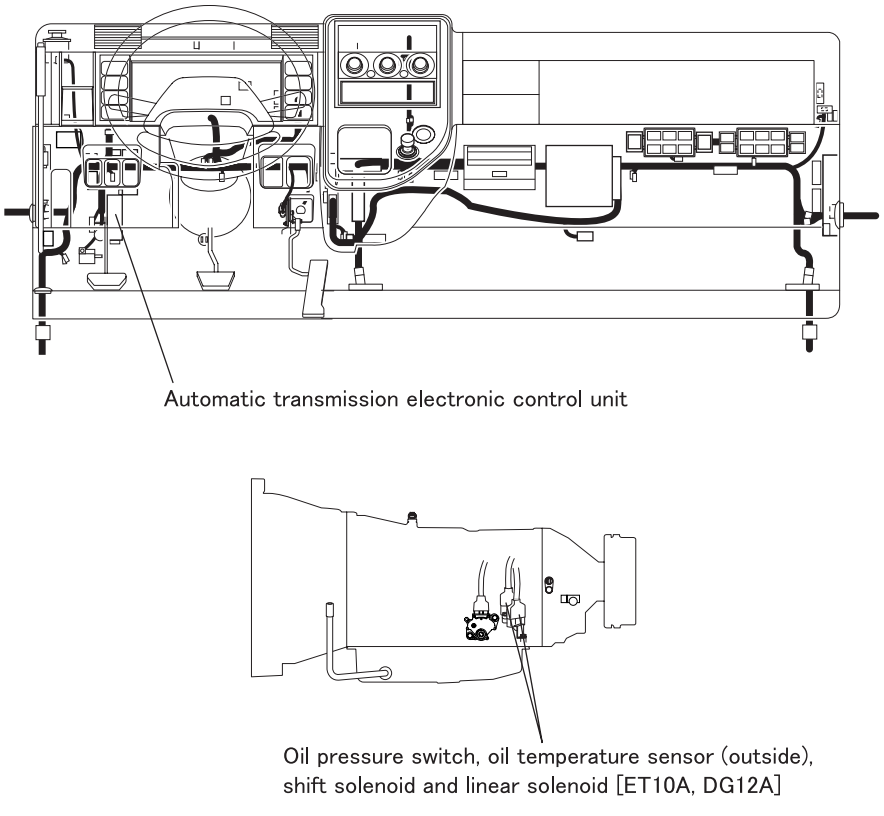
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



P103560-1

[Parts Identification and Location]



P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 16 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 66 “Oil Press SW 6” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

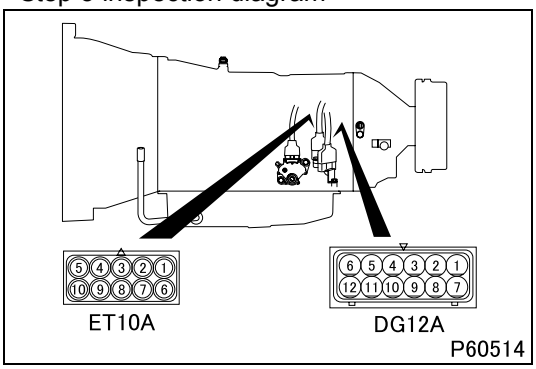
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 16 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (DG12A) terminal No. 2 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 2 and electronic control unit connector (CY17A) terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 16 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 66 “Oil Press SW 6” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of shift solenoid 3 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P0995/Flash code: 55
[Monitor ID]
65
[Fault (outline)]
Failure of oil pressure switch 6
[Diagnosis check]
- Oil pressure switch 6 is monitored for fault when the shift solenoid 3 is deenergized (low pressure).

[Code generation condition]
- Oil pressure switch 6 remains ON (high pressure) for 0.1 second.

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

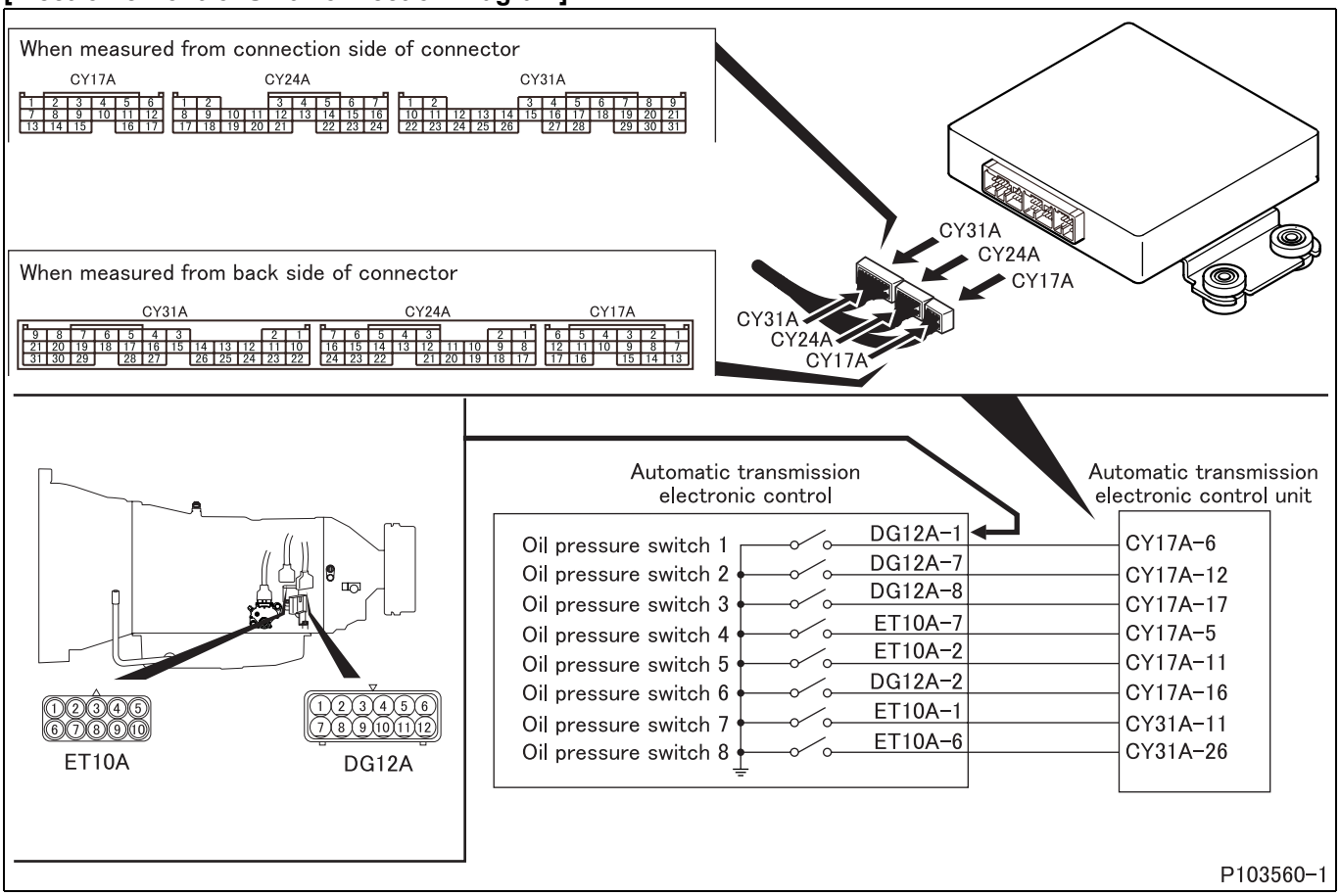
[Diagnostic requirement]
- Shift solenoid 3 is OFF

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (2nd).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil pressure switch 6 or shift solenoid 3
- Malfunction of each connector
- Malfunction of oil pressure switch 6 or shift solenoid 3
- Malfunction of electronic control unit

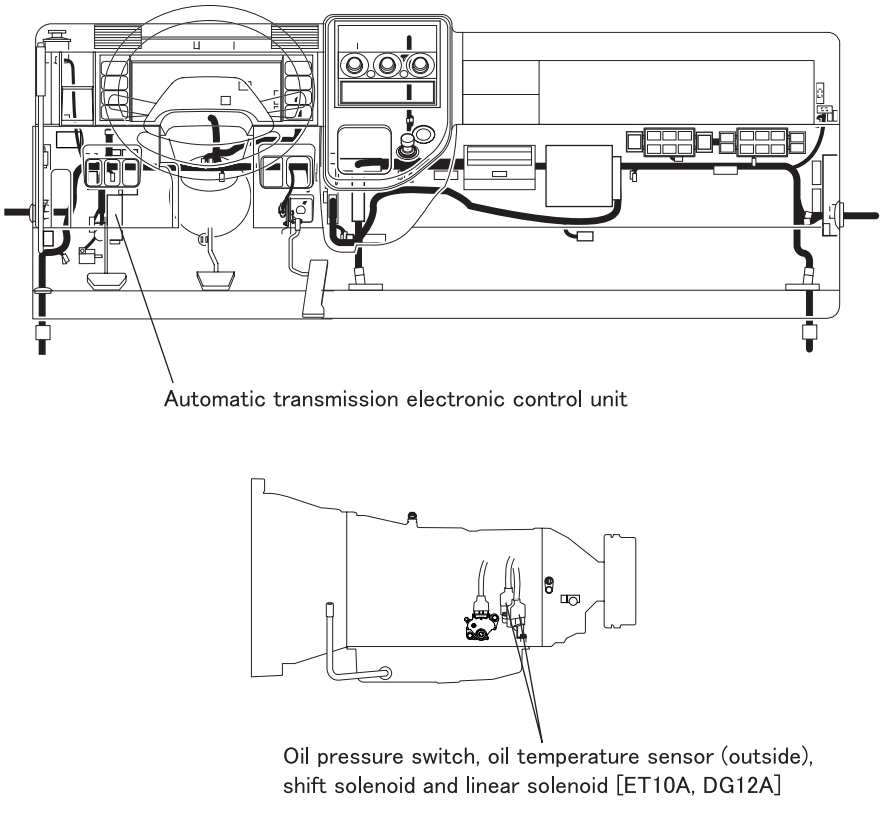
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



P103560-1

[Parts Identification and Location]



P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 16 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 66 “Oil Press SW 6” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

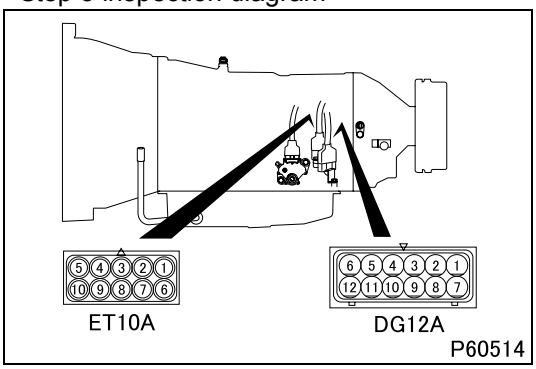
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure continuity between connector (CY17A) terminal No. 16 and chassis ground.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify connector.

Step 4	Inspection items		Inspection of switch connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of switch unit
	Maintenance item		Check continuity between connector (DG12A) terminal No. 2 and automatic transmission case.
	Inspection condition		• Disconnect connector, and measure switch side terminal. • Starter switch: OFF
	Requirements		There is no continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of oil pressure switch (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between switch and electronic control unit (signal)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 2 and electronic control unit connector (CY17A) terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of voltage between connector (CY17A) terminal No. 16 (+) and connector (CY24A) terminal No. 8 (–). **<Multi-Use Tester used>** Measure item No. 66 “Oil Press SW 6” of Service Data.
	Inspection condition		Engine in operation **<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** • In 1st gear: 0 V • In 2nd, 3rd, 4th, 5th, 6th gears: 12 V **<Multi-Use Tester used>** • In 1st gear: ON • In 2nd, 3rd, 4th, 5th, 6th gears: OFF
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	• Inspection of shift solenoid 3 is performed. • Replacement of electronic control unit

[Fault code]
Diagnosis code: P1604/Flash code: 24
[Monitor ID]
10
[Fault (outline)]
Abnormality in accelerator pedal position signal
[Diagnosis check]
- Accelerator pedal position signal from engine electronic control unit is monitored for abnormality.

[Code generation condition]
- Signal outputted from engine electronic control unit remains abnormal for 5 seconds. (This condition is not caused by abnormal accelerator opening but by abnormal signal.)

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

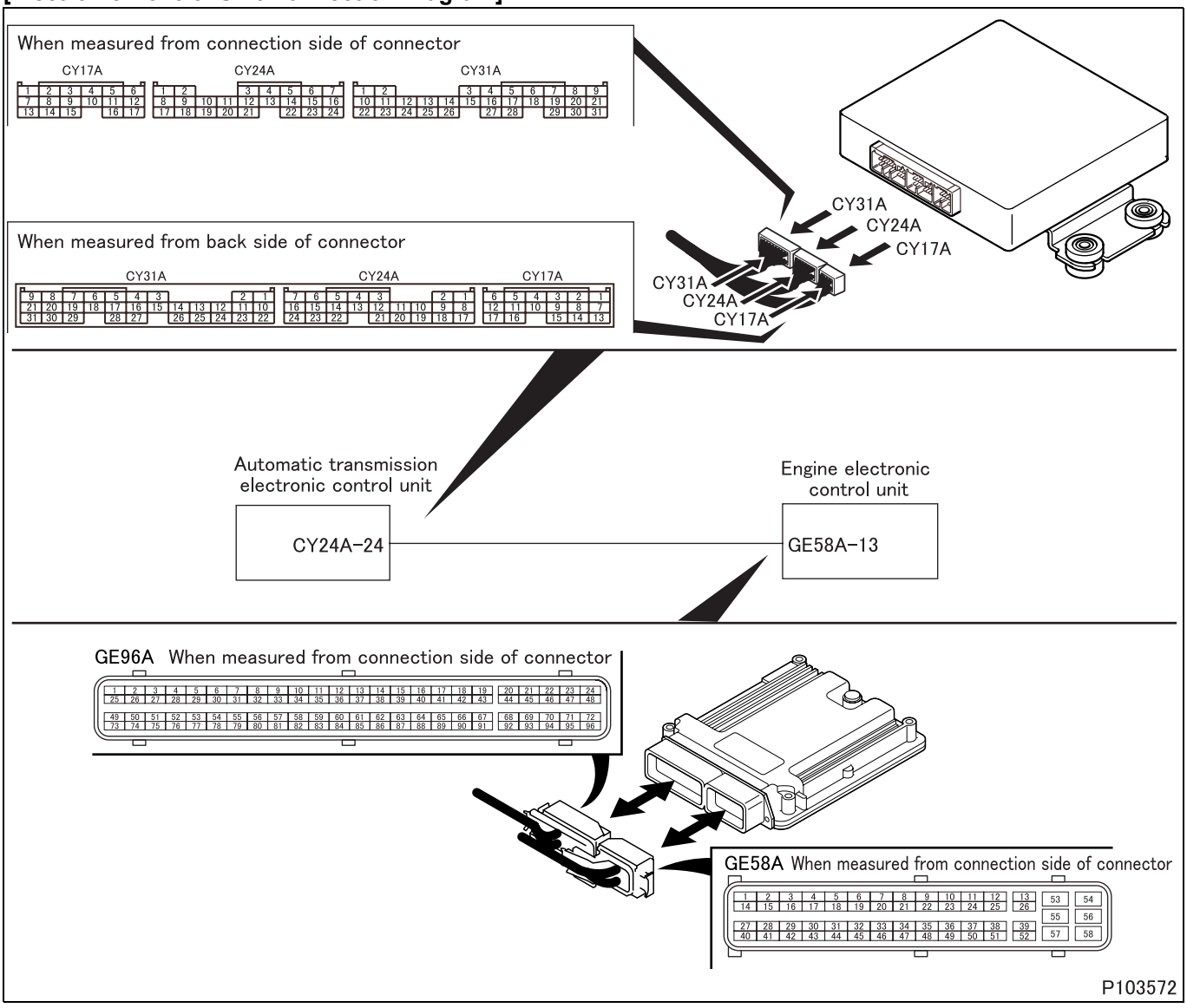
[Diagnostic requirement]
- Starter switch: ON

[Control effected by electronic control unit during fault]
- Oil pressure control is executed on the basis of the preset value for accelerator pedal position of 100%
- Shift point control is executed on the basis of the preset value for the accelerator pedal position of 0%
- Braking force control is inhibited.

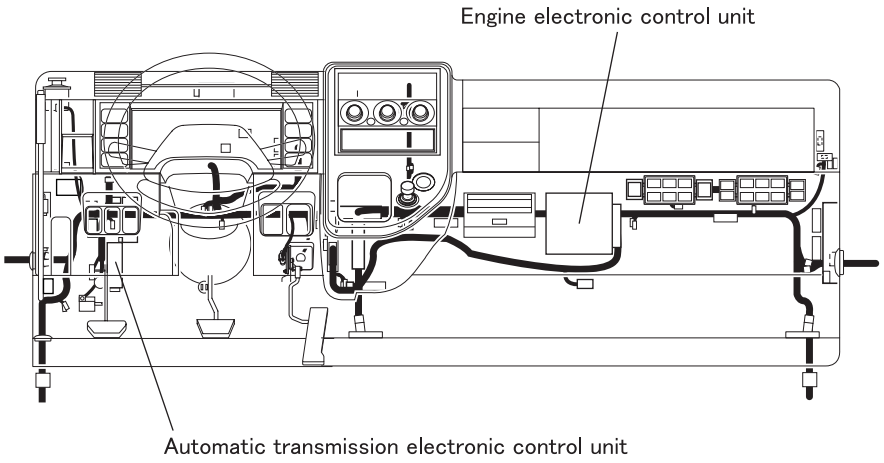
[Probable cause of trouble]
- Open-circuit or short-circuit between electronic control unit and engine electronic control unit or between engine electronic control unit and accelerator pedal position sensor
- Malfunction of each connector
- Malfunction of accelerator pedal position sensor
- Malfunction of electronic control unit
- Malfunction of engine electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



P103565-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 58 “Accel Percent” of Service Data.
	Inspection condition		–
	Requirements		• Accelerator pedal released (fully closed): 0% • Accelerator pedal pressed (fully opened): 100%
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of engine electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of engine electronic control unit
	Maintenance item		Inspection of engine electronic control unit
	Inspection condition		–
	Requirements		Free of errors related to accelerator opening
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Perform troubleshooting on engine electronic control unit (See Gr13EA).

Step 5	Inspection items		Inspection of harness between electronic control unit and engine electronic control unit
	Maintenance item		Check circuit between connector (CY24A) terminal No. 24 and engine electronic control unit connector (GE58A) terminal No. 13.
	Inspection condition		Disconnect each electronic control unit from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 58 “Accel Percent” of Service Data.
	Inspection condition		–
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • Accelerator pedal released (fully closed): 0% • Accelerator pedal pressed (fully opened): 100%
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit (If replacement of electronic control unit does not eliminate trouble, replace engine electronic control unit.)

[Fault code]
Diagnosis code: P2716/Flash code: 34
[Monitor ID]
27, 28
[Fault (outline)]
PL linear solenoid is open-circuited or short-circuited.
[Diagnosis check]
- Resistance and current in the PL linear solenoid are monitored for fault.

[Code generation condition]
- Resistance in the PL linear solenoid remains at or above the specified value (100 kΩ) for 0.065 second (open-circuit or short-circuit in power supply side).
- Current in the PL linear solenoid remains at or above the specified value (4A) for 0.065 second (short-circuit in ground side).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

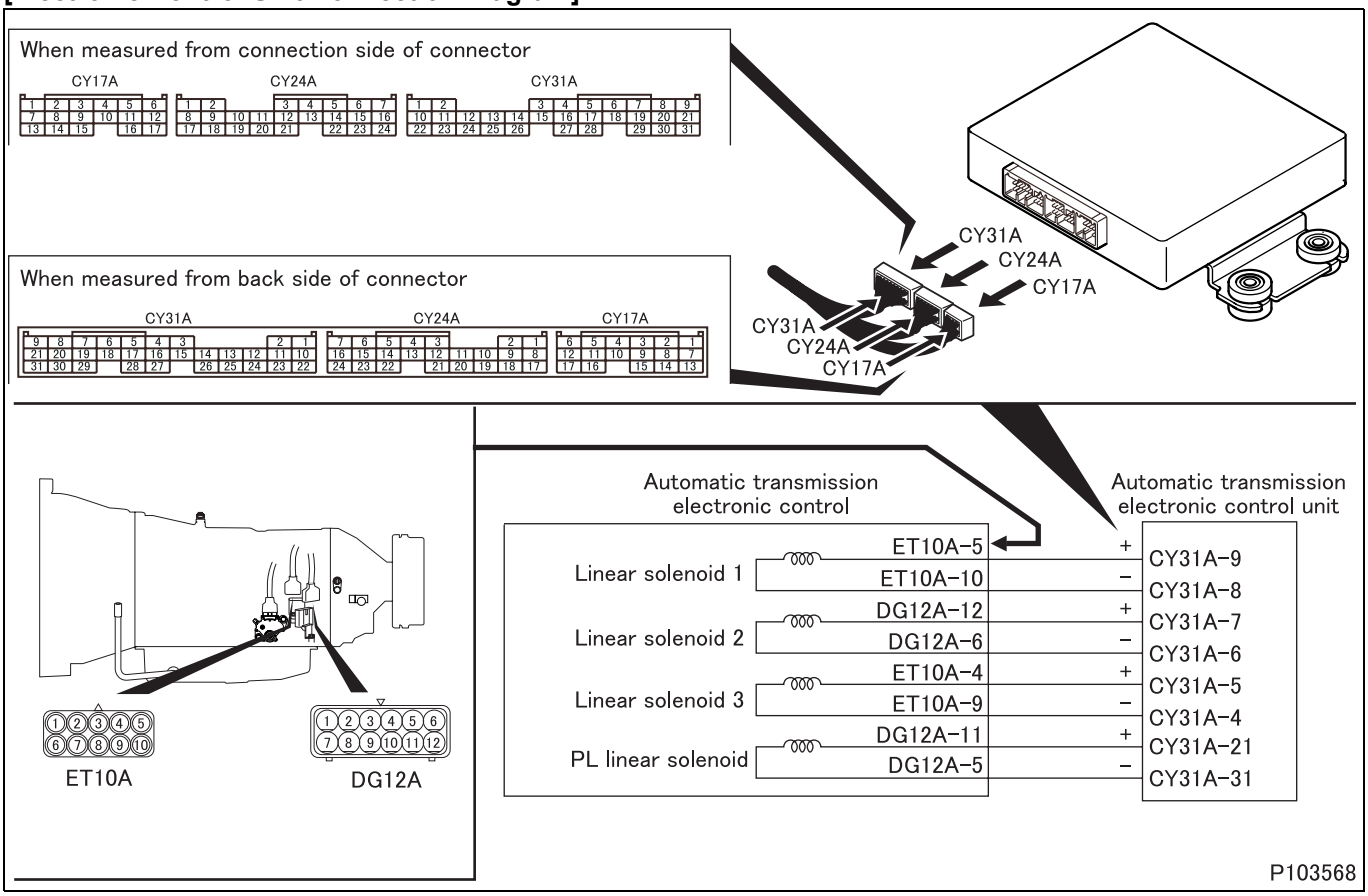
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- PL linear solenoid is turned OFF (line pressure held in high pressure side).

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and PL linear solenoid
- Malfunction of each connector
- Malfunction of PL linear solenoid
- Malfunction of electronic control unit

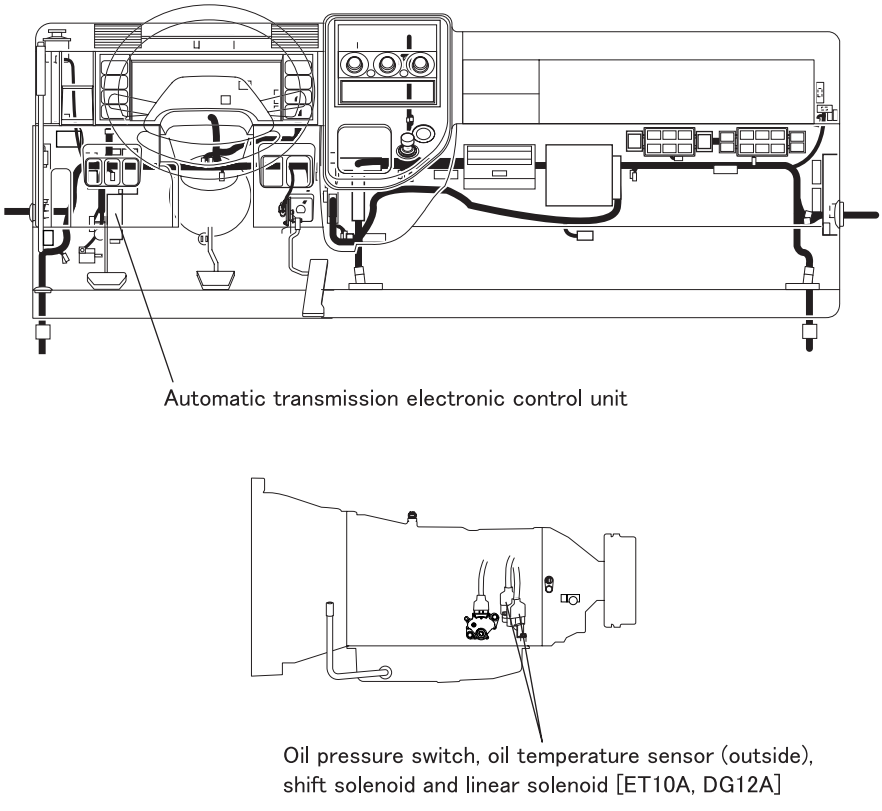
[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



P103568

[Parts Identification and Location]



P103560-2

[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 34 “Linear Sol Press 4” of Service Data.
	Inspection condition		• Engine in operation • With the brake pedal pressed down, shift the range selector lever.
	Requirements		• In R range, 1st gear (high accelerator pedal position): 260 lbf/in^2 • In any gears except above: 100 lbf/in^2
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

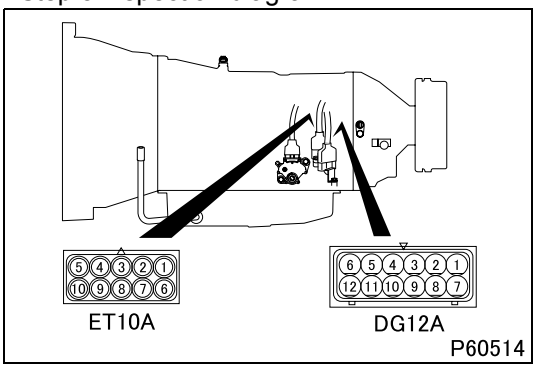
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminals No. 21 and 31.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (DG12A) terminals No. 11 and 5.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 11 and electronic control unit connector (CY31A) terminal No. 21.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (ground)
	Maintenance item		Check circuit between connector (DG12A) terminal No. 5 and electronic control unit connector (CY31A) terminal No. 31.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 34 “Linear Sol Press 4” of Service Data.
	Inspection condition		• Engine in operation • With the brake pedal pressed down, shift the range selector lever.
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • In R range, 1st gear (high accelerator pedal position): 260 lbf/in^2 • In any gears except above: 100 lbf/in^2
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2742/Flash code: 17
[Monitor ID]
16
[Fault (outline)]
Failure of oil temperature sensor (outside)
[Diagnosis check]
- Automatic transmission fluid temperature is monitored by oil temperature sensor (outside).

[Code generation condition]
- Oil temperature sensor (outside) output temperature remains excessively high (over 180°C {355°F}) for 0.5 second.

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

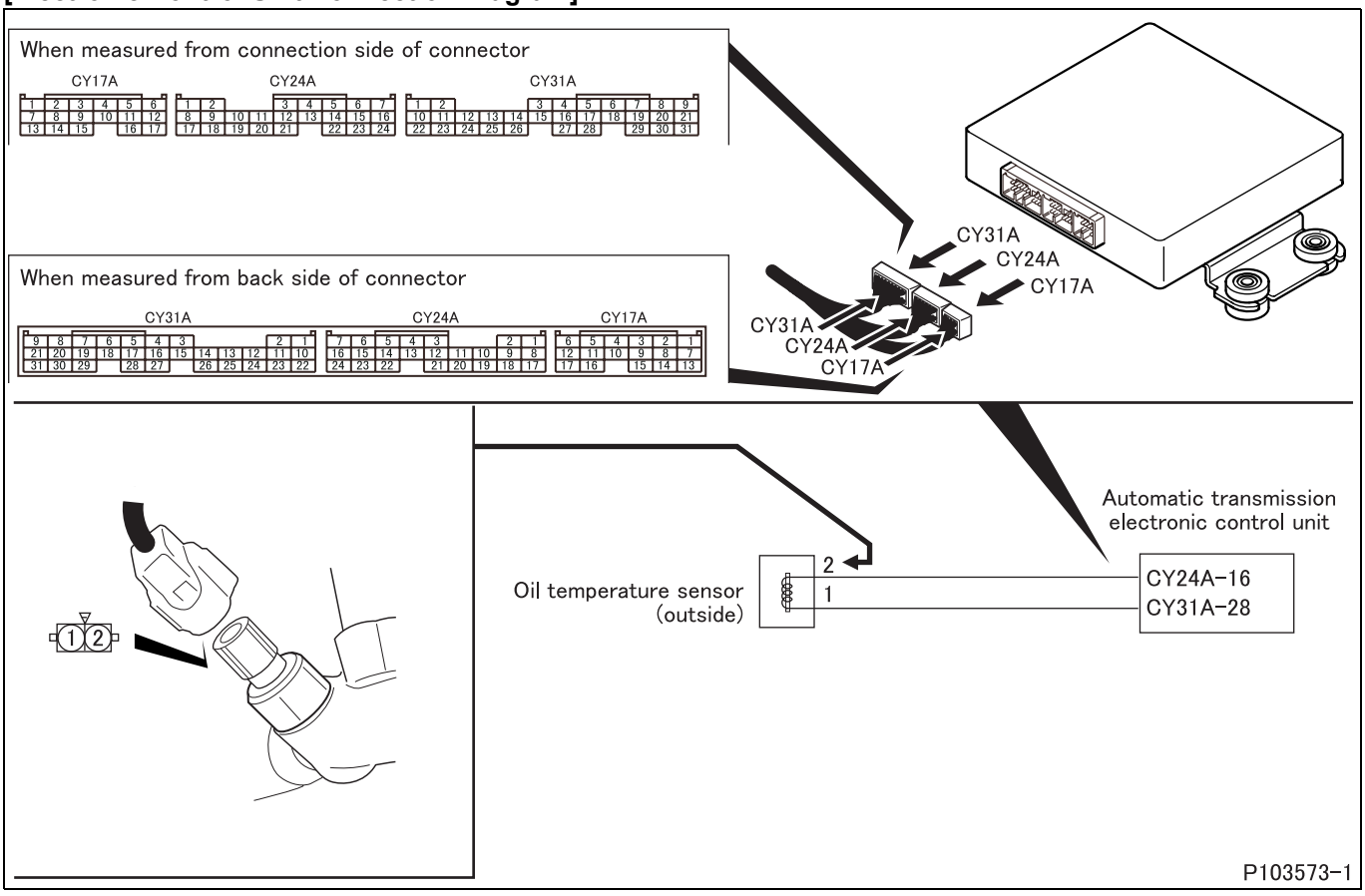
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Control is effected with oil temperature at 80°C {175°F}.
- Braking force control is inhibited.

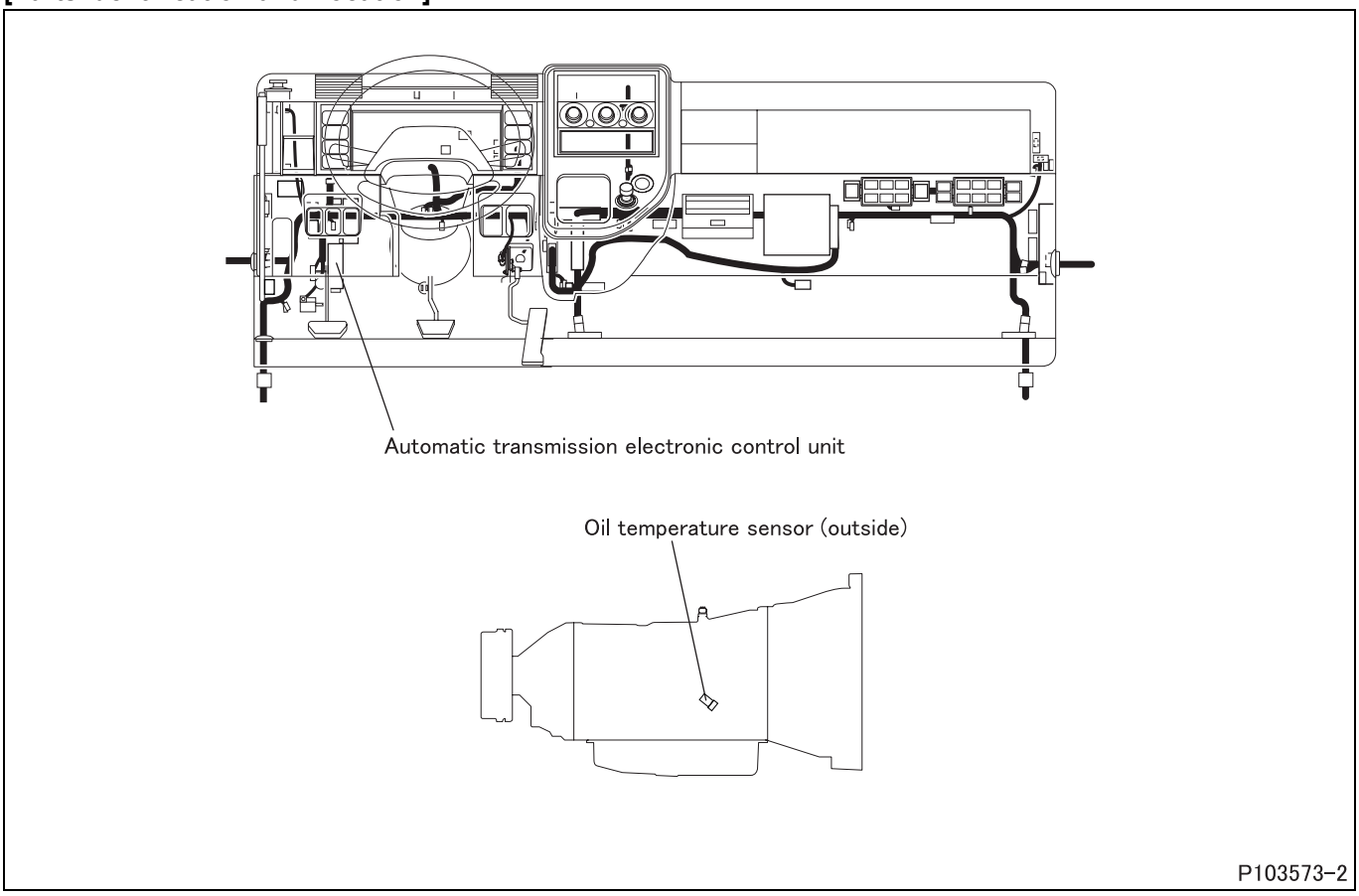
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil temperature sensor (outside)
- Malfunction of each connector
- Malfunction of oil temperature sensor (outside)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between connector (CY24A) terminal No. 16 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 17 “A/T Oil Temp (TC)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

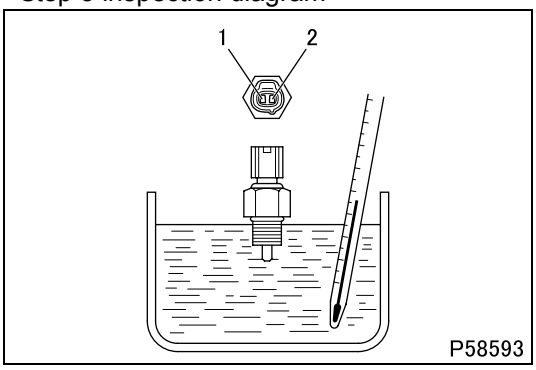
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 16 and connector (CY31A) terminal No. 28.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		• 115°C {240°F}: 655 to 730 Ω • 120°C {250°F}: 585 to 645 Ω • 145°C {295°F}: 340 to 375 Ω • 155°C {310°F}: 280 to 305 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 or 2 and body.
	Inspection condition		• Put sensor in vessel filled with automatic transmission fluid. • Measure value of resistance the sensor in each temperature (Wait for more than 5 minutes in each time to measure correct resistances).
	Requirements		• 115°C {240°F}: 655 to 730 Ω • 120°C {250°F}: 585 to 645 Ω • 145°C {295°F}: 340 to 375 Ω • 155°C {310°F}: 280 to 305 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between connector terminal No. 2 and electronic control unit connector (CY24A) terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between connector terminal No. 1 and electronic control unit connector (CY31A) terminal No. 28.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between connector (CY24A) terminal No. 16 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 17 “A/T Oil Temp (TC)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2743/Flash code: 17
[Monitor ID]
17, 18
[Fault (outline)]
Failure of oil temperature sensor (outside)
[Diagnosis check]
- Automatic transmission fluid temperature is monitored by oil temperature sensor (outside).

[Code generation condition]
Diagnosis code is generated under either of the following conditions.
- Oil temperature sensor (outside) output temperature remains excessively low (under –50°C {–56°F}) for 0.5 second. (Lamp indication: IMD) <A>
- Engine coolant temperature is above 70°C {160°F} and while oil temperature sensor (inside) output temperature is less than 60°C {140°F}, oil temperature sensor (outside) output temperature remains not less than 140°C {285°F} for 1 minute. (Lamp indication: 2DC) <B>

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

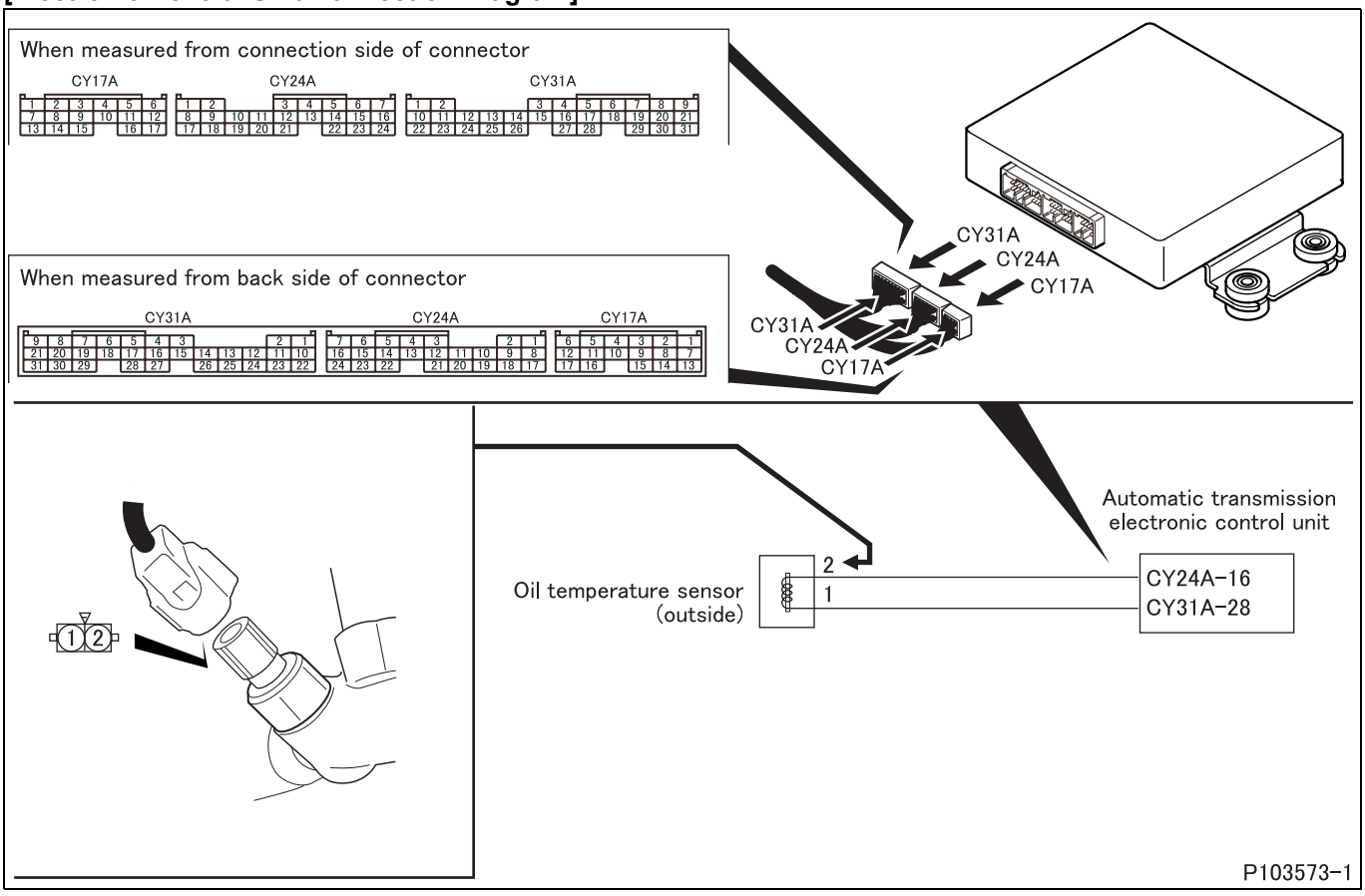
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Control is effected with oil temperature at 80°C {175°F}. <A>
- Braking force control is inhibited. <A>
- None <B>

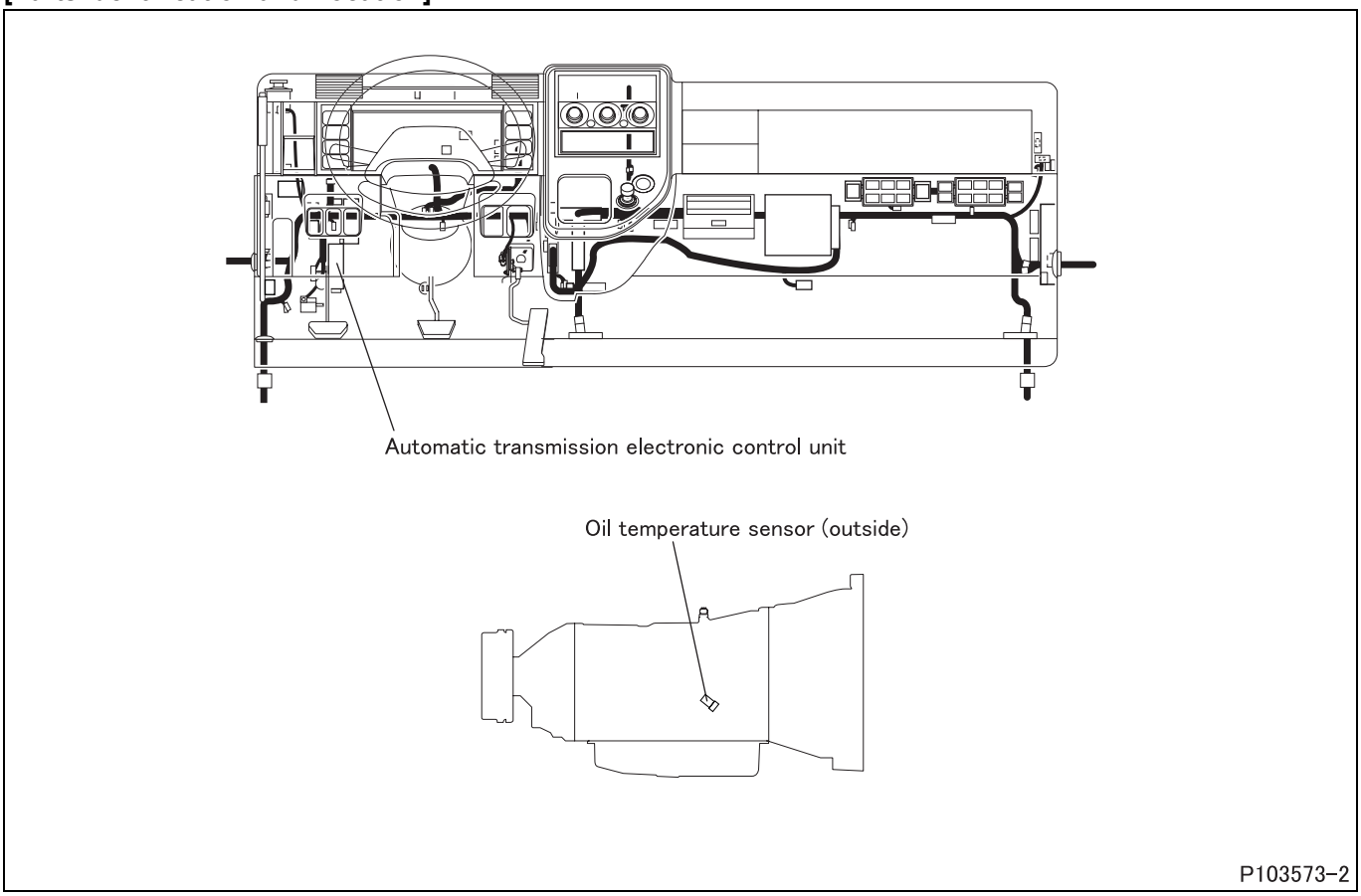
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and oil temperature sensor (outside)
- Malfunction of each connector
- Malfunction of oil temperature sensor (outside)
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position. <A>

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between connector (CY24A) terminal No. 16 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 17 “A/T Oil Temp (TC)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

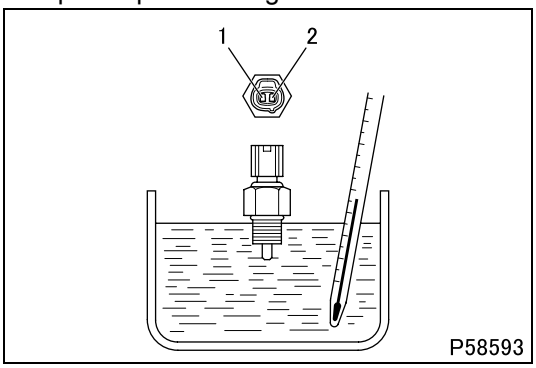
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 16 and connector (CY31A) terminal No. 28.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		• 115°C {240°F}: 655 to 730 Ω • 120°C {250°F}: 585 to 645 Ω • 145°C {295°F}: 340 to 375 Ω • 155°C {310°F}: 280 to 305 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Replacement of electronic control unit
		NO	Modify connector.

Step 4	Inspection items		Inspection of sensor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of sensor unit
	Maintenance item		Measure value of resistance between connector terminal No. 1 or 2 and body.
	Inspection condition		• Put sensor in vessel filled with automatic transmission fluid. • Measure value of resistance the sensor in each temperature (Wait for more than 5 minutes in each time to measure correct resistances).
	Requirements		• 115°C {240°F}: 655 to 730 Ω • 120°C {250°F}: 585 to 645 Ω • 145°C {295°F}: 340 to 375 Ω • 155°C {310°F}: 280 to 305 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of sensor

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between sensor and electronic control unit (signal)
	Maintenance item		Check circuit between connector terminal No. 2 and electronic control unit connector (CY24A) terminal No. 16.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between sensor and electronic control unit (ground)
	Maintenance item		Check circuit between connector terminal No. 1 and electronic control unit connector (CY31A) terminal No. 28.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Measure value of resistance between connector (CY24A) terminal No. 16 and connector (CY31A) terminal No. 28. **<Multi-Use Tester used>** Measure item No. 17 “A/T Oil Temp (TC)” of Service Data.
	Inspection condition		**<Multi-Use Tester not used>** Measure from back side of harness connector with electronic control unit connected to harness.
	Requirements		**<Multi-Use Tester not used>** Cold engine → during warm-up: Resistance is gradually reduced. **<Multi-Use Tester used>** • Cold engine: Proportionate to outside air temperature • During warm-up: Gradually increased.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: P2757/Flash code: 61
[Monitor ID]
9
[Fault (outline)]
Failure of lockup clutch
[Diagnosis check]
- Engine speed is compared with turbine speed during lockup control.

[Code generation condition]
- Difference between engine speed and turbine speed is higher than specification (200 rpm).

[Diagnosis check timing]
- Fault diagnosis is performed each time when the control is activated.

[Diagnostic requirement]
- Lockup control: Lockup is in operation.
- Turbine speed sensor related diagnosis code does not occur.
- Engine speed sensor related diagnosis code does not occur.

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF.

[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and turbine speed sensor
- Malfunction of each connector
- Malfunction of turbine speed sensor
- Malfunction of electronic control unit
- Malfunction of automatic transmission

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Fault diagnosis]
- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Replacement of automatic transmission **<Multi-Use Tester used>** Measure item No. 15 “Engine Speed” and No. 16 “Turbine Speed” of Service Data.
	Inspection condition		• P0717 “Turbine Speed Sensor No Signal” and P0726 “Engine Speed Sensor Performance” diagnosis codes do not occur. • Item No. 13 “A/T Oil Temp (OP)” indicates 25°C {77°F} or higher. • Item No. 35 “Linear Sol Press 3”: Vehicle runs at approx. 100 lbs/in^2 (during lockup) or the lockup speed. • Lockup speed (2nd gear, accelerator pedal fully pressed down): 15 to 17 km/h {9.3 to 10.6 mph} • Item No. 15 “Engine Speed” is compared with No. 16 “Turbine Speed” during lockup operation.
	Requirements		Both speeds are matched.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Replacement of automatic transmission

[Fault code]
Diagnosis code: P2759/Flash code: 35
[Monitor ID]
25, 26
[Fault (outline)]
Linear solenoid 3 is open-circuited or short-circuited.
[Diagnosis check]
- Resistance and current in the linear solenoid 3 are monitored for fault.

[Code generation condition]
- Resistance in the linear solenoid 3 remains at or above the specified value (100 kΩ) for 0.065 second (open-circuit or short-circuit in power supply side).
- Current in the linear solenoid 3 remains at or above the specified value (4A) for 0.065 second (short-circuit in ground side).

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

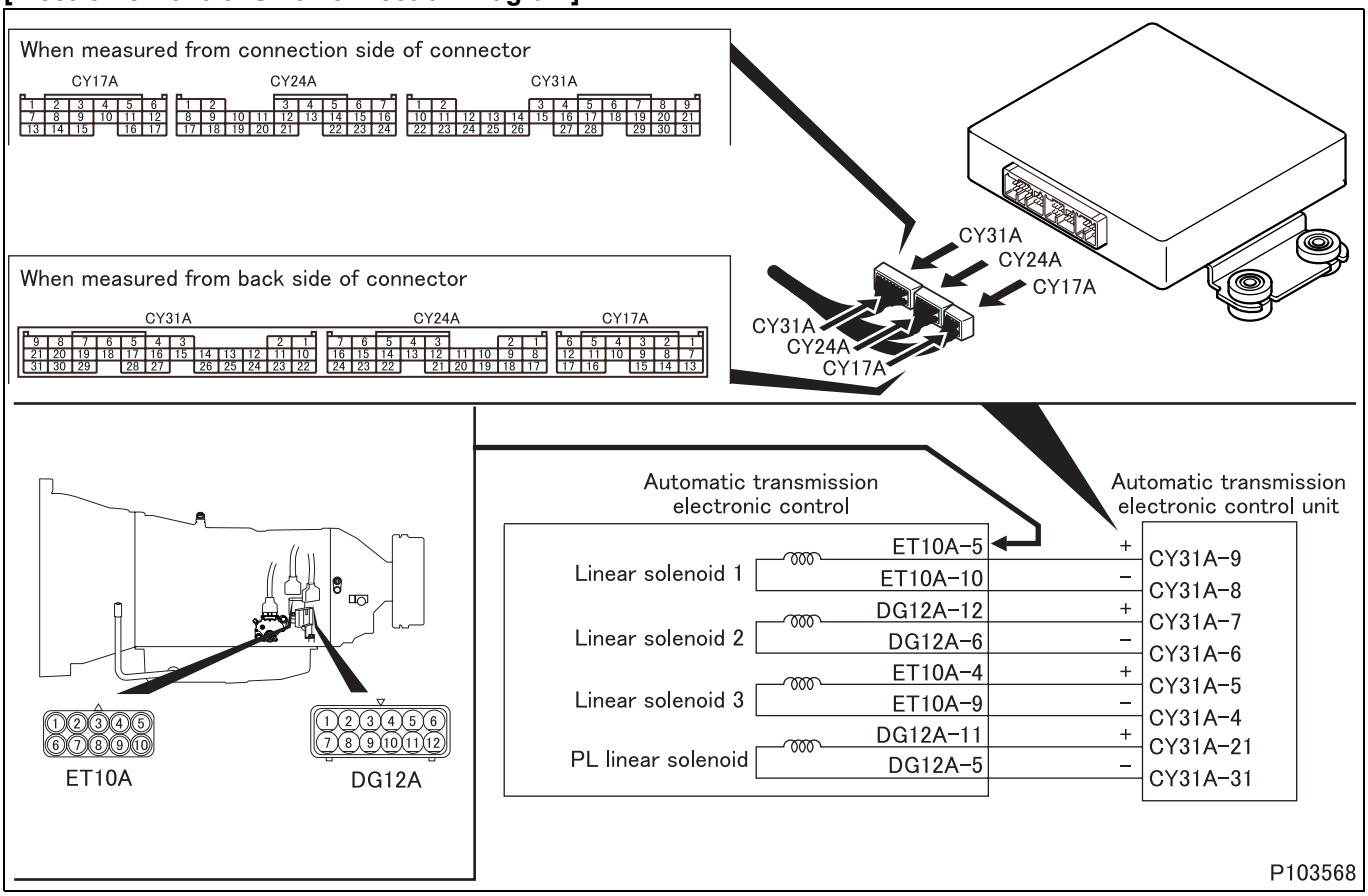
[Diagnostic requirement]
- Continuous

[Control effected by electronic control unit during fault]
- Lockup control is turned OFF
- Control is effected on fixed speed gear output (3rd for open-circuit, 2nd for short-circuit).

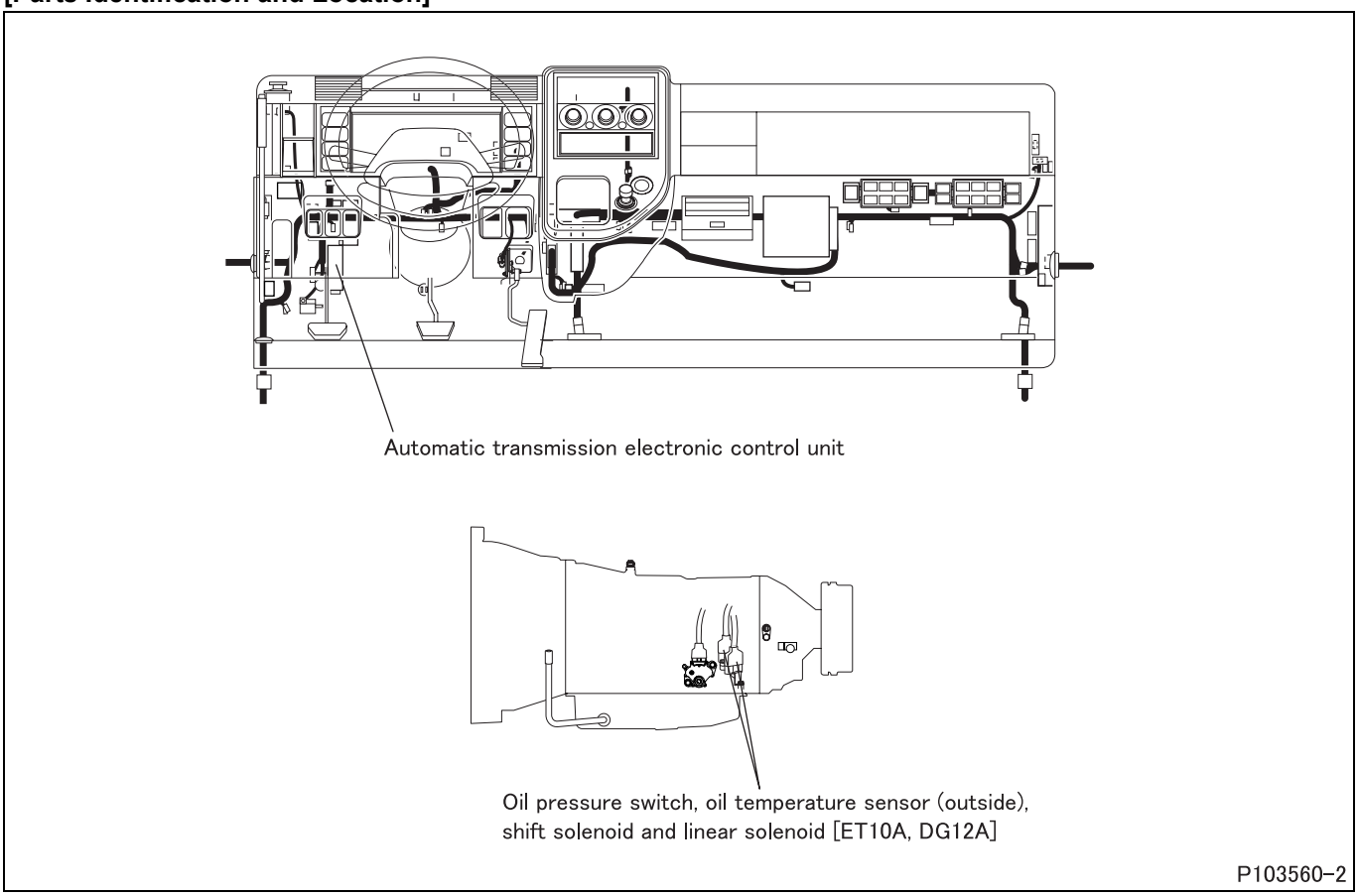
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and linear solenoid 3
- Malfunction of each connector
- Malfunction of linear solenoid 3
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal when starter switch is turned OFF to ON (power supply resumed to electronic control unit).

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

Step 1	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Go to step 2. **<Multi-Use Tester used>** Measure item No. 35 “Linear Sol Press 3” of Service Data.
	Inspection condition		Engine in operation <When shifting from N to D> With the brake pedal pressed down, shift the range selector lever (from N to D). <In lock-up state> • Item No. 13 “A/T Oil Temp (OP)” indicates 25°C {77°F} or higher. • Lock-up speed (2nd gear, accelerator pedal fully pressed down): 15 to 17 km/h {9.3 to 10.6 mph}
	Requirements		• When shifting from N to D: Varies • In lock-up state: 100 lbf/in^2
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

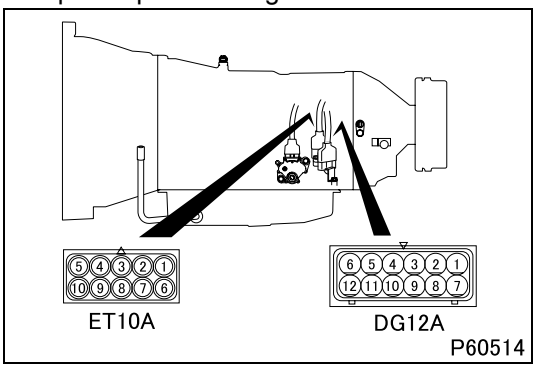
Step 2	Inspection items		Inspection by electronic control unit connector (signal)
	Maintenance item		Measure value of resistance between connector (CY31A) terminals No. 5 and 4.
	Inspection condition		• Disconnect electronic control unit and harness, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Go to step 4.

Step 3	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify connector.

Step 4	Inspection items		Inspection of solenoid connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Modify connector.

Step 5	Inspection items		Inspection of solenoid unit
	Maintenance item		Measure value of resistance between connector (ET10A) terminals No. 4 and 9.
	Inspection condition		• Disconnect connector, and measure solenoid side terminal. • Starter switch: OFF
	Requirements		5.5 ± 0.5 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Replacement of solenoid (contact an Aisin Service Station)

<Step 5 inspection diagram>



Step 6	Inspection items		Inspection of harness between solenoid and electronic control unit (power supply)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 4 and electronic control unit connector (CY31A) terminal No. 5.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection of harness between solenoid and electronic control unit (ground)
	Maintenance item		Check circuit between connector (ET10A) terminal No. 9 and electronic control unit connector (CY31A) terminal No. 4.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 8.
		NO	Modify harness.

Step 8	Inspection items		Inspection by control data
	Maintenance item		**<Multi-Use Tester not used>** Check for recurrence of the same diagnosis code. **<Multi-Use Tester used>** Measure item No. 35 “Linear Sol Press 3” of Service Data.
	Inspection condition		Engine in operation <When shifting from N to D> With the brake pedal pressed down, shift the range selector lever (from N to D). <In lock-up state> • Item No. 13 “A/T Oil Temp (OP)” indicates 25°C {77°F} or higher. • Lock-up speed (2nd gear, accelerator pedal fully pressed down): 15 to 17 km/h {9.3 to 10.6 mph}
	Requirements		**<Multi-Use Tester not used>** If the same diagnosis code occurs, replace electronic control unit. **<Multi-Use Tester used>** • When shifting from N to D: Varies • In lock-up state: 100 lbf/in^2
	Inspection result (Is the judging standard satisfied?)	YES	If the diagnosis code remains after actual run, replace the electronic control unit.
		NO	Replacement of electronic control unit

[Fault code]
Diagnosis code: U0100/Flash code: 88
[Monitor ID]
68, 69, 70, 71
[Fault (outline)]
Abnormality in controller area network communication
[Diagnosis check]
- Controller area network communication between engine electronic control unit is monitored for abnormality according to the controller area network signal to be received 1 second after the starter switch is turned ON.

[Code generation condition]
- Any of the signals to be received from engine electronic control unit through controller area network communication is not received for 0.5 second.

[Diagnosis check timing]
- Fault diagnosis is continuously performed.

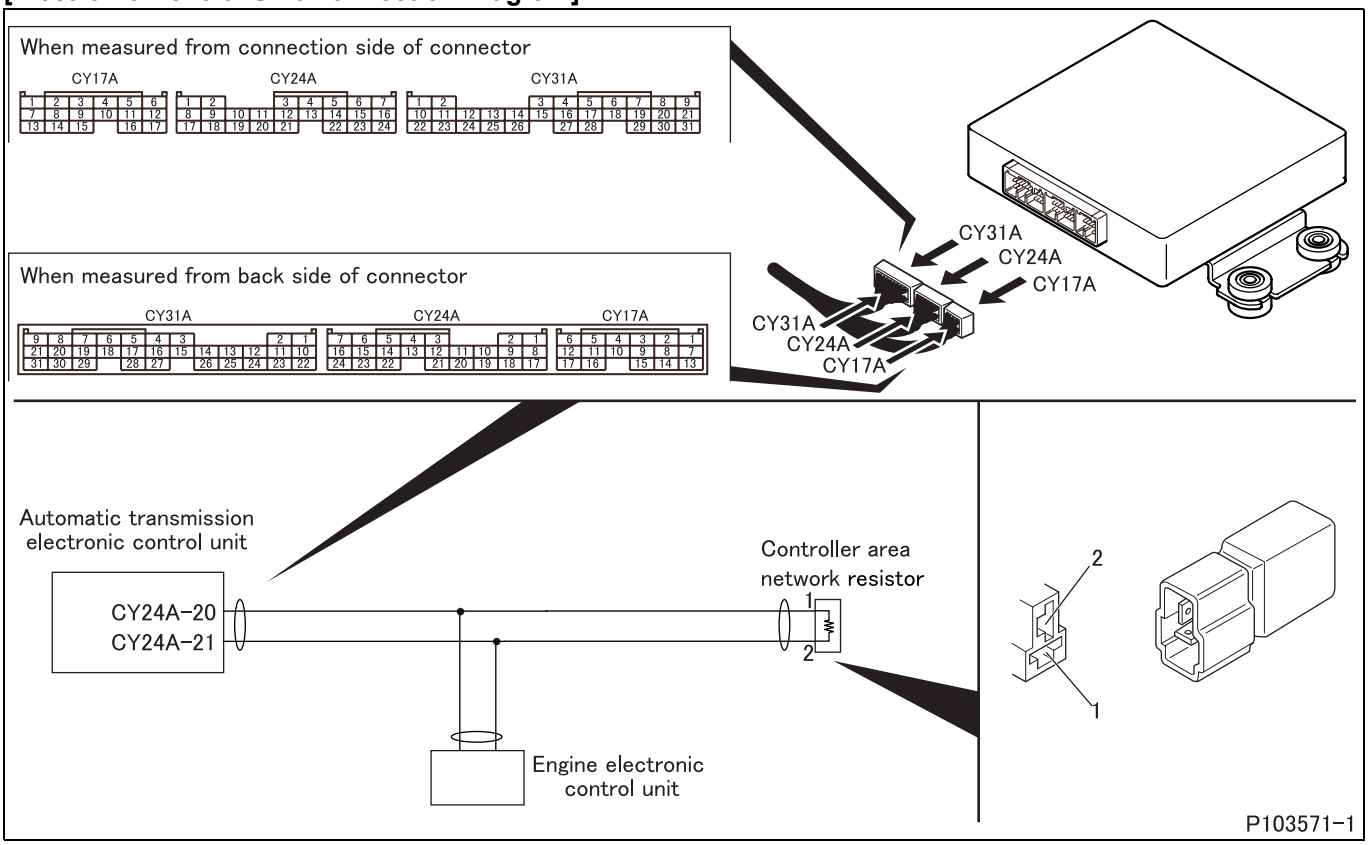
[Diagnostic requirement]
- Starter switch ON battery voltage is higher than 10 V.
- Starter switch: ON (not less than 1 sec.)

[Control effected by electronic control unit during fault]
- Effects no special control.

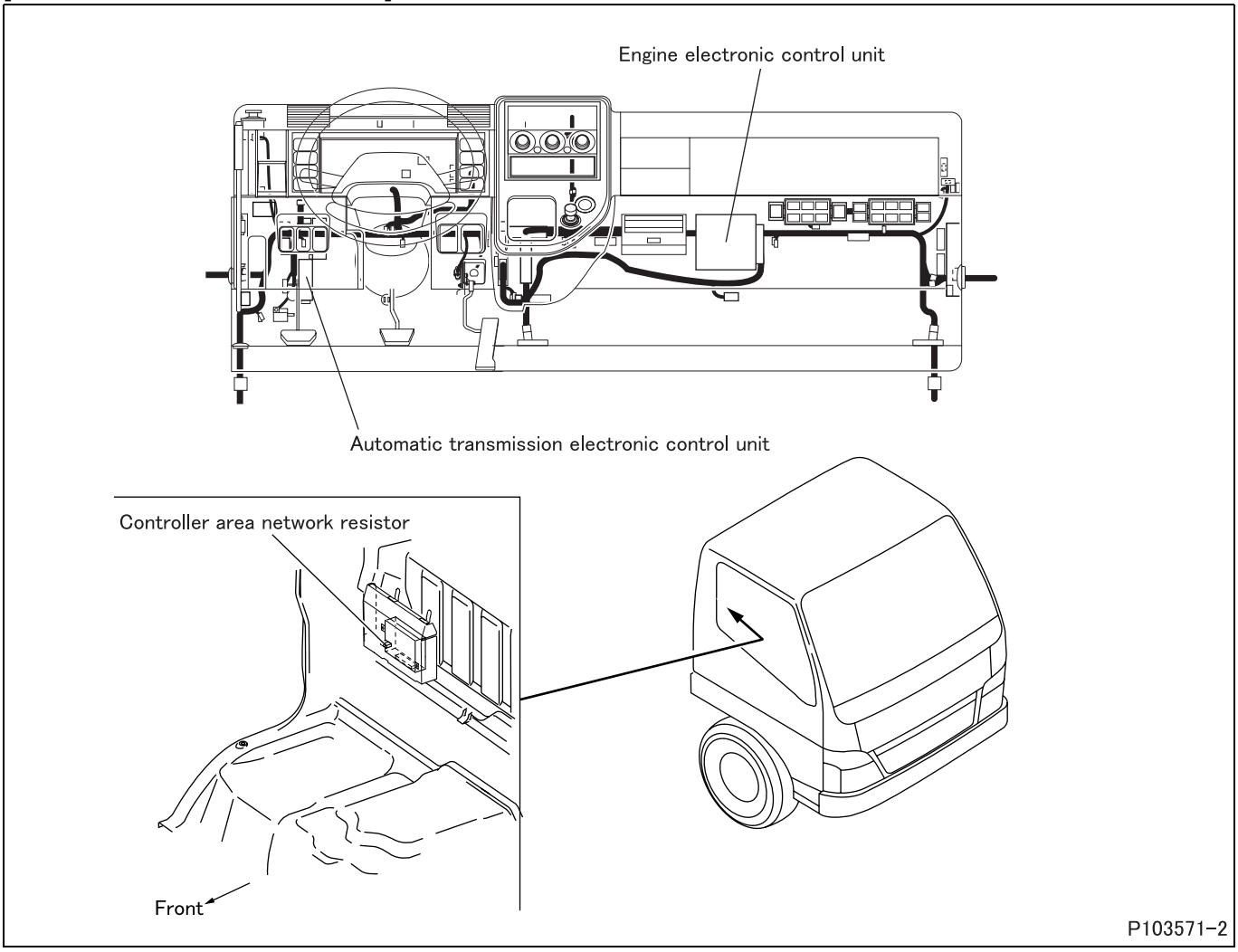
[Probable cause of trouble]
- Open-circuit or short-circuit of harness between electronic control unit and controller area network resistor
- Malfunction of each connector
- Malfunction of controller area network resistor
- Malfunction of electronic control unit

[Recoverability]
- Recovered if signal becomes normal with starter switch in ON position.

[Electronic Control Unit Connection Diagram]



[Parts Identification and Location]



[Fault diagnosis]

- Perform checks in the sequence of the following steps.

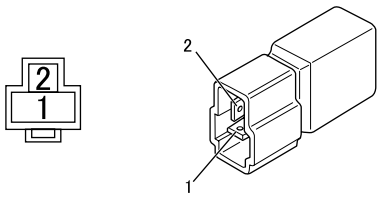
Step 1	Inspection items		Inspection by electronic control unit connector
	Maintenance item		Measure value of resistance between connector (CY24A) terminal No. 20 and 21.
	Inspection condition		• Disconnect the engine electronic control unit and automatic transmission electronic control unit connectors, and measure from connection side of harness connector. • Starter switch: OFF
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Go to step 2.

Step 2	Inspection items		Inspection of electronic control unit connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 3.
		NO	Modify connector.

Step 3	Inspection items		Inspection of controller area network resistor connector
	Maintenance item		Inspection of connector
	Inspection condition		–
	Requirements		• Connector is properly connected. • No trace of water entry is found. • No corrosion is found in terminal. • Connection to terminal is appropriate.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 4.
		NO	Modify connector.

Step 4	Inspection items		Inspection of controller area network resistor unit
	Maintenance item		Measure value of resistance between connector terminals No. 1 and 2.
	Inspection condition		–
	Requirements		120 ± 6 Ω
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 5.
		NO	Replacement of controller area network resistor

<Step 4 inspection diagram>



P63068

Step 5	Inspection items		Inspection of harness between electronic control unit and controller area network resistor (HIGH)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 1 and electronic control unit connector (CY24A) terminal No. 20.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 6.
		NO	Modify harness.

Step 6	Inspection items		Inspection of harness between electronic control unit and controller area network resistor (LOW)
	Maintenance item		Check circuit between controller area network resistor connector terminal No. 2 and electronic control unit connector (CY24A) terminal No. 21.
	Inspection condition		Disconnect each device from harness and measure from connection side of harness connector.
	Requirements		There is continuity.
	Inspection result (Is the judging standard satisfied?)	YES	Go to step 7.
		NO	Modify harness.

Step 7	Inspection items		Inspection by Multi-Use Tester diagnosis code
	Maintenance item		Check for occurrence of the diagnosis code No. P0863 “CAN Communication”.
	Inspection condition		Starter switch: ON
	Requirements		No codes occur.
	Inspection result (Is the judging standard satisfied?)	YES	Go to transient fault (See Gr00.).
		NO	Perform troubleshooting for the controller area network communication system in the engine electronic control. If the fault is not still removed, replace the automatic transmission electronic control unit.

4. Multi-Use Tester Service Data

NOTE

- **It is possible to see service data and actuator tests simultaneously.**

No.	Item	Data	Inspection condition	Requirement
11	IG	■■. ■V	Stater switch ON	Value matches battery voltage.
12	VEH Speed 1	■■■. ■MPH	Vehicle being driven	Value corresponds to speedometer indication.
13	A/T Oil Temp (OP)	■■■■.°F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
15	Engine Speed	■■■■.rpm	Racing (engine running)	Value corresponds to tachometer indication.
16	Turbine Speed	■■■■.rpm	Vehicle stationary with shift lever in D position	0 rpm
			Vehicle driven from abovementioned condition	Value increases.
17	A/T Oil Temp (TC)	■■■■.°F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
19	P Pos. SW	ON/OFF	Shift lever in P position	ON
			Shift lever in position except P	OFF
20	R Pos. SW	ON/OFF	Shift lever in R position	ON
			Shift lever in position except R	OFF
21	N Pos. SW	ON/OFF	Shift lever in N position	ON
			Shift lever in position except N	OFF
22	D Pos. SW	ON/OFF	Shift lever in D position	ON
			Shift lever in position except D	OFF
24	3 Pos. SW	ON/OFF	Shift lever in 3 position	ON
			Shift lever in position except 3	OFF
25	VEH Speed 2	■■■. ■MPH	Vehicle being driven	Value corresponds to speedometer indication.
26	Linear Sol Press 1	■■■. ■lbf/in^2	When shifting (1→2, 3→4, 5→6)	Increase
			When shifting (2→3, 4→5)	Decrease
27	Linear Sol Press 2	■■■. ■lbf/in^2	When shifting (2→3, 4→5)	Increase
			When shifting (1→2, 3→4, 5→6)	Decrease
28	OD-OFF SW	ON/OFF	Overdrive switch ON	ON
			Overdrive switch OFF	OFF
31	Shift Valve 1	ON/OFF	In 3rd gear and in 4th gear	ON
			In any gear except above	OFF
32	Shift Valve 2	ON/OFF	In 4th gear, in 5th gear and in 6th gear	ON
			In any gear except above	OFF
33	Shift Valve 3	ON/OFF	In 1st gear	ON
			In any gear except above	OFF
34	Linear Sol Press 4	■■■. ■lbf/in^2	In R range and 1st gear (large throttle opening)	260 lbf/in^2
			In any range/gear except above	100 lbf/in^2

No.	Item	Data	Inspection condition	Requirement
35	Linear Sol Press 3	■■■. ■lbf/in^2	Shift from N to D	Value changes
			During lockup	100 lbf/in^2
36	Oil Temp Lamp	ON/OFF	Oil temperature abnormal (excessively high)	ON
			Oil temperature normal	OFF
37	Brake SW	ON/OFF	Brake pedal pressed	ON
			Brake pedal not pressed	OFF
38	Exh. Brake SIG	ON/OFF	Decelerating (engine braking in progress)	ON
			Accelerating	OFF
47	ABS SW	ON/OFF	Anti-lock brake system operating	ON
			Anti-lock brake system not operating	OFF
49	Diagnosis SW	ON/OFF	Diagnosis switch fuse removed	ON
			Diagnosis switch fuse fitted	OFF
52	Shift Valve 4	ON/OFF	In R range (large throttle opening)	OFF
			In R range (small throttle opening)	ON
53	Diagnosis Lamp	ON/OFF	Warning lamp illuminated	ON
			Warning lamp not illuminated	OFF
54	Exh Brake Cut SIG	ON/OFF	Decelerate and stop	OFF → ON
			Accelerating	OFF
55	Selector Pos.	P-Range/R-Range/ N-Range/D-Range/ 3-Range/2-Range	Shift lever in P position	P-Range
			Shift lever in R position	R-Range
			Shift lever in N position	N-Range
			Shift lever in D position	D-Range
			Shift lever in 3 position	3-Range
			Shift lever in 2 position	2-Range
56	Gear Pos.	1ST/2ND/3RD/ 4TH/5TH/6TH/N/R	In 1st gear	1ST
			In 2nd gear	2ND
			In 3rd gear	3RD
			In 4th gear	4TH
			In 5th gear	5TH
			In 6th gear	6TH
			In neutral (shift lever in P or N position)	N
			Reversing	R
58	Accel Percent	■■■%	Accelerator pedal not pressed (throttle fully closed)	0%
			Accelerator pedal pressed (throttle wide open)	100%
61	Oil Press SW1	ON/OFF	In 2nd gear, in 4th gear and in 6th gear	ON
			In 1st gear, in 3rd gear and in 5th gear	OFF
62	Oil Press SW2	ON/OFF	In 1st gear, in 3rd gear and in 5th gear	ON
			In 2nd gear, in 4th gear and in 6th gear	OFF

No.	Item	Data	Inspection condition	Requirement
63	Oil Press SW3	ON/OFF	In 3rd gear and in 4th gear	ON
			In 1st gear, in 2nd gear, in 5th gear and in 6th gear	OFF
64	Oil Press SW4	ON/OFF	In 4th gear, in 5th gear and in 6th gear	ON
			In 1st gear, in 2nd gear and in 3rd gear	OFF
65	Oil Press SW5	ON/OFF	In 1st gear	ON
			In 2nd gear, in 3rd gear, in 4th gear, in 5th gear and in 6th gear	OFF
66	Oil Press SW6	ON/OFF	In 1st gear	ON
			In 2nd gear, in 3rd gear, in 4th gear, 5th gear and in 6th gear	OFF
67	Oil Press SW7	ON/OFF	Shift from N to D	OFF → ON → OFF
68	Oil Press SW8	ON/OFF	In D range	ON
			In P, R, N range	OFF
69	Coolant Temp	■■■■.°F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
			Engine stopped after warming up	Value gradually decreases.
71	Shift Valve Press 1	HIGH/LOW	In 3rd gear and in 4th gear	HIGH
			In any gear except above	LOW
72	Shift Valve Press 2	HIGH/LOW	In 4th gear, in 5th gear and 6th gear	HIGH
			In any gear except above	LOW
73	Shift Valve Press 3	HIGH/LOW	In 1 gear	HIGH
			In any gear except above	LOW
74	Shift Valve Press 4	HIGH/LOW	In R range (large throttle opening)	HIGH
			In R range (small throttle opening)	LOW
78	2 Pos. SW	ON/OFF	Shift lever in 2 position	ON
			Shift lever in position except 2	OFF

5. Possible Causes of Symptoms

Symptoms / Possible causes	Abnormal movement						Shift abnormality					
	Vehicle can be driven in N range.	Transmission stays in P range when lever is moved out of P position.	Vehicle moves with lever in P position.	Vehicle does not move in any range.	Vehicle does not move in R range.	Vehicle does not move in D, 3, and 2 ranges.	Lockup point is excessively high or low.	Lockup does not occur.	Engine braking does not occur in 3 range.	Engine braking does not occur in 2 range.	Kickdown does not occur.	Shift point is excessively high or low.
Abnormality in automatic transmission fluid level and condition				O	O	O						
Abnormality in automatic transmission control	O	O	O	O		O						
Abnormality in inhibitor switch									O	O		
Abnormality in throttle opening signal							O	O	O	O	O	O
Abnormality in turbine speed sensor								O				
Abnormality in output speed sensor							O	O	O	O	O	O
Abnormality in engine speed signal								O				
Abnormality in linear solenoid 1											O	
Abnormality in linear solenoid 2											O	
Abnormality in linear solenoid 3				O	O	O	O	O				
Abnormality in shift solenoid 1											O	
Abnormality in shift solenoid 2				O	O	O					O	
Abnormality in shift solenoid 3								O			O	
Abnormality in automatic transmission electronic control unit							O	O	O	O	O	O
Abnormality in torque converter				O	O	O		O				
Abnormality in automatic transmission-proper	O	O	O	O	O	O	O	O	O	O	O	

Symptoms / Possible causes	Shift abnormality													
	Downshifts from 6th gear to 5th gear do not take place.	Downshifts from 5th gear to 4th gear do not take place.	Downshifts from 4th gear to 3rd gear do not take place.	Downshifts from 3rd gear to 2nd gear do not take place.	Downshifts from 2nd gear to 1st gear do not take place.	Upshifts from 5th gear to 6th gear do not take place.	Upshifts from 4th gear to 5th gear do not take place.	Upshifts from 3rd gear to 4th gear do not take place.	Upshifts from 2nd gear to 3rd gear do not take place.	Upshifts from 1st gear to 2nd gear do not take place.	Engine revs during shifts from 2nd gear to 3rd gear.	Engine revs during shifts from 3rd gear to 4th gear.	Engine revs during shifts from 4th gear to 5th gear.	Engine revs during shifts from 5th gear to 6th gear.
Abnormality in inhibitor switch								O	O					
Abnormality in throttle opening signal											O	O	O	O
Abnormality in vehicle speed sensor	O	O	O	O	O	O	O	O	O	O				
Abnormality in engine speed sensor											O	O	O	O
Abnormality in linear solenoid 1	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in linear solenoid 2	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in shift solenoid 1	O	O	O	O	O	O	O	O	O	O				
Abnormality in shift solenoid 2	O	O	O	O	O	O	O	O	O	O				
Abnormality in shift solenoid 3	O	O	O	O	O	O	O	O	O	O				
Abnormality in oil pressure switch 1	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in oil pressure switch 2	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in oil pressure switch 3	O	O	O	O	O	O	O	O	O	O				
Abnormality in oil pressure switch 4	O	O	O	O	O	O	O	O	O	O				
Abnormality in oil pressure switch 5	O	O	O	O	O	O	O	O	O	O				
Abnormality in oil pressure switch 6	O	O	O	O	O	O	O	O	O	O				
Abnormality in overdrive OFF switch						O	O							
Abnormality in automatic transmission electronic control unit	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in automatic transmission-proper	O	O	O	O	O	O	O	O	O	O	O	O	O	O

Symptoms / Possible causes	Excessive shift shock													
	During lockup	During shifts from 6th gear to 5th gear	During shifts from 5th gear to 4th gear	During shifts from 4th gear to 3rd gear	During shifts from 3rd gear to 2nd gear	During shifts from 2nd gear to 1st gear	During shifts from 5th gear to 6th gear	During shifts from 4th gear to 5th gear	During shifts from 3rd gear to 4th gear	During shifts from 2nd gear to 3rd gear	During shifts from 1st gear to 2nd gear	During shifts from N range to R range and from N range to D range	During shifts from N range to R range	During shifts from N range to D range
Abnormality in throttle opening signal	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in turbine speed sensor	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in engine speed sensor	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in linear solenoid 1		O	O	O	O	O	O	O	O	O	O			
Abnormality in linear solenoid 2		O	O	O	O		O	O	O					
Abnormality in linear solenoid 3	O											O	O	O
Abnormality in oil pressure switch 1											O			
Abnormality in automatic transmission electronic control unit	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in torque converter	O													
Abnormality in automatic transmission-proper	O	O	O	O	O	O	O	O	O	O	O	O	O	O

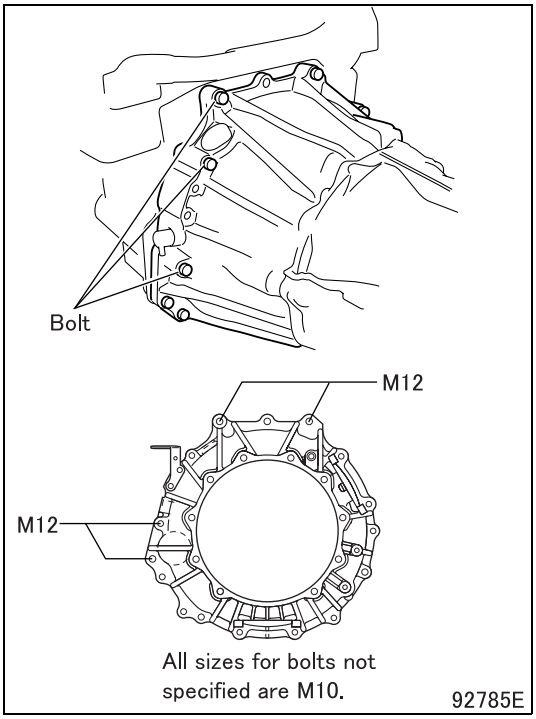
Symptoms / Possible causes	Clutch slippage, judder							Other				
	In 6th gear	In 5th gear	In 4th gear	In 3rd gear	In 2nd gear	In 1st gear	In R range	During forward movement and during reverse movement	Transmission overheats; oil emerges from breather.	Engine stalls when R, D, or 3, 2 range is selected or when vehicle is stationary.	Engine can be started in range except N and P.	Engine cannot be started in N and P ranges.
Abnormality in automatic transmission fluid level and condition									O			
Abnormality in control linkage											O	O
Abnormality in inhibitor switch											O	O
Abnormality in throttle opening signal	O	O	O	O	O	O	O	O				
Abnormality in turbine speed sensor	O	O	O	O	O	O	O	O				
Abnormality in linear solenoid 1	O	O	O	O	O							
Abnormality in linear solenoid 2	O	O	O	O	O		O	O				
Abnormality in linear solenoid 3						O	O	O		O		
Abnormality in PL linear solenoid	O	O	O	O	O	O	O	O	O			
Abnormality in shift solenoid 3										O		
Abnormality in gain change solenoid	O	O	O	O	O	O	O	O				
Abnormality in automatic transmission electronic control unit	O	O	O	O	O	O	O	O	O			
Abnormality in torque converter									O	O		
Abnormality in automatic transmission-proper	O	O	O	O	O	O	O	O	O	O		

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspection of Area Around Automatic Transmission

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Bolt (automatic transmission mounting)	47 {35, 4.8}	M10
		82 {60, 8.4}	M12



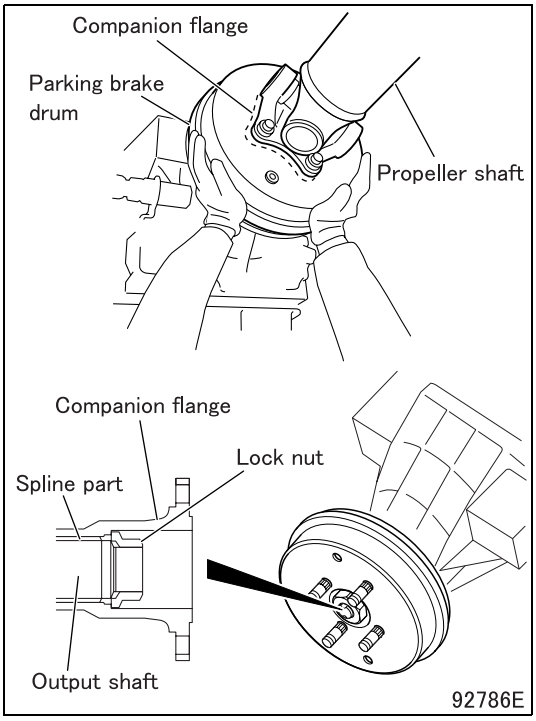
1.1 Inspection of oil leakage

- Check the area around the automatic transmission for deposits of oil leaking from the engine and elsewhere.
- Oil deposits can loosen automatic transmission mounting bolts. Repair oil leak(s), then remove the automatic transmission and clean the mounting surface and neighboring area using brake cleaner or the like.

1.2 Inspection of looseness in bolts

- Check the automatic transmission mounting bolts for looseness.
- Retighten any loose bolt to the specified torque.

2. Inspection of Play in Companion Flange and Looseness in Lock Nut



- Move the parking brake drum or companion flange in axial and vertical directions to check for excessive play between the companion flange and output shaft.
- If excessive play is detected, remove the propeller shaft, then check the lock nut for looseness and the splines on companion flange and output shaft for abnormalities.
- If found loose, tighten the lock nut to the specified torque, then crimp it at two places. (See PARKING BRAKE.)
- If the companion flange is found detective, replace the part. (See “PARKING BRAKE” section.)
- If the companion flange is not found detective, the output shaft may be defective, contact the Aisin Service Station for repair.

3. Stall Test

Service standards

Mark	Maintenance item	Standard value	Limit	Remedy
–	Stall speed	2000 ± 150 rpm	–	Contact an Aisin Service Station for repair

3.1 Purpose of stall test

- A stall test is performed to check for slipping of the frictional elements in the transmission and of the one-way clutch in the torque converter. It gives an indication of the torque converter's operating condition and of the engine's overall performance.

3.2 Test procedure

- Before performing a stall test, inspect the engine coolant, engine oil, and automatic transmission fluid levels. Then, allow the engine and transmission to warm up.
- To prevent the vehicle from moving, apply the parking brake and place chocks before and after the front and rear wheels. Also, hold down the brake pedal firmly when pressing the accelerator pedal during the test.
- Start the engine and move the range selector lever to the D position.
- Gradually press the accelerator pedal until it reaches the end of its stroke. When the engine speed stabilizes, promptly read the engine speed (this is the stall speed) and release the accelerator pedal.

CAUTION ⚠

- **The period during which the accelerator pedal is fully pressed must be shorter than 5 seconds. Complete the measurement within this period.**
- **If the engine speed does not stabilize (if the engine speed continues to gradually increase or the engine suddenly revs), immediately stop the test.**

- Move the range selector lever to the N position, then allow the engine to cool down by running it at 1200 rpm for one minutes or longer.
- Perform the test procedure similarly for the R range.

3.3 Evaluation of test results

Test result	Main causes
Stall speed is lower than standard value in each range.	Engine output is insufficient. (See Gr11.)
	One-way clutch in torque converter is malfunctioning.
Stall speed is higher than standard value in D range.	Clutch No. 1 is slipping.
	One-way clutch is malfunctioning.
	Line pressure is too low.
Stall speed is higher than standard value in R range.	Clutch No. 3 is slipping.
	Brake No. 2 is slipping.
	Line pressure is too low.

- If abnormalities are found in the automatic transmission unit itself, contact an Aisin Service Station for repair.

4. Time Lag Test

Service standards

Mark	Maintenance item		Standard value	Limit	Remedy
–	Time lag	With shift from N to D	0.7 sec	–	Contact an Aisin Service Station for repair
		With shift from N to R	1.2 sec		

4.1 Purpose of time lag test

- A time lag test is performed to check the respective conditions of the one-way clutch, clutch No. 1, clutch No. 3, and brake No. 2.

4.2 Test procedure

- Raise the oil temperature to 50 to 80°C {120 to 175°F} (the range that corresponds to normal vehicle operation).
- Apply chocks to the front and rear wheels from both sides and apply the parking brake to hold the vehicle in place.
- Start the engine and check the idling speed.
- While stepping on the brake pedal, move the range selector lever from the N position to the D position. Use a stopwatch to measure the time (time lag) that elapses until you feel shock.
- In a similar manner, measure the time lag for a shift from the N range to the R range.

4.3 Evaluation of results

Test result	Conceivable cause
Time lag with shift from N to D is too long.	Line pressure is too low.
	Clutch No. 1 is slipping.
	One-way clutch is malfunctioning.
Time lag with shift from N to R is too long.	Line pressure is too low.
	Clutch No. 3 is slipping.
	Brake No. 2 is slipping.

- If abnormalities are found in the automatic transmission unit itself, contact an Aisin Service Station for repair.

5. Line Pressure Test

Service standards

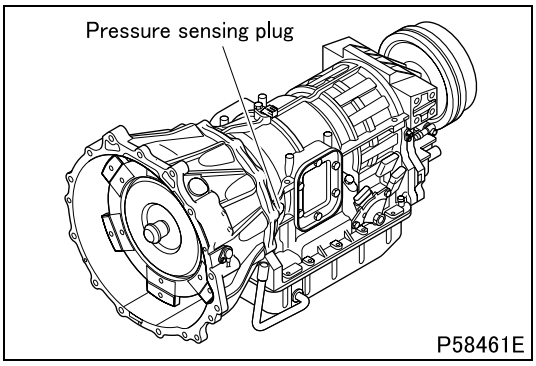
Mark	Maintenance item			Standard value	Limit	Remedy
–	Line pressure	At idling speed	D range	1000 to 2010 kPa {145 to 290 psi, 10.2 to 20 kgf/cm^2}	–	Contact an Aisin Service Station for repair
			R range			
		At stalling speed	D range	1660 to 2010 kPa {240 to 290 psi, 17 to 20 kgf/cm^2}		
			R range			

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Pressure sensing plug	27 {20, 2.8}	1/2-20 UNF

5.1 Purpose of line pressure test

- A line pressure test is performed to check the performance of the oil pump, to check the functionality of the control valve, and to check parts for oil leakage.



5.2 Test procedure

- Apply chocks to the front and rear wheels from both sides and apply the parking brake to hold the vehicle in place.
- The line pressure test should be performed by two people. One person moves away from the vehicle and checks the condition of the tires and wheel chocks. The other person performs the test.
- Remove the pressure sensing plug and fit the oil pressure gauge.
- Start the engine. Allow it to warm up until the automatic transmission fluid reaches a temperature of 50 to 80°C {120 to 175°F}. Check the idling speed.
- Press the brake pedal firmly with your left foot. While holding down the brake pedal, shift to the D range. Then, measure the oil pressure while the engine is idling.
- Fully press the accelerator pedal. Quickly measure the oil pressure at the stall speed.

CAUTION ⚠

- **If the engine speed does not reach the stall level and the rear wheels start to turn, ease off the accelerator pedal and stop the test.**

- Take a measurement in a similar manner for the R range.
- After taking the measurements, fit the pressure sensing plug and tighten it to the specified torque.
- If the measured value does not conform to the standard value, locate the possible cause by referring to the following table and inspect.

5.3 Locating possible causes

Test result	Conceivable cause
Measured value is higher than standard value in all ranges.	Regulator valve is sticking.
Measured value is lower than standard value in all ranges.	Regulator valve is sticking.
	Oil pump is worn.
Measured value is lower than standard value in D range only.	Oil leak exists in D range system.
	Clutch No. 1 is abnormal.
Measured value is lower than standard value in R range only.	Oil leak exists in R range system.
	Clutch No. 3 is abnormal.
	Brake No. 2 is abnormal.

- If abnormalities are found in the automatic transmission unit itself, contact an Aisin Service Station for repair.

6. Road Test

Service standards (Unit: km/h {mph})

Location	Maintenance item			Standard value	Limit	Remedy
–	Vehicle speeds during shifts (D range)	Half open (Accelerator pedal position: 4/8)	1st → 2nd	8 to 10 {4.97 to 6.21}	–	Contact an Aisin Service Station for repair
			2nd → 3rd	23 to 25 {14.3 to 15.5}	–	
			3rd → 4th	36 to 38 {22.4 to 23.6}	–	
			4th → 5th	47 to 49 {29.2 to 30.4}	–	
			5th → 6th	59 to 61 {36.7 to 37.9}	–	
		Fully open (Accelerator pedal position: 8/8)	1st → 2nd	15 to 17 {9.32 to 10.6}	–	
			2nd → 3rd	34 to 36 {21.1 to 22.4}	–	
			3rd → 4th	53 to 55 {32.9 to 34.2}	–	
			4th → 5th	73 to 75 {45.4 to 46.6}	–	
			5th → 6th	95 to 96 {59.0 to 59.7}	–	
		Fully closed (Accelerator pedal position: 0/8)	1st → 2nd	8 to 10 {4.97 to 6.21}	–	
			2nd → 3rd	18 to 20 {11.2 to 12.4}	–	
			3rd → 4th	28 to 30 {17.4 to 18.6}	–	
			4th → 5th	39 to 41 {24.2 to 25.5}	–	
			5th → 6th	55 to 57 {34.2 to 35.4}	–	
–	Vehicle speeds during lockup	Half open (Accelerator pedal position: 4/8)	2nd gear ON	15 to 17 {9.32 to 10.6}	–	Contact an Aisin Service Station for repair
			3rd gear ON	23 to 25 {14.3 to 15.5}	–	
			4th gear ON	33 to 35 {20.5 to 21.7}	–	
			5th gear ON	40 to 42 {24.9 to 26.1}	–	
			6th gear ON	49 to 51 {30.4 to 31.7}	–	
		Fully open (Accelerator pedal position: 8/8)	2nd gear ON	22 to 24 {13.7 to 14.9}	–	
			3rd gear ON	34 to 36 {21.1 to 22.4}	–	
			4th gear ON	46 to 48 {28.6 to 29.8}	–	
			5th gear ON	60 to 62 {37.3 to 38.5}	–	
			6th gear ON	73 to 75 {45.4 to 46.6}	–	
		Fully closed (Accelerator pedal position: 0/8)	2nd gear OFF	14 to 16 {8.70 to 9.94}	–	
			3rd gear OFF	21 to 23 {13.0 to 14.3}	–	
			4th gear OFF	28 to 30 {17.4 to 18.6}	–	
			5th gear OFF	37 to 39 {23.0 to 24.2}	–	
			6th gear OFF	45 to 47 {28.0 to 29.2}	–	

6.1 Test procedure

- Before performing a road test, check the fluid level and automatic transmission fluid condition and make sure the selector cable and accelerator control cable are correctly adjusted.
- During the road test, operate the automatic transmission in each range. Check the slip feel and other changes during shifts.
- Check whether the shift feel gets firmer and softer.
- Check the shift points where upshifts and downshifts occur.
- When a Multi-Use Tester is used, check the lockup points according to Multi-Use Tester Service Data No. 35 “Linear Sol Press 3.”
- All data correspond to a differential ratio of 5.285 and to a tire radius of 0.387 m (215/85R16).
- If the differential ratio or tire radius is different, the speeds will be concomitantly slower or higher. Adjust the values in the table accordingly.
- If measurements deviate from specified standard values, contact an Aisin Service Station for repair.

7. Inspection of Automatic Transmission Fluid

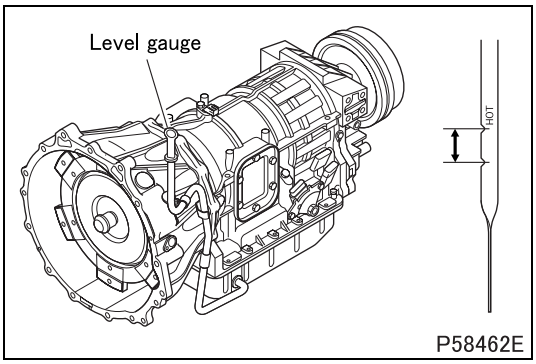
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Automatic transmission	Mobil ATF3309 or equivalent	–

- If the automatic transmission fluid level is too low, the pump can draw in air together with the automatic transmission fluid, and the resulting air bubbles can make the automatic transmission fluid spongy, resulting in a pressure reduction that causes the clutches in the automatic transmission to slip.
- If the automatic transmission fluid level is too high owing to incorrect replenishment, rotating parts can agitate it, resulting in air bubbles that, as with an excessively low automatic transmission fluid level, make the automatic transmission fluid spongy, resulting in a pressure reduction that causes the clutches in the automatic transmission to slip.
- Whether the automatic transmission fluid level is too low or too high, air bubbles lead to overheating and to oxidation of and varnish formation by the oil, thereby impeding proper operation of the valves and clutches.
- Air bubbles can also cause foaming such that automatic transmission fluid emerges from the vent hole and filler tube of the automatic transmission. This phenomenon can be mistaken for automatic transmission fluid leakage.
- To prevent the above mentioned problems, you must check the automatic transmission fluid level accurately in accordance with the following instructions.

7.1 Inspection of automatic transmission fluid condition

- If the automatic transmission fluid smells burned and contains particles of metal and friction material, a complete overhaul of the automatic transmission is necessary. Carefully inspect the automatic transmission fluid that adheres to the level gauge. If you have any doubts about the condition of the automatic transmission fluid, take a sample and perform another check.



7.2 Inspection of automatic transmission fluid level

- Drive the vehicle until the automatic transmission fluid is adequately warm (70 to 80°C {160 to 175°F}).
- Stop the vehicle on a level surface, securely apply the parking brake, and apply chocks to the wheels.
- With the engine idling, slowly move the range selector lever from the P position to each position through L then back to the P position to ensure that the hydraulic circuit is filled with automatic transmission fluid.
- Remove all dirt from the top of the filler tube.
- With the engine still idling, withdraw the level gauge, wipe the ATF off it, and re-insert it. Then, withdraw the level gauge again and check the automatic transmission fluid level.
- The automatic transmission fluid level is acceptable if the level on the level gauge is within the HOT range.

CAUTION ⚠

- **Be sure to inspect the automatic transmission fluid level with the vehicle parked on a level surface.**
- **Be sure to inspect the automatic transmission fluid level with the engine idling and with the N range selected. If the engine was not running during the inspection, the automatic transmission fluid level would look higher.**
- **Since the engine is running, you must pay attention to safety. Be careful not to get trapped or burned.**
- **Keep the engine idling until you have finished adjusting the automatic transmission fluid level. Do not increase the engine speed.**

- If the automatic transmission fluid level is too low, add specified automatic transmission fluid through the filler tube until it reaches the specified part of the level gauge.

CAUTION ⚠

- **Never use the automatic transmission fluid except the specified one.**

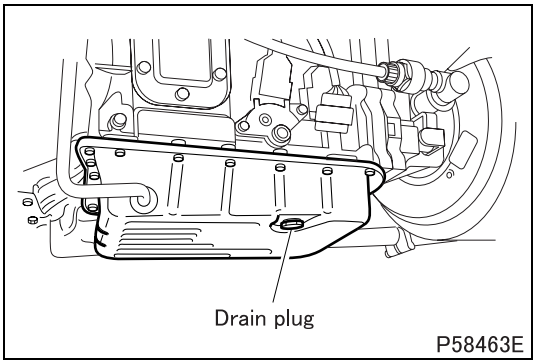
8. Replacement of Automatic Transmission Fluid

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug	27 {20, 2.8}	–

Lubricant and/or sealant

Mark	Points of application		Specified lubricant and/or sealant	Quantity
–	Automatic transmission	Replaced with oil pan removed	Mobil ATF3309 or equivalent	Approx. 8.4 L {8.9 qts}
		Replaced with drain plug removed		Approx. 6.4 L {6.8 qts}



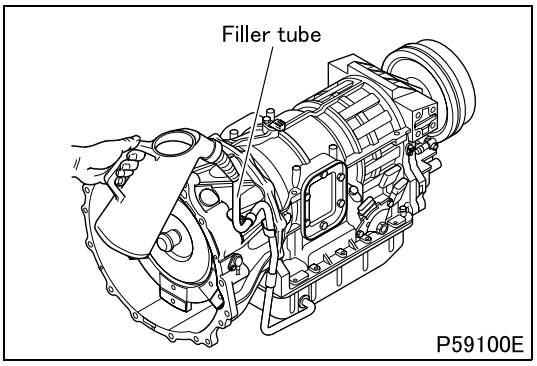
8.1 Draining

- Place a container under the transmission oil pan. Remove the drain plug near the front of the oil pan and allow the automatic transmission fluid to drain out.
- At the same time, check whether the drained automatic transmission fluid is dirty and whether it contains metallic particles.
  Note that the automatic transmission fluid will drain out more quickly if you warm it by allowing the engine to warm up.

CAUTION ⚠

- **The automatic transmission fluid is extremely hot immediately after driving. To avoid the risk of being scalded, wait for the automatic transmission fluid to cool to a safe temperature before starting work.**
- **It is not possible to drain out the automatic transmission fluid that is in the hydraulic circuit, torque converter, and oil cooler.**

- At this point, approximately 2 L {2.1 qts} of automatic transmission fluid remains in the oil pan. If you wish to replace this automatic transmission fluid, remove the oil pan.



8.2 Filling

- Make ready the new automatic transmission fluid.
- Fit the oil pan drain plug and gasket in their original conditions.
- Supply new automatic transmission fluid through the filler tube in a quantity equivalent to that of the automatic transmission fluid that drained out.

CAUTION ⚠

- **Never use the automatic transmission fluid except the specified one.**
- **Be careful not to allow dirt and other foreign matter to enter.**

- Place the range selector lever in the P position. Start the engine and allow it to idle for at least 2 minutes.
- Place the range selector lever in each other position then return it to the P position.

CAUTION ⚠

- **Keep the engine idling. Do not rev the engine.**

- Check the automatic transmission fluid level.

8.3 Fluid leakage

- Check the torque converter housing for fluid leakage. If fluid leakage is found, locate the origin of the leakage.
  - If leakage is found on the torque converter or the surrounding area, it is not necessarily automatic transmission fluid but can possibly be leaked engine oil.
  - Automatic transmission fluid is red in color and therefore is distinguishable from engine oil.
  - If the fluid that is leaking is automatic transmission fluid, check carefully whether it is from the torque converter, or from the transmission (through the oil seal of the oil pump housing or from between the oil pump housing and transmission case).

9. Dealer Adjust

• What is Dealer Adjust?

Individual automatic transmissions have different characteristics from each other. By carrying out Adjust Steps 1 to 4, electronic control unit will learn specific characteristics of the automatic transmission that it controls and thereby compensate for improved gear shift quality.

Dealer Adjust must be performed whenever:
- The automatic transmission has been replaced.
- The electronic control unit has been replaced.

NOTE
- **If the dealer adjustment has not performed, ATF temperature warning lamp stays on.**
- **During Dealer Adjust process, the clutches will be activated, which may generate shock loads and/or clutch noise.**
- **To ensure safety, chock all of the front and rear wheels and firmly apply the parking brake.**
- **When the engine speed is set at 1000 to 1500 rpm during Dealer Adjust, firmly press the brake pedal with your left foot.**

9.1 Dealer Adjust procedure

- Turn off all electrical equipment including the air conditioner and headlights.
- Ensure that the parking brake is applied ant that all wheels are chocked.
- Ensure that automatic transmission fluid is at the specified level.
- Start the engine and run it at idle for 5 minutes for warm-up.
- Move the range selector lever form N to D, and from N to R. Repeat this 3 to 5 times.

↓

Enter Adjust Mode
ATF temperature warning lamp flashes (at intervals of 0.2 sec.)

Conditions for entering Adjust Mode
- Diagnosis switch: Open
- Output shaft speed: 0 rpm (vehicle stationary)
- Brake pedal: Pressed
- Automatic transmission fluid temperature: 40 to 90°C {105 to 195°F}
- Engine speed: 500 rpm or above
- Move the lever from D to 3, three times within 10 sec.

If the ATF temperature warning lamp comes on, this means that the temperature of automatic transmission fluid in the oil pan is below the specified level. Warm up the transmission and try entering Adjust Mode again.

↓

Ensure that the engine speed remains stable within the specified idle speed range.

↓

Prepare for Adjust Steps 1 and 2

Conditions for Adjust Steps 1 and 2
- Range selector lever: In D range
- Overdrive switch: ON → OFF (5th and 6th gears disabled)
- Brake pedal: Pressed

NOTE
- **If the vehicle moves after Adjust Steps have started, Dealer Adjust process needs to be stopped (ATF temperature warning lamp illuminates 2 sec. and then extinguishes 1 sec., and repeats this cycle). Stop the engine and try the procedure again from the start.**

↓

(Continued to next page)

(Continued from previous page)

Start Adjust Step 1
ATF temperature warning lamp flashes (intervals: 0.2 sec. → 0.5 sec.)

- Succeeded: ATF temperature warning lamp flashes (at intervals of 0.2 sec.)
- Failed: ATF temperature warning lamp illuminates

If failed, ensure that the engine is running within the specified idle speed range. Prepare for Adjust Steps 1 and 2 again.

Within 30 sec. from the time when Adjust Step 1 has successfully started, press the accelerator pedal to maintain the engine speed within the range of 1000 to 1500 rpm.

Start Adjust Step 2
ATF temperature warning lamp continues to flash (at intervals of 0.2 sec.)

Maintain the current state (engine running at 1000 to 1500 rpm)

- Succeeded: ATF temperature warning lamp extinguishes
- Failed: ATF temperature warning lamp illuminates

If failed, ensure that the engine is running within the specified idle speed range. Prepare for Adjust Steps 1 and 2 again.

Ensure that the engine speed remains stable within the specified idle speed range.

Prepare for Adjust Steps 3 and 4

Conditions for Adjust Steps 3 and 4

- Range selector lever: In R range
- Overdrive switch: ON → OFF (5th and 6th gears disabled)
- Brake pedal: Pressed

Start Adjust Step 3
ATF temperature warning lamp extinguishes → flashes (at intervals of 0.5 sec.)

- Succeeded: ATF temperature warning lamp flashes (at intervals of 0.2 sec.)
- Failed: ATF temperature warning lamp illuminates

If failed, prepare for Adjust Steps 3 and 4 again.

Within 30 sec. from the time when Adjust Step 3 has successfully started, press the accelerator pedal to maintain the engine speed within the range of 1000 to 1500 rpm.

(Continued to next page)

(Continued from previous page)

↓

Start Adjust Step 4
ATF temperature warning lamp continues to flash (at intervals of 0.2 sec.)

Maintain the current state (engine running at 1000 to 1500 rpm)
- Succeeded: ATF temperature warning lamp extinguishes
- Failed: ATF temperature warning lamp illuminates

When the lamp has illuminated or extinguished, release the accelerator pedal and return the engine to idle speed.

If failed, prepare for Adjust Steps 3 and 4 again.

↓

End of Adjust Steps
ATF temperature warning lamp flashes
(extinguishes for 2 sec., then illuminates for 1 sec., and this is repeated)

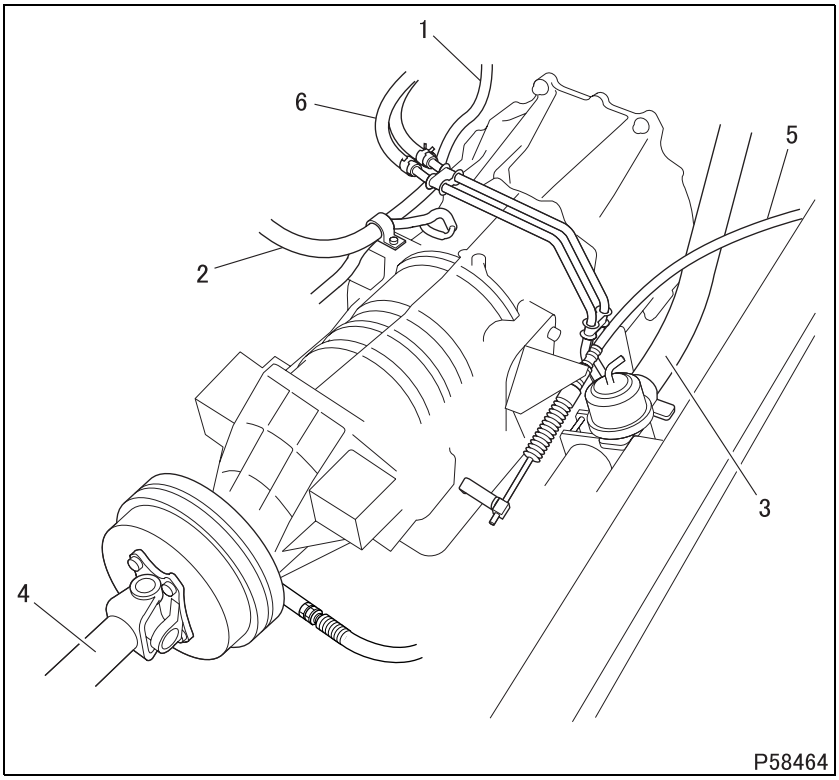
↓

Move the range selector lever to P range.

↓

Stop the engine. This is the end of Dealer Adjust.
ATF temperature warning lamp extinguishes.

Preparatory Work



● Removal sequence

1 Filler tube
2 Electrical harness
3 Exhaust pipe
4 Propeller shaft (See Gr25.)
5 Selector cable (See later section.)
6 Oil cooler hose (See later section.)

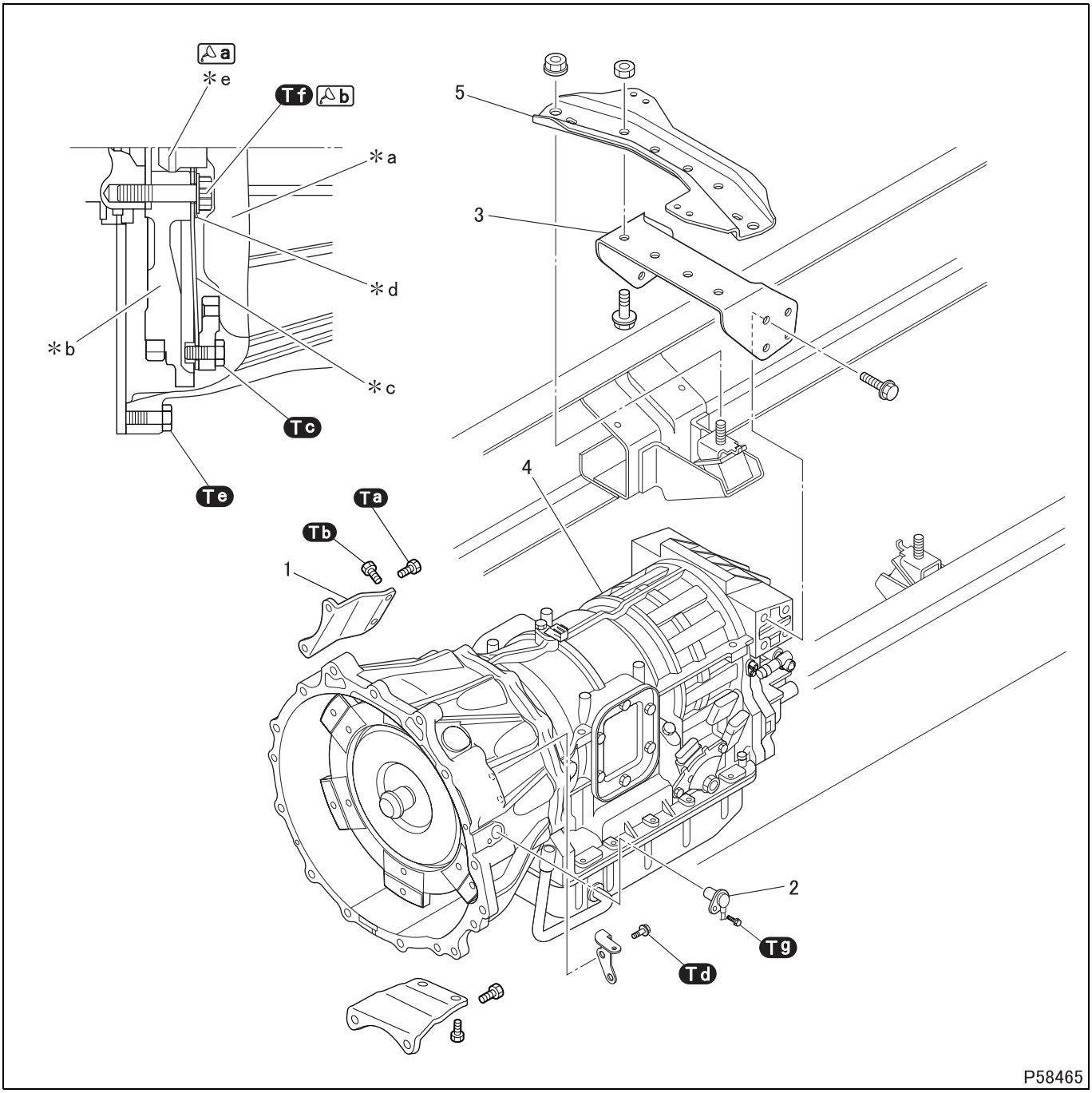
● Installation sequence

Perform installation by following the removal sequence in reverse.

CAUTION ⚠

- **If the automatic transmission fluid contains a large amount of impurities when you replace the automatic transmission because of an abnormality in the main body of the automatic transmission, flush the oil cooler circuit.**

M E M O



● **Removal sequence**

1 Dust cover
2 Engine speed sensor (See Gr13EA.)
3 Mounting bracket
4 Automatic transmission
5 Mounting support

***a**: Torque converter
***b**: Flywheel
***c**: Drive plate
***d**: Wear plate
***e**: Pilot

● **Installation sequence**

Follow the removal sequence in reverse.

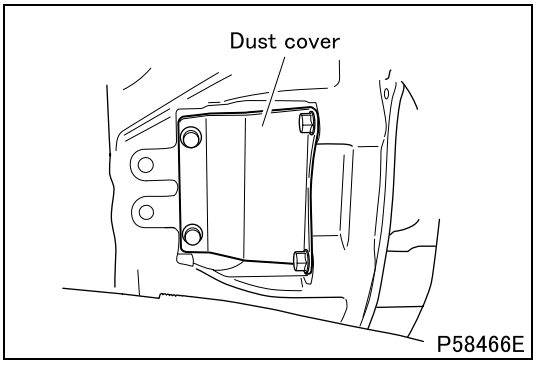
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (dust cover and automatic transmission mounting)	47 {35, 4.8}	–
Tb	Bolt (dust cover mounting)	13 {9.6, 1.3}	–
Tc	Bolt (flywheel and drive plate mounting)	50 {37, 5.1}	–
Td	Bolt (bracket mounting)	40 {30, 4.1}	–
Te	Bolt (automatic transmission mounting)	82 {60, 8.4}	M12
		47 {35, 4.8}	M10
Tf	Bolt (drive plate mounting)	118 {87, 12} + 90°	Wet
Tg	Bolt (engine speed sensor mounting)	8 {5.9, 0.82}	–

Lubricant and/or sealant

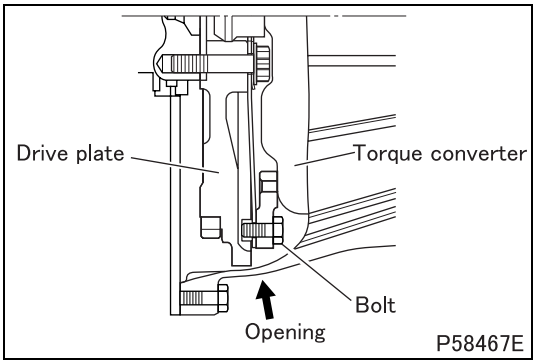
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Pilot of torque converter	Molybdenum disulfide grease [NLGI No. 2 (Li soap)]	As required
b	Bolt threads	Engine oil	As required

◆Removal procedure◆

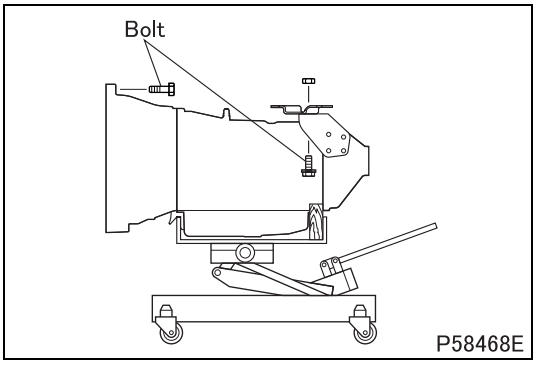


■ **Removal: Automatic transmission**

- Remove the dust cover.



- Crank the engine to bring one of the bolts to the opening.
- Remove the bolt that is accessible through the opening. Also remove all of the rest of the six bolts, cranking the engine to bring each one to the opening in turn.



- Support the automatic transmission with a jack and remove each of the bolts.
- Move the automatic transmission rearward to remove it.

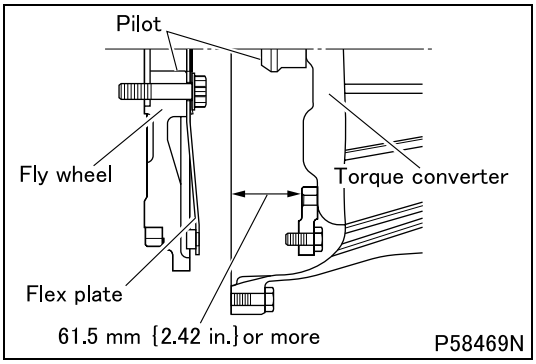
CAUTION ⚠

- **Do not apply the jack to the oil pan. Doing so would deform the oil pan and the oil pan gasket.**
- **The torque converter will come away by itself. Be careful not to let it drop.**

NOTE

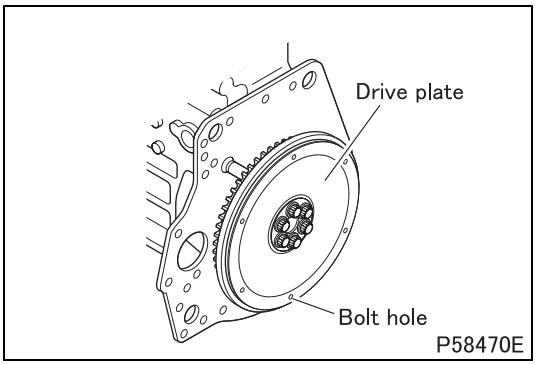
- **The bolts that join the automatic transmission to the engine are not all the same length. Make a note of the position of each one as you remove it.**

◆Installation procedure◆

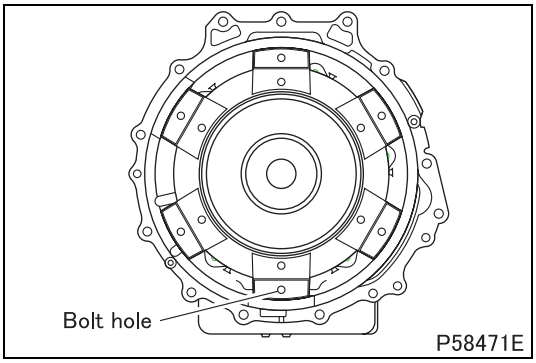


■ Installation: Automatic transmission

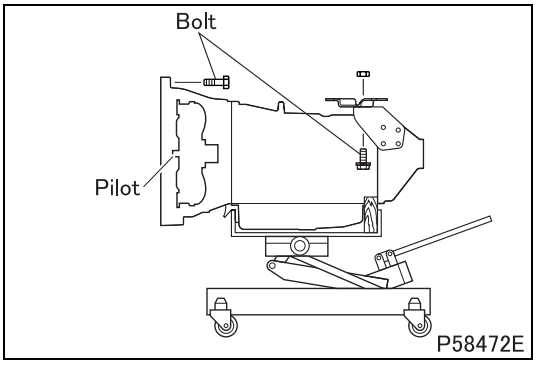
- Make sure the torque converter is correctly installed on the automatic transmission. With the torque converter correctly installed, the dimension from the drive plate surface to the case mounting surface is as shown in the diagram.
- Apply grease to the pilot.



- Position one of the drive plate's mounting bolt holes at the very bottom.



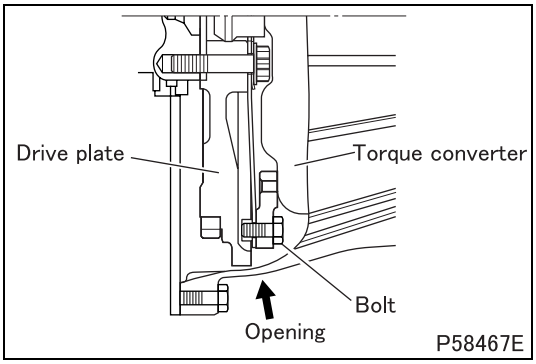
- Position one of the torque converter's mounting bolt holes at the very bottom.



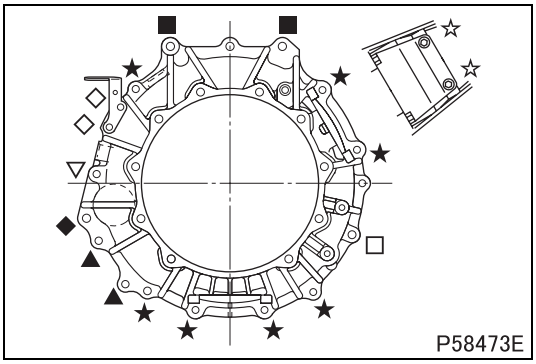
- Wipe all oil and grease off the inside wall of the torque converter housing.
- With the pilot of the torque converter and the dowel pin of the rear plate aligned with each other, slowly move the assembly onto the engine.
- Fit several of the bolts that join the automatic transmission to the engine, then tighten the rear mounting bolt to the specified torque.

NOTE

- **The torque converter can easily come off by itself. Slightly lower the rear of the automatic transmission to keep the torque converter correctly positioned.**

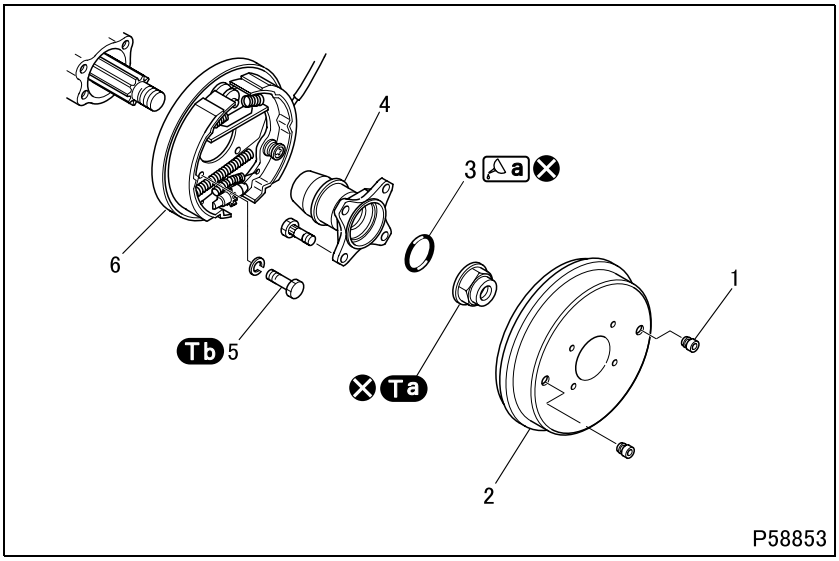


- Through the opening, align the holes for one of the bolts that join the drive plate and the torque converter and fit the bolt.
- Fit all of the rest of the six bolts, cranking the engine to bring the holes to the opening for each one. Next, tighten each bolt to specification, cranking the engine to being each bolt to the opening in turn.



- With the dust cover and bracket mounted using the same bolts, tighten to torque all of the bolts that join the automatic transmission and engine.
  - ▲: M10 × 1.25 - 55
  - ★: M10 × 1.25 - 80
  - □: M10 × 1.25 - 95
  - ◇: M10 × 1.5 - 20 (for bracket)
  - ◆: M12 × 1.75 - 45
  - ■: M12 × 1.75 - 60
  - ▽: M12 × 1.75 - 100
- Tighten the dust cover's remaining mounting bolts (marked ☆) to the specified torque to retain the dust cover.

PARKING BRAKE



● **Removal sequence**

1 Dust plug
2 Parking brake drum
3 O-ring
4 Companion flange
5 Reamer bolt
6 Parking brake (See Gr36.)

⊗: Non-reusable parts

● **Installation sequence**

Follow the removal sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
2	Parking brake drum	Inner diameter	$\phi 190\ ^{+0.2}_{0}$ {7.48 $^{+0.0079}_{0}$}	ϕ191 {7.52}	Replace
		Squareness	0 to 0.05 {0 to 0.0020}	–	
		Concentricity	0 to 0.1 {0 to 0.0039}	–	
		Cylindricity	0 to 0.05 {0 to 0.0020}	–	
		Static rotation imbalance	0 to 0.0049 N·m {0 to 0.004 ft.lbs, 0 to 0.5 gf·m}	–	
4	Runout at socket portion of companion flange		0 to 0.15 {0.0059}	0.5 {0.020}	

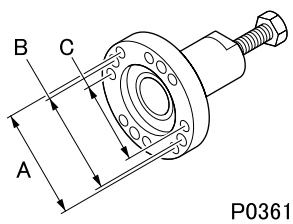
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (companion flange mounting)	190 {140, 19}	After tightening, crimp at two places.
Tb	Reamer bolt	52 to 66.7 {38 to 49, 5.3 to 6.8}	–

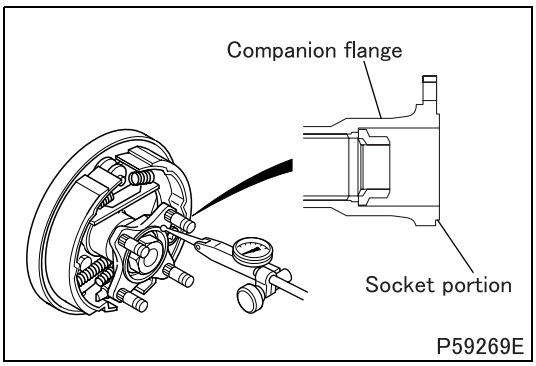
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Mobil ATF3309	As required

Special tools (Unit: mm {in.})

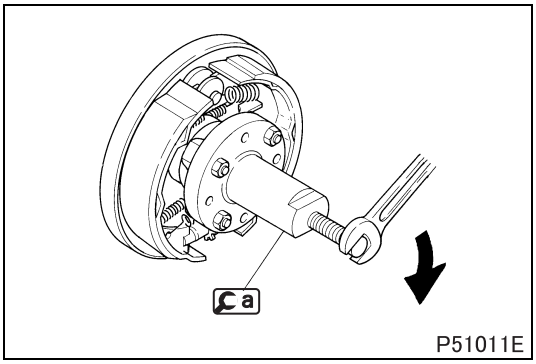
Mark	Tool name and shape	Part No.	Application
a	Flange puller A: ϕ95 {3.74} B: ϕ100 {3.94} C: ϕ90 {3.54} 	MH061848	Removal of companion flange

◆Removal procedure◆



■ **Inspection: Runout of socket portion of companion flange**

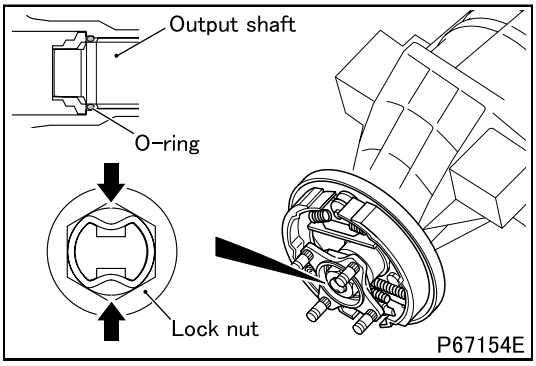
- If the measured valve exceeds the limit, replace the companion flange.



■ **Removal: Companion flange**

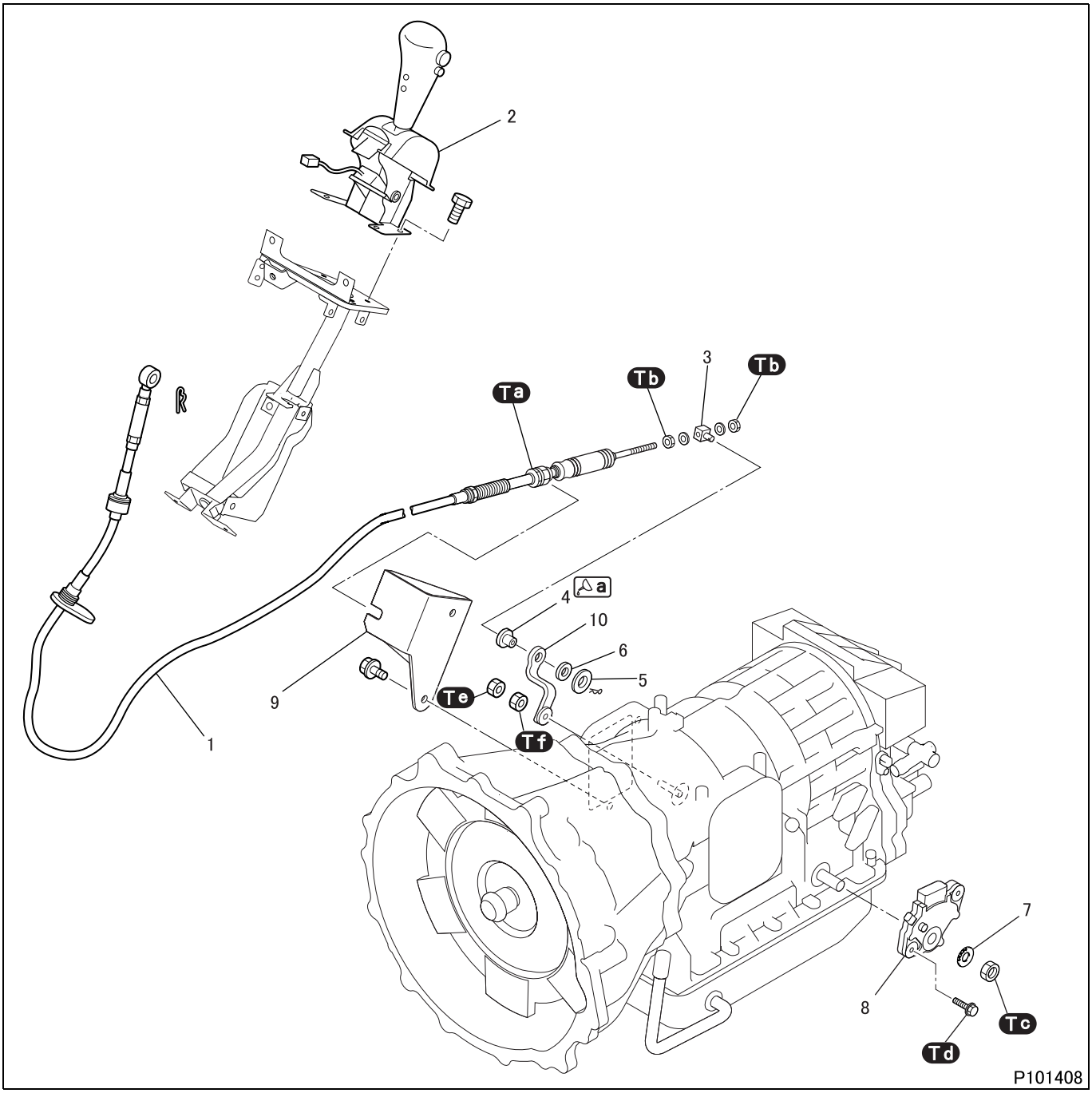
- Attach the special tool a to the companion flange with propeller shaft mounting nut. Using a, remove the companion flange.

◆Installation procedure◆



■ **Inspection: Companion flange**

- After installing O-ring to output shaft and tightening the lock nut to the specified torque, crimp the lock nut at two places.
- After installing the companion flange, check the companion flange for excessive play and looseness. (See “ON-VEHICLE INSPECTION AND ADJUSTMENT.”)



● **Removal sequence**

1 Selector cable
2 Range selector lever (See later section.)
3 Adjuster
4 Bush
5 Plane washer
6 Spacer
7 Lock washer
8 Inhibitor switch
9 Bracket
10 Control lever

● **Installation sequence**

Follow the removal sequence in reverse.

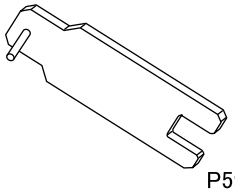
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Selector cable (mounting on bracket)	30 to 38 {22 to 28, 3.1 to 3.9}	–
Tb	Nut (adjuster mounting)	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–
Tc	Nut (inhibitor switch mounting)	7 {5.2, 0.7}	–
Td	Bolt (inhibitor switch mounting)	12.5 {9.2, 1.3}	–
Te	Nut (control lever mounting)	15 {11, 1.5}	Outside
Tf	Nut (control lever mounting)	13 {9.6, 1.3}	Inside

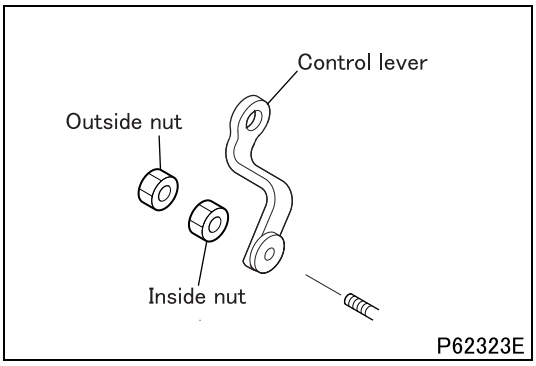
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Part of bush that slides against adjuster	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools

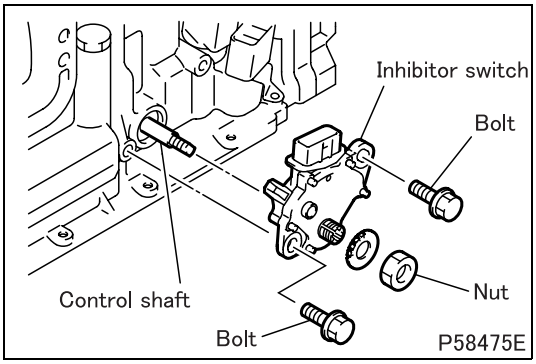
Mark	Tool name and shape	Part No.	Application
Ca	Plate  P59101	MH063642	Locating inhibitor switch

◆Installation procedure◆



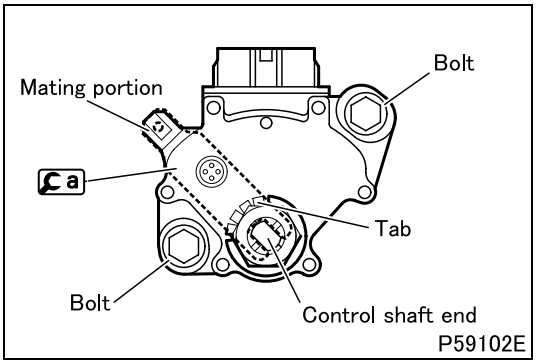
■ Installation: Control lever

- Tighten inside nut to the specified torque and then tighten outside nut to the specified torque with holding the inside nut by spanner.



■ Installation: Inhibitor switch

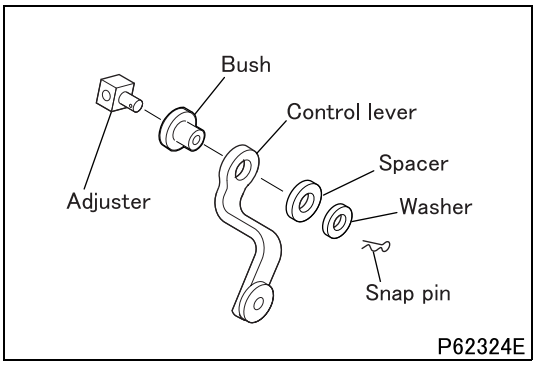
- Position the inhibitor switch onto the control shaft.
- Loosely tighten the bolts (× 2).
- Tighten the nut to the specified torque.



- Loosen the two bolts to enable the special tool a to be installed such that one end of the tool with a pin engages with the mating portion of the inhibitor switch while the other end of the tool engages with the end of the control shaft.
- While holding the inhibitor switch with one hand, tighten the two bolts to the specified torque.
- Stake the nut by bending over two of the tabs on the inhibitor switch.

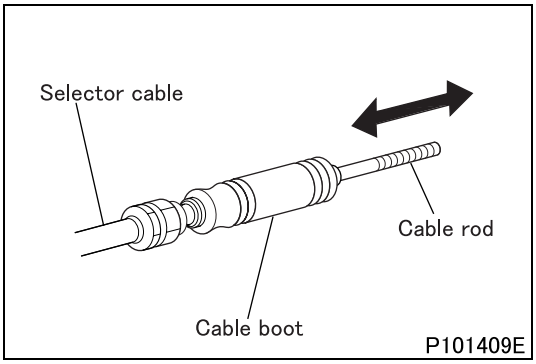
CAUTION ⚠

- **After installation, check the inhibitor switch if it is normal. This must be confirmed before commencing the following work.**



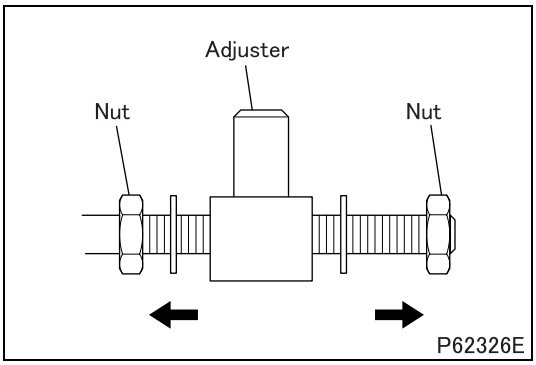
■ Installation: Adjuster

- Check if the adjuster turns smoothly to the control lever after mounting the adjuster to the control lever with the snap pin.
- When if the adjuster does not turn smoothly, replace the adjuster, plane washer, snap pin and control lever.
- Check the abrasion and damage of the brush and the spacer. This damage means dust, breakage, loosen, bend, twist, and so on.

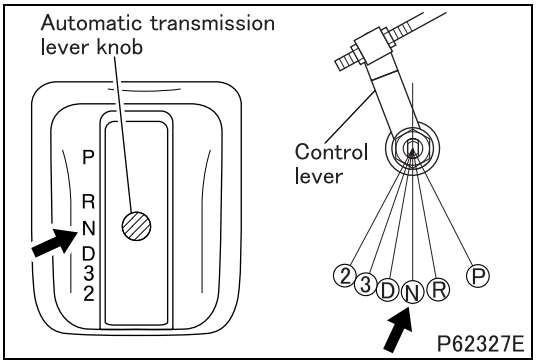


■ Installation: Selector cable

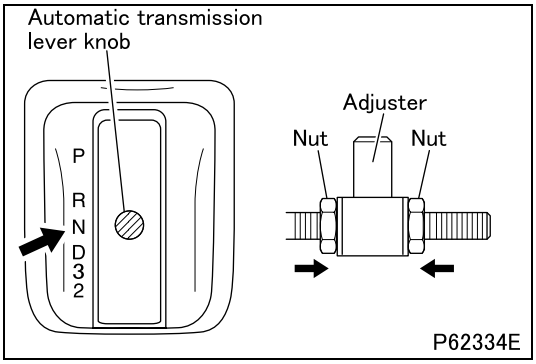
- When the selector cable stroke is not smooth, replace selector cable.
- Check the damage of the cable boot and the cable rod. Replace the selector cable if necessary. This damage means dust, breakage, loosen, bend, twist, and so on.



- Loosen the nuts to the both ends of thread.



- Place the automatic transmission lever knob inside the cab in the N position. Also, place the control lever on the automatic transmission main body side in the N position.

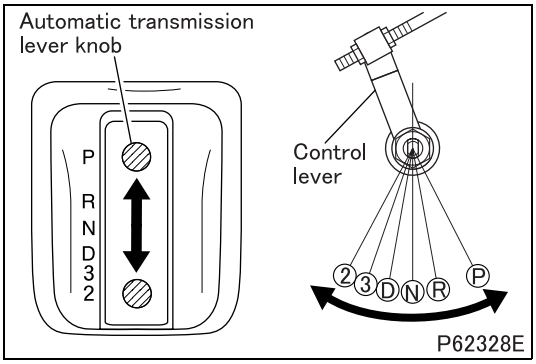


- Confirm that the automatic transmission lever knob inside the cab is in the N position, then tighten the nuts to the specified torque.

CAUTION ⚠

- **Do not move the adjuster's set position when tightening the nuts.**

◆Inspection after installation◆



■ Inspection: Operate performance of range selector lever

[Inspection]

- After fixing adjuster, move the automatic transmission lever knob from the P position to the 2 position and back to the P position two or three times and check the following.

(1) The automatic transmission lever knob inside the cab and the control lever on the automatic transmission main body side correctly enter each range position between the 2 position and the P position.

(2) On the meter cluster, the range indicator lamp of the selected range illuminates.

(3) The range selector lever operates smoothly and has a positive in-position feel in each range position.

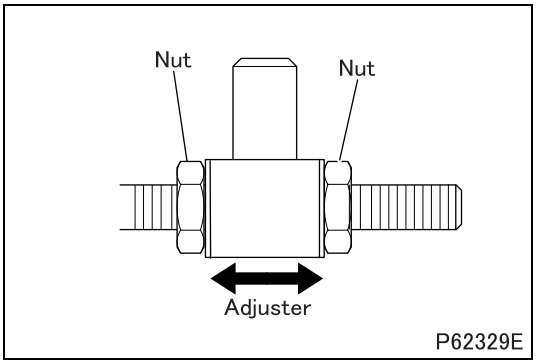
(4) The starter key can be removed from the key cylinder at the P position.

(5) The backup lamp turns on and the back buzzer sounds in the R position, and the engine starter operates in the N and P position.

CAUTION ⚠

- **This inspection should be performed after taking measures to prevent the vehicle from moving.**
- **Inspect the item (5) after confirming that there is no abnormality related to items (1) to (4).**

- If there is abnormality related to items (1) through (4), adjust the selector cable. If there is abnormality related to item (5), check the backup lamp circuit and the engine starter circuit. (See Gr54.)

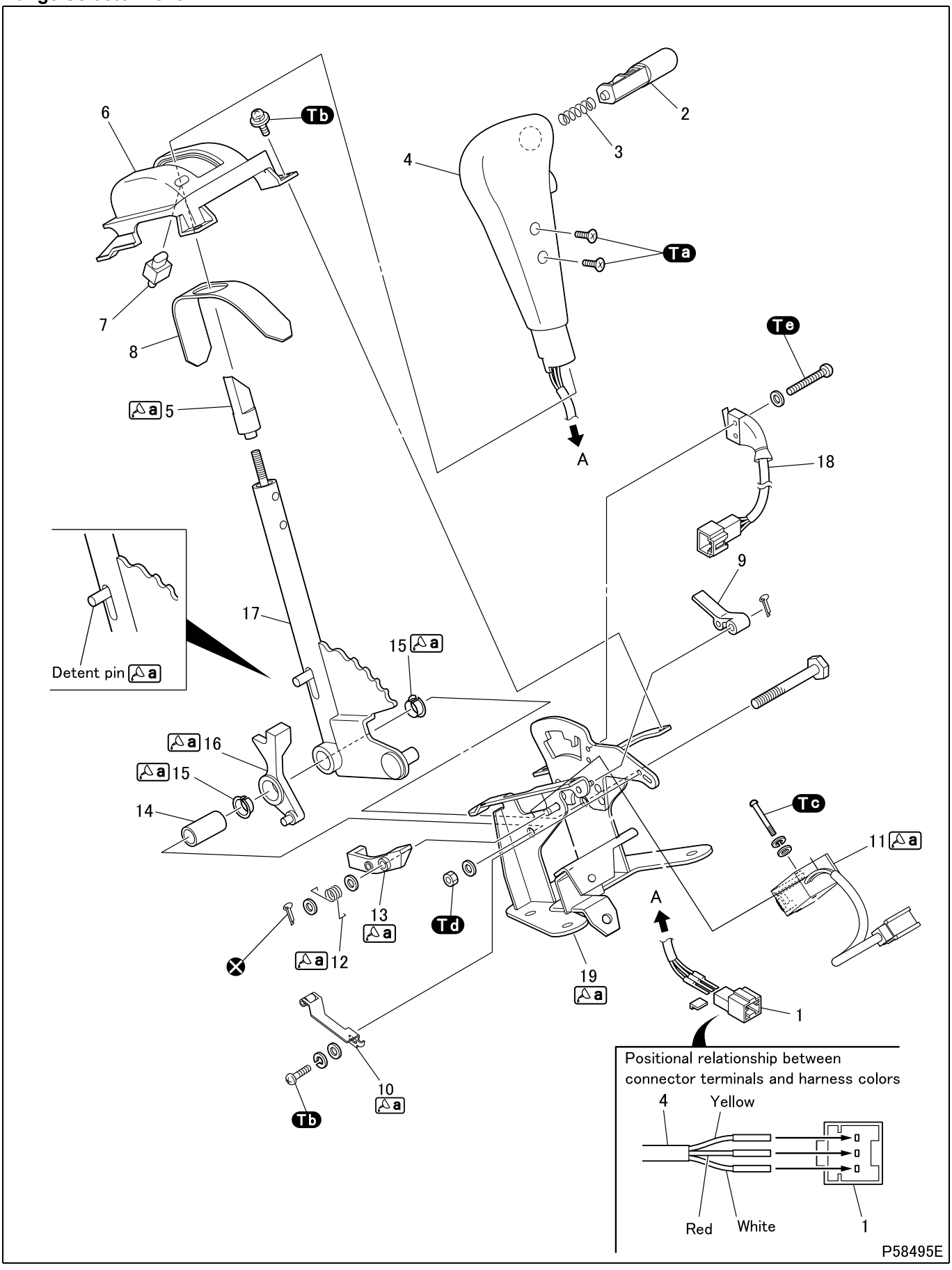


[Adjustment]

- Loosen each nut and then adjust the adjuster position in accordance with the procedure in "■**Installation: Selector cable**".
- If the control lever is shifted toward "2" position, move the adjuster toward the selector cable end. If the lever is shifted toward "P" position, move the adjuster in the opposite direction.
- After adjustment, recheck the operate performance of range selector lever to confirm that there is no abnormality.
- If the abnormality has not solved by the adjustment, check the indicator lamp-related circuit in the meter cluster (See Gr54.) and P range switch.

M E M O

Range Selector Lever



● Removal sequence

1 Connector housing (for overdrive switch)
2 Push-button
3 Spring
4 Knob
5 Sleeve
6 Indicator panel
7 Shift lock cancel button
8 Slider
9 Cam
10 Detent spring
11 Shift lock actuator
12 Spring
13 Arm
14 Pipe
15 Bushing
16 Arm
17 Lever
18 P range switch
19 Bracket

● Installation sequence

Follow the removal sequence in reverse.

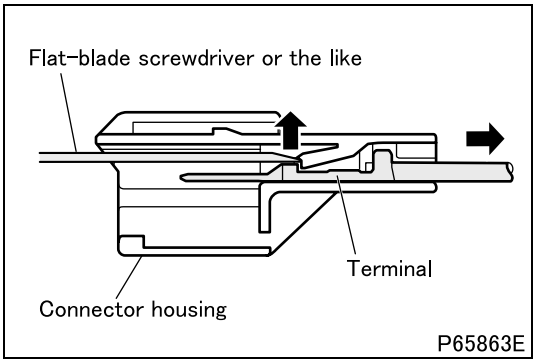
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (knob mounting)	1.5 to 2 {1.1 to 1.5, 0.15 to 0.20}	–
Tb	Screw (indicator panel mounting)	1 to 1.5 {0.7 to 1.1, 0.10 to 0.15}	–
	Screw (detent spring mounting)		
Tc	Screw (shift lock actuator mounting)	1 to 2 {0.7 to 1.5, 0.10 to 0.20}	–
Td	Nut (lever mounting)	9 to 14 {6.6 to 10, 0.92 to 1.4}	–
Te	Screw (P range switch mounting)	0.1 to 0.15 {0.074 to 0.11, 0.01 to 0.02}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Sliding part of detent spring	Chassis grease [NLGI No. 1 (Ca soap)]	As required
	Sliding parts of shift lock actuator and arm		
	Sliding parts of spring and arm		
	Bushing		
	Detent pin of lever		
	Part of bracket that makes contact with detent pin		
	Part of sleeve that makes contact with push-button, and sliding part of sleeve		

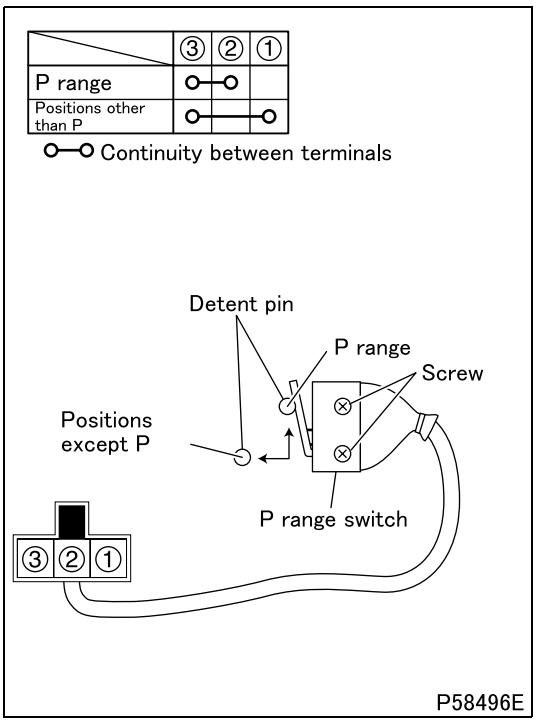
◆Removal procedure◆



■ Removal: Connector housing

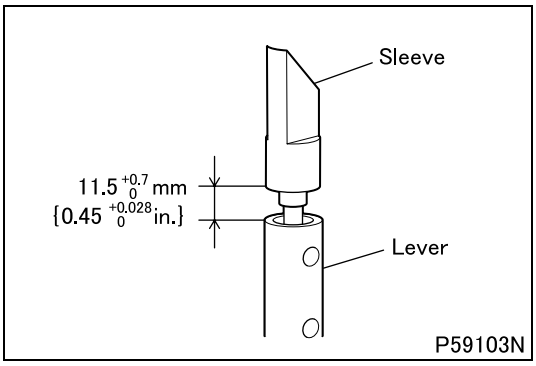
- Use a flat-blade screwdriver or the like to free the terminal in the connector, then remove the connector housing.

◆Installation procedure◆



■ **Installation: P range switch**

- Tighten the screws to the specified torque with the P range switch positioned such that the continuity of the P range switch is as shown in the illustration.

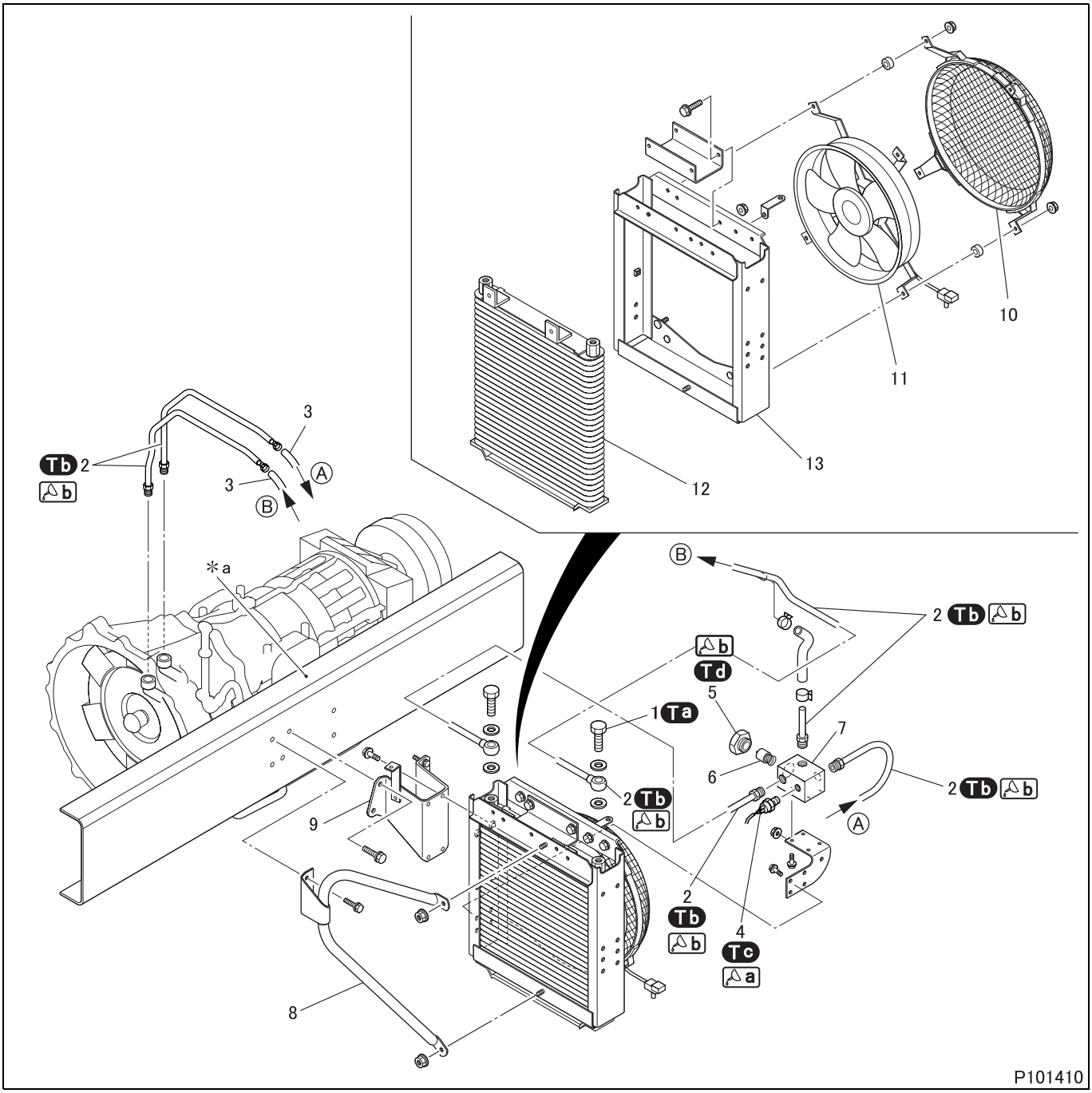


■ **Installation: Sleeve**

- Turn the sleeve to install it such that the dimension between the sleeve and the end of the lever is as shown in the illustration when the lever is in the R position.
- Install the sleeve with its tapered part on the same side as the push-button.

M E M O

OIL COOLER



● **Removal sequence**

1 Eyebolt
2 Oil cooler tube
3 Oil cooler hose
4 ATF thermo switch
5 Plug
6 Thermo valve
7 Connector
8 Oil cooler stay
9 Oil cooler bracket
10 Fan cover
11 ATF cooler fan motor
12 Oil cooler
13 Oil cooler mount

***a**: Frame

● **Installation sequence**

Perform installation by following the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eyebolt	29 to 34 {21 to 25, 3.0 to 3.5}	–
Tb	Oil cooler tube (flare nut)	53 {39, 5.4}	Wet
Tc	ATF thermo switch	29 to 39 {21 to 29, 3.0 to 4.0}	Sealant
Td	Plug	167 ± 20 {125 ± 15, 17 ± 2.0}	Wet

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Thread of ATF thermo switch	ThreeBond 1110B	As required
b	Thread of oil cooler tube	Mobil ATF3309 or equivalent	As required
	Thread of plug		

◆Work before installation◆

■ Flushing: Oil cooler circuit

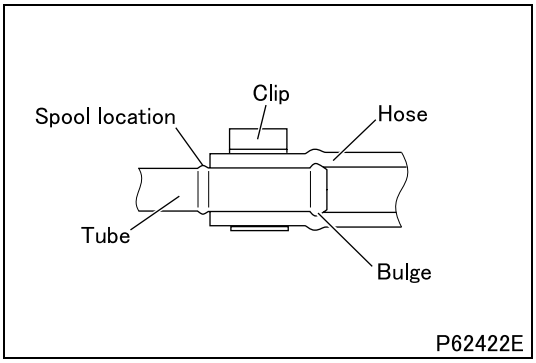
- If the oil cooler circuit contains a large amount of impurities, flush the cooler circuit.
- Remove the cooler tubes from the automatic transmission and oil cooler.
- Blow compressed air into the oil cooler and cooler tubes to clean them.

◆Inspection after installation◆

■ Inspection: Automatic transmission fluid level

- After oil line is removed, check the automatic transmission fluid level and replenish the fluid if necessary.

◆Installation procedure◆



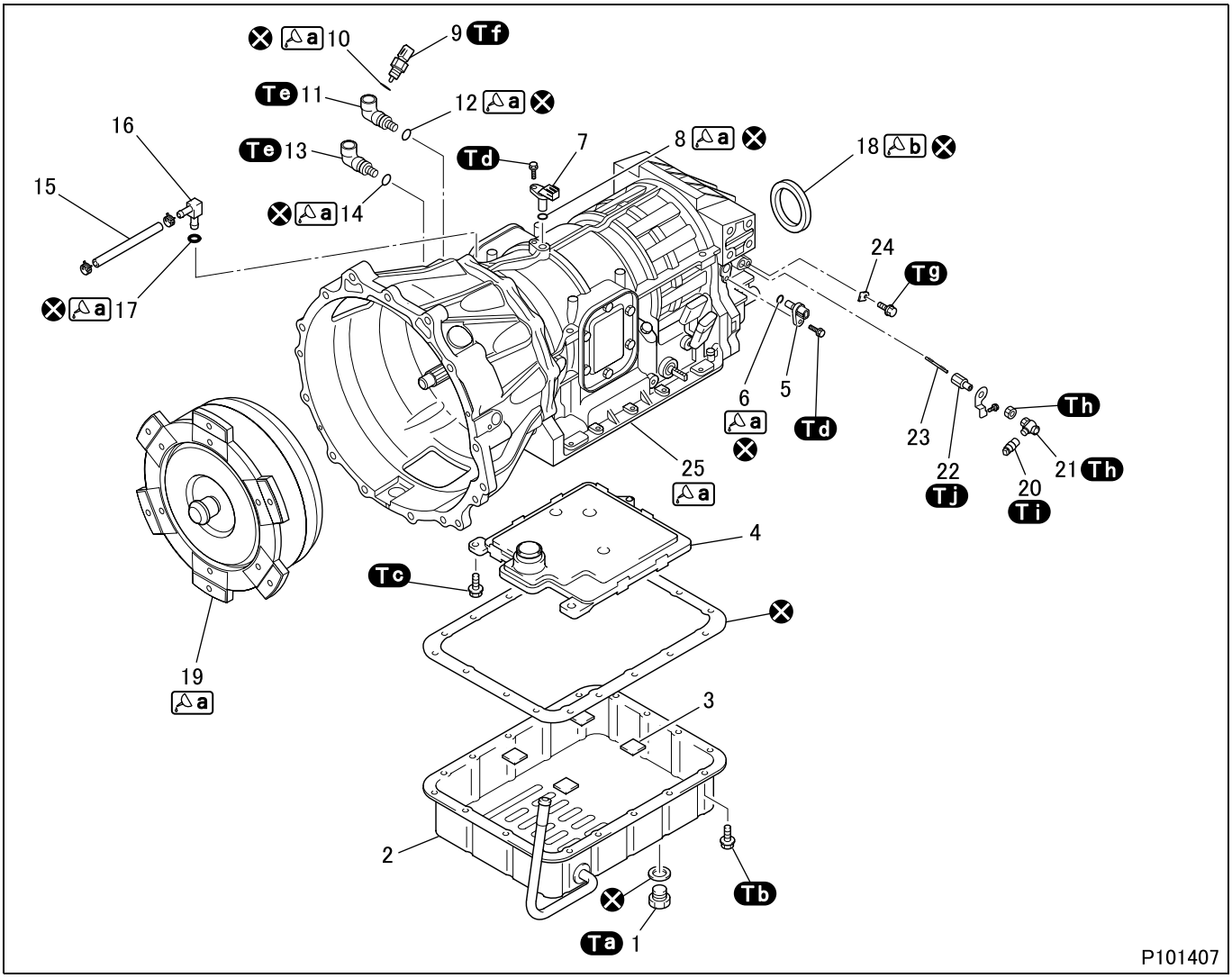
■ Installation: Oil cooler hose

- Fit the oil cooler hose all the way to the spool at the end or the oil cooler tube.
- Fasten the hose with the clip avoiding the bulge.

CAUTION ⚠

- **Install the oil cooler hose without forced bend and twist.**
- **When installing the oil cooler hose, do not apply oil to its joints.**

REPLACEMENT OF PARTS OF AUTOMATIC TRANSMISSION MAIN BODY



● Removal sequence

1 Drain plug
2 Oil pan
3 Oil cleaner magnet
4 Oil strainer
5 Output speed sensor
6 O-ring
7 Turbine speed sensor
8 O-ring
9 Oil temperature sensor (outside)
10 O-ring
11 Elbow
12 O-ring
13 Elbow
14 O-ring
15 Hose
16 Breather plug
17 O-ring
18 Rear oil seal
19 Torque converter
20 Vehicle speed sensor
21 L-joint
22 Speedometer joint
23 Speedometer shaft
24 Lock plate
25 Automatic transmission

⊗: Non-reusable parts

● Installation sequence

Perform installation by following the removal sequence in reverse.

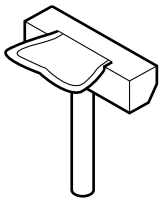
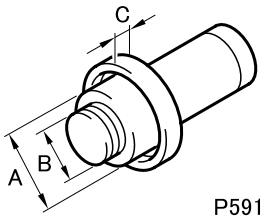
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	27 {20, 2.8}	Magnet attached
Tb	Bolt (oil pan mounting)	7 {5.2, 0.7}	–
Tc	Bolt (oil strainer mounting)	10 {7.4, 1.0}	–
Td	Bolt (output speed sensor and turbine speed sensor mounting)	8 {5.9, 0.8}	–
Te	Elbow mounting	32 {24, 3.3}	–
Tf	Oil temperature sensor (outside) mounting	34 {25, 3.5}	–
Tg	Bolt (lock plate mounting)	12.5 {9.2, 1.3}	–
Th	L-joint	34 to 39 {25 to 29, 3.5 to 4.0}	–
	Nut (speedometer joint mounting)		
Ti	Vehicle speed sensor	14.7 to 29.4 {11 to 22, 1.5 to 3.0}	–
Tj	Speedometer joint	20 to 30 {15 to 22, 2.0 to 3.1}	–

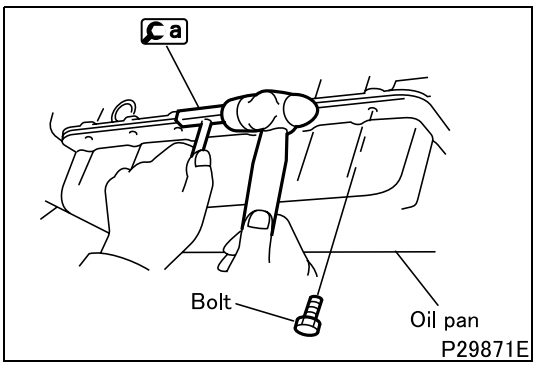
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Mobil ATF3309 or equivalent	As required
	Torque converter		2 L {2.1 qts}
	Front oil seal (automatic transmission)		As required
b	Rear oil seal lips	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools

Mark	Tool name and shape	Part No.	Application
a	Oil pan remover  P29856	MD998727	Removal of oil pan
b	Oil seal installer A: ϕ66, B: ϕ53, C: 17  P59105	MH063641	Installing rear oil seal

◆Removal procedure◆



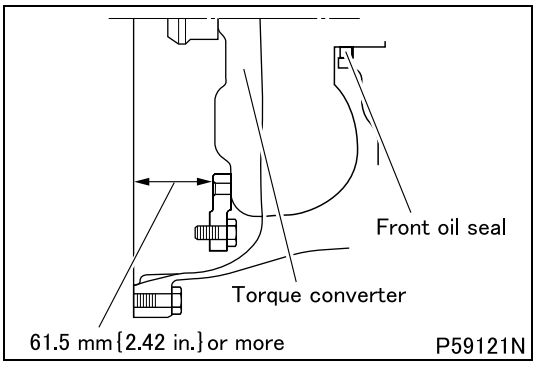
■ **Removal: Oil pan**

- Remove the bolts, leaving one bolt (not tightened) in every third hole to prevent the oil pan from falling.
- Remove the oil pan using the special tool a as illustrated. Insert the special tool at one corner of the oil pan.

CAUTION ⚠

- **Do not deform the oil pan when tapping in the special tool a.**
- **Oil remains in the oil pan. Do not tip the oil pan when removing it.**

◆Installation procedure◆



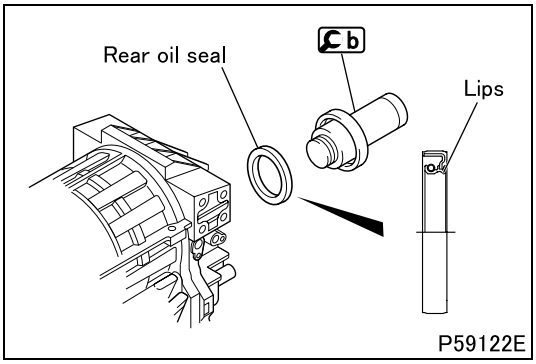
■ **Installation: Torque converter**

- If the torque converter is replaced and the replacement is new, fill it with fresh automatic transmission fluid up to the specified level.
- Apply automatic transmission fluid to the front oil seal, then install the torque converter on the oil pump.

CAUTION ⚠

- **Do not damage the oil seal when installing the torque converter.**

- Measure the dimension from the torque converter housing to the torque converter's set block. Confirm that the torque converter is correctly positioned.



■ **Installation: Rear oil seal**

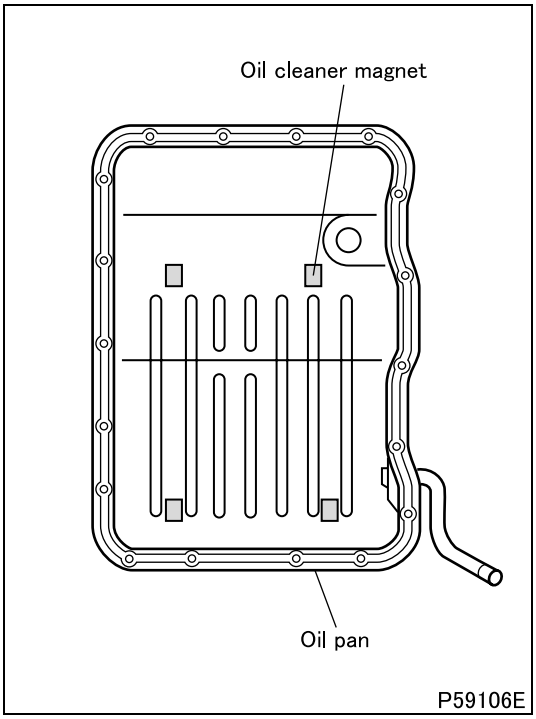
NOTE

- **Before installing the rear oil seal, ensure that the seal mounting face on the automatic transmission is clean.**

- Apply grease to the rear oil seal lips.
- Install the rear oil seal using b. Ensure that the seal is firmly against the extension housing end face of the automatic transmission main body.

CAUTION ⚠

- **Install the rear oil seal evenly throughout its periphery.**
- **Be careful not to deform or otherwise damage the rear oil seal.**

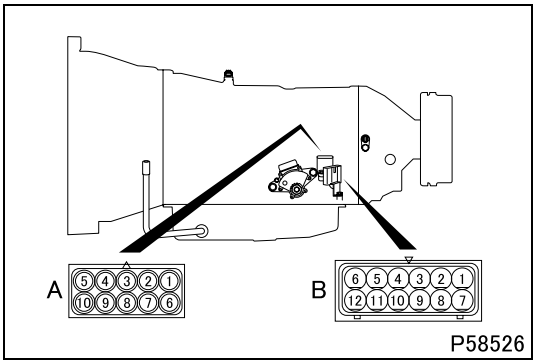


■ **Installation: Oil pan**

- Remove any gasket that may be remaining on the mating faces of the automatic transmission main body and the oil pan.
- Clean the oil cleaner magnet and install it onto the oil pan.
- Install new gasket onto the oil pan, then install them onto the automatic transmission main body.
- Tighten the bolts evenly in several steps, in each step tightening individual bolts a little in a set sequence to the specified torque.

CAUTION ⚠

- **Ensure that the mating faces of the oil pan and the automatic transmission main body are free from automatic transmission fluid spill.**
- **After installing the oil pan, do not operate the automatic transmission for at least one hour.**



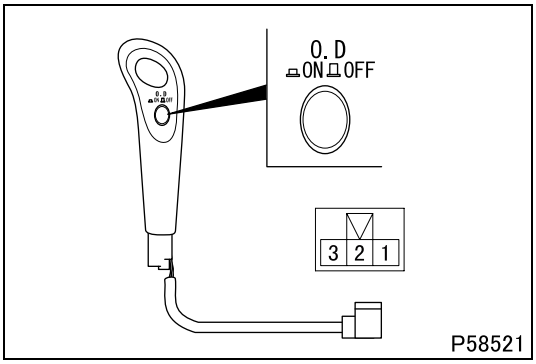
#140 Inspection of oil pressure switch

- Measure the resistance between the indicated terminals.

Standard value	Oil pressure switch 1	B1-*	No continuity (When starter switch is OFF)
	Oil pressure switch 2	B7-*	
	Oil pressure switch 3	B8-*	
	Oil pressure switch 4	A7-*	
	Oil pressure switch 5	A2-*	
	Oil pressure switch 6	B2-*	
	Oil pressure switch 7	A1-*	
	Oil pressure switch 8	A6-*	

*: Automatic transmission case

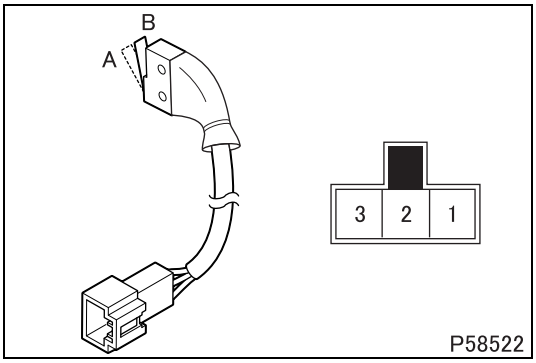
- If any measured value is out of specification, replace the relevant oil pressure switch. Have replacement performed by an Aisin service station.



#150 Inspection of overdrive switch

Switch position	Terminals with continuity
OFF	1-3
ON	2-3

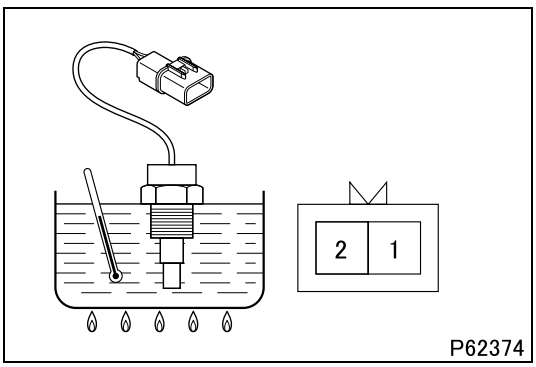
- If there is any abnormality, replace the knob.



#151 Inspection of P range switch

Switch position	Terminals with continuity
A	1-3
B	2-3

- If there is any abnormality, replace the P range switch.



#153 Inspection of ATF thermo switch

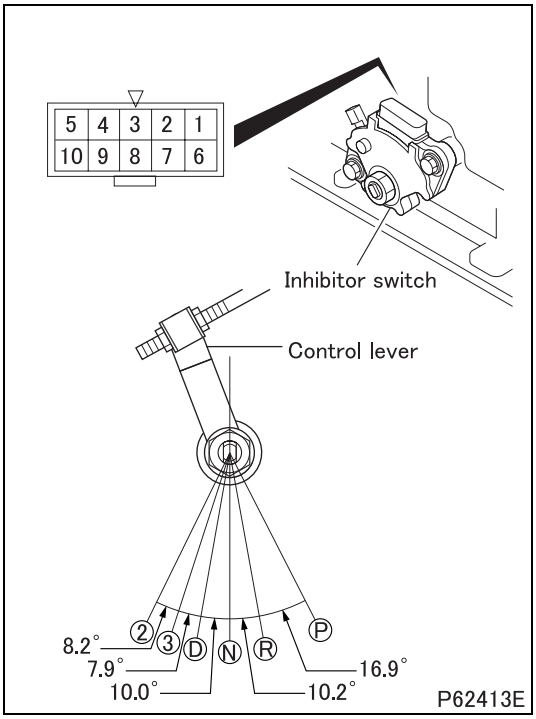
- Place the ATF thermo switch in a container filled with automatic transmission fluid and use a heater to raise the temperature of the fluid.
- Measure the temperature of the fluid at which continuity becomes established between terminals 1 and 2 and check that the measurement is within the standard value range.

Standard value (OFF to ON temperature)	97 ± 3°C {205 ± 5.4°F}

- Measure the temperature of the fluid at which the continuity between terminals 1 and 2 is lost and check that the measurement is within the standard value range.

Standard value (ON to OFF temperature)	90°C {195°F} or higher

- If any of the above measurements is not within the standard value range, replace the ATF thermo switch.

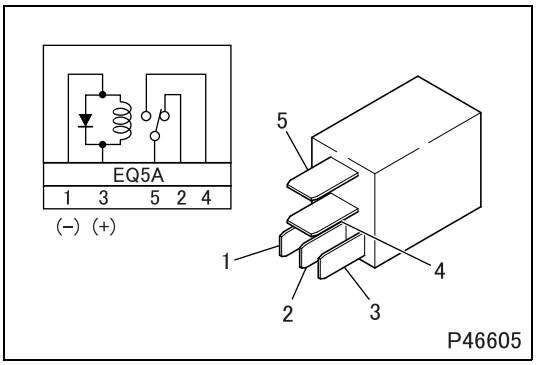


#159 Inspection of Inhibitor switch

- After installing the inhibitor switch to the automatic transmission and connecting the control lever, check the continuity in the following conditions.

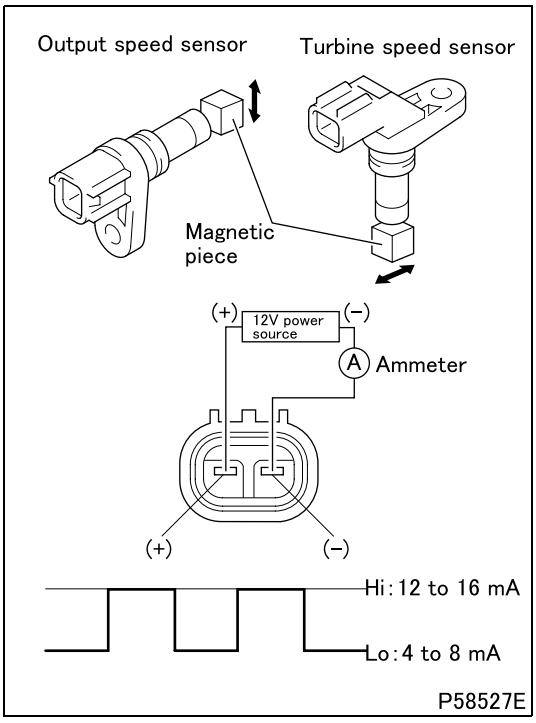
Transmission control lever position	Terminals with continuity
P	4-5, 6-10
R	4-9
N	1-4, 6-10
D	4-8
3	2-4
2	4-7

- If there is any abnormality, replace the inhibitor switch.



#201 Inspection of relay (normally open, 5-pin type)

- Perform a continuity check and an operation check. If there is any abnormality, replace the relay.

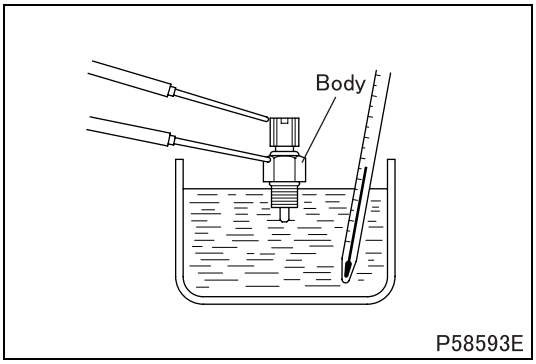


#293 Inspection of speed sensors

- Connect the speed sensor to the power source and an ammeter as illustrated.
- While moving a magnetic piece (metal that attaches to magnet) in the illustrated directions near the end of the speed sensor, read the ammeter. (Distance between sensor and magnetic piece: 5 mm {0.20 in.} or less)

Standard value (at normal temperature)	Hi	12 to 16 mA
	Lo	4 to 8 mA

- If the measured value does not conform to the standard value, replace the speed sensor.



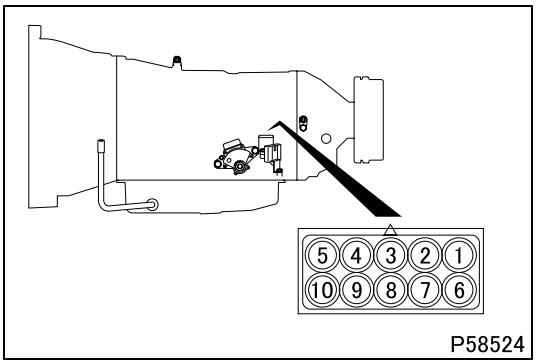
#312 Inspection of oil temperature sensor

<Outside>

- Immerse the oil temperature sensor in a container filled with automatic transmission fluid.
- Measure the resistance at the temperatures listed below. (To obtain the correct reading, the sensor needs to be exposed to the specified temperature for at least 5 minutes.)

Standard value	115°C {240°F}	655 to 730 Ω
	120°C {250°F}	585 to 645 Ω
	145°C {295°F}	340 to 375 Ω
	155°C {310°F}	280 to 305 Ω

- If there is any abnormality, replace the oil temperature sensor.

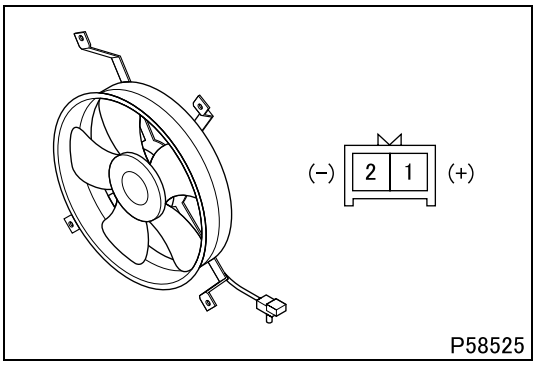


<Inside>

- Measure the resistance between terminals 3 and 8 on the automatic transmission.

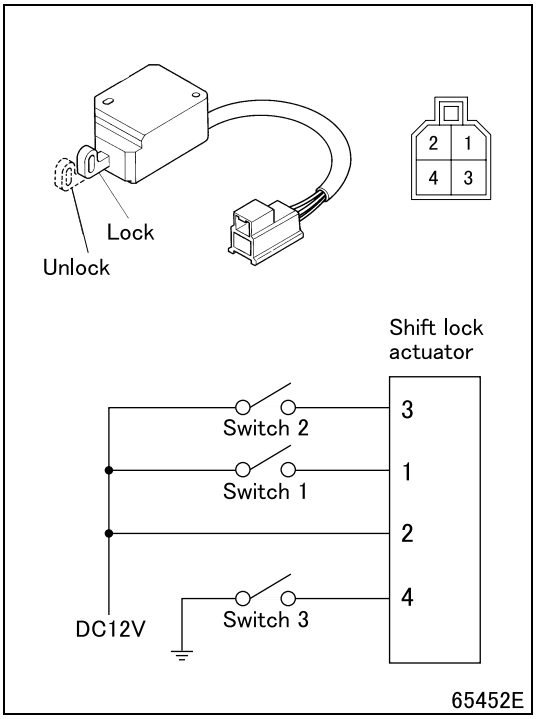
Standard value	–30°C {–22°F}	44 ± 6.6 kΩ
	10°C {50°F}	6445 ± 645 Ω
	110°C {230°F}	247 ± 16 Ω
	145°C {295°F}	111 ± 6 Ω

- If a measured value differs greatly from the standard value or the resistance does not change when the temperature is changed, have an Aisin service station perform the necessary work.



#489 Inspection of ATF cooler fan motor

- Check that the ATF cooler fan motor runs when the battery voltage is applied to terminals 1 and 2.
- If there is any abnormality, replace the ATF cooler fan motor.

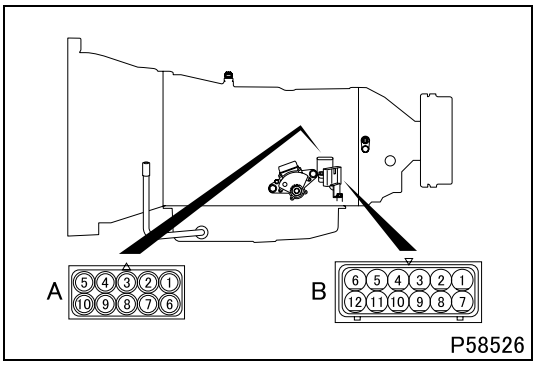


#535 Inspection of shift lock actuator

- Wire the shift lock actuator as illustrated.
- Check the lever position with each combination of switch conditions shown in the following table.

Switch 1	Switch 2	Switch 3	Lever position
ON	ON	ON	Unlock
ON	OFF	ON	Lock
ON	ON	OFF	Unlock
ON	OFF	OFF	Unlock
OFF	ON	ON	Lock
OFF	OFF	ON	Lock
OFF	ON	OFF	Unlock
OFF	OFF	OFF	Unlock

- If there is any abnormality, replace the shift lock actuator.



#585 Inspection of solenoid valves

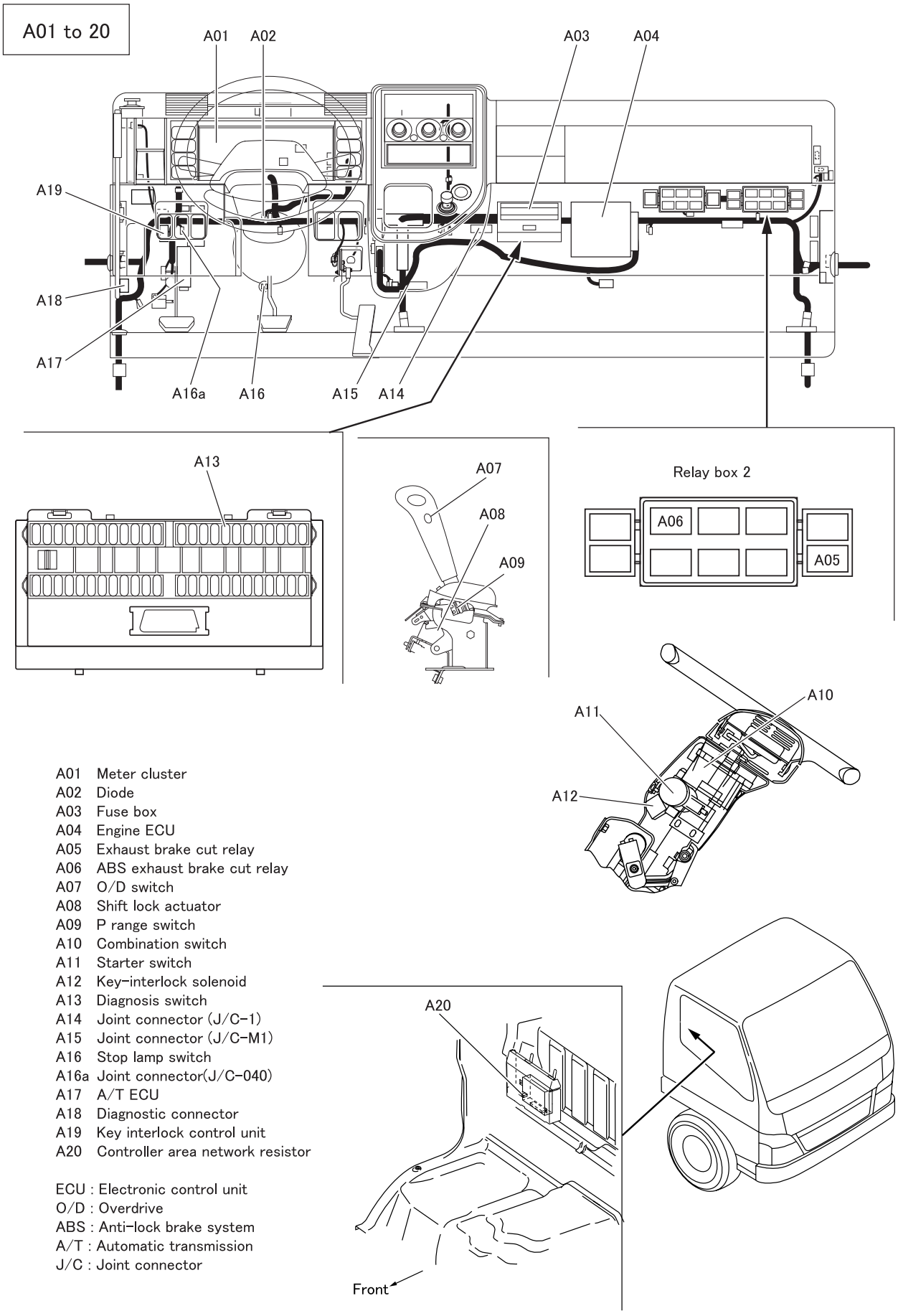
- Measure the resistance between the indicated terminals.

Standard value (at normal temperature)	Shift solenoid 1	B10-*	13 ± 2 Ω
	Shift solenoid 2	B3-*	
	Shift solenoid 3	B9-*	
	Gain change solenoid	B4-*	
	Linear solenoid 1	A5-A10	5.5 ± 0.5 Ω
	Linear solenoid 2	B6-B12	
	Linear solenoid 3	A4-A9	
	PL linear solenoid	B5-B11	

*: Automatic transmission case

- If any measured value is out of specification, replace the relevant solenoid valve. Have replacement performed by an Aisin service station.

INSTALLED LOCATIONS OF PARTS

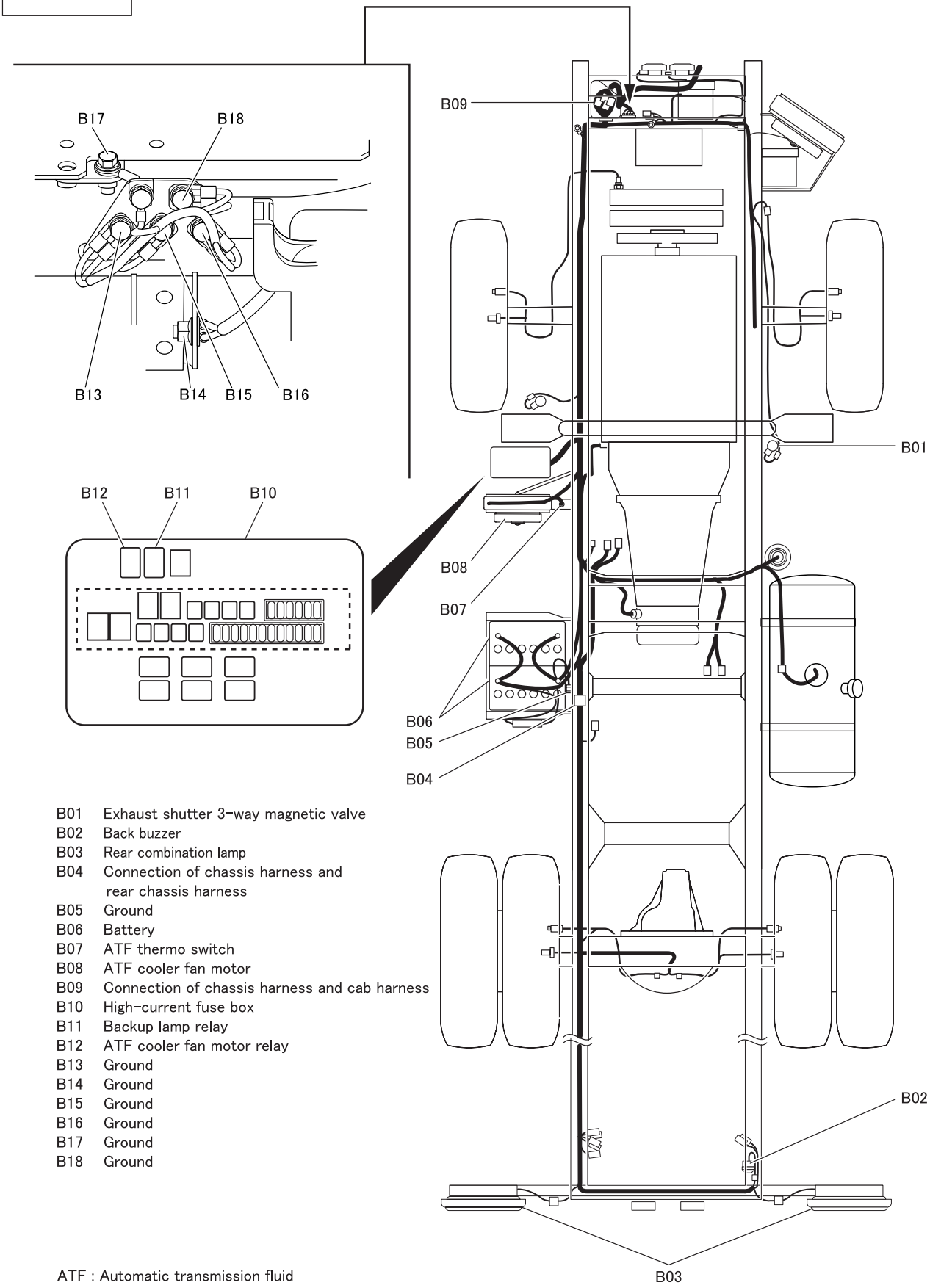


A01 Meter cluster
A02 Diode
A03 Fuse box
A04 Engine ECU
A05 Exhaust brake cut relay
A06 ABS exhaust brake cut relay
A07 O/D switch
A08 Shift lock actuator
A09 P range switch
A10 Combination switch
A11 Starter switch
A12 Key-interlock solenoid
A13 Diagnosis switch
A14 Joint connector (J/C-1)
A15 Joint connector (J/C-M1)
A16 Stop lamp switch
A16a Joint connector(J/C-040)
A17 A/T ECU
A18 Diagnostic connector
A19 Key interlock control unit
A20 Controller area network resistor

ECU : Electronic control unit
O/D : Overdrive
ABS : Anti-lock brake system
A/T : Automatic transmission
J/C : Joint connector

L02386

B01 to 18



B01 Exhaust shutter 3-way magnetic valve
B02 Back buzzer
B03 Rear combination lamp
B04 Connection of chassis harness and rear chassis harness
B05 Ground
B06 Battery
B07 ATF thermo switch
B08 ATF cooler fan motor
B09 Connection of chassis harness and cab harness
B10 High-current fuse box
B11 Backup lamp relay
B12 ATF cooler fan motor relay
B13 Ground
B14 Ground
B15 Ground
B16 Ground
B17 Ground
B18 Ground

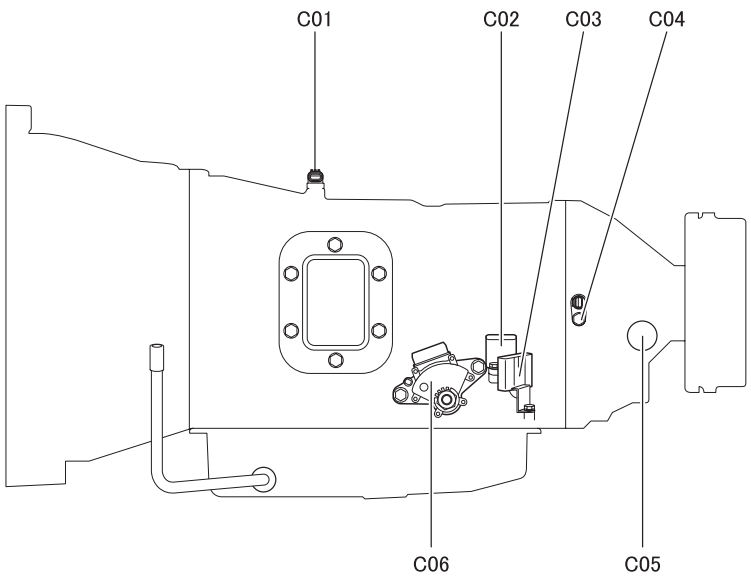
ATF : Automatic transmission fluid

L02387

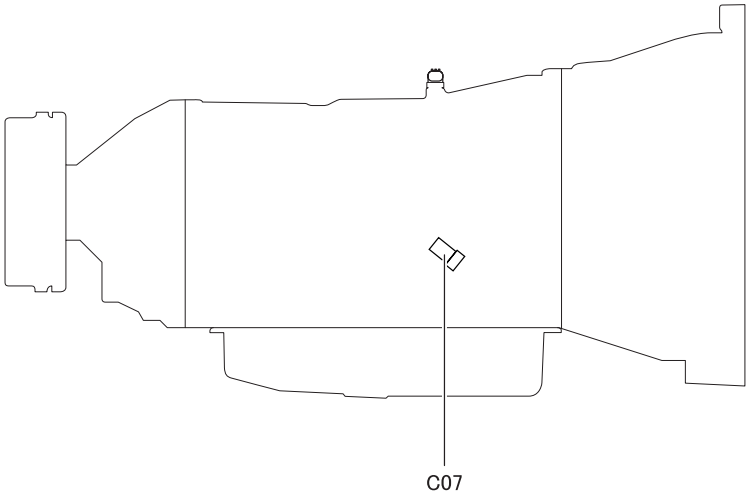
INSTALLED LOCATIONS OF PARTS

C01 to 07

Left side view



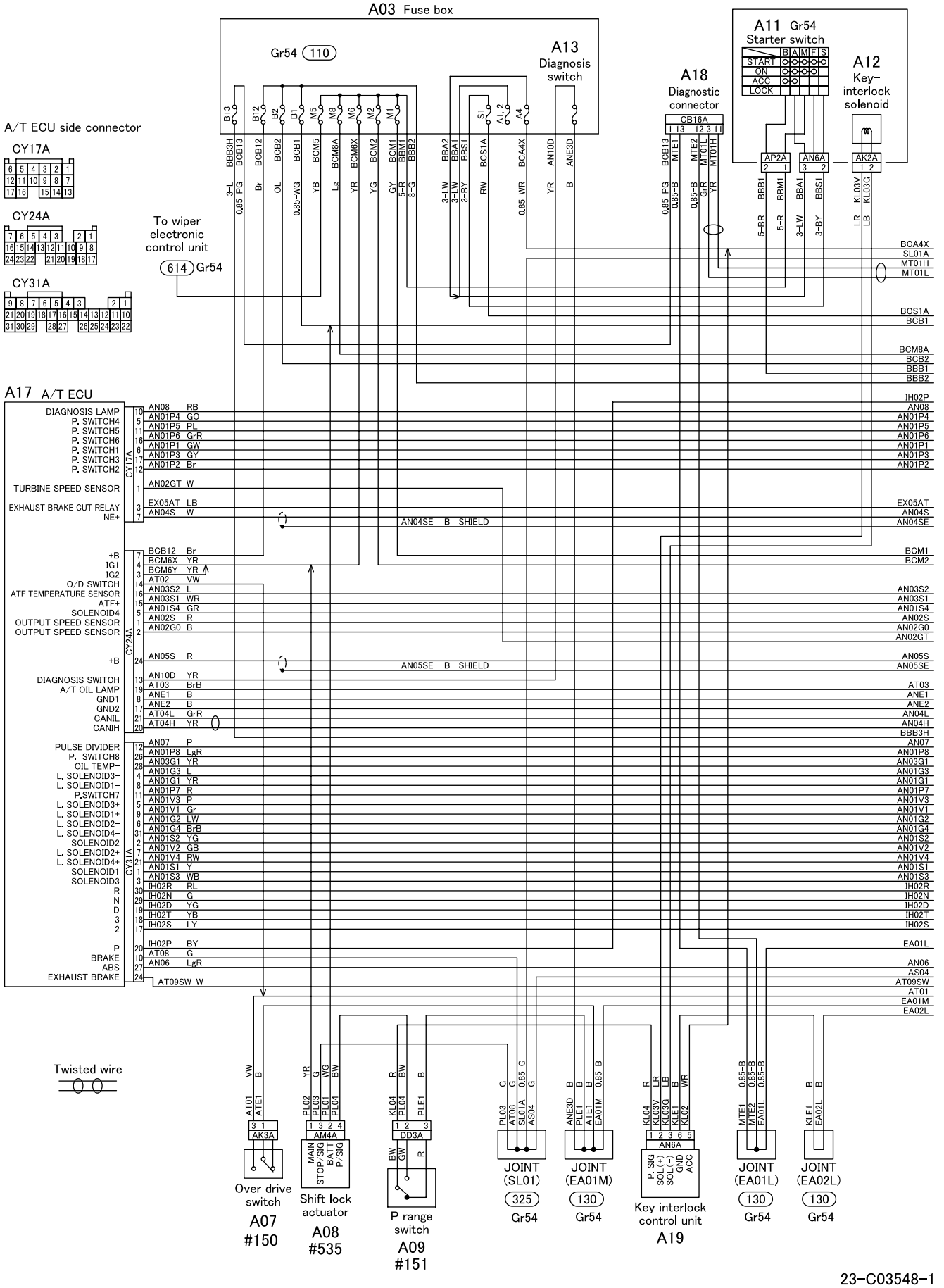
Right side view



C01 Turbine speed sensor
C02 A/T solenoid [ET10A]
C03 A/T solenoid [DG12A]
C04 Output speed sensor
C05 Vehicle speed sensor
C06 Inhibitor switch
C07 Oil temperature sensor (outside)

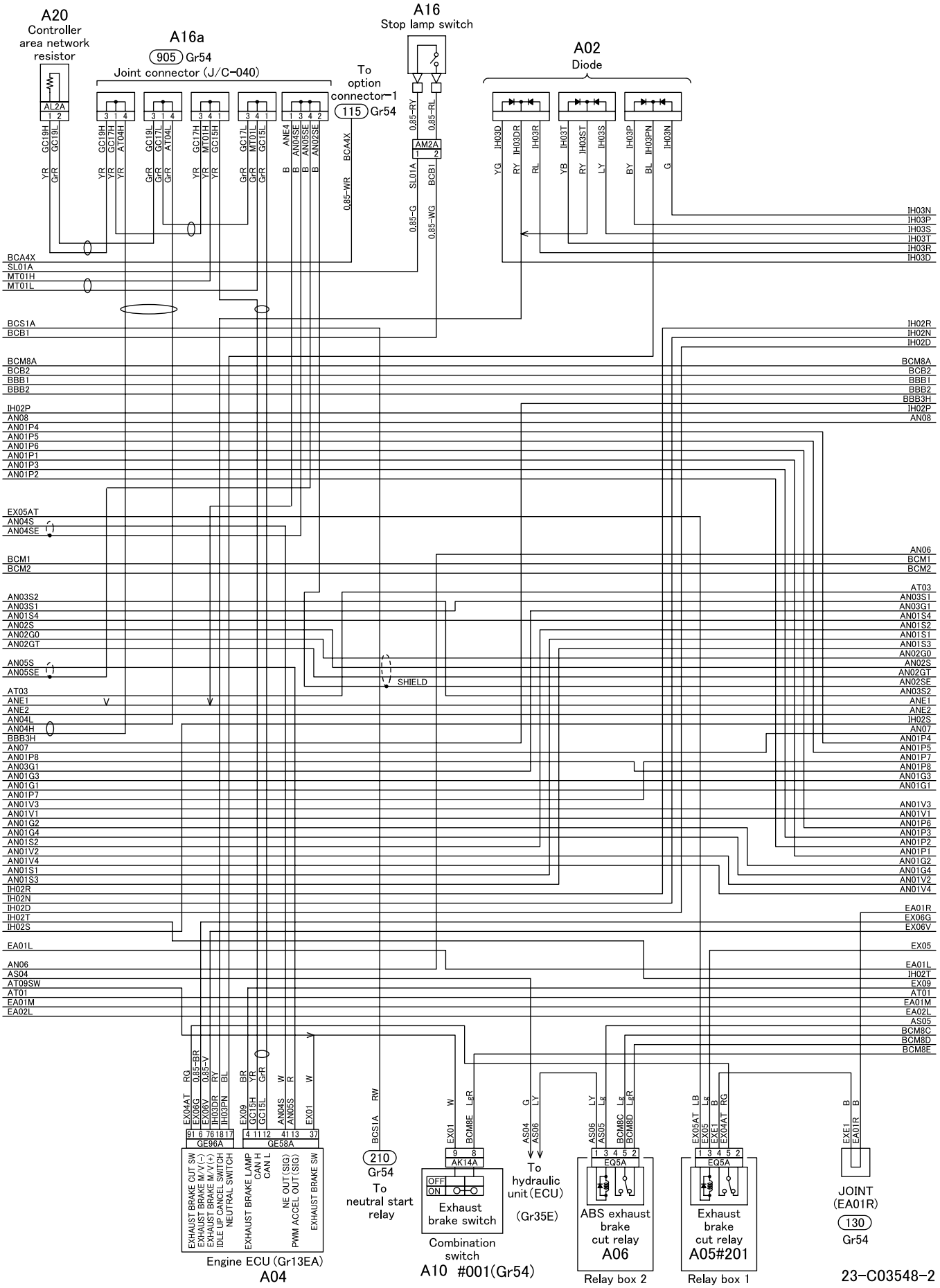
A/T : Automatic transmission

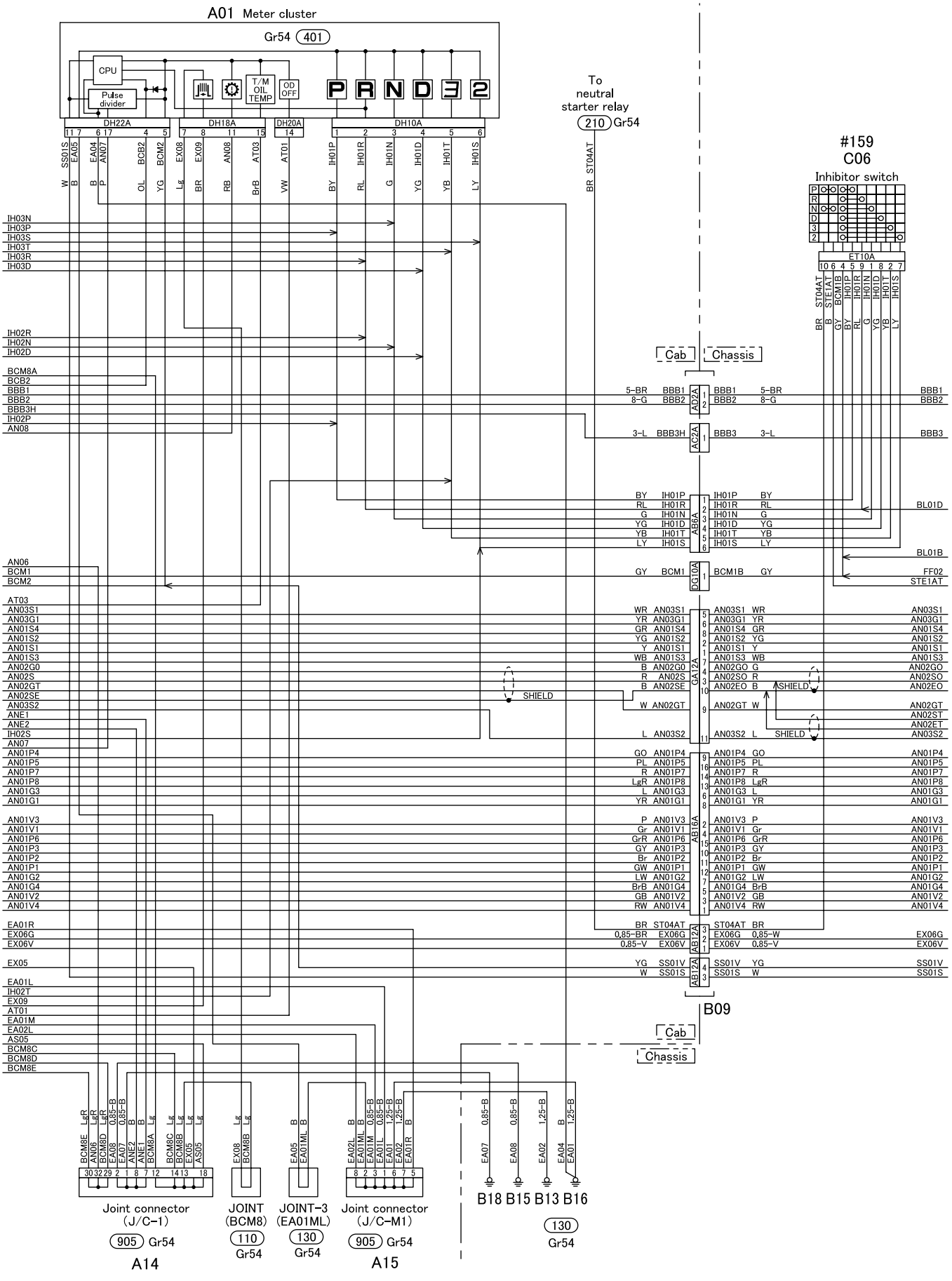
L02388


A03 Fuse box
Gr54 110
A13 Diagnosis switch
A11 Gr54 Starter switch
START
ON
ACC
LOCK
A12 Key-interlock solenoid
A18 Diagnostic connector
CB16A
A/T ECU side connector
CY17A
CY24A
CY31A
To wiper electronic control unit
614 Gr54
A17 A/T ECU
DIAGNOSIS LAMP
P. SWITCH4
P. SWITCH5
P. SWITCH6
P. SWITCH1
P. SWITCH3
P. SWITCH2
TURBINE SPEED SENSOR
EXHAUST BRAKE CUT RELAY
NE+
+B
IG1
IG2
O/D SWITCH
ATF TEMPERATURE SENSOR
ATF+
SOLENOID4
OUTPUT SPEED SENSOR
OUTPUT SPEED SENSOR
+B
DIAGNOSIS SWITCH
A/T OIL LAMP
GND1
GND2
CANIL
CANIH
PULSE DIVIDER
P. SWITCH8
OIL TEMP-
L. SOLENOID3-
L. SOLENOID1-
P.SWITCH7
L. SOLENOID3+
L. SOLENOID1+
L. SOLENOID2-
L. SOLENOID4-
SOLENOID2
L. SOLENOID2+
L. SOLENOID4+
SOLENOID1
SOLENOID3
R
N
D
3
2
P
BRAKE
ABS
EXHAUST BRAKE
Twisted wire
Over drive switch
A07
#150
Shift lock actuator
A08
#535
P range switch
A09
#151
JOINT (SL01)
325 Gr54
JOINT (EA01M)
130 Gr54
Key interlock control unit
A19
JOINT (EA01L)
130 Gr54
JOINT (EA02L)
130 Gr54

23-C03548-1

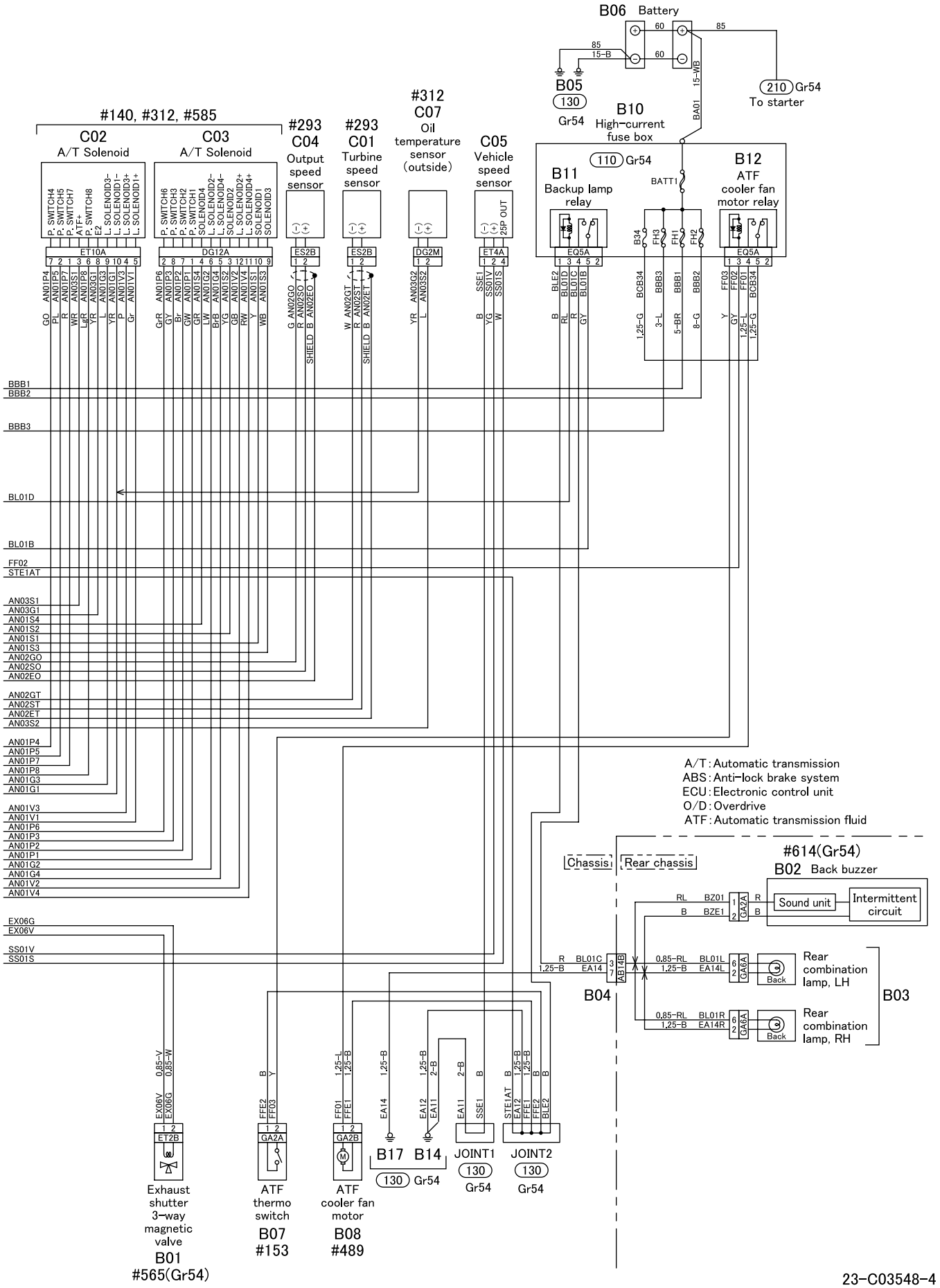
ELECTRICAL CIRCUIT DIAGRAM




A01 Meter cluster
Gr54 401
CPU
Pulse divider
T/M OIL TEMP
OD OFF
P R N D 3 2
DH22A
DH18A
DH20A
DH10A
To neutral starter relay
210 Gr54
#159 C06
Inhibitor switch
ET10A
Cab
Chassis
B09
SHIELD
Joint connector (J/C-1)
905 Gr54
A14
JOINT (BCM8)
110 Gr54
JOINT-3 (EA01ML)
130 Gr54
Joint connector (J/C-M1)
905 Gr54
A15
B18 B15 B13 B16
130 Gr54

23-C03548-3

ELECTRICAL CIRCUIT DIAGRAM



GROUP 25 INDEX

SPECIFICATIONS 25-2

STRUCTURE AND OPERATION

1. **Configuration of Propeller Shaft (Driveshaft) Connection 25-2**
2. **Propeller Shaft <Without Center (Midship) Bearing> 25-3**
3. **Propeller Shaft <With Center (Midship) Bearing> 25-3**

TROUBLESHOOTING 25-4

REMOVAL AND INSTALLATION OF PROPELLER SHAFT <BETWEEN T/M AND REAR AXLE> 25-6

PROPELLER SHAFT 25-10

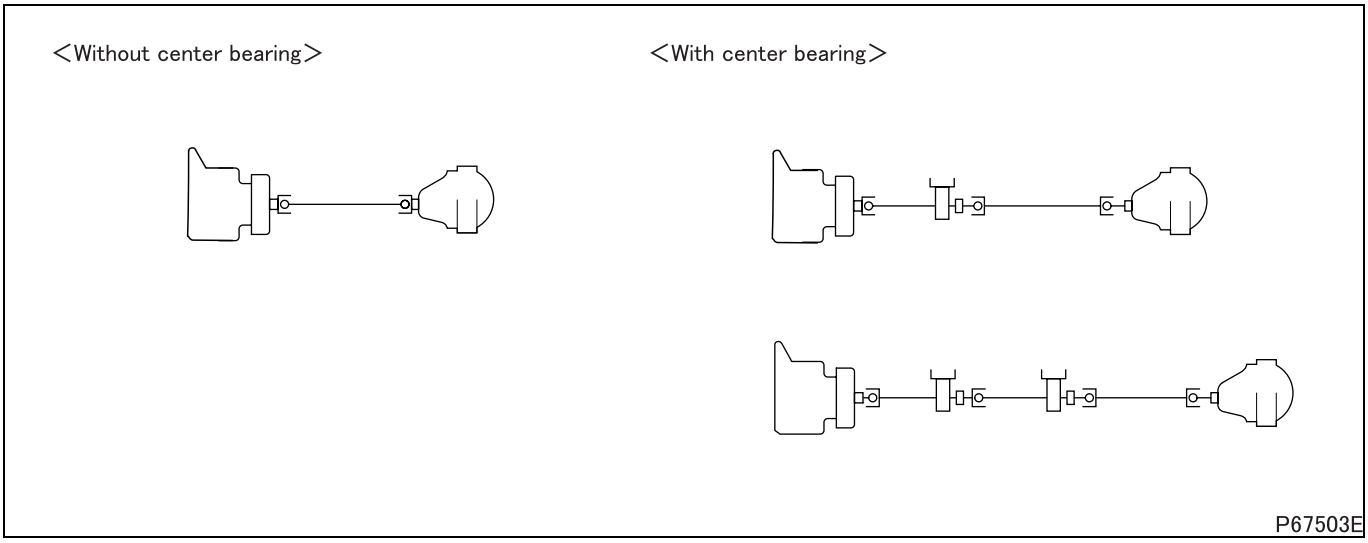
SPECIFICATIONS / STRUCTURE AND OPERATION

SPECIFICATIONS

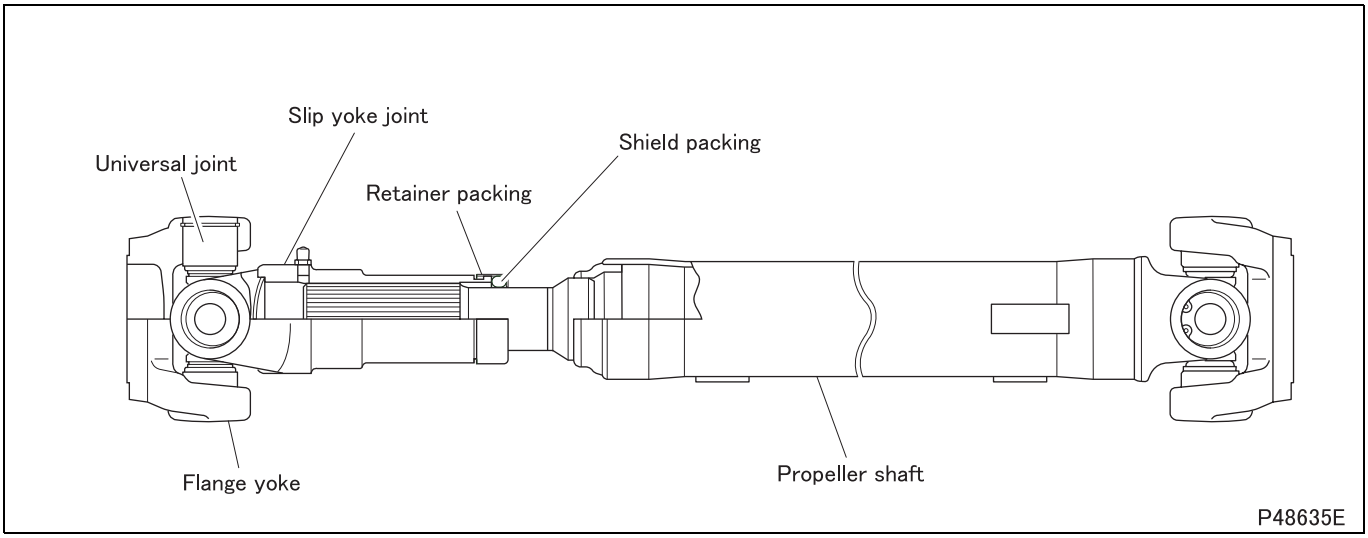
Item		Specifications
Propeller shaft (driveshaft)	Model	P3

STRUCTURE AND OPERATION

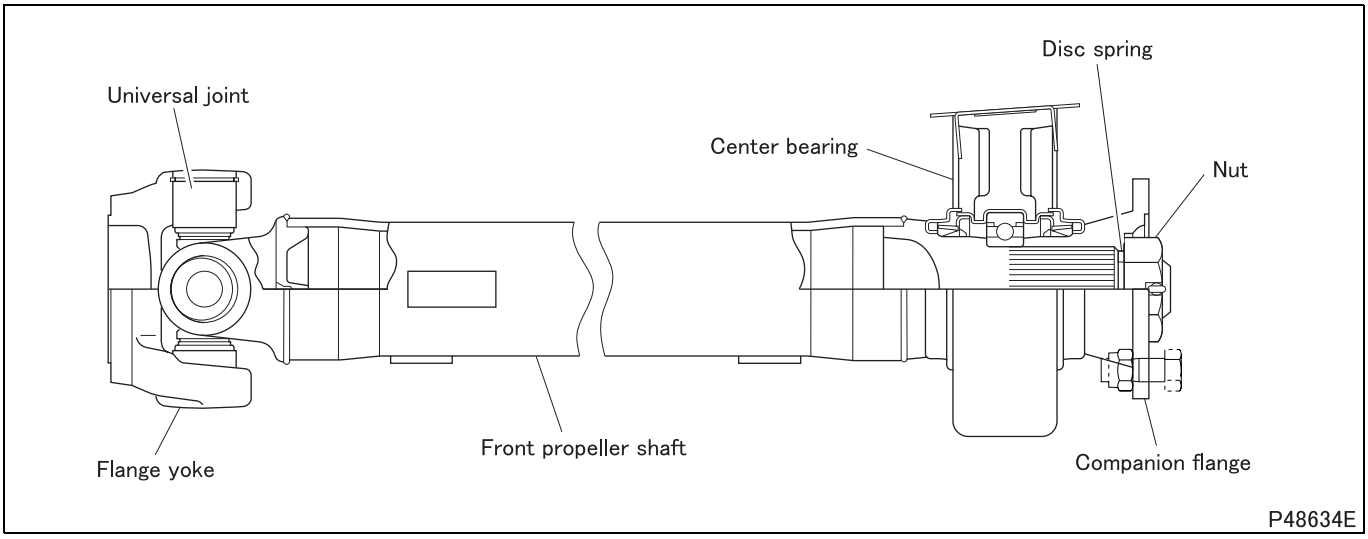
1. Configuration of Propeller Shaft (Driveshaft) Connection



2. Propeller Shaft <Without Center (Midship) Bearing>



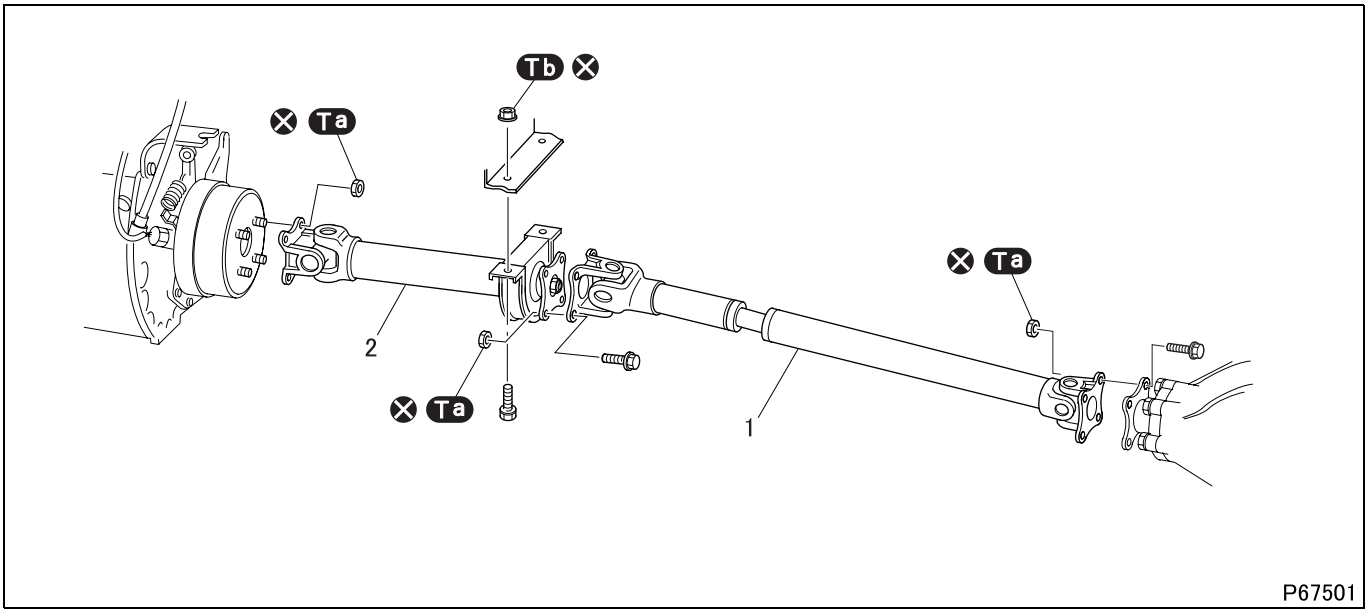
3. Propeller Shaft <With Center (Midship) Bearing>



Symptoms / Possible causes		Propeller shaft vibrates		Abnormal noise from propeller shaft	
		Vibration at high speed	Vibration at low speed	Abnormal noise at acceleration from zero or at coasting	Abnormal noise at normal running
Wrong combination of flange yoke directions		O			
Slip yoke joint	Insufficient grease				O
	Excessive play at spline		O	O	
Universal joint	Excessive clearance in axial direction of spider shaft		O		O
	Insufficient grease on needle bearing				O
	Worn out needle bearing	O		O	O
Center bearing	Insufficient grease				O
	Seizure, wear or improper rotation	O			O
	Deteriorated or deformed cushion rubber			O	
	Loose hanger mounting bolt			O	
Propeller shaft	Loose mounting bolts	O		O	
	Bent	O			
	Dynamic balance improper	O			
T/M in high speed gear			O		

M E M O

REMOVAL AND INSTALLATION OF PROPELLER SHAFT <BETWEEN T/M AND REAR AXLE>



● Removal sequence

1 Propeller shaft <Without center (midship) bearing> (see later section)
2 Propeller shaft <With center (midship) bearing> (see later section)

⊗: Non-reusable parts

CAUTION ⚠

- **Chock the tires fore and aft to prevent the vehicle from moving.**
- **Do not remove the chocks until the entire operation is completed.**

● Installation sequence

Follow the removal sequence in reverse.

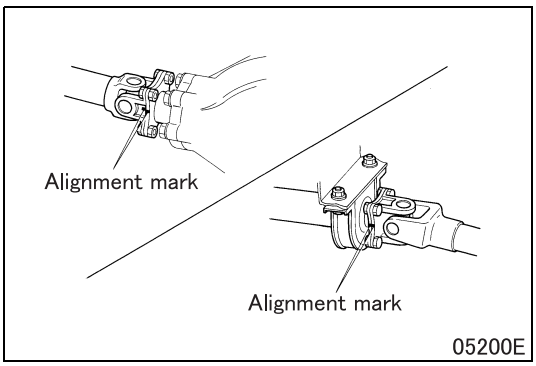
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
1	Permissible amount of imbalance for propeller shaft <Without center bearing>	10 g (0.35 oz} max./3000 rpm (periphery of pipe portion of shaft)	–	Adjust
2	Permissible amount of imbalance for propeller shaft <With center bearing>	5 g (0.18 oz} max./3000 rpm (periphery of pipe portion of shaft)	–	Adjust

Torque: N·m (lbf·ft)

ID	Fastener	Value	Remarks
Ta	Nut (propeller shaft mounting)	100 to 120 (74 to 89)	–
Tb	Nut (front propeller shaft bracket mounting)	47 to 65 (35 to 48)	–

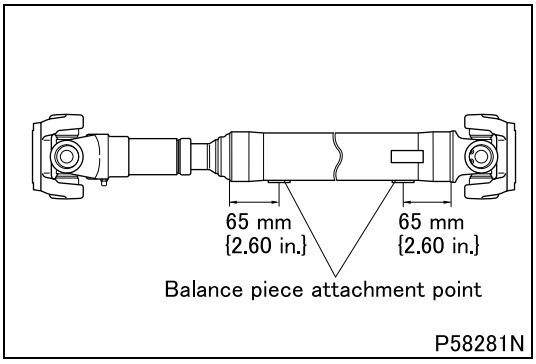
◆Work before removal◆



■ Alignment mark: Propeller shaft

- Before removing the U-joints, make alignment marks on the end yokes for ease of installation.

◆Inspection procedure◆



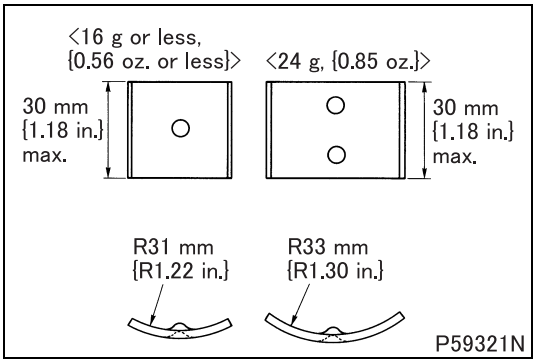
■ Inspection: Propeller shaft <Without center bearing>

[Inspection]

- Measure the amount of dynamic balance on a balancing machine.
- If the measured value exceeds the standard value, make adjustment as follows.

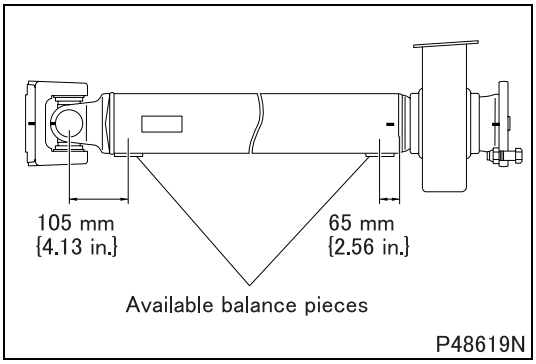
[Adjustment]

- Attach appropriate balance pieces (shims) at the illustrated points to reduce the imbalance to within the standard range.
- Maximum allowance for one point is 3.53 oz (100 g).
- Use a combination that keeps the number of balance pieces to a minimum.



Available balance pieces (shims)

Mass
2 g (0.07 oz)
4 g (0.14 oz)
6 g (0.21 oz)
8 g (0.28 oz)
10 g (0.35 oz)
12 g (0.42 oz)
16 g (0.56 oz)
24 g (0.85 oz)



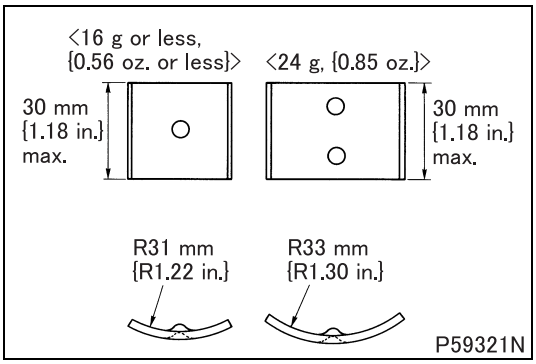
■ **Inspection: Propeller shaft <With center bearing>**

[Inspection]

- Measure the amount of dynamic balance on a balancing machine.
- If the measured value exceeds the standard value, make adjustment as follows.

[Adjustment]

- Attach appropriate balance pieces (shims) at the illustrated points to reduce the imbalance to within the standard range.
- Maximum allowance for one point is 100 g {3.53 oz}.
- Use a combination that keeps the number of balance pieces to a minimum.

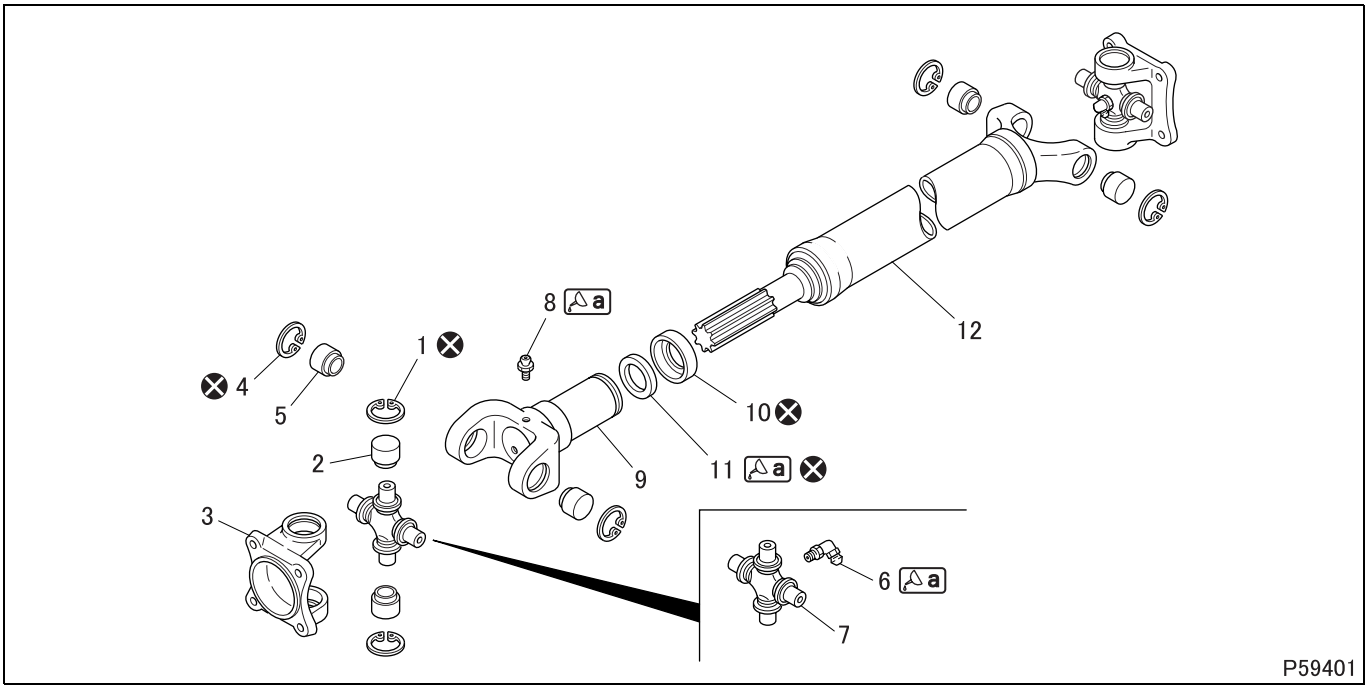


Available balance pieces (shims)

Mass
2 g (0.07 oz)
4 g (0.14 oz)
6 g (0.21 oz)
8 g (0.28 oz)
10 g (0.35 oz)
12 g (0.42 oz)
16 g (0.56 oz)
24 g (0.85 oz)

M E M O

<Without center bearing>



● Disassembly sequence

1 Snap ring
2 Needle bearing
3 Flange yoke
4 Snap ring
5 Needle bearing
6 Grease fitting
7 Spider
8 Grease fitting
9 Slip yoke joint
10 Retainer packing
11 Shield packing
12 Propeller shaft (driveshaft)

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse, excepting:
12→10→11→9

Repair kit: Universal joint spider kit

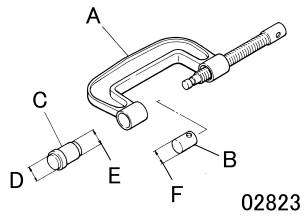
Service standards: mm (in)

Location	Maintenance item	Standard value	Limit	Remedy
–	Axial clearance of spider	0 to 0.06 (0 to 0.0024)	–	Adjust
2, 3	Clearance between needle bearing and flange yoke	0.008 to –0.033 (0.00031 to –0.0013) "–" means interference	0.1 (0.004)	Replace
2, 5, 6	Play between needle bearing and spider	0.01 to 0.06 (0.0004 to 0.0024)	0.1 (0.004)	Replace
5, 9	Clearance between needle bearing and slip joint	0.008 to –0.033 (0.00031 to –0.0013) "–" means interference	0.1 (0.004)	Replace
9, 12	Play in direction of rotation between the slip yoke joint and the propeller shaft spline	0.01 to 0.09 (0.00039 to 0.0035)	0.3 (0.012)	Replace
	Play in the opposite direction between the slip yoke joint and the propeller shaft spline	0.02 to 0.16 (0.0008 to 0.0063)	0.3 (0.012)	Replace
12	Bend of propeller shaft	–	0.4 (0.016)	Correct or replace

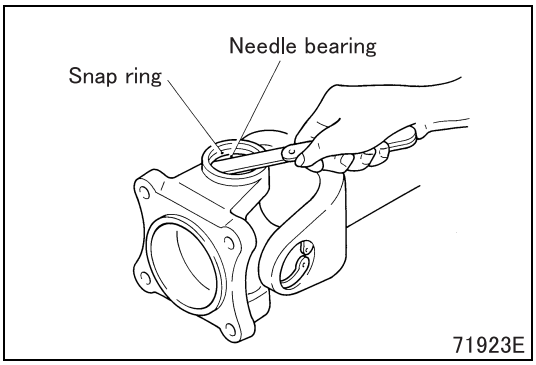
Lubricant and/or sealant

ID	Points of application	Specified lubricant and/or sealant	Quantity
a	Supply through grease fitting	Wheel bearing grease [NGLI No. 2 (Li soap)]	As required
	Lips of shield packing		

Special tools: mm (in)

ID	Tool name and shape	Part No.	Application
a	Universal joint tool set **A:** Yoke assembly **B:** Push rod **C:** Guide **D** ϕ29 {1.14}, **E** ϕ29 {1.14}, **F** ϕ27.7 {1.09} 	MB999024 A: MB999025 B: MB999026 C: MB999010	Removal and installation of needle bearing

◆Work before removal◆

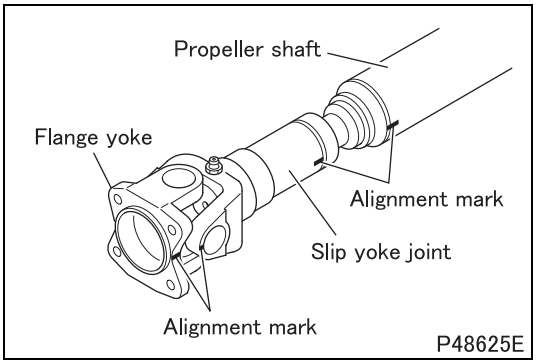


■ Inspection: Axial clearance of spider

- Press down on the needle bearing, and measure clearance between the snap ring and the needle bearing.
- If the measured value exceeds the standard value, correct by changing the snap ring thickness.
  To adjust, use snap rings for both ends with the same thickness. If necessary, use the table below to select the best combination of snap rings.

Table of snap rings (solid line indicates best combination)

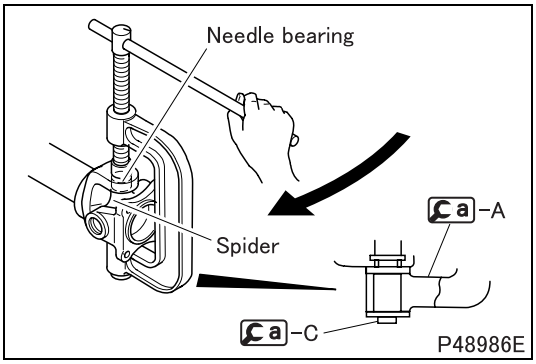
Thickness	Identification color	Combination	Thickness	Identification color
0.059 in (1.49 mm)	None		0.059 in (1.49 mm)	None
0.060 in (1.52mm)	Black		0.060 in (1.52mm)	Black
0.061 in (1.55 mm)	Blue		0.061 in (1.55 mm)	Blue
0.062 in (1.58 mm)	Yellow		0.062 in (1.58 mm)	Yellow
0.063 in (1.61 mm)	Purple		0.063 in (1.61 mm)	Purple
0.065 in (1.64 mm)	None		0.065 in (1.64 mm)	None
0.066 in (1.67 mm)	Black		0.066 in (1.67 mm)	Black
0.067 in (1.70 mm)	Blue		0.067 in (1.70 mm)	Blue



■ **Alignment mark: Propeller shaft**

- For ease of installation, make alignment marks on the flange yoke, slip yoke joint, and propeller shaft.

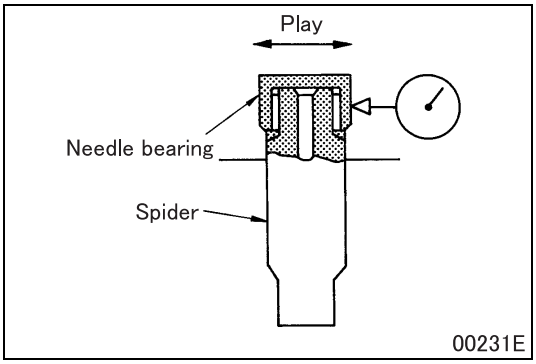
◆Removal procedure◆



■ **Removal: Needle bearing**

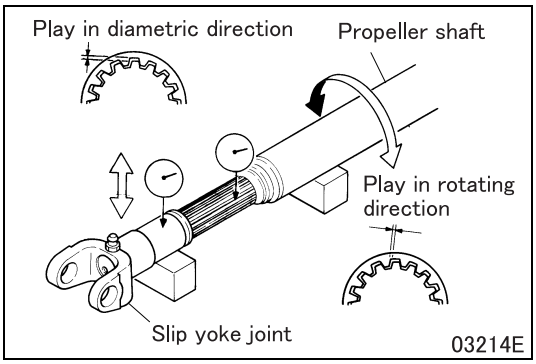
- Fit the needle bearing guide Ca **-C** into the yoke assembly Ca **-A** from outside.
- Applying the needle bearing guide Ca **-C** to the spider, operate the yoke assembly Ca **-A** to force out the spider and remove the needle bearing.

◆Inspection procedure◆



■ **Inspection: Clearance between needle bearing and spider**

- If the clearance is above the limit, replace the needle bearing out of the universal joint spider kit.

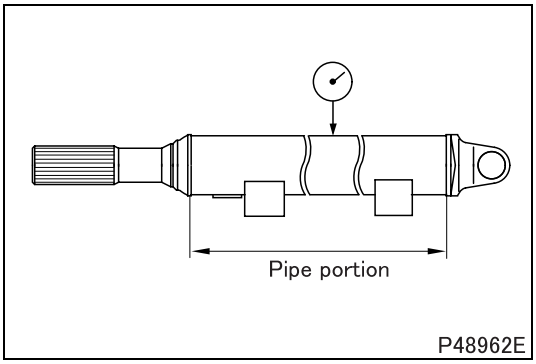


■ **Inspection: Play between slip yoke joint and propeller shaft spline**

- Check the following, and if the measurement is higher than the limit, replace the faulty part.

(1) Play of spline in the direction of rotation

(2) Play of spline in the opposite direction



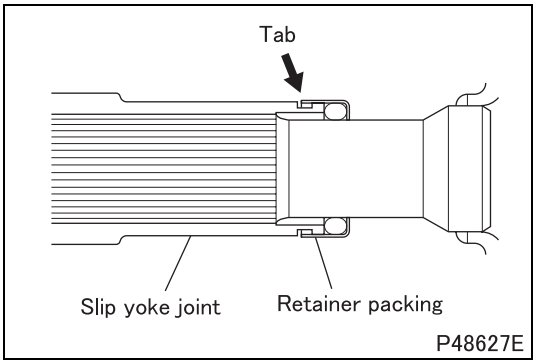
■ **Inspection: Bend in propeller shaft**

- Measure the bend in the propeller shaft at the center of its pipe portion.
- If the measurement is higher than the limit, correct the bend with a press or replace the propeller shaft.

NOTE

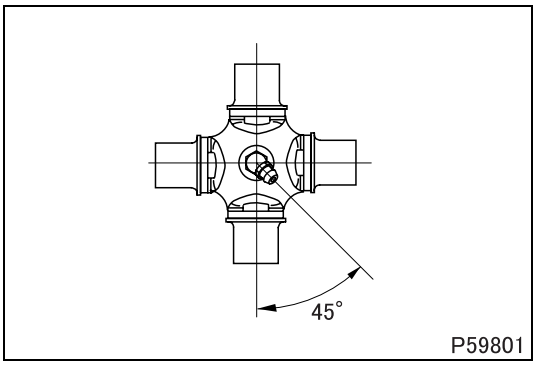
- **To measure the bend in the propeller shaft, turn it fully once and read the dial gauge indicator. The bend is one-half of the indicated value.**
- **Check the propeller shaft for cracks in the welded area after using a press to correct the bend. If cracks are found, replace the propeller shaft.**

◆Installation procedure◆



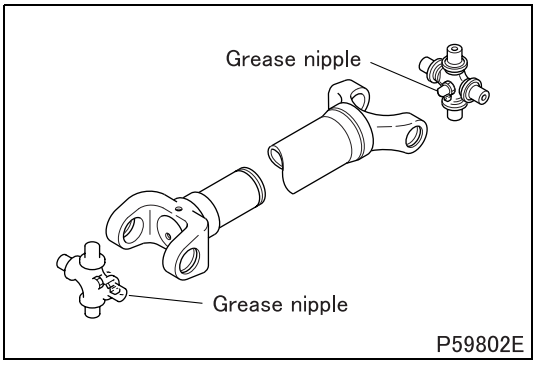
■ **Installation: Retainer packing**

- Hold the retainer packing against the slip yoke joint and caulk the tabs (at eight places).

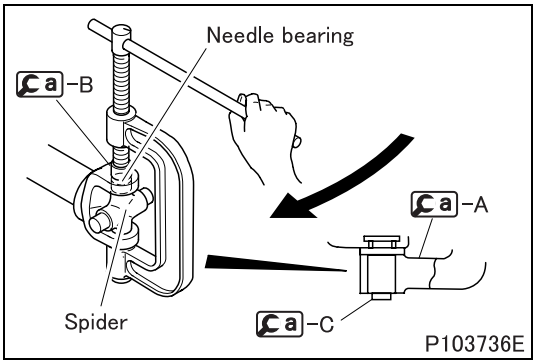


■ **Installation: Spider**

- Install the grease fitting on the spider at the angle shown in the illustration.



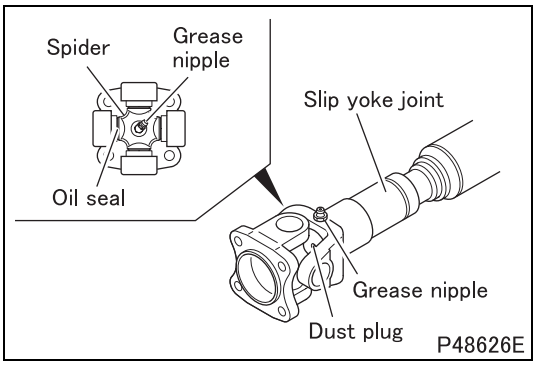
- Install the spiders on the both ends of propeller shaft. so that the direction of grease fittings must be the same.



■ **Installation: Needle bearing**

- Fit the needle bearing guide Ca**-C** into the yoke assembly Ca**-A** from inside.
- Operating the yoke assembly Ca**-A**, install the needle bearing.

◆**Work after installation**◆



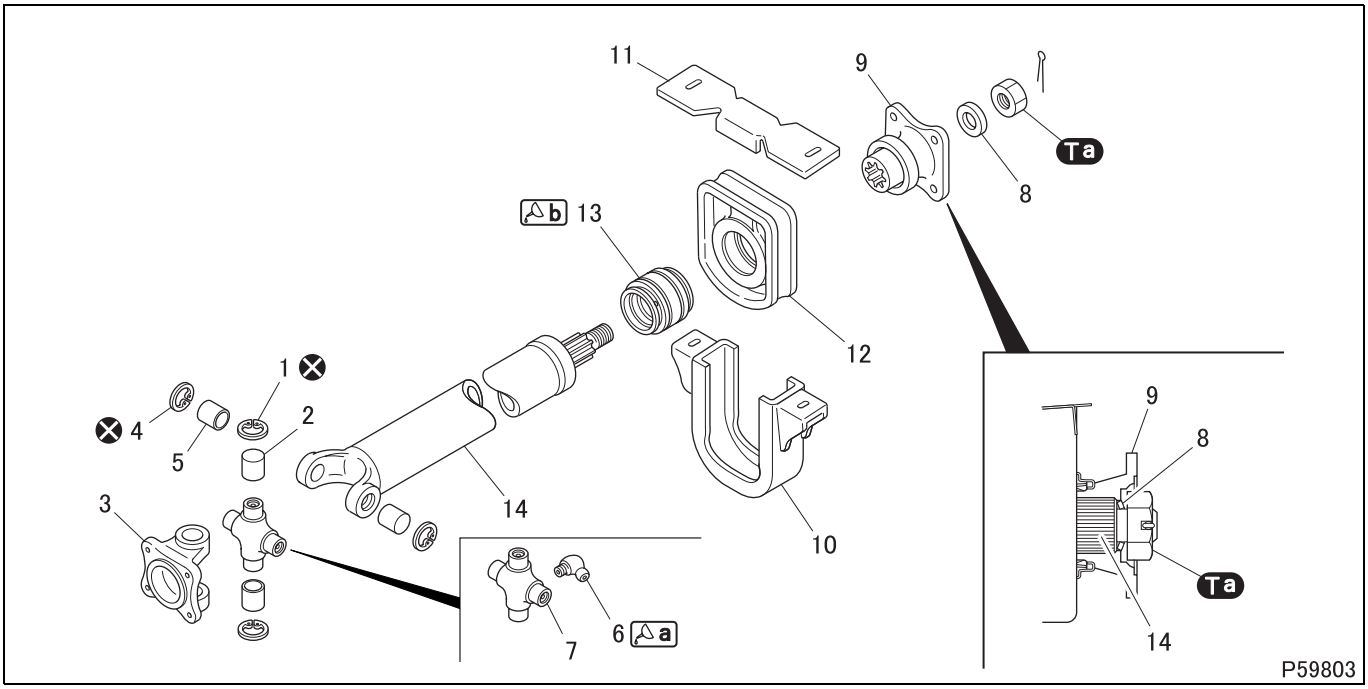
■ **Lubrication: Grease fittings**

- Add grease through the grease fitting until clean grease overflows from the oil seal of the spider.
- Add grease through the grease fitting until clean grease overflows from the hole in the dust plug of the slip yoke joint.

M E M O

PROPELLER SHAFT

<With center (midship) bearing>



● Disassembly sequence

1 Snap ring, spider
2 Needle bearing
3 Flange yoke
4 Snap ring, end yoke
5 Needle bearing
6 Grease fitting
7 Spider
8 Washer
9 Companion flange
10 Center bearing bracket
11 Center bearing hanger
12 Center bearing housing
13 Center (midship) bearing
14 Propeller shaft (driveshaft)

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Universal joint spider kit

Service standards: mm (in)

Location	Maintenance item	Standard value	Limit	Remedy
–	Axial clearance of spider	0 to 0.06 {0 to 0.0024}	–	Adjust
2, 3	Clearance between needle bearing and flange yoke	0.008 to –0.033 {0.00031 to –0.0013} "–" means interference.	0.1 {0.0039}	Replace
2, 5, 6	Play between needle bearing and spider	0.01 to 0.06 {0.00039 to 0.0024}	0.1 {0.0039}	Replace
5, 14	Clearance between needle bearing and propeller shaft	0.008 to –0.033 {0.00031 to –0.0013} "–" means interference.	0.1 {0.0039}	Replace
14	Bend of propeller shaft	–	0.4 {0.016}	Correct or replace

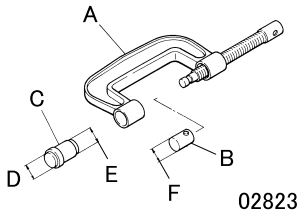
Torque: N·m (lbf·ft)

ID	Fastener	Value	Remarks
Ta	Nut (companion flange mounting)	290 to 390 (215 to 285)	–

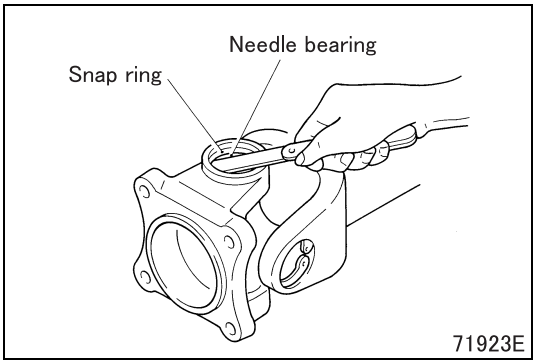
Lubricant and/or sealant

ID	Points of application	Specified lubricant and/or sealant	Quantity
a	Supply through grease fitting	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
b	Fill space in center bearing housing	Heat-resisting grease [NLGI No. 3]	70 to 100% of space capacity: 0.71 to 1.0 oz (20 to 29 g)
	Lips of the center bearing seal		As required

Special tools: mm (in)

ID	Tool name and shape	Part No.	Application
a	Universal joint tool set **A:** Yoke assembly **B:** Push rod **C:** Guide D: ϕ29 {1.14}, E: ϕ29 {1.14}, F: ϕ27.7 {1.09} 	MB999024 A: MB999025 B: MB999026 C: MB999010	Removal and installation of needle bearing

◆Work before removal◆

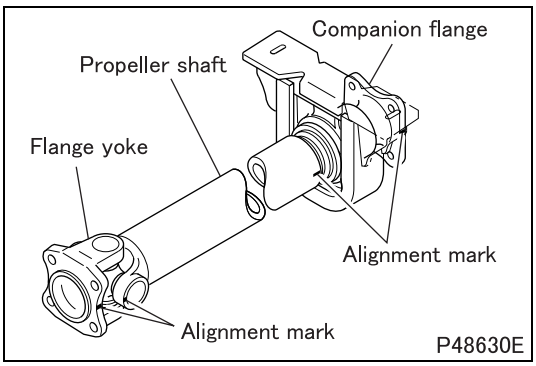


■ Inspection: Axial clearance of spider

- Press down on the needle bearing, and measure clearance between the snap ring and the needle bearing.
- If the measured value exceeds the standard value, correct by changing the snap ring thickness.
  To adjust, use snap rings for both ends with the same thickness. If necessary, use the table below to select the best combination of snap rings.

Table of snap rings (solid line indicates best combination).

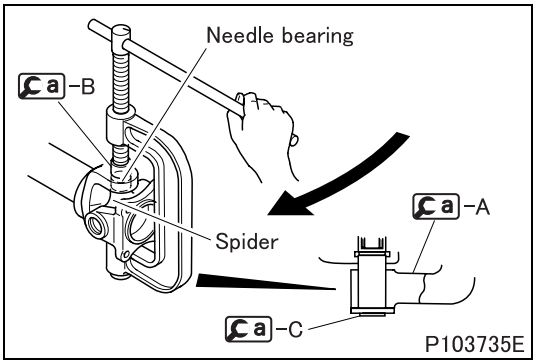
Thickness	Identification color	Combination	Thickness	Identification color
0.059 in (1.49 mm)	None		0.059 in (1.49 mm)	None
0.060 in (1.52mm)	Black		0.060 in (1.52mm)	Black
0.061 in (1.55 mm)	Blue		0.061 in (1.55 mm)	Blue
0.062 in (1.58 mm)	Yellow		0.062 in (1.58 mm)	Yellow
0.063 in (1.61 mm)	Purple		0.063 in (1.61 mm)	Purple
0.065 in (1.64 mm)	None		0.065 in (1.64 mm)	None
0.066 in (1.67 mm)	Black		0.066 in (1.67 mm)	Black
0.067 in (1.70 mm)	Blue		0.067 in (1.70 mm)	Blue



■ **Alignment mark: Propeller shaft**

- For ease of installation, make alignment marks on the flange yoke, companion flange and propeller shaft.

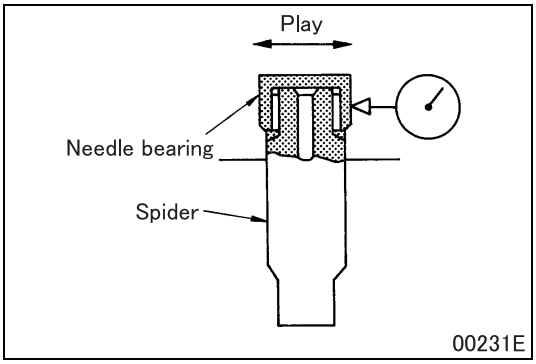
◆Removal procedure◆



■ **Removal: Needle bearing**

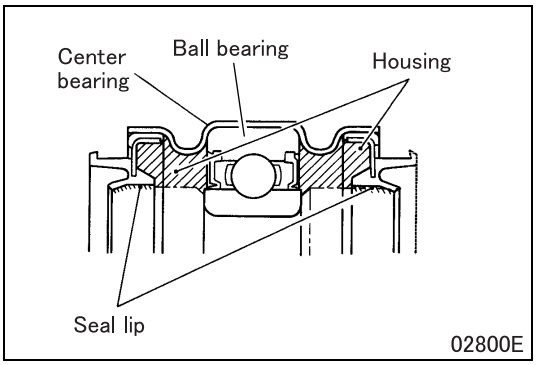
- Fit the needle bearing guide **-C** into the yoke assembly **-A** from outside.
- Applying the needle bearing guide **-C** to the spider, operate the yoke assembly **-A** to force out the spider and remove the needle bearing.

◆Inspection procedure◆



■ **Inspection: Clearance between needle bearing and spider**

- If the clearance is above the limit, replace the needle bearing out of the universal joint spider kit.

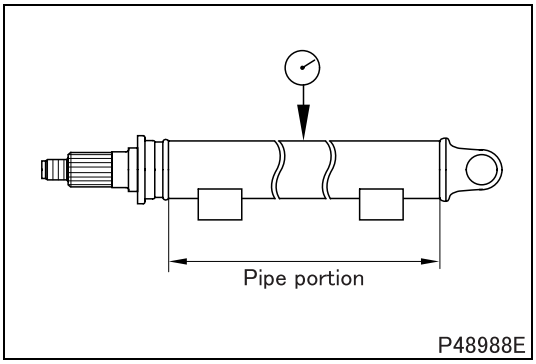


■ **Inspection: Center (midship) bearing**

- Check the bearing every 31,070 miles (50 000 km) or at the nearest regular maintenance interval. If excessive grease outflow is evident, pack grease into the center bearing housing up to 70 to 100% of capacity: 0.71 to 1.02 oz (20 to 29 g).
- Apply grease to the lips of the bearing seal.

NOTE

- **The ball bearing portion of the center bearing is provided with an oil seal and requires no lubrication.**



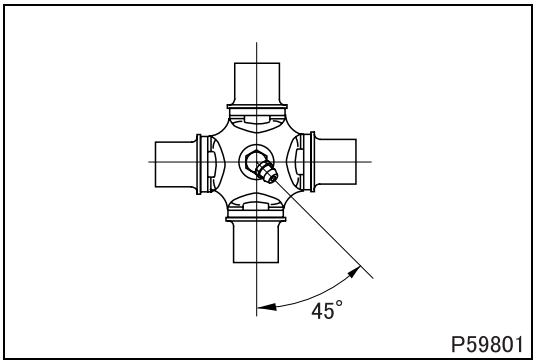
■ **Inspection: Bend in propeller shaft**

- Measure the bend in the propeller shaft at the center of its pipe portion.
- If the measurement is higher than the limit, correct the bend with a press or replace the propeller shaft.

NOTE

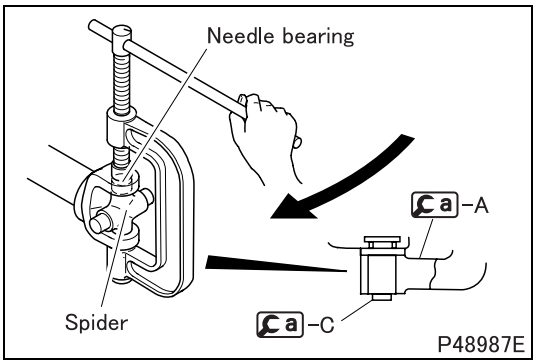
- **To measure the bend in the propeller shaft, turn it fully once and read the dial gauge indicator. The bend is one-half of the indicated value.**
- **Check the propeller shaft for cracks in the welded area after using a press to correct the bend. If cracks are found, replace the propeller shaft.**

◆Installation procedure◆



■ **Inspection: grease fitting**

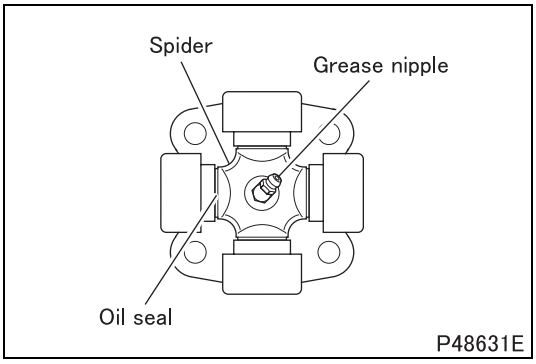
- Install the grease fitting on the spider at the angle shown in the illustration.



■**Installation: Needle bearing**

- Fit the needle bearing guide a **-C** into the yoke assembly a **-A** from inside.
- Operating the yoke assembly a **-A**, install the needle bearing.

◆Work after installation◆



■ **Lubrication: grease fitting**

- Add grease through the grease fitting until clean grease overflows from the oil seal of the spider.

Group 26 INDEX

SPECIFICATIONS 26-2

STRUCTURE AND OPERATION
1. **Wheel Hub and Rotor 26-3**
2. **Knuckle and King Pin, Front Axle 26-4**

TROUBLESHOOTING 26-5

ON-VEHICLE INSPECTION AND ADJUSTMENT
1. **Inspection and Adjustment of Wheel Alignment 26-6**
2. **Inspection and Adjustment of Steering Angle 26-10**
3. **Inspection of Side Slip 26-11**
4. **Inspection of Tie Rod End Ball Joint 26-11**

WHEEL HUB AND ROTOR 26-12

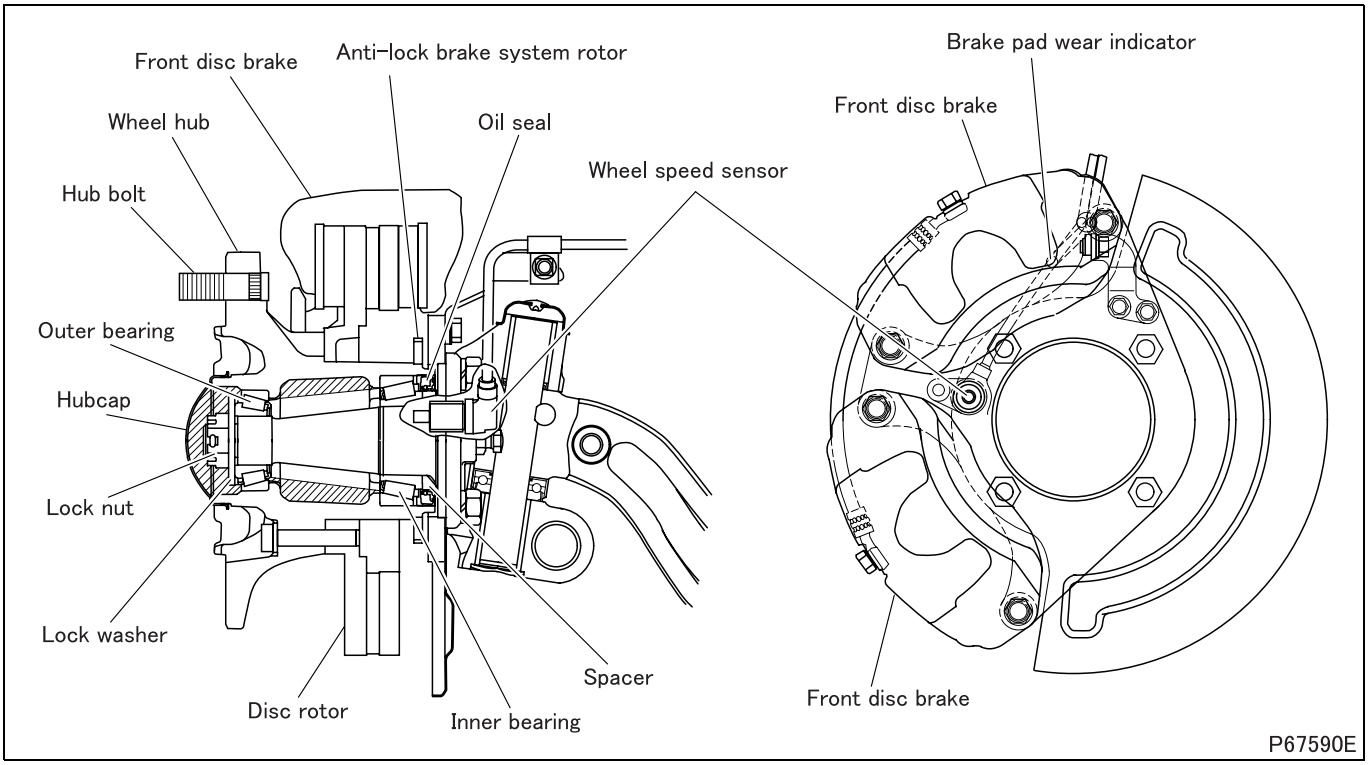
KNUCKLE AND KING PIN, FRONT AXLE 26-22

TIE ROD 26-30

SPECIFICATIONS

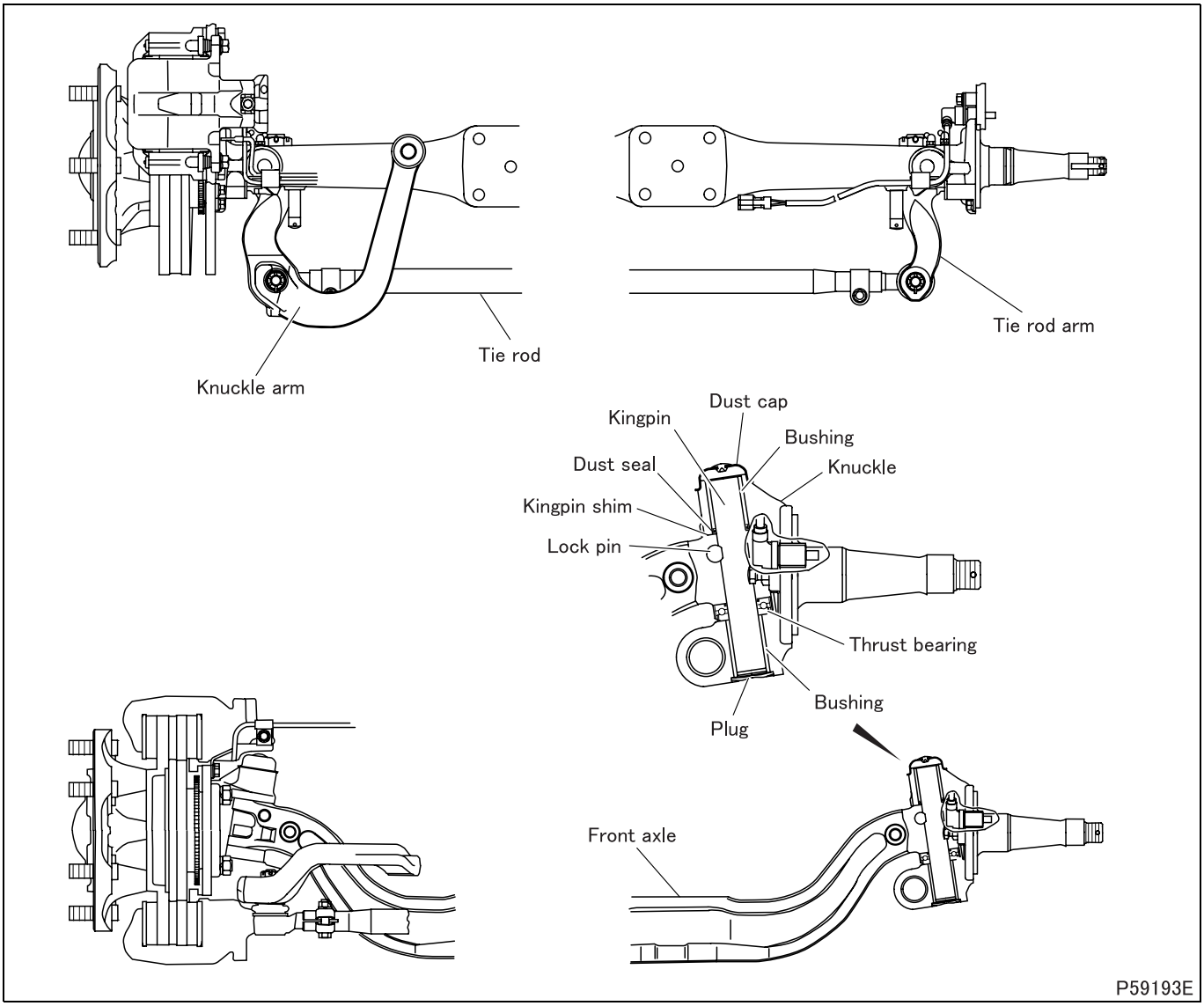
Item			Specifications		
			COE 40	COE 45	COE 50
Front axle	Model		F200T	F300T	F350T
	Type		Reverse Elliot, “I” beam		
King pin Outer diameter × Length		mm (in.)	28 × 180 (1.10 × 7.09)		
Tread (dimension notified to the authorities)		mm (in.)	1665 (65.6)		
Mass (with disc brakes)		kg (lb)	Approx. 150 (331)	Approx. 155 (342)	Approx. 165 (365)

1. Wheel Hub and Rotor



- The brake pad wear indicator is installed on the right wheels or on both the right and left wheels.

2. Knuckle and King Pin, Front Axle



Possible causes	Symptoms	Continuous noise while cruising	Intermittent noise while cruising	Steering wheel shakes	Steering feels stiff	Steering wheel return poor	Unable to steer the steering wheel	Steering pulls to one side	Uneven wear or early wear of front tires	Reference Gr
Wheel hub, knuckle and king pin, front axle	Wheel alignment misaligned			O	O	O			O	
	Steering angle adjustment faulty						O			
	Wheel hub bearing seized, worn or rotation faulty	O		O						
	Wheel hub bearing broken		O							
	King pin worn			O						
	Clearance between king pin and king pin bushing excessive			O	O					
	Greasing to king pin insufficient				O					
	King pin thrust bearing seized, worn or rotation faulty				O					
	Vertical clearance between knuckle and front axle excessive			O						
	Knuckle arm and tie rod arm tightening nuts loose			O						
	Ball stud tightening nut of tie rod end loose			O						
	Tie rod end ball stud worn			O						
	Tie rod bent						O			
	Knuckle bent							O		
	Front axle bent							O		
	Various parts of front axle tightened excessively					O				
Front suspension	U-bolt nut of front suspension loose			O						Gr33
	One of front springs worn-out or broken							O		
Tire	Tire inflation pressure uneven			O					O	Gr31
	Tire inflation pressure too little				O					
	Inflation pressure uneven for right and left tires							O		
	Size and type of right and left tires different							O	O	
	Outer diameters of right and left tires remarkably different							O		
	Handling of tires inadequate								O	

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Wheel Alignment

Before performing a wheel alignment, do the following:
- Park the vehicle unloaded on a level place.
- Make sure that the tires are the proper size and inflated to the proper pressure.
- If tire wear is noticeably different on one side of the vehicle, replace the tires.
- Check the vehicle body for tilt to either side, and correct if necessary.
- Service all parts of the front axle and correct any problems, including the following.
  - King pin play or loose king pin
  - Loose front wheel hub
  - Loose bolts used for tightening various parts of tie rod arm, knuckle arm and tie rod
  - Bend of knuckle and front axle
- Make sure steering wheel free play is correct.
- Both wheel alignment and side slip must conform to the standard values.

Service standards: mm (in.)

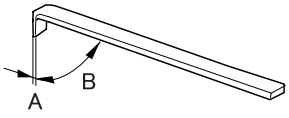
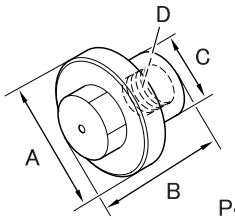
Location	Maintenance item	Standard value	Limit	Remedy
–	Toe-in	0 to 6 (3 ± 3) (0 to 0.24)	–	Adjust
	Camber	1°00 ± 1°00’	–	*
	Caster	1°15’ ± ’45	–	Replace
	King pin inclination angle	8° ± 30	–	Replace

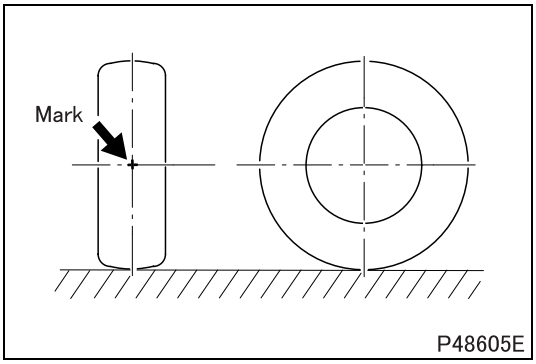
*: If the measured value deviates from the standard value, abnormalities such as wear of king pin and king pin bushing, loose hub bearing, and bend of knuckle and front axle are suspected. Inspect each part and replace defective parts.

Torque Value: N·m (lbf·ft)

Mark	Component	Torque value	Remarks
–	Clamp nut (tie rod end clamp fastening)	25 ± 5 (18 ± 3.6)	–
–	Alignment gauge adapter	113 ± 15 (83 ± 11)	–

Special tools: mm (in)

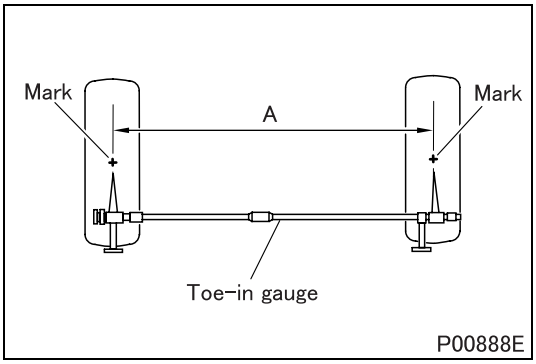
Mark	Tool name and shape	Part No.	Application
a	Hubcap wrench  P49261 A: 0.5 (0.020) B: 78°	MB999108	Removal of hubcap
b	Alignment gauge adapter  P48604 A: ϕ80 (3.15) B: 69 (2.72) C: ϕ45 (1.77) D: M24 × 1.5	MH063428	Measurement of camber, caster and king pin inclination angle



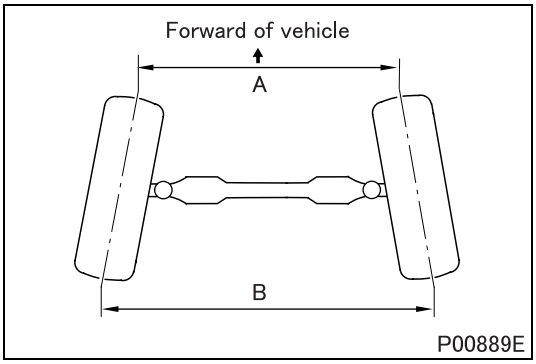
1.1 Inspection and adjustment of toe-in

[Inspection]

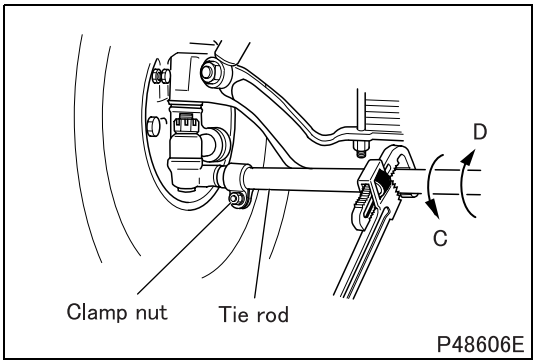
- Put the front wheels exactly in forward running position.
- Put a mark on each tire, right and left, at the height of front wheel axis and in the middle of tire width.



- Align the two points of the toe-in gauge with respective marks and measure distance **A** between the marks.

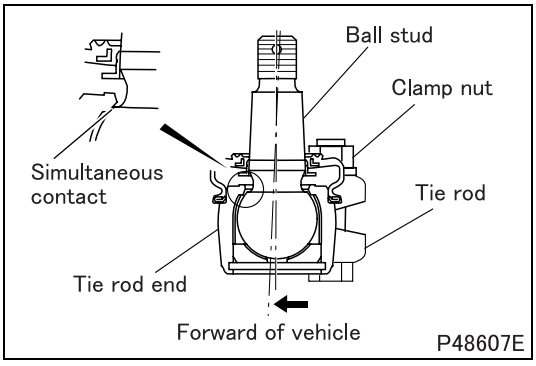


- Push the vehicle to roll the tires 180 degrees.
- Measure distance **B** between the marks that have moved to the rear of the vehicle.
- If toe-in (difference between **A** and **B**) deviates from the standard value, adjust.



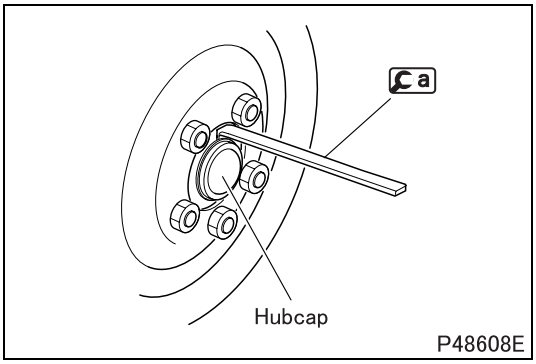
[Adjustment]

- Loosen the clamp nuts on the right and left.
- Turn the tie rod with a pipe wrench to adjust the toe-in.
  C: When adjusting to the toe-out direction
  D: When adjusting to the toe-in direction
- After adjustment, tighten the clamp nut to the specified torque.



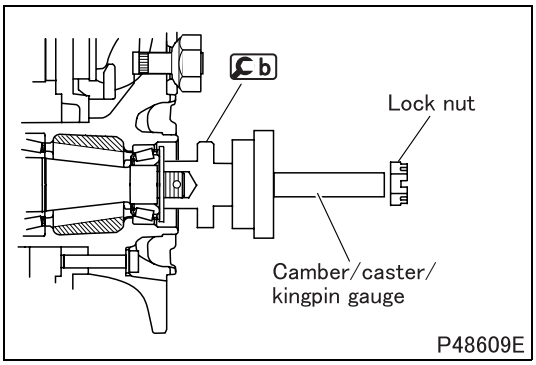
CAUTION ⚠

- **Hold down the tie rod end toward the front of the vehicle with the front wheels directed to forward running position so that the right and left tie rod ends are in contact with the ball studs at the same time. In this state adjust so that the specified toe-in is achieved and tighten the clamp nut to secure the tie rod.**



1.2 Inspection of camber

- Direct the front wheels exactly to forward running position.
- Remove the hubcap using the hubcap wrench a.

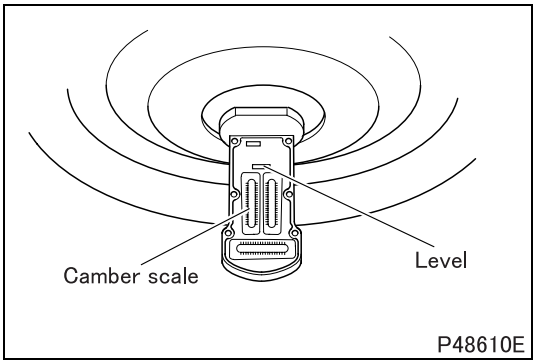


- Remove the lock nut.

CAUTION ⚠

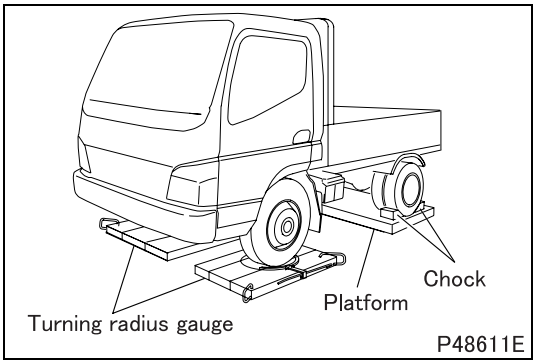
- **Do not apply a vehicle weight to the hub bearing with the lock nut loosened.**

- Wipe off grease from the knuckle end, attach the alignment gauge adapter b and tighten it to the specified torque.
- Attach the camber/caster/king pin gauge.

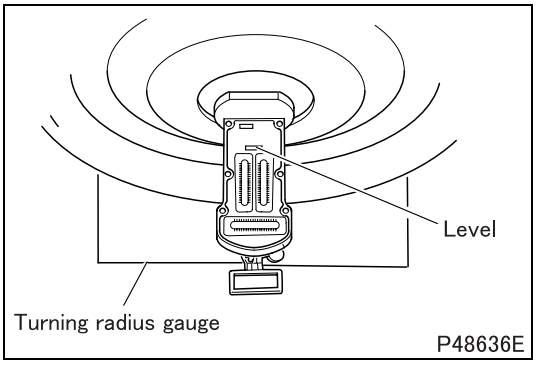


- Adjust the level until the bubble stays in the middle of the scale.
- On the camber scale, read the degree of camber. Do the same procedure for both front tires.
- If the measured value deviates from the standard value, disassemble the front axle for service.

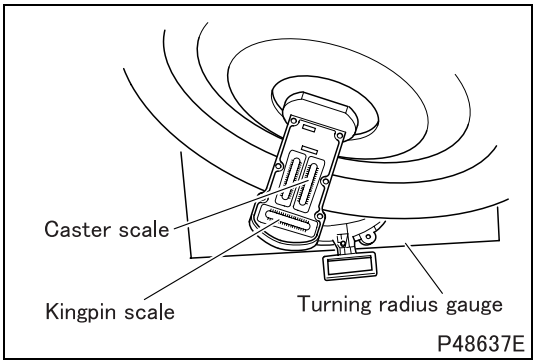
1.3 Inspection of caster and king pin inclination angle



- Prepare a platform with the same height as the turning radius gauge and place it under the rear wheels so that the vehicle will be level.
- Chocks the rear tires.
- Keep the turning radius gauge locked.
- Raise the vehicle, and set the right and left front wheels so that respective ground contact area centers of two wheels and turn table centers may meet.



- Unlock the turning radius gauge, and set the scale to 0 degrees.
- In a way similar to the camber measurement in Section **1.2**, attach the camber/caster/king pin gauge, and set the level so that the bubble is centered.



- Apply brake, and with brake applied to the front wheels, turn steering wheel slowly from the point of 0 degrees on the turning radius gauge, until the direction is changed by 20 degrees each to the right side in case of the right front wheel and to the left in case of the left front wheel.

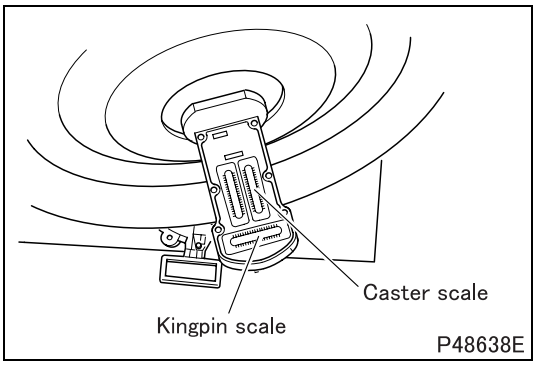
NOTE

- **It is not possible to make exact measurements unless the brake is continuously applied. Otherwise, the wheels will turn slightly.**

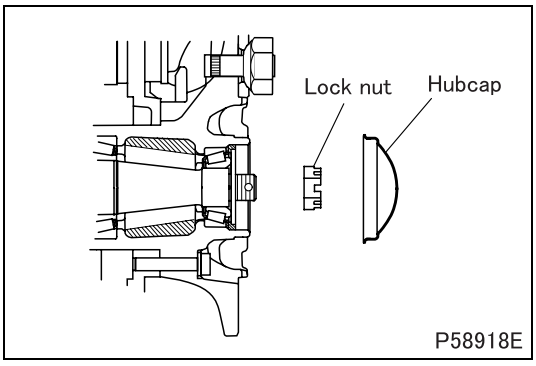
- At the point where the steering wheel has been turned 20 degrees, set the caster scale and the center of the bubble of the king pin scale to 0 degrees by turning the adjuster.

NOTE

- **Pay attention to the king pin scale because it has scales for right and left: align the right king pin scale for the right front wheel, and left king pin scale for the left front wheel.**



- Now reverse this position. Turn the steering wheel slowly until the direction of the front wheels changes by 20 degrees in the opposite direction.
- Read the caster scale and king pin scale to find the caster and king pin inclination angles.
- If the measured value deviates from the standard value, disassemble the front axle for service.



- After inspection, install the lock nut and measure the starting torque of the wheel hub bearing. If the starting torque deviates from the standard value, check the wheel bearings and perform expedient adjustment.
- Fill the specified amount of grease into wheel hub by using nozzle so that the outer bearing is covered with the grease and then install a new hubcap.

2. Inspection and Adjustment of Steering Angle

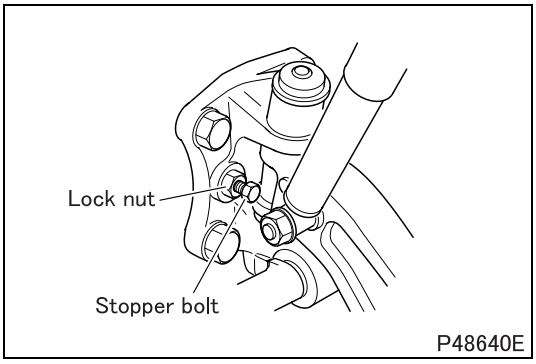
- Perform steering angle inspection and adjustment only after wheel alignment inspection and adjustment has been completed.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Steering angle	Inside (outside steering angle is for reference only)	45° $^{+0°}_{-2°}$ (34°)	–	Adjust

Torque Value: N·m (lbf·ft)

Mark	Fastener	Torque value	Remarks
–	Lock nut (knuckle stopper bolt mounting)	46.5 ± 7 (34 ± 5.4)	–



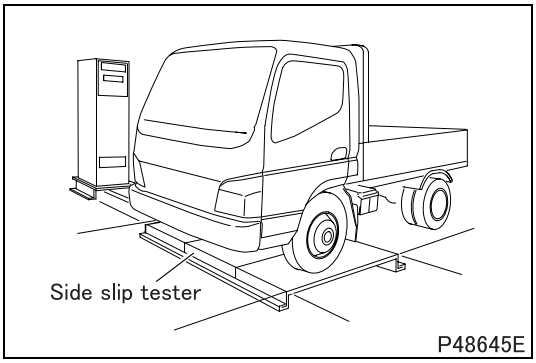
- Set the turning radius gauge and a platform on the vehicle in the same manner as in case of caster and king pin inclination angle measurement performed in Section **1.3**.
- Turn the steering wheel right or left completely from the position where the turning radius gauge is set to 0 degrees, and read the scale of the turning radius gauge to measure the steering angle.
- If the measured value deviates from the standard value, adjust with the knuckle stopper bolt and tighten the lock nut to the specified torque.

3. Inspection of Side Slip

- Perform side slip inspection only after wheel alignment inspection and adjustment has been completed.
- For the side slip amount, which is related to wheel alignment, both the side slip amount and wheel alignment must conform to the standard values.

Service standards: mm (in)

Location	Maintenance item	Standard value	Limit	Remedy
–	Side slip amount	0 ± 3 (0 ± 0.12)	–	Adjust



- Set the front wheels exactly to forward running position.
- Move the vehicle forward past the side slip tester as slowly as possible to inspect side slip.

NOTE

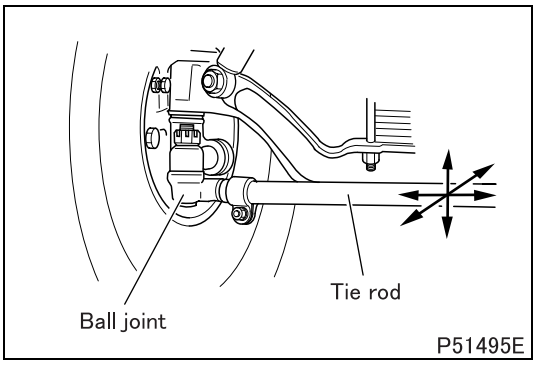
- **Pay attention to the following when moving over the side slip tester.**
- **Be sure to hold steering exactly at the forward running position, and make no turn.**
- **Do not apply brake.**
- **Keep the speed constant.**

- If the measured value deviates from the standard value, inspect and adjust wheel alignment.

4. Inspection of Tie Rod End Ball Joint

Service standards: mm (in)

Location	Maintenance item	Standard value	Limit	Remedy
–	Play of tie rod end ball joint	0	–	Replace



(1) Play of tie rod end ball joint

- Hold the tie rod section of the tie rod with the vehicle kept stationary, and move it in the back-and-forth, up-and-down and right-and-left directions to check for play at ball joints of the tie rod end.

NOTE

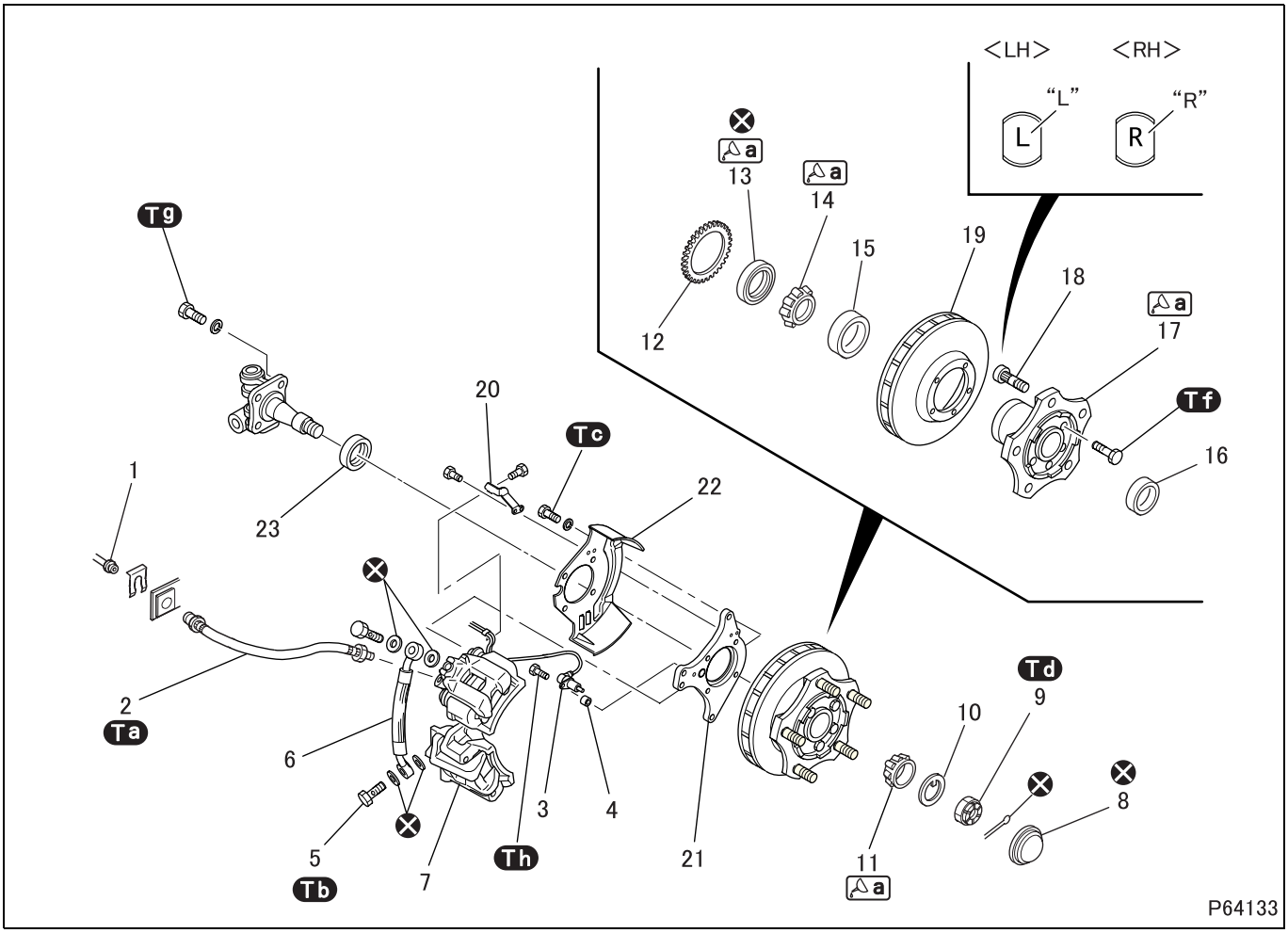
- **Be sure to check for play at ball joints of both right and left sides of the tie rod.**

- If there is play, replace the tie rod end of the tie rod.

(2) Dust cover

- Check the dust cover for wear, cracks and other damage.
- If there is any abnormality, replace the tie rod end.

WHEEL HUB AND ROTOR



● **Disassembly sequence**

1 Brake pipe
2 Brake hose
3 Wheel speed sensor
4 Spacer
5 Eyebolt
6 Brake hose
7 Front disc brake (See Gr35A.)
8 Hubcap
9 Lock nut
10 Lock washer
11 Outer bearing inner race
12 Antilock brake system rotor
13 Oil seal
14 Inner bearing inner race
15 Inner bearing outer race
16 Outer bearing outer race
17 Wheel hub
18 Hub bolt
19 Disc rotor
20 Bracket
21 Adapter
22 Dust shield
23 Spacer

⊗: Non-reusable parts

CAUTION ⚠

- **Plug the brake hose to prevent entry of dust and dirt after it has been removed.**
- **Be careful not to damage the tip of the wheel speed sensor after removing it.**

NOTE

- **Do not remove the antilock brake system rotor unless replacing it.**
- **Do not disassemble the wheel hub and disc rotor unless replacing them.**

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **Make sure that the disc rotor surface and disc brake pad surface are free from grease to avoid malfunction of brakes.**
- **Make sure that the brake hose is not twisted when installing it.**
- **Inspect the drag torque of disc brakes after assembly. (See Gr35A.)**

Service standards: mm (in)

Location	Maintenance item		Standard value	Limit	Remedy
–	Starting torque of wheel hub bearing (tangential force at hub bolt position with oil seal assembled)		1 to 3.5 N·m (0.7 to 2.6 ft.lbs) (tangential force: 8.8 to 28.4 N (2.0 to 6.4 lb)	–	Adjust or replace
17	Wear at the outer periphery of wheel hub		–	0.8	Replace
19	Disc rotor	Runout (measure, assembling it into front axle)	0.07 (0.0028) or less	0.10 (0.0039)	Replace
		Thickness	40 (1.57)	38 (1.50)	Replace

Torque Value: N·m (lbf·ft)

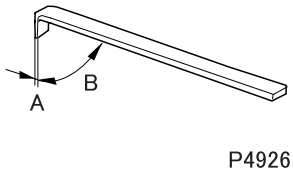
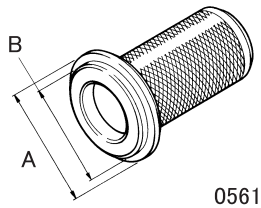
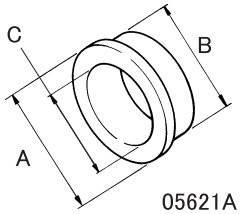
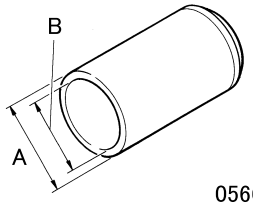
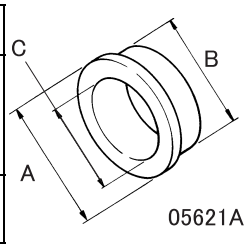
Mark	Component		Torque value	Remarks
Ta	Brake hose		25.5 to 34.3 (18.8 to 25.3)	–
Tb	Eyebolt		22 ± 2 (16 ± 1.5)	–
Tc	Bolt (front disc brake mounting)		152 ± 25 (112 ± 18)	–
Td	Lock nut	Primary tightening	113 ± 15 (83 ± 11)	–
		Secondary tightening after complete tightening	59 (44)	Back-off angle 45° (1/8 of a turn)
Tf	Bolt (wheel hub and disc rotor mounting)		85.8 ± 12 (63 ± 8.9)	–
Tg	Bolt (adapter mounting)		118 ± 20 (87 ± 1.5)	–
Th	Bolt (speed sensor mounting)		12.3 ± 2.5 (9.1 ± 1.8)	–

Lubricant and/or sealant

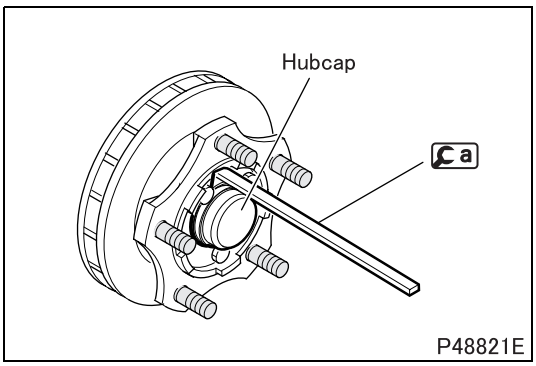
Mark	Points of application			Specified lubricant and/or sealant	Quantity
△a	Pack outside of wheel hub	5 studs		Wheel bearing grease [NLGI No. 2 (Li soap)]	※65 ± 10 g (2.29 ± 0.35 oz)
		6 studs			※90 ± 10 g (3.17 ± 0.35 oz)
	Pack inside of wheel hub	5 studs			※210 ± 20 g (7.41 ± 0.71 oz)
		6 studs	COE 40/45		※130 ± 10 g (4.59 ± 0.35 oz)
			COE 50		※155 ± 10 g (5.47 ± 0.35 oz)
	Pack space between rollers of outer bearing inner race and inner bearing inner race				As required
	Lip area of oil seal				

※: For a wheel hub

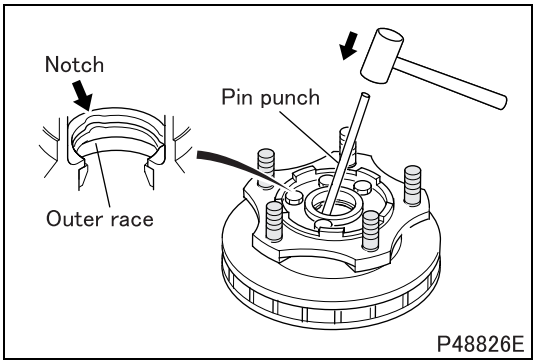
Special tools: mm (in)

<table>
<tr><th>Mark</th><th>Tool name and shape</th><th>Part No.</th><th>Application</th></tr>
<tr><td>a</td><td>Hubcap wrench
<table><tr><th>A</th><th>B</th></tr><tr><td>0.5
(0.020)</td><td>78°</td></tr></table> 
P49261</td><td>MB999108</td><td>Removal of hubcap</td></tr>
<tr><td>b</td><td>Oil seal installer
<table><tr><th>A</th><th>B</th></tr><tr><td>ϕ84
(3.31)</td><td>ϕ70
(2.76)</td></tr></table> 
05619</td><td>MB999097</td><td rowspan="2">Installation of oil seal (to be used in combination)</td></tr>
<tr><td>c</td><td>Bearing installer
<table><tr><th>Part No.</th><th>A</th><th>B</th><th>C</th><th>Vehicle model</th></tr><tr><td>MB999099</td><td>ϕ88.5
(3.48)</td><td>ϕ71
(2.80)</td><td>ϕ51
(2.01)</td><td>Five studs</td></tr><tr><td>MB999069</td><td>ϕ94.5
(3.72)</td><td>ϕ92.5
(3.64)</td><td>ϕ60
(2.36)</td><td>Six studs</td></tr></table> 
05621A</td><td>MB999099
MB999069</td></tr>
<tr><td>d</td><td>Bearing installer
<table><tr><th>A</th><th>B</th></tr><tr><td>ϕ70
(2.76)</td><td>ϕ57
(2.24)</td></tr></table> 
05668</td><td>MB999100</td><td rowspan="2">Installation of inner bearing outer race and outer bearing outer race (to be used in combination)</td></tr>
<tr><td>e</td><td>Bearing installer
<table><tr><th>Part No.</th><th>A</th><th>B</th><th>C</th><th>Vehicle model</th></tr><tr><td>MB999099</td><td>ϕ88.5
(3.48)</td><td>ϕ71
(2.80)</td><td>ϕ51
(2.01)</td><td>Inner side of five-stud models and outer side of all models</td></tr><tr><td>MB999069</td><td>ϕ94.5
(3.72)</td><td>ϕ92.5
(3.64)</td><td>ϕ60
(2.36)</td><td>Inner side of six-stud models</td></tr></table> 
05621A</td><td>MB999099
MB999069</td></tr>
</table>

◆Removal procedure◆

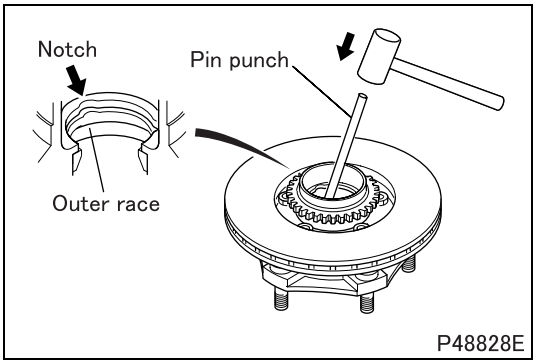


■ **Removal: Hubcap**



■ **Removal: Inner bearing outer race**

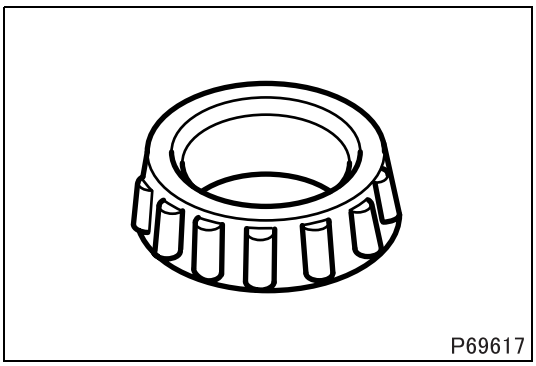
- Drive out the inner bearing outer race by tapping evenly at three indented parts in the wheel hub.



■ **Removal: Outer bearing outer race**

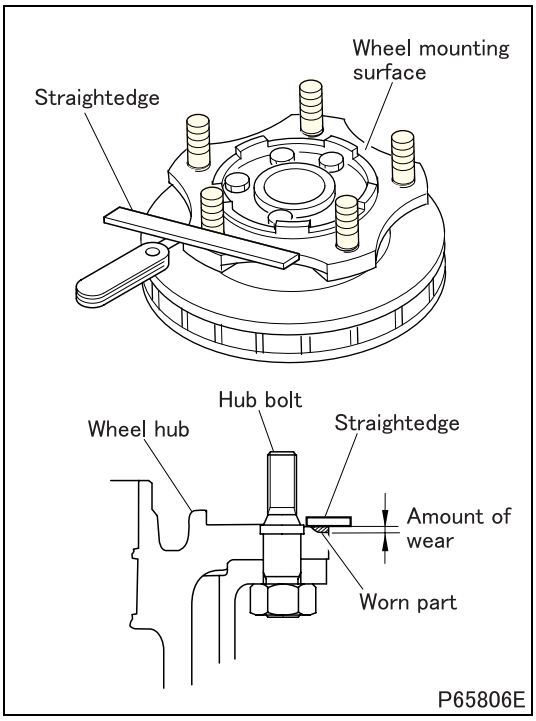
- Drive out the outer bearing outer race by tapping evenly at three indented parts in the wheel hub.

◆Inspection nspection procedure◆



■ Inspection: Outer bearing inner race

- Inspect the outer bearing inner race after cleaning the bearing to remove grease completely.
- If any damage, wear, or poor rotating condition is evident in the inner race, replace it with a new one.
- The inner race and outer race should be replaced as a set.



■ Inspection: Wear at the outer periphery of wheel hub

Measurement of the amount of the wear at the outer periphery of wheel hub.

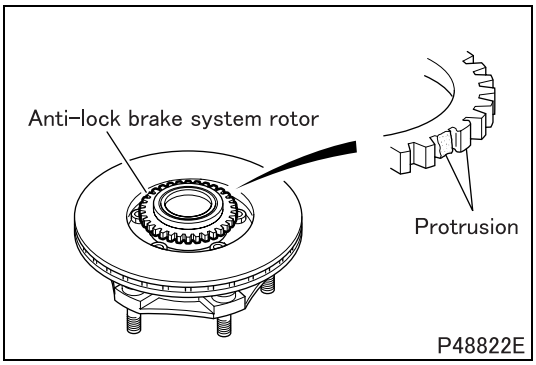
CAUTION ⚠

- **Clean the wheel mounting surface of the wheel hub before inspection.**
- **The straightedge should be placed on the hub so as not to contact to the hub bolt.**

- Place the straightedge on the wheel mounting surface as shown in the drawing.
- Using the straightedge and feeler gauges, measure the amount of wear at the outer periphery of the wheel hub at five positions.
- If the amount of wear at any point exceeds the limit, replace the wheel hub.
- If the wheel has cracks or has a stepped wear at the wheel hub mounting surface, replace the wheel.

CAUTION ⚠

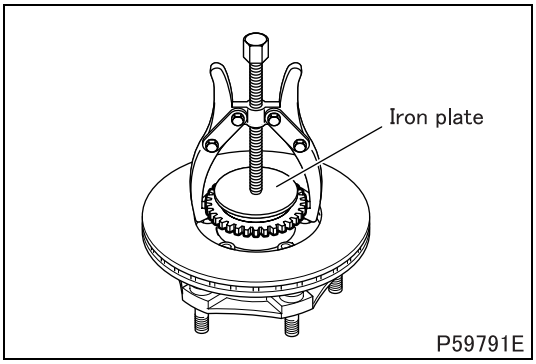
- **Never paint the wheel mounting surface of the wheel hub as it may be a cause of loose bolt.**



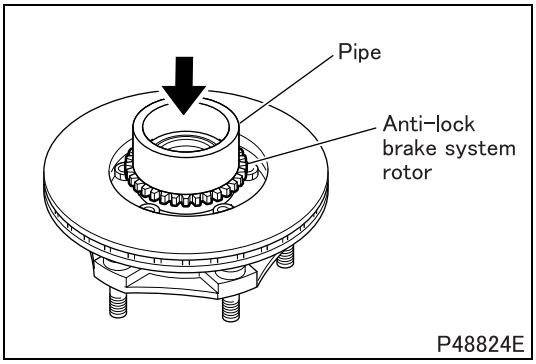
■ Inspection: Antilock brake system rotor

[Inspection]

- Check protrusions of the antilock brake system rotor for chipping and flattening.
- If any abnormality is found, replace the antilock brake system rotor.



[Removal]



[Installation]

- Warm the antilock brake system rotor to approximately 150°C.
- Install the antilock brake system rotor and wheel hub evenly using a pipe so as not to allow them to tilt.

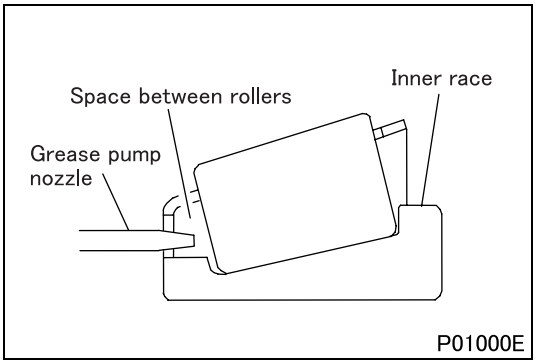
WARNING ⚠

- **Handling the warmed rotor by bare hands may burn.**

■ Inspection: Inner bearing inner race

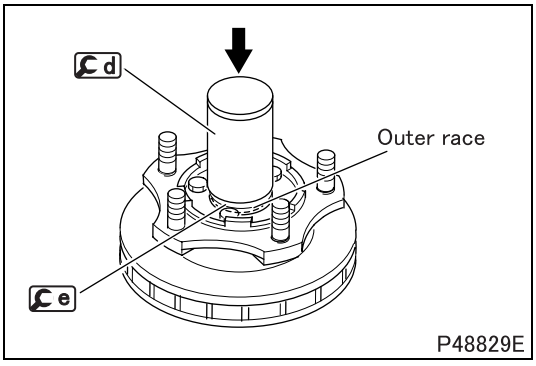
- Inspect the inner bearing inner race in the same manner as for the outer bearing inner race.
  (See **"■ Inspection: Outer bearing inner race".**)

◆Installation procedure◆

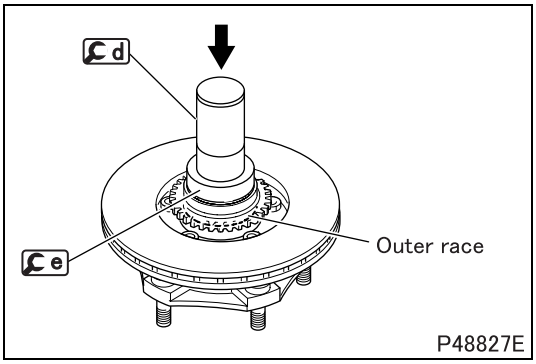


■ Installation: Packing grease in inner bearing inner race

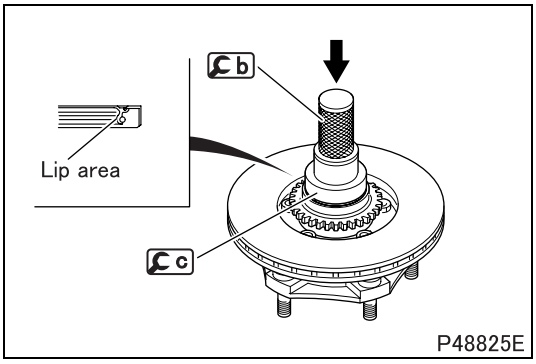
- Insert the grease pump nozzle into the space between rollers of the inner bearing inner race to pack grease sufficiently.



■ Installation: Outer bearing outer race

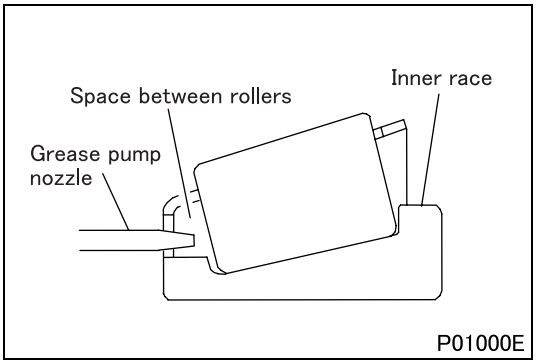


■ **Installation: Inner bearing outer race**



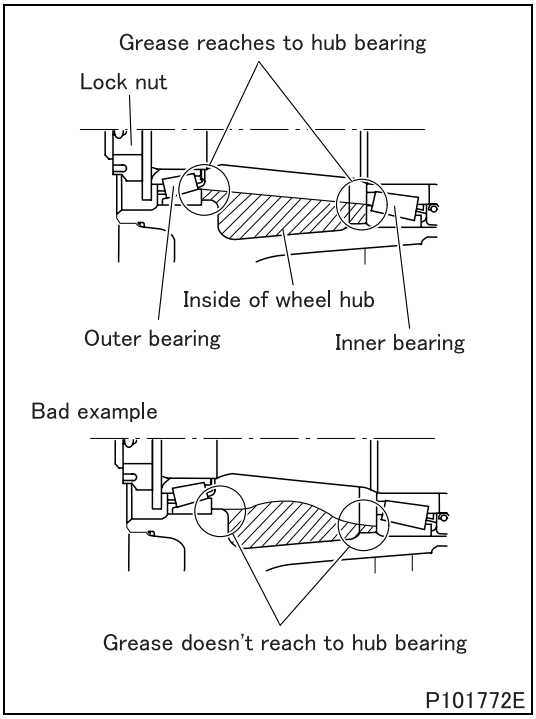
■ **Installation: Oil seal**

- Apply grease to the lip area of the oil seal and install it on the wheel hub in the illustrated direction.



■ **Installation: Packing grease in outer bearing inner race**

Insert the grease pump nozzle into the space between rollers of the inner bearing inner race to pack grease sufficiently.

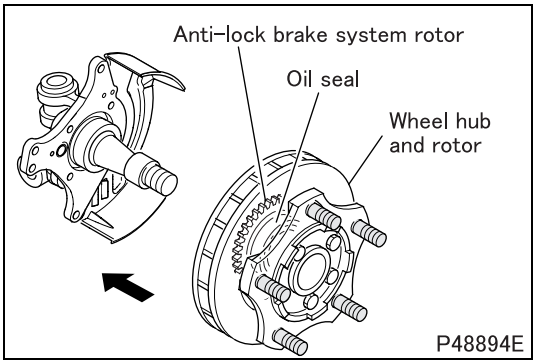


■ **Installation: Packing grease inside of wheel hub**

- Apply specified amount of grease to inside A of wheel hub so that the grease reaches inner bearing and outer bearing as illustrated.
- After installing lock nut, insert grease pump nozzle into outside B of wheel hub and fill specified amount of grease so as to make a grease wall outside of the outer bearing.

CAUTION ⚠

- **Applying grease as illustrated in the "bad example" causes the wheel hub bearing to seize.**

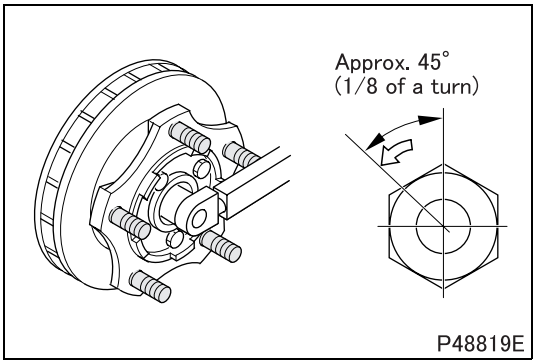


■ **Installation: Wheel hub and rotor**

- Slowly install the wheel hub and rotor assembly so as not to cause damage to the oil seal and antilock brake system rotor.

CAUTION ⚠

- **If the antilock brake system rotor is damaged, wheel speed sensor signals become abnormal, causing the antilock brake system to malfunction.**



■ **Adjustment: Starting torque of wheel hub bearing**

CAUTION ⚠

- **Unless this adjustment procedure is performed, seizure of the wheel hub bearing can be caused.**

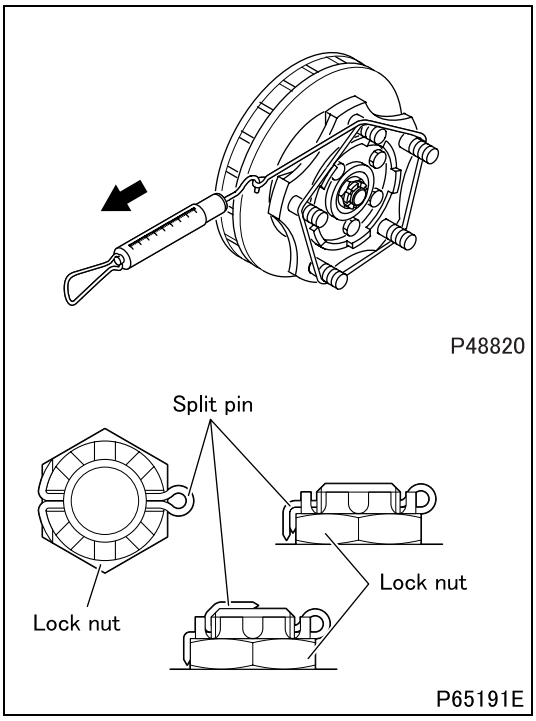
[Adjustment]

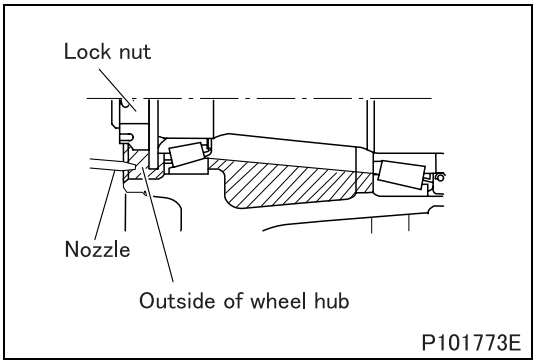
- Tighten the lock nut to the specified torque (primary tightening) while turning the wheel hub and rotor, and then loosen it completely.
- Smooth operation of the outer bearing and inner bearing by turning the wheel hub and rotor several times, and then tighten the lock nut to the specified torque (secondary tightening).
- Return the lock nut by approximately 45 degrees (1/8 of a turn) and secure it with a split pin. If pin holes do not align, align them in the course of loosening. Make sure that there is no play in the axial direction.
- Perform measurement again after adjustment. If any fault is found, replace the outer and inner bearings.

■ **Inspection: Starting torque of wheel hub bearing**

[Inspection]

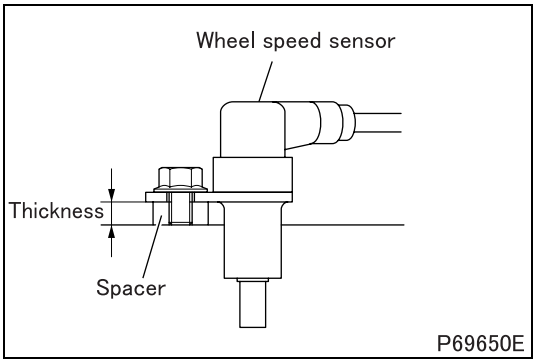
- After installing the lock nut, perform the following inspection.
- Measure the tangential force at the hub bolt position using a spring balance.
- If the tangential force is within the specified value, the starting torque conforms to the standard value. When the measured value is the specified value, install the split pin following either of method in the illustration.
- If the measured value deviates from the specified value, repeat adjustment because the adjustment of the lock nut may be insufficient.
- If the result is found to be abnormal, replace the outer and inner bearings.





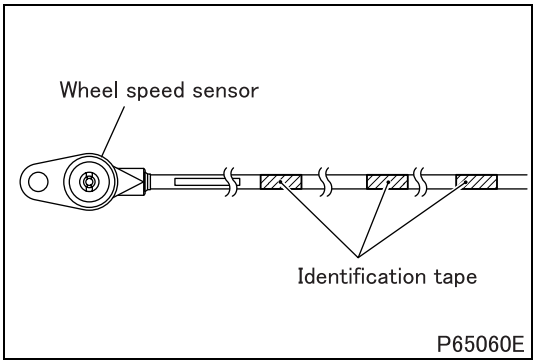
■ **Installation: Packing grease outside of wheel hub**

- After installing lock nut, insert grease pump nozzle into outside of wheel hub and fill specified amount of grease so as to make a grease wall outside of the outer bearing.



■ **Installation: Spacer**

- Install a spacer and wheel speed sensor in the position shown in the illustration.
  Thickness of spacer: 16.0 mm <FE (Except COE 50)>
  14.5 mm <COE 50>

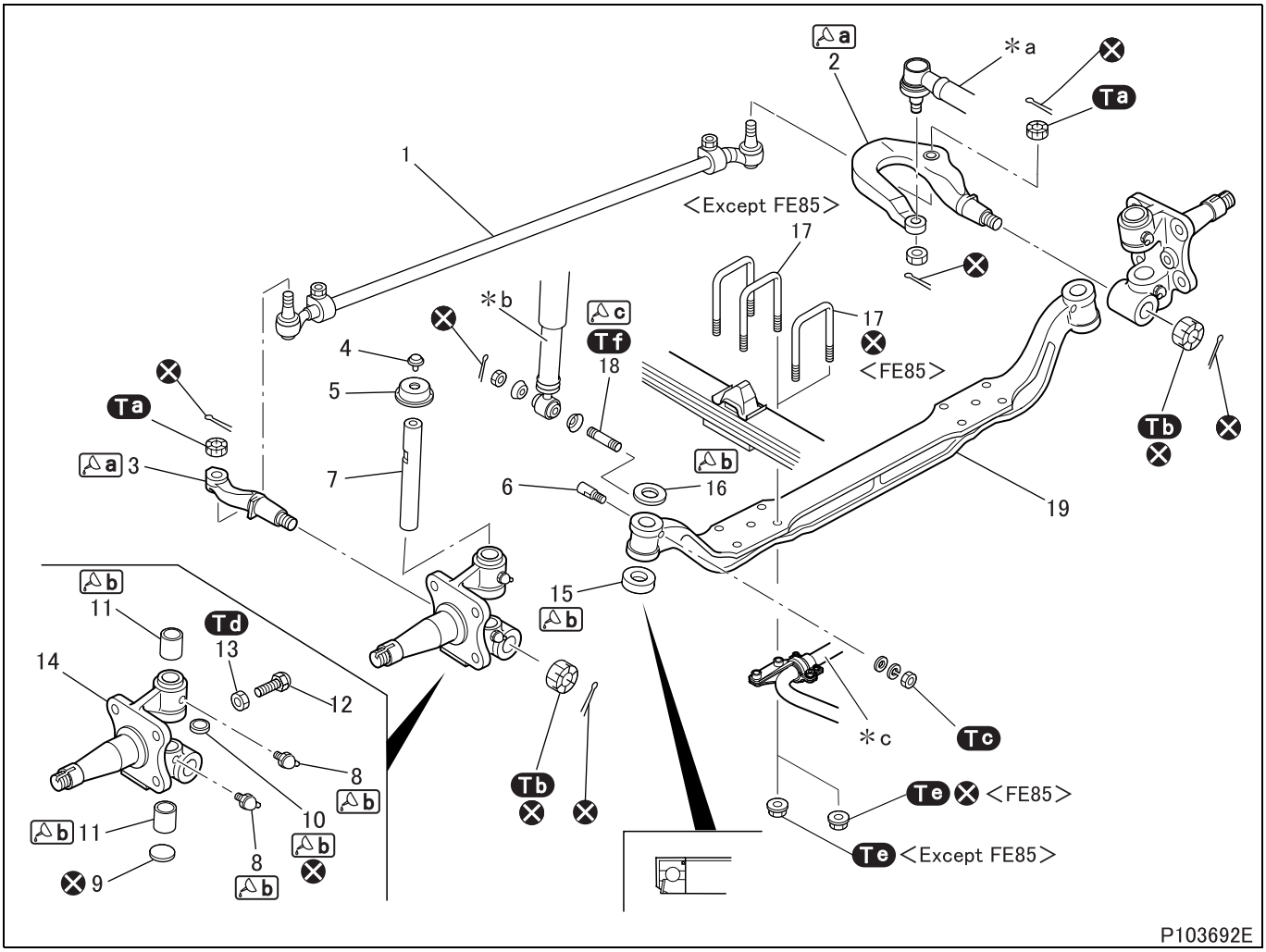


■ **Installation: Wheel speed sensor**

- Using clips, secure in place the wheel speed sensor harness at the identification tape portions, ensuring that the harness is free of kinks, slack and/or interference with other parts.

M E M O

KNUCKLE AND KING PIN, FRONT AXLE



P103692E

● Disassembly sequence

1 Tie rod (See later section.)
2 Knuckle arm
3 Tie rod arm
4 Dust plug
5 Dust cap
6 Lock pin
7 King pin
8 Grease nipple
9 Plug
10 Dust seal
11 Bushing
12 Knuckle stopper bolt
13 Lock nut
14 Knuckle
15 Thrust bearing
16 King pin shim
17 U-bolt
18 Stud bolt
19 Front axle

***a**: Drag link
***b**: Shock absorber
***c**: Stabilizer
⊗: Non-reusable parts

CAUTION ⚠

- **When removing the tie rod, take care not to deform or damage the dust cover.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: King pin kit

Service standards: mm (in)

Location	Maintenance item		Standard value	Limit	Remedy
7	Outer diameter of king pin		27.947 to 27.980 (1.100 to 1.102)	27.9 (1.098)	Replace
7, 11	Clearance between king pin and bushing		0.020 to 0.086 (0.00079 to 0.0034)	0.15 (0.0059)	Replace
7, 19	Clearance between king pin and front axle		0.020 to 0.074 (0.00079 to 0.0029)	0.1 (0.0039)	Replace
11	Inner diameter of bushing (after having been pressed into knuckle)		28.000 to 28.033 (1.102 to 1.103)	–	Replace
14, 19	Vertical clearance between knuckle and front axle		0.02 to 0.10 (0.00079 to 0.0039)	0.20 (0.0079)	Adjust
19	Front axle	Horizontal bend	–	2 (0.079)	Replace
		Vertical bend	–	2 (0.079)	
		King pin inclination angle	8° ± 10’	–	

Torque Value: N·m (lbf·ft)

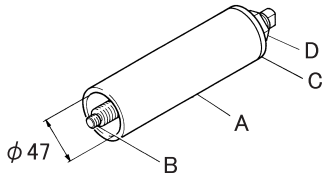
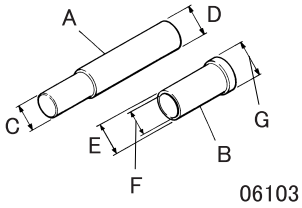
Mark	Component		Torque value	Remarks
Ta	Nut (tie rod mounting)		93 ± 25 (69 ± 18)	–
Tb	Nut (knuckle arm mounting)		345 ± 49 (254 ± 36)	–
	Nut (tie rod arm mounting)			
Tc	Nut (lock pin mounting)		33 ± 5 (25 ± 3.6)	–
Td	Lock nut (knuckle stopper bolt tightening)		46.5 ± 7 (34 ± 5.4)	–
Te	Nut (U-bolt mounting)	Except COE 50	162 ± 15 (120 ± 11)	–
		COE 50	175 ± 5 (129 ± 3.7)	–
Tf	Stud bolt	Stud	88 (65) or more	–
		Nut (return)	137 (101) or more	–

Lubricant and/or sealant

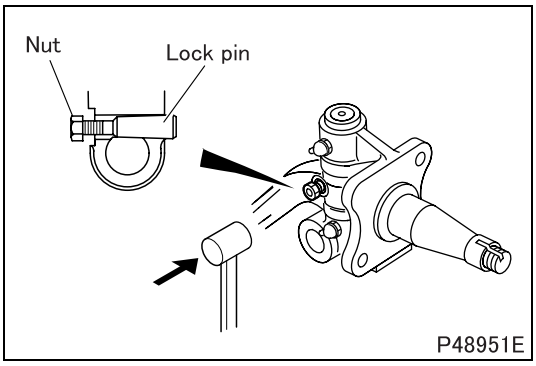
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Knuckle arm and tie rod arm threads	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required when parts are reused
b	Lip area of dust seal		As required
	Inside surface of bushing		
	Top face of thrust bearing		
	Both sides of king pin shim		
	Fill from grease nipple		Until grease starts overflowing from dust plug
c	Stud threads of stud bolt	Loctite 271	As required

KNUCKLE AND KING PIN, FRONT AXLE

Special tools: mm (in)

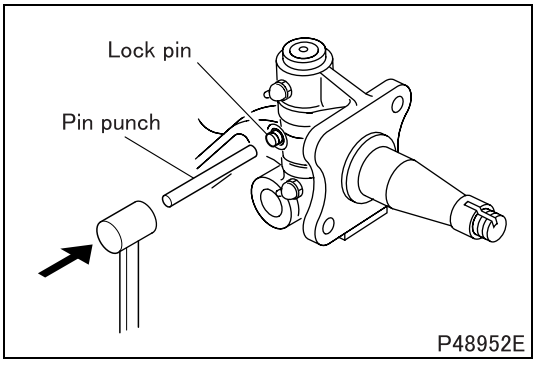
Mark	Tool name and shape	Part No.	Application
a	King pin puller A: Pipe B: Bolt C: Cap D: Nut  06102	MB999013 A: MB999014 B: MB999015 C: MB999016 D: MB999017	Removal of king pin
b	Bushing installer A: Bushing installer A B: Bushing installer B  06103 C: ϕ25 (0.98) D: ϕ30 (1.18) E: ϕ28 (1.10) F: ϕ25 (0.98) G: ϕ32.8 (1.29)	MB999066 A: MB999067 B: MB999068	Removal and installation of king pin bushing

◆Removal procedure◆

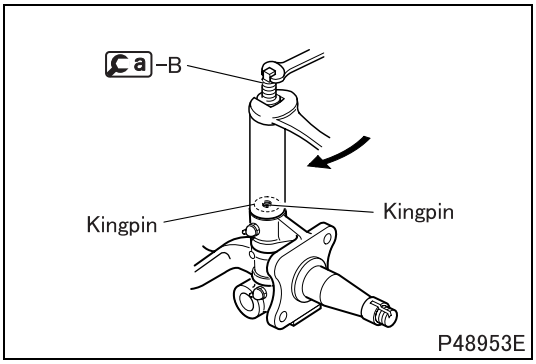


■ **Removal: Lock pin**

- Remove the nut, spring washer and washer.
- Screw in the nut again until just before it is flush with the lock pin, and lightly tap the nut to loosen the lock pin.



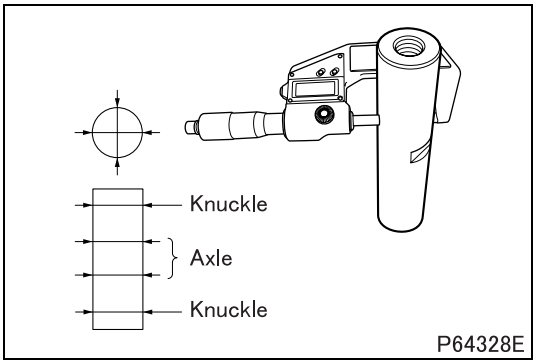
- Remove the nut, apply a pin punch to the lock pin and lightly tap it to remove.



■ **Removal: King pin**

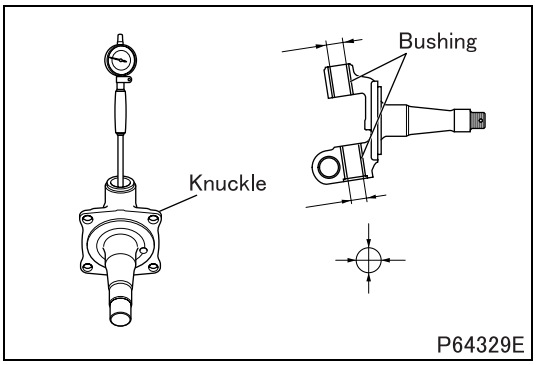
- Screw the bolt of the kin pin puller a-B into the king pin threads to remove the king pin.

◆Inspection procedure◆



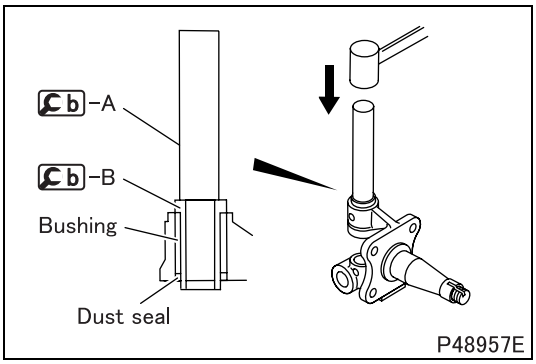
■ **Inspection: Outer diameter of king pin**

- Take measurement at a total of four levels on the king pin: two levels for the axle fitting portion and one level each for the upper and lower knuckle fitting portions.
- If the measured value is under the limit, replace the king pin with a new one.



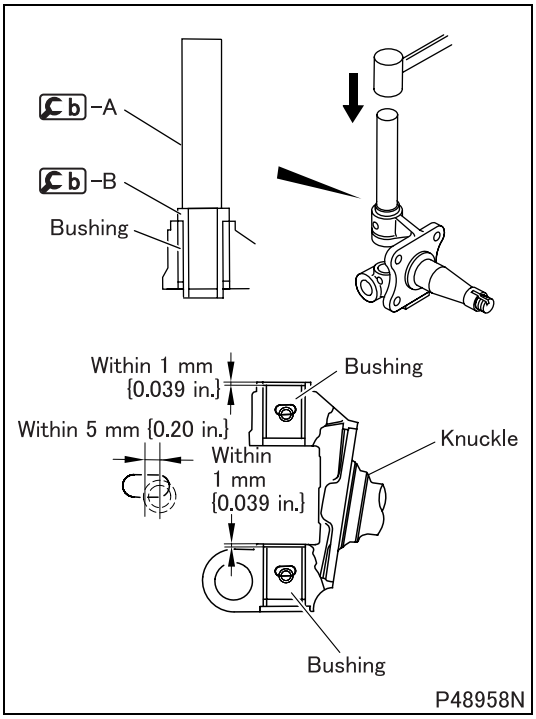
■ **Inspection: Clearance between king pin and bushing**

- Measure the inner diameter of the upper and lower bushings using a cylinder gauge and calculate the clearance deducting the outer diameter of the king pin from the inner diameter of the bushing.
  If the clearance exceeds the limit, replace the bushings with new ones.



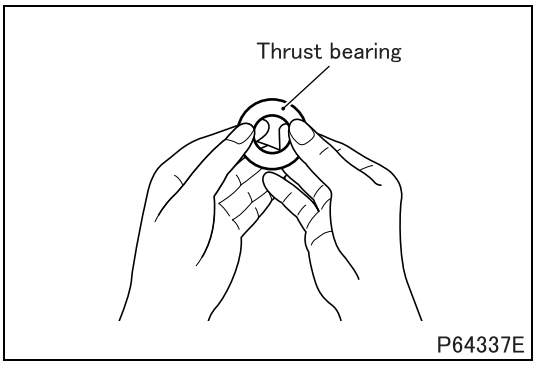
Replacement of bushing
[Removal]

- Remove the bushing and the dust seal at the same time using the bushing installer b.



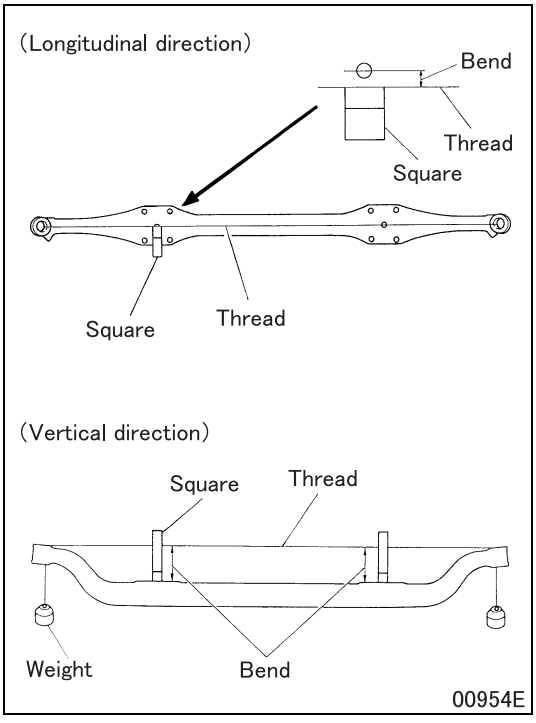
[Installation]

- Install the bushing using the bushing installer b so that a step height between the bushing and knuckle is within 1 mm (0.039 in.).
- The oil hole of the bushing must not deviate from the screw hole of the knuckle more than 5 mm (0.20 in.).



■ Inspection: Thrust bearing

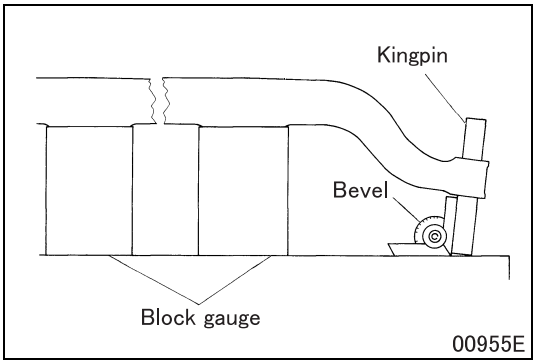
- Inspect the aspect and smooth turning of the thrust bearing. If any crack, damage, or un-smooth turning is found, replace the thrust bearing with a new one.



■ Inspection: Front axle

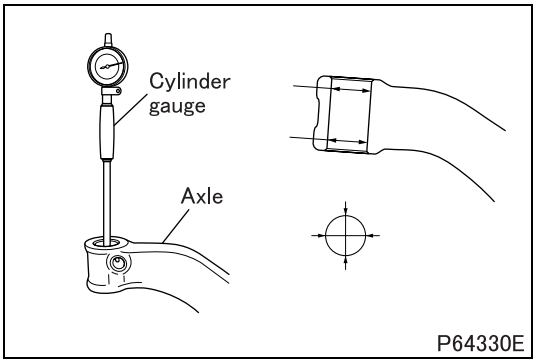
(1) Bend of front axle in the back-and-forth direction and vertical direction

- Put a piece of thread through king pin holes of the front axle and hang weights at both ends.
- Use a square to find bend to each of back-and-forth and vertical directions.
- If the measured value exceeds the limit, replace the front axle.



(2) King pin inclination angle

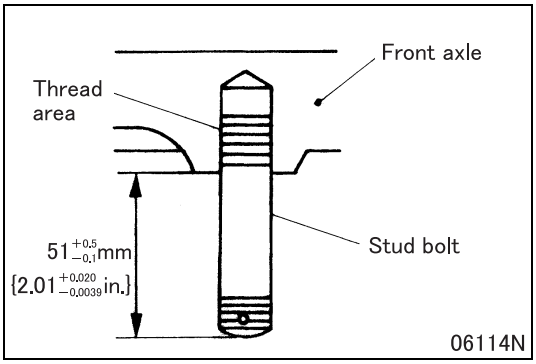
- Set the king pin on the front axle as illustrated to measure the angle.
- If the measured value deviates from the standard value, replace the front axle.



(3) Clearance between king pin and front axle

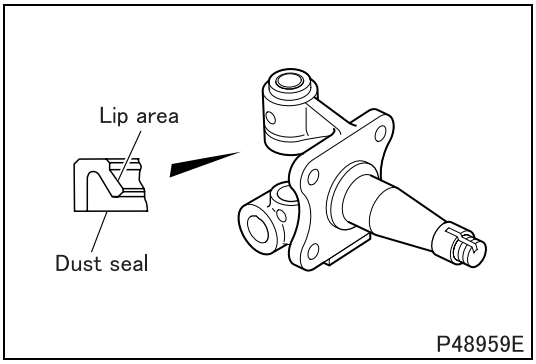
- Measure the inner diameter of the axle's hole where the king pin is inserted using a cylinder gauge and calculate the clearance deducting the outer diameter of the king pin from the inner diameter.
  If the clearance exceeds the limit, replace the axle or the king pin with a new one.

◆Installation procedure◆



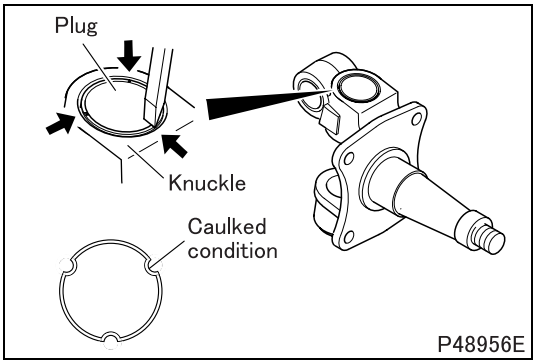
■ Installation: Stud bolt

- Apply Loctite to front axle mounting threads of the stud bolt.
- Install the stud bolt to the dimension as illustrated.



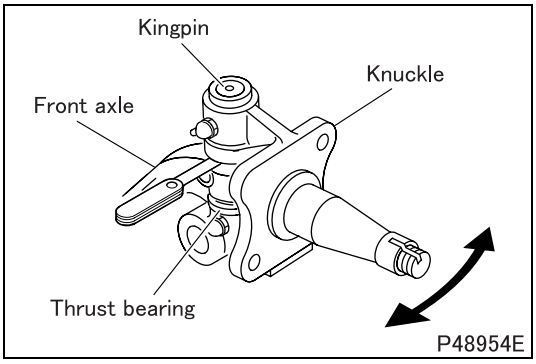
■ Installation: Dust seal

- Apply grease to the lip area of the dust seal and install it on the knuckle in the illustrated direction.



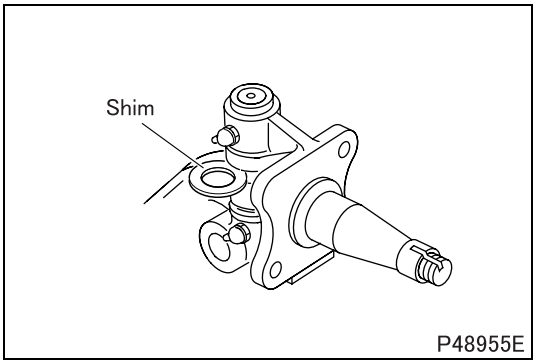
■ **Installation: Plug**

- After installing the plug, caulk the knuckle at three evenly spaced points of the plug circumference avoiding previously caulked points.



■ **Installation: Knuckle**

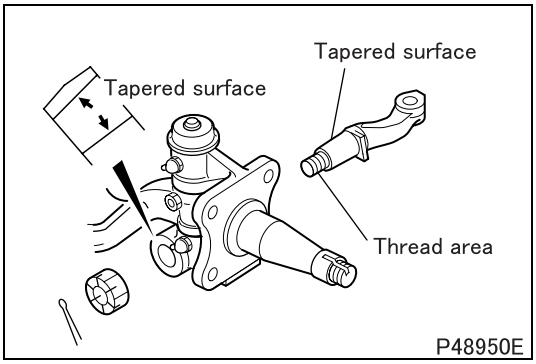
- After temporarily assembling the thrust bearing, knuckle and king pin into the front axle, move the knuckle several times to smooth its operation.
- Measure clearance between the front axle top face and the knuckle bottom.



- If the measured value exceeds the limit, adjust with a king pin shim.
  Thickness of king pin shims available
  0.10, 0.15, 0.20, 0.30, 0.40, 0.50, 0.60, 0.70 mm
  (0.0039, 0.0059, 0.0079, 0.012, 0.016, 0.020, 0.023, 0.028 in.)
  (Eight thickness)

CAUTION ⚠

- **Select a king pin shim so that the clearance is as small as possible within the range of the standard value.**
- **After assembly, make sure that the knuckle moves smoothly.**



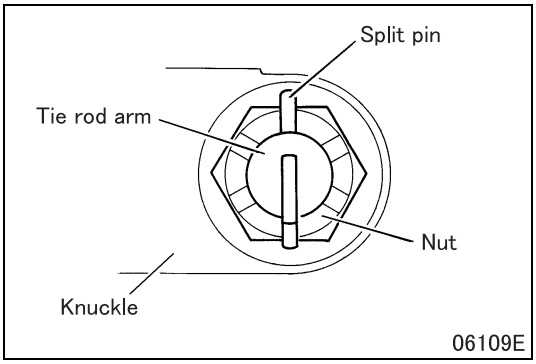
■ **Installation: Tie rod arm and knuckle**

(1) When one or both of the tie rod arm and knuckle need reassembly making use of existing parts

- Polish the entire tapered surfaces of the tie rod arm and knuckle evenly by means of sand paper #120 or above until sand paper score is visible on polished surfaces. (This does not apply to new replacement parts.)
- Clean the tapered surfaces and thread areas of the tie rod arm and knuckle.

NOTE

- **Use acetone, cleaning fluid for color check, or equivalent as solvent.**



• Apply grease to the thread area of the tie rod arm and install it.

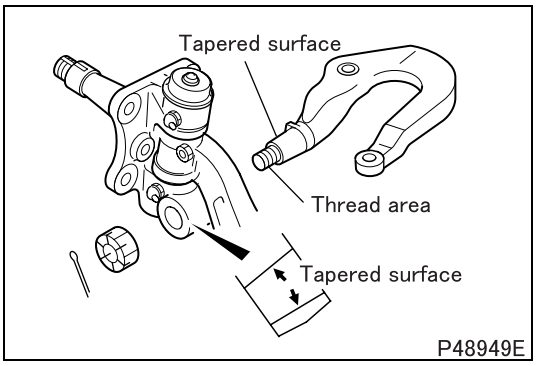
CAUTION ⚠

• When installing the tie rod arm, make sure that tapered surfaces of the tie rod arm and knuckle are free from grease.

• Tighten the nut to the specified torque. Be sure to align pin holes in the course of tightening and insert the split pin as illustrated.

(2) When both of the tie rod arm and knuckle for assembling are new parts

• Clean tapered surfaces and thread areas of the tie rod arm and knuckle.
• Tighten the nut to the specified torque. Be sure to align pin holes in the course of tightening and insert the split pin as illustrated.



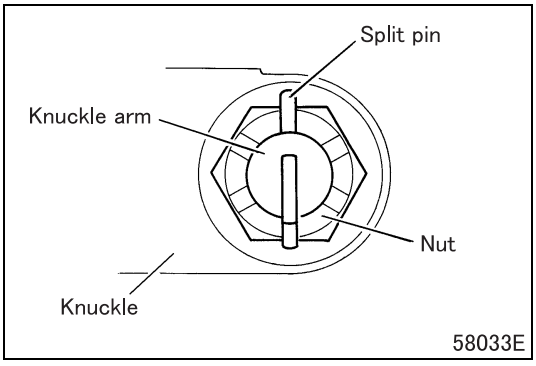
■ Installation: Knuckle arm and knuckle

(1) When one or both of the knuckle arm and knuckle need reassembly making use of existing parts

• Polish the entire tapered surfaces of the knuckle arm and knuckle evenly by means of sand paper #120 or above until sand paper score is visible on polished surfaces. (This does not apply to new replacement parts.)
• Clean the tapered surfaces and thread areas of the knuckle arm and knuckle.

NOTE

• Use acetone, cleaning fluid for color check, or equivalent as solvent.



• Apply grease to the thread area of the knuckle arm and install it.

CAUTION ⚠

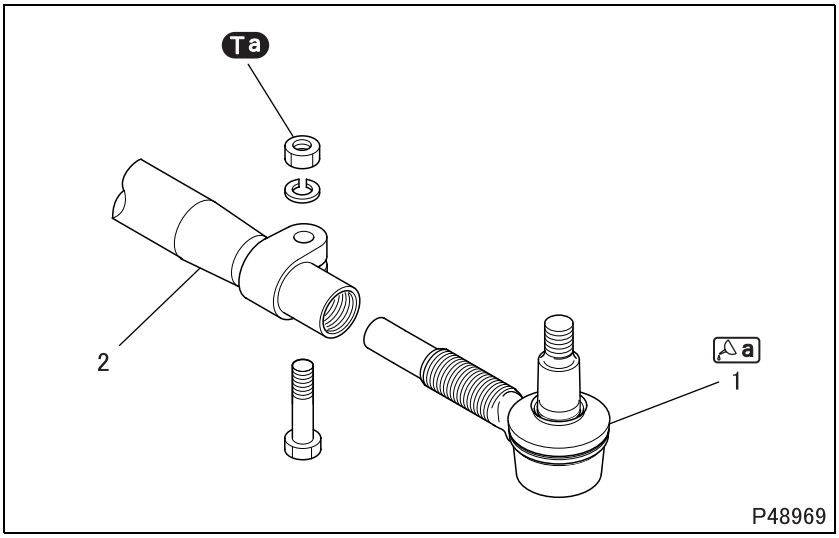
• When installing the knuckle arm, make sure that tapered surfaces of the knuckle arm and knuckle are free from grease.

• Tighten the nut to the specified torque. Be sure to align pin holes in the course of tightening and insert the split pin as illustrated.

(2) When both of the knuckle arm and knuckle for assembling are new parts

• Clean tapered surfaces and thread areas of the knuckle arm and knuckle.
• Tighten the nut to the specified torque. Be sure to align pin holes in the course of tightening and insert the split pin as illustrated.

TIE ROD



● **Disassembly sequence**

1 Tie rod end
2 Tie rod

CAUTION ⚠

- **If any abnormality such as tear is found in the dust boot of the tie rod end, replace the tie rod end.**

NOTE

- **Do not disassemble the tie rod end.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Service standards: mm (in)

Location	Maintenance item		Standard value	Limit	Remedy
1	Ball joint of tie rod end	Play (± 980 N (220 lbs, ± 100 kgf) loaded)	0 to 0.15 (0 to 0.0059)	–	Replace
		Rotation torque	1.0 to 5.9 N·m (0.7 to 4.4 ft.lbs, 0.1 to 0.6 kgf·m)	–	
2	Bend of tie rod		–	1 (0.039) or less	Correct or replace

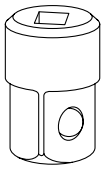
Torque Value: N·m (lbf·ft)

Mark	Component	Torque value	Remarks
Ta	Nut (tie rod end tightening)	25 ± 5 (18 ± 3.7)	–

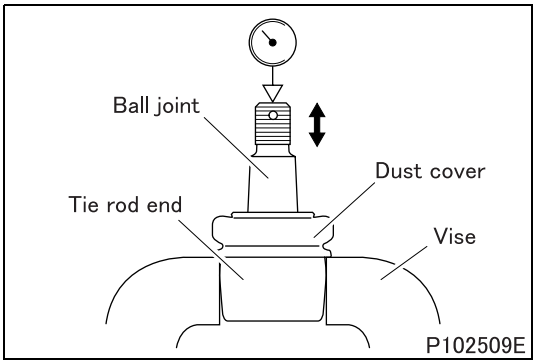
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Lip area of dust cover of tie rod end	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools

Mark	Tool name and shape	Part No.	Application
a	Preload socket  P48876	MB999326	Measurement of rotation torque of tie rod end

◆Inspection procedure◆



■ **Inspection: Tie rod end**

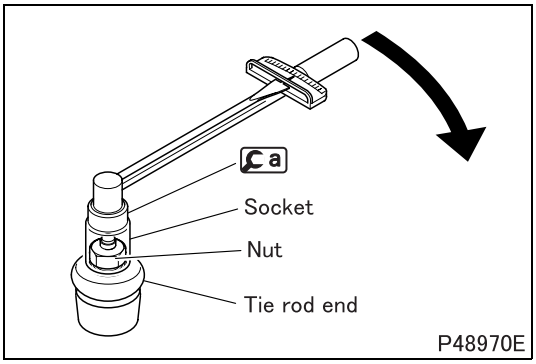
(1) Play

- Fix the tie rod end with a vise.

CAUTION ⚠

- **Take care not to deform or damage the dust cover when fixing it with a vise.**

- If measured value deviates from the standard value with applying the specified load (push and pull) to the ball joint, replace the tie rod end.

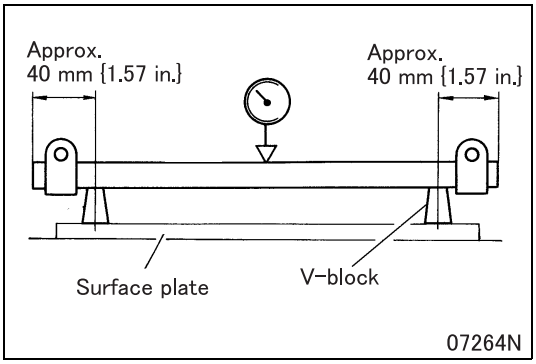


(2) Rotation torque

- Install the tie rod mounting nut on the tie rod end.
- Install the socket, Ca and torque wrench to measure the rotation torque.
- If the measured value deviates from the standard value, replace the tie rod end.

(3) Dust cover

- Check the dust cover for wear, cracks and other damage. These abnormalities may cause water infiltration to the ball joint and wear out it at early stage.
- If any abnormality is found in the dust cover, replace the tie rod end.



■ **Inspection: Bend of tie rod**

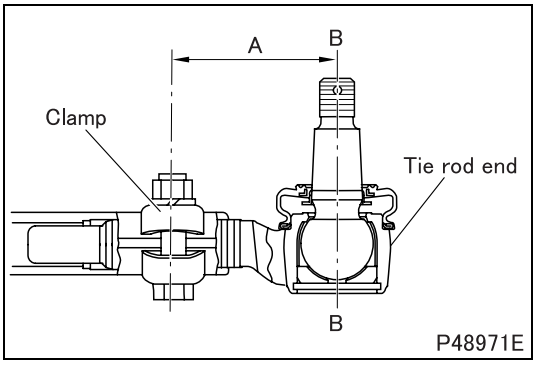
- Measure the bend of the tie rod at its center.

NOTE

- **Give the tie rod one complete turn and read the dial gauge at this time. The bend is one half of the reading.**

- If the measured value exceeds the limit, correct or replace the tie rod.

◆Installation procedure◆



■ **Installation: Tie rod end**

- Screw in the tie rod end so that difference of dimension **A** between the tie rod end and the clamp is within 1.5 mm (0.059 in.) between right and left.
  A: Approximately 74 mm (2.91 in.)

CAUTION ⚠

- **Ensure that difference of an amount of screwing in the tie rod end between right and left is within one turn.**
- **Secure the tie rod ends so that illustrated axis B-B on the right is parallel to that on the left.**

GROUP 27 INDEX

SPECIFICATIONS **27-2**

STRUCTURE AND OPERATION
1. **Wheel Hub and Rotor** **27-3**
2. **Reduction and Differential** **27-4**
3. **Limited Slip Differential** **24-5**

TROUBLESHOOTING **27-8**

ON-VEHICLE INSPECTION AND ADJUSTMENT
1. **Axle Oil Level Check and Axle Oil Change** **27-10**

WHEEL HUB AND ROTOR **27-12**

AXLE HOUSING **27-22**

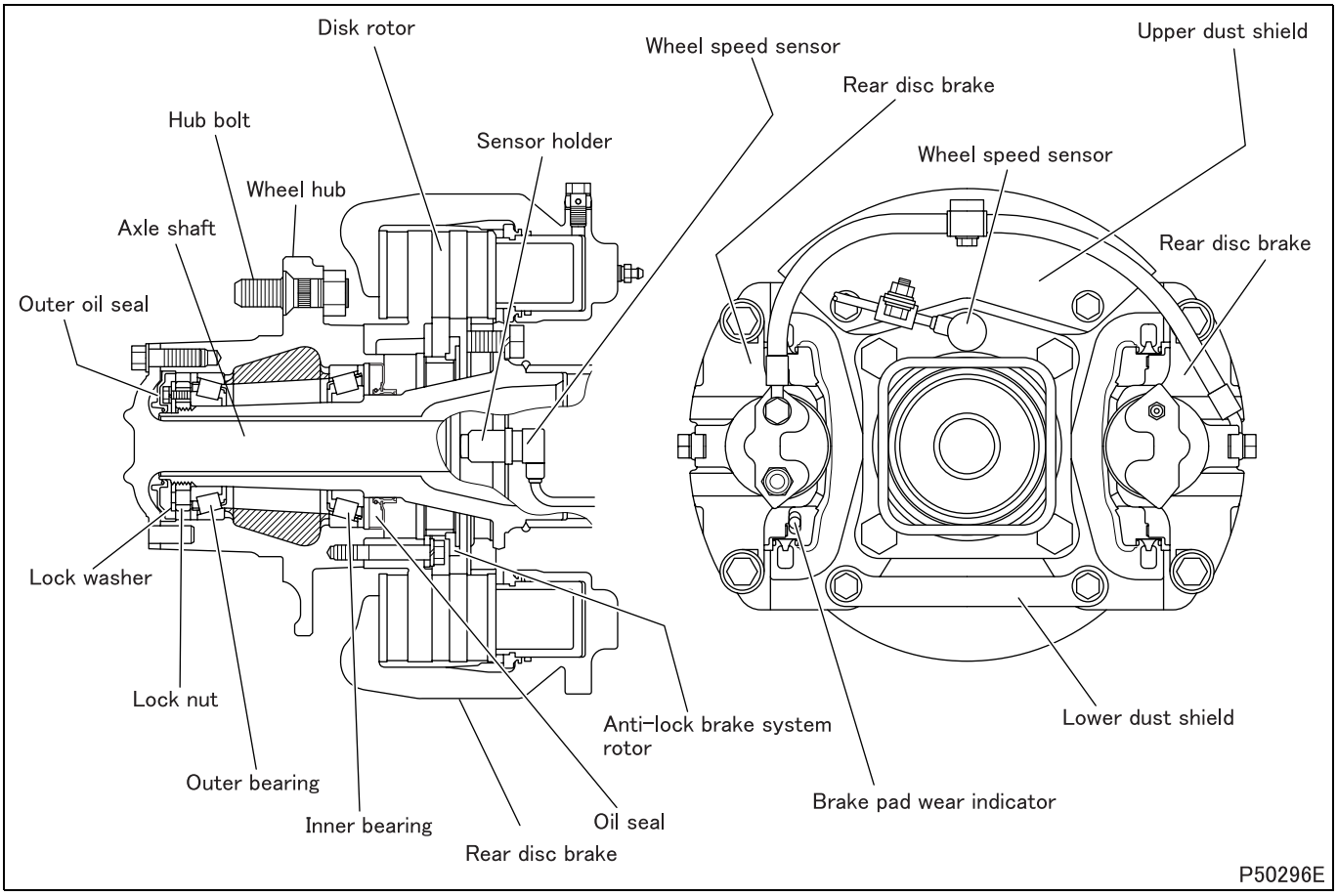
REDUCTION AND DIFFERENTIAL **27-26**

SPECIFICATIONS

Item		Specifications	
		COE 40/45	COE 50
Rear axle	Model	R033T	R035T
	Type	Banjo type, full floating	
Reduction	Model	D033H	D035H
	Type	Single-reduction hypoid gear	
	Gear ratio	4.875 5.285	5.285 5.714
Differential	Tooth shape	Straight bevel gear	
Gear oil	Grade	Normal: Maximum air temperature during operation below 40°C {104°F} API GL-5 SAE 90 Hot area: Maximum air temperature during operation above 40°C {104°F} API GL-5 SAE 140	
	Quantity L {qt}	4.5 {4.8}	
Weight kg {lb}		210 to 230 {460 to 505} (approximately)	250 {550} (approximately)

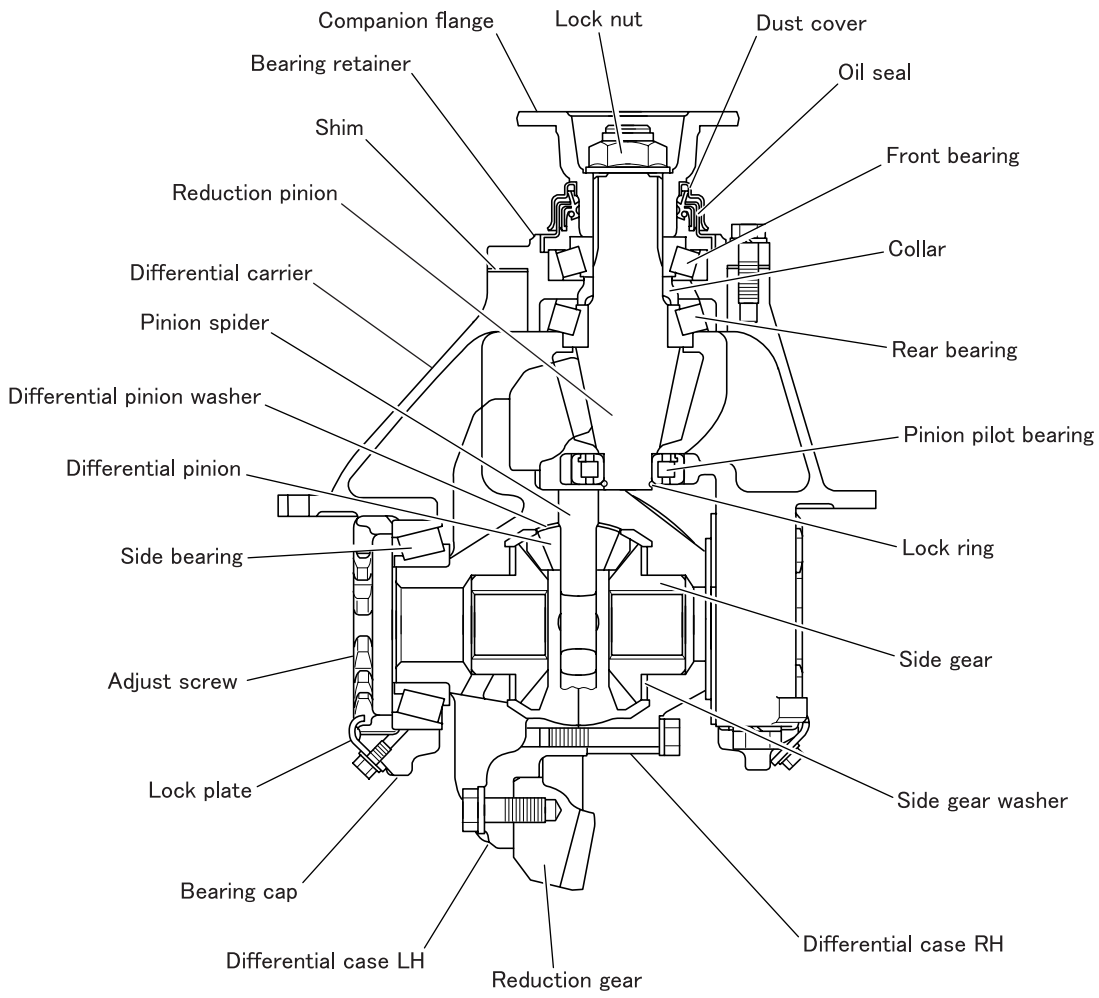
- Use gear oil with a SAE viscosity of 140 when a vehicle is used under heavy load conditions, including frequent driving on prolonged upgrades when the air temperature is above 10°C.
- Limited-slip differential oil API GL-5 SAE 90 is used for models with LSD (limited-slip differential).
- The weight varies according to vehicle model.

1. Wheel Hub and Rotor

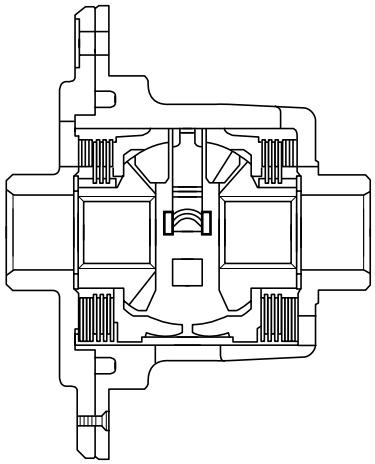


- The brake pad wear indicator is installed only on the right wheels.

2. Reduction and Differential

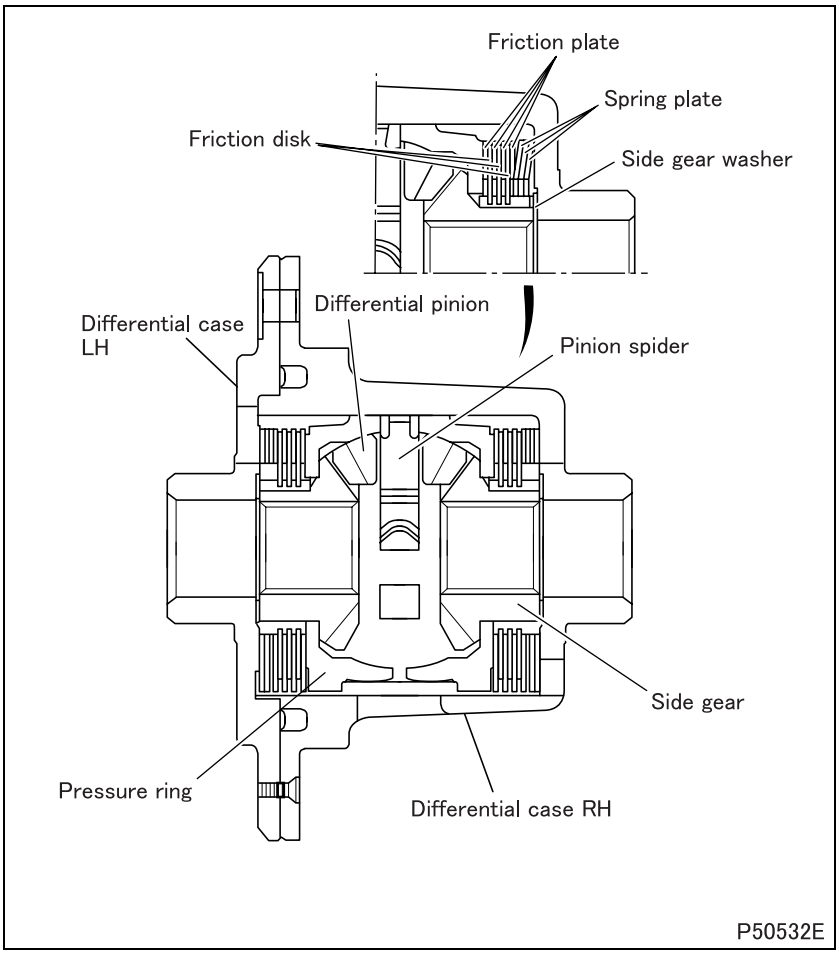


Limited slip differential



P58332E

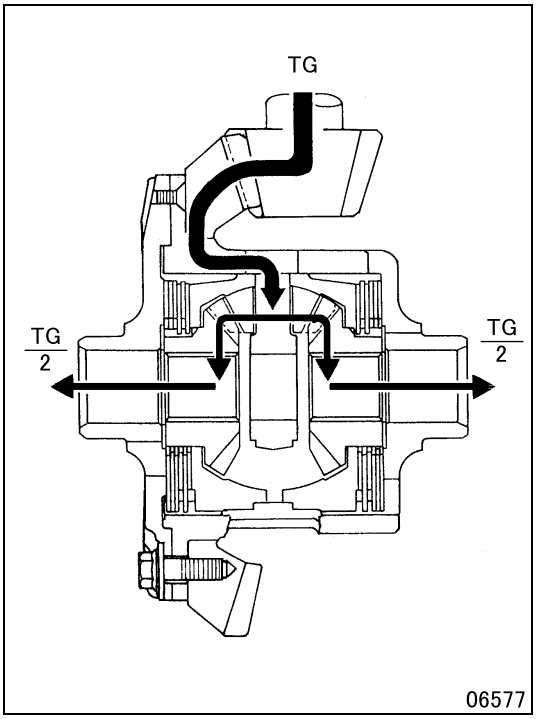
3. Limited Slip Differential



- The friction discs and spring discs, which are fitted in the side gears, and the friction plates, which are fitted in the R/H differential case, are pushed against the pressure rings by the spring plates.
- The pressure rings fit in the groove inside the R/H differential case and always rotate at the same speed.

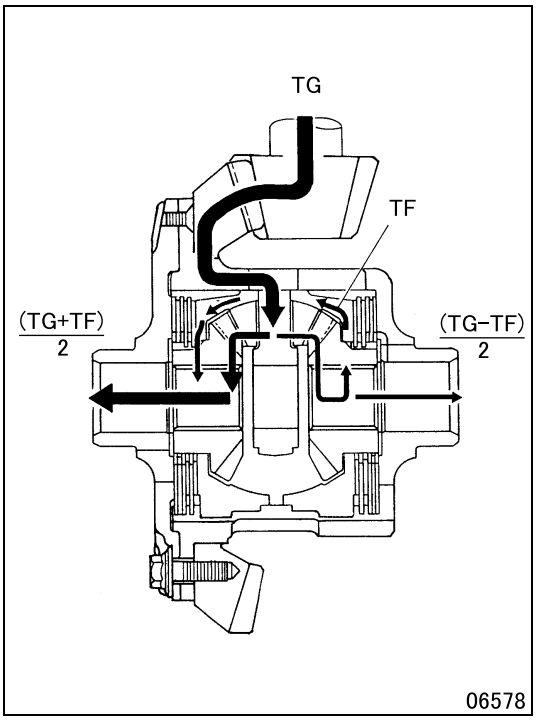
3.1 Operating mechanism

- When one wheel spins, a difference in the revolution speed generates between the side gear and the differential case, L/H and R/H, which causes the friction discs, spring discs and friction plates to revolve with respect to each other. This relative revolution produces a friction torque between the friction discs and friction plates.



3.2 Operation during straight driving

- During straight driving, the right and left axle shafts rotate at the same speed, and no friction torque generates.
  TG: input torque



3.3 Operation when there is a difference in rotation speed between right and left wheels

- If one wheel is on a slippery surface such as mud and the other wheel is not, the differential function becomes effective. Under these conditions, friction torque **TF** is generated, reducing the difference in rotations between right and left wheels. That is, the faster axle shaft is forced to slow down, and the slower axle shaft is forced to turn faster.
  If one wheel spins, a large friction torque is generated, because the spinning creates a large difference in rotational speed. In this way, a small torque is distributed to the spinning wheel at the same time that a large torque is distributed to the non-spinning wheel, which makes it easier for the vehicle to get out of the mud.

$\frac{\mathbf{TG-TF}}{\mathbf{2}}$ High-speed side (spinning side)

$\frac{\mathbf{TG+TF}}{\mathbf{2}}$ Low-speed side

M E M O

Possible causes	Symptoms	Power transmission insufficient						Oil leakage from companion flange assembly	Oil leakage from differential carrier and axle housing	Oil leakage from axle shaft	Reference Gr
		Noise when starting and changing gears	Continuous noise while cruising	Intermittent noise while cruising	Noise while cornering	Tires drag while cornering	Propeller shaft turns but vehicle does not move				
Wheel hub, axle shaft, axle housing	Wheel hub bearing seized, worn or rotation faulty		O								
	Wheel hub bearing broken			O							
	Axle shaft mounting bolts loose			O						O	
	Axle shaft broken						O				
	Axle shaft slips out of spline of side gear						O				
	Axle shaft to spline of side gear backlash excessive	O									
	Oil seal faulty									O	
	Axle housing bent		O								
	Inspection plug and drain plug loose								O		
	Air breather and vent plug clogged							O		O	
Reduction and differential	Gear oil excessive							O			
	Gear oil insufficient	O	O								
	Oil seal faulty							O			
	Sealant faulty								O		
	Reduction and differential assembly mounting nuts and bolts loose			O					O		
	Differential carrier cracked or damaged								O		
	Bearing cap mounting bolts loose			O							
	Side bearing seized, worn or rotation faulty		O		O						
	Side bearing broken			O							
	Side bearing preload adjusted incorrectly		O								
	Reduction pinion or reduction gear broken	O		O	O		O				
	Reduction pinion or reduction gear worn		O		O						
	Reduction pinion or reduction gear damaged		O								
	Reduction gear backlash excessive	O									
	Reduction gear backlash or tooth contact adjusted incorrectly		O								

Possible causes	Symptoms	Power transmission insufficient						Oil leakage from companion flange assembly	Oil leakage from differential carrier and axle housing	Oil leakage from axle shaft	Reference Gr
		Noise when starting and changing gears	Continuous noise while cruising	Intermittent noise while cruising	Noise while cornering	Tires drag while cornering	Propeller shaft turns but vehicle does not move				
Reduction and differential	Starting torque of pinion bearing faulty	O	O								
	Locknut loose	O	O								
	Front and rear bearings seized		O								
	Front and rear bearings worn		O								
	Front and rear bearings broken			O							
	Pinion pilot bearing worn		O								
	Pinion pilot bearing seized or broken			O							
	Pinion shaft and pinion spider broken						O				
	Reduction gear and differential case mounting bolt and nut loose	O		O							
	Side gear backlash excessive	O									
	Side gear or differential pinion broken			O	O	O	O				
	Side gear or differential pinion seized					O	O				
	Side gear or differential pinion worn				O	O					
	Side gear washer worn or damaged			O	O	O					
	Limited-slip differential (LSD) broken <On vehicles with LSD>	O	O	O	O		O				

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Axle Oil Level Check and Axle Oil Change

Torque value: N·m (lbf·ft)

Mark	Component	Torque value	Remarks
–	Inspection plug	110 ± 10 (81 ± 7.4)	–
	Drain plug		

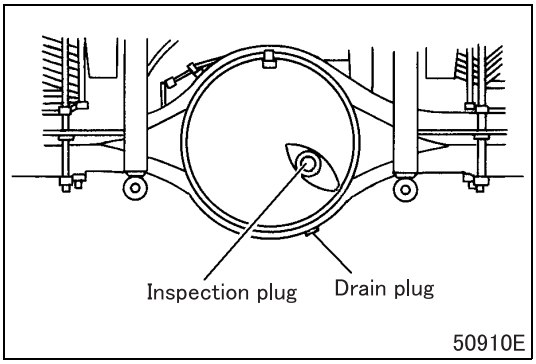
Lubricant and/or sealant

Mark	Points of application		Specified lubricant and/or sealant	Quantity
–	Axle housing	D033H, D035H	Normal: Maximum air temperature during operation below 40°C {104°F} API GL-5 SAE 90 Hot area: Maximum air temperature during operation above 40°C {104°F} API GL-5 SAE 140	4.5 L {4.8 qt}

- Use gear oil with a SAE viscosity of 140 when a vehicle is used under heavy load conditions, including frequent driving on prolonged upgrades when the air temperature is above 10°C.
- Limited-slip differential oil API GL-5 SAE 90 is used for models with LSD (limited-slip differential).

WARNING ⚠

- **Axle oil is extremely hot immediately after vehicle operation. Hot axle oil can cause burns.**



(1) Oil level check

- Remove the fill plug, and check that the axle is filled with oil up to the level of the fill opening.
- If needed, add oil through the fill hole until it is at the level of the fill opening.
- Install the fill plug and tighten it to the specified torque.

(2) Oil change

[Draining and inspection]

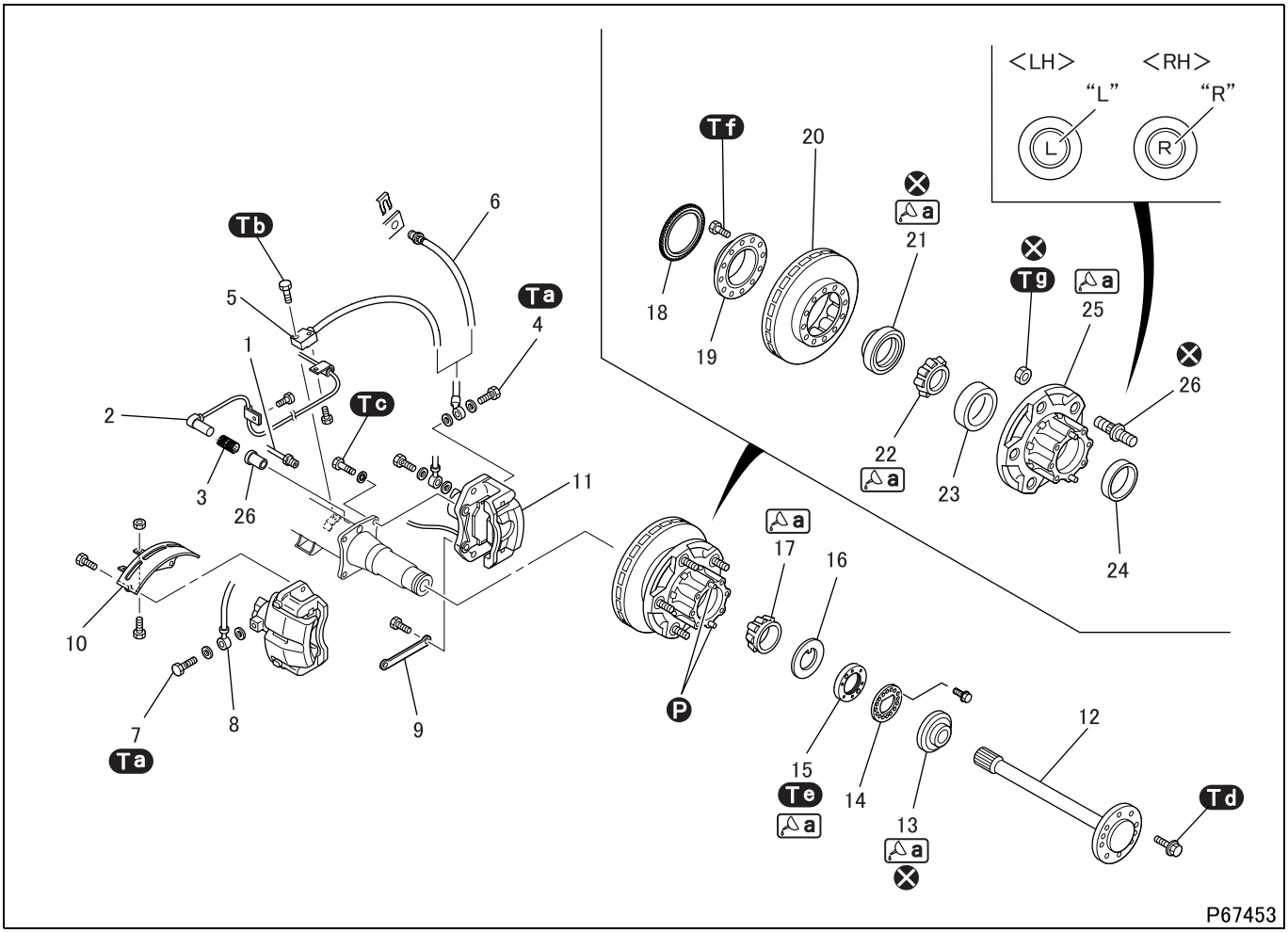
- Remove the fill plug and magnetic drain plug. Drain the oil while the axle is still warm. Catch the unused oil in a suitable container.
- Check the drained oil for presence of metal chips and metal powder. Dispose of the oil properly.
- If an abnormally large amount of metal chips and metal powder is found, remove the axle.

[Filling]

- Clean the magnetic drain plug before installation.
- Add gear oil in the specified quantity through the fill plug opening.
- After filling, check that oil is filled up to the level of the fill opening. If needed, add oil through the fill hole until it is at the level of the fill opening.
- Tighten the fill and drain plugs to the specified torque.

M E M O

WHEEL HUB AND ROTOR



● Disassembly sequence

1 Brake line
2 Wheel speed sensor
3 Spring spacer
4 Eye bolt
5 Brake hose (with connector)
6 Brake hose (without connector)
7 Eye bolt
8 Brake hose
9 Lower dust shield
10 Upper dust shield
11 Rear disc brake (see Gr35A)
12 Axle shaft
13 Outer oil seal
14 Lock washer
15 Locknut
16 Lock plate <COE 50>
17 Outer bearing inner race
18 Antilock brake system rotor
19 Antilock brake system rotor flange
20 Disc rotor
21 Oil seal
22 Inner bearing inner race
23 Inner bearing outer race
24 Outer bearing outer race
25 Wheel hub
26 Hub bolt
27 Sensor holder

Ⓟ: Locating pin
⊗: Non-reusable parts

CAUTION ⚠

- **Plug the brake hose to prevent entry of dust and dirt after it has been removed.**

NOTE

- **Do not remove the antilock brake system rotor and sensor holder except to replace them.**
- **Do not disassemble the disc rotor and wheel hub except to replace them.**

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **Make sure that the disc rotor surface and disc brake pad surface are free from grease.**
- **Make sure that the brake hose is not twisted or kinked.**
- **Inspect the drag torque of disc brakes after assembly. (See Gr35A.)**

Service standards: mm {in}

Location	Maintenance item		Standard value	Limit	Remedy
–	Starting torque of wheel hub bearing (inertial force at hub bolt position with oil seal assembled)		2.0 to 3.9 N·m {1.4 to 2.9 lbf·ft} (inertial force: 18 to 32 N {4.0 to 7.2 lb}	–	Adjust or replace
12	Axle shaft	Bend	1 {0.039} or less	2 {0.079}	Replace
		Bend at flange face	0.03 {0.0012} or less	0.05 {0.0020}	
19	Disc rotor	Runout (measure runout, assembling disc rotor in rear axle)	0.07 {0.0028} or less	0.10 {0.0039}	Replace
		Thickness	40 {1.57}	38 {1.50}	

Torque value: N·m (lbf·ft)

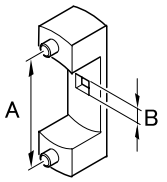
Mark	Fastener			Torque value	Remarks
Ta	Eye bolt			22 ± 2 (16 ± 1.5)	–
Tb	Bolt (brake hose mounting) (with connector)			43.2 ± 10 (32 ± 7.4)	–
Tc	Bolt (rear disc brake mounting)			98 to 140 (72 to 103)	–
Td	Bolt (axle shaft mounting)			98 to 120 (72 to 87)	–
Te	Locknut	Primary tightening	COE 40/45	98 to 130 (72 to 96)	–
			COE 50	150 to 180 (110 to 130)	
		Secondary tightening after complete tightening	COE 40/45	30 to 40 (22 to 29)	–
			COE 50	50 to 60 (37 to 44)	
Tf	Bolt (wheel hub and disc rotor mounting)			45 to 60 (33 to 44)	–
Tg	Nut (hub bolt mounting)			340 ± 40 (251 ± 30)	–

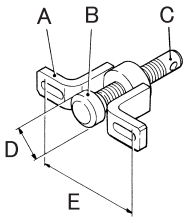
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
△a	Lip area of outer oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Thread area of locknut		
	Pack space between rollers of outer bearing inner race and inner bearing inner race		
	Lip area of oil seal		
	Pack interior of wheel hub		370 ± 37 g ※ {13.1 ± 1.31 oz}

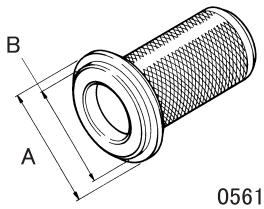
※: For a wheel hub

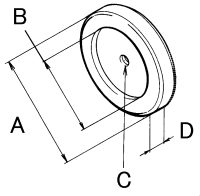
Special tools (Unit: mm {in})

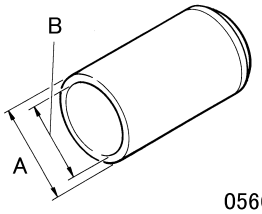
<table>
<tr><th>Mark</th><th>Tool name and shape</th><th>Part No.</th><th>Application</th></tr>
<tr><td>a</td><td>Locknut adjuster
 

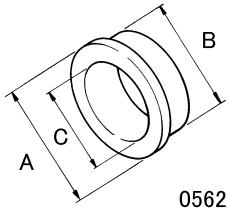
P05617
<table><tr><th>Parts No.</th><th>A</th><th>B</th></tr><tr><td>MB999150</td><td>70
{2.76}</td><td>□12.7
{0.50}</td></tr><tr><td>MC888793</td><td>80
{3.15}</td><td>□12.7
{0.50}</td></tr></table></td><td><FE84>
MB999150
<FE85>
MC888793</td><td>Removal and installation of locknut</td></tr>
<tr><td>b</td><td>Hub puller
A: Hub puller body
B: Attachment
C: Bolt
 

05618
<table><tr><th>D</th><th>E</th></tr><tr><td>ϕ50
{1.97}</td><td>165
{6.50}</td></tr></table></td><td>MB999070

A: MB999071
B: MB999073
C: MB999072</td><td>Removal of wheel hub and rotor</td></tr>
<tr><td>c</td><td>Oil seal installer
 

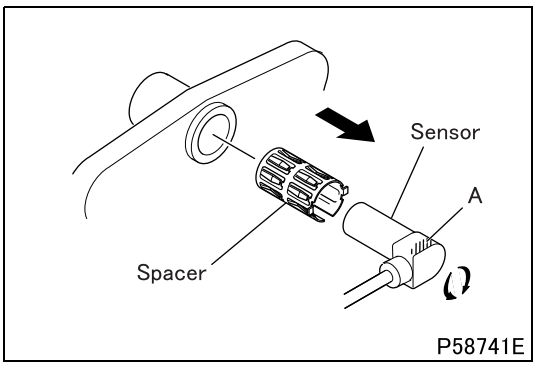
05619
<table><tr><th>A</th><th>B</th></tr><tr><td>ϕ84
{3.31}</td><td>ϕ70
{2.76}</td></tr></table></td><td>MB999097</td><td rowspan="3">Installation of oil seal (to be used in combination)</td></tr>
<tr><td>d</td><td>Oil seal installer
 

51705
<table><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr><tr><td>ϕ117
{4.61}</td><td>ϕ84
{3.31}</td><td>M10 × 1.25</td><td>20
{0.79}</td></tr></table></td><td>MH062607</td></tr>
<tr><td>e</td><td>Bearing installer
 

05668
<table><tr><th>A</th><th>B</th></tr><tr><td>ϕ70
{2.76}</td><td>ϕ57
{2.24}</td></tr></table></td><td>MB999100</td><td rowspan="2">Installation of inner and outer bearing outer races (to be used in combination)</td></tr>
<tr><td>f</td><td>Bearing installer
 

05621
<table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>ϕ109
{4.29}</td><td>ϕ99
{3.90}</td><td>ϕ77
{3.03}</td></tr></table></td><td>MB999098</td></tr>
</table>

◆Removal procedure◆

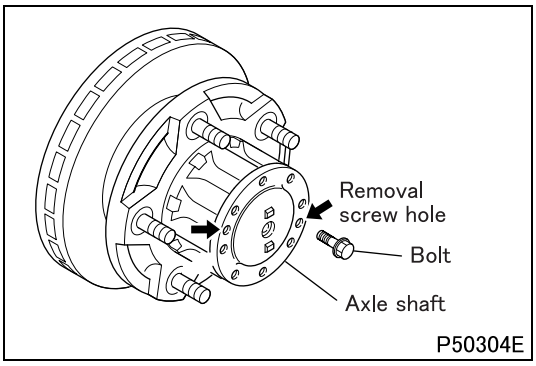


■ Removal: Wheel speed sensor

- Hold the shaded section (section A) of the wheel speed sensor with pliers. Remove the sensor by twisting it slightly to the left and right.
- If the wheel speed sensor pulls out without any resistance, replace the spring spacer.

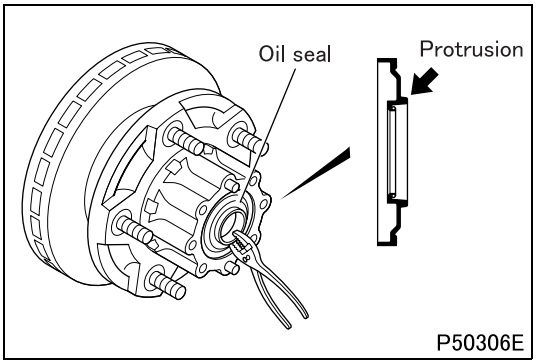
CAUTION ⚠

- **When removing the wheel speed sensor, never apply force to it, such as tapping it with a hammer, prying it with a screwdriver, or yanking on the harness. This could cause the wire to break.**



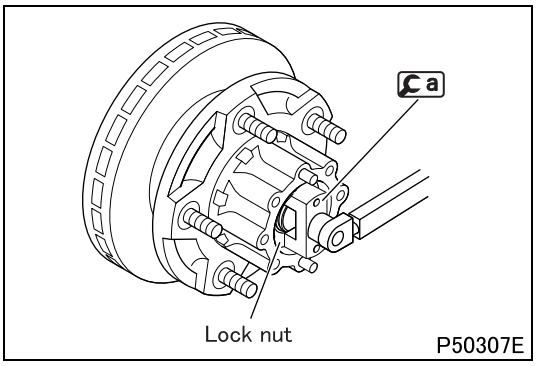
■ Removal: Axle shaft

- Remove the axle shaft mounting bolts that attach the axle shaft to the wheel hub.
- Screw two axle shaft mounting bolts evenly into the axle shaft removal screw holes. Use them as handles to remove the axle shaft.

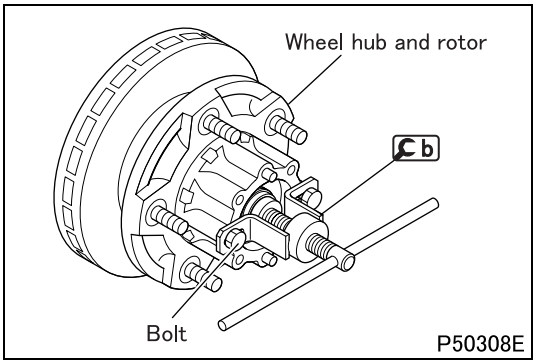


■ Removal: Outer oil seal

- To remove the outer oil seal, use pliers to pull on the protrusions on the outer edge of the outer oil seal. Pull evenly around the whole circumference of the seal.

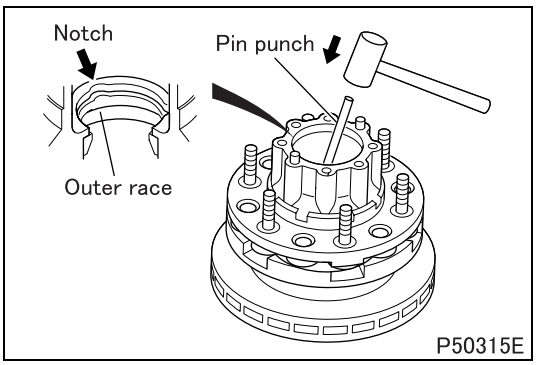


■ Removal: Locknut



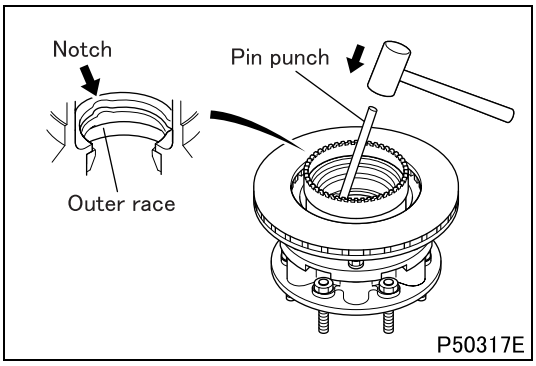
■ **Removal: Wheel hub and rotor**

- Install the hub puller [b] and fasten it with axle shaft mounting bolts. Remove the wheel hub and rotor assembly.



■ **Removal: Inner bearing outer race**

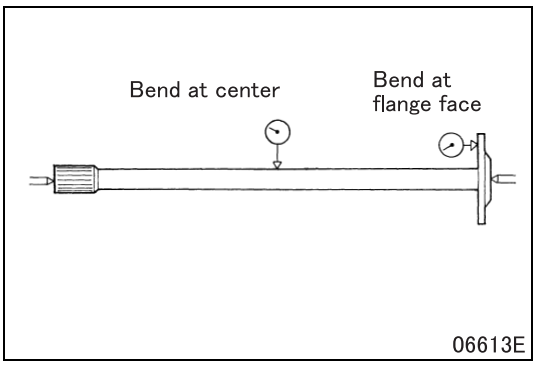
- Drive out the inner bearing outer race by tapping at each of the three indentations in the wheel hub. Keep the race level as it is being removed.



■ **Removal: Outer bearing outer race**

- Drive out the outer bearing outer race by tapping at each of the three indentations in the wheel hub. Keep the race level as it is being removed.

◆Inspection procedure◆

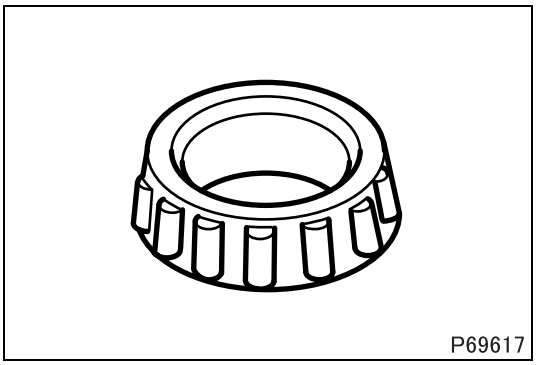


■ **Inspection: Axle shaft**

- Measure the bend of the axle shaft at its center.

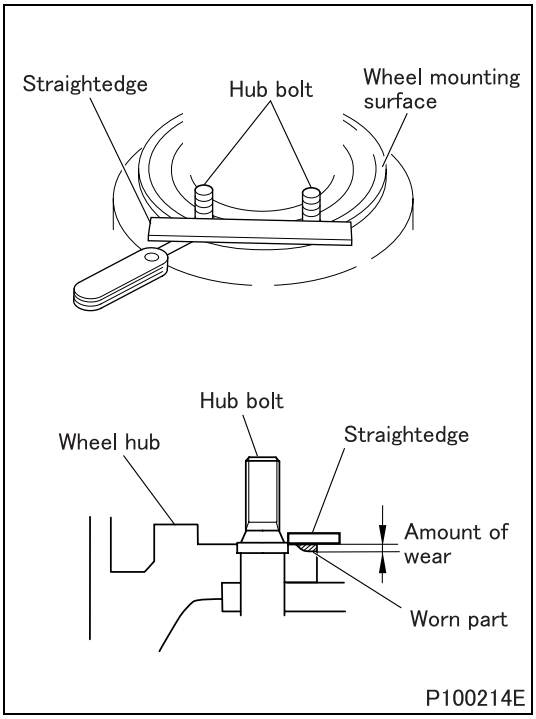
NOTE

- **Give the axle shaft one complete turn and read the dial gauge at this time. The bend is one half of the dial gauge reading.**
- If the measured value exceeds the limit, replace the axle shaft.
- Measure the bend of the flange face of the axle shaft.
- If the measured value exceeds the limit, replace the axle shaft.



■ **Inspection: Outer bearing inner race**

- Inspect the outer bearing inner race after cleaning the bearing to remove grease completely.
- If any damage, wear, or poor rotating condition is evident in the inner race, replace it with a new one.
- The inner race and outer race should be replaced as a set.



■ **Inspection: Wear at the outer periphery of wheel hub**

- Clean the wheel mounting surface of the wheel hub before inspection.
- Place a straight edge on the hub so as to contact to the two hub bolts on the wheel mounting surface.

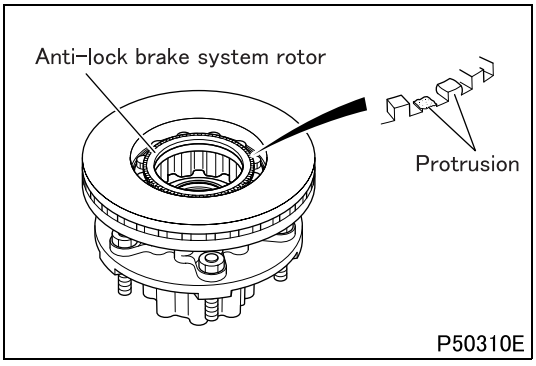
CAUTION ⚠

- **Make sure that the straight edge does not run onto the hub bolt.**

- Use feeler gauges to measure the amount of wear at the outer periphery of the wheel hub.
  Measure the amount of wear in the area of every hub bolt.
- If the amount of wear at any point exceeds the limit, replace the wheel hub.
- If the wheel has cracks or has a stepped wear at the wheel hub mounting surface, replace the wheel.

CAUTION ⚠

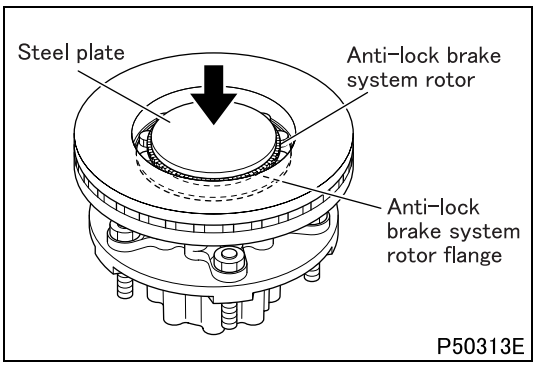
- **Never paint the wheel mounting surface of the wheel hub as it may be a cause of loose wheel nut.**



■ **Inspection: Antilock brake system rotor**

[Inspection]

- Remove any debris on the antilock brake system rotors. Check the protrusions on the antilock brake system rotor for chipping and flattening.
- If any problem is found, replace the antilock brake system rotor.



[Installation]

- Heat the antilock brake system rotor to approximately 150°C (302°F).
- Install the antilock brake system rotor and antilock brake system rotor flange evenly using a steel plate so as not to allow them to tilt.

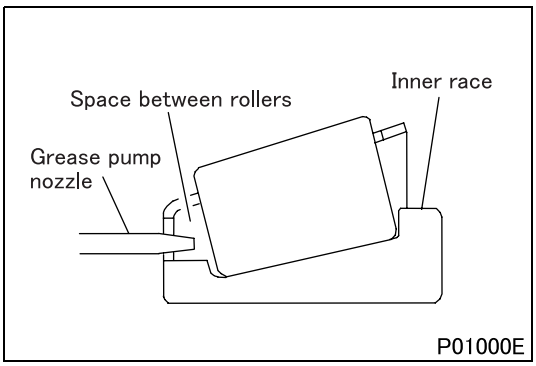
WARNING ⚠

- **Touching the heated rotor will cause burns.**

■ **Inspection: Inner bearing inner race**

- Inspect the inner bearing inner race in the same manner as for the outer bearing inner race.
  (See **"■ Inspection: Outer bearing inner race".**)

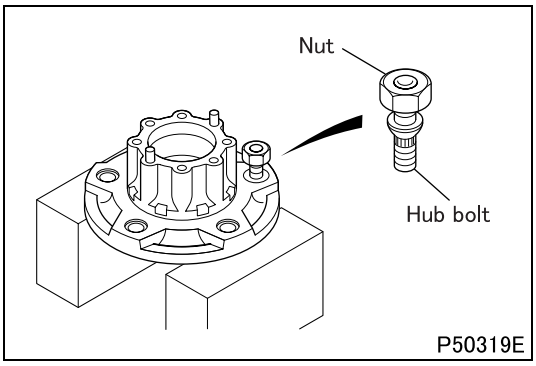
◆Installation procedure◆



■ **Installation: Packing grease in inner bearing inner race**

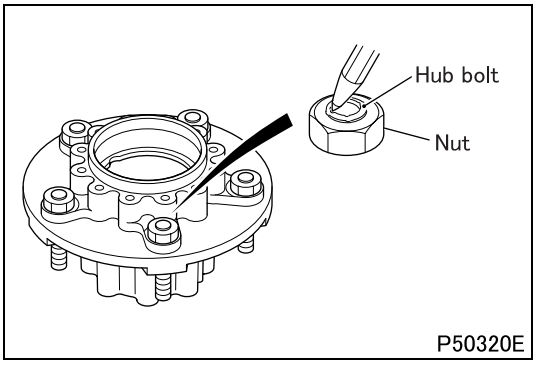
- Insert the grease pump nozzle into the space between rollers of the inner bearing inner race to pack grease sufficiently.

◆Installation procedure◆

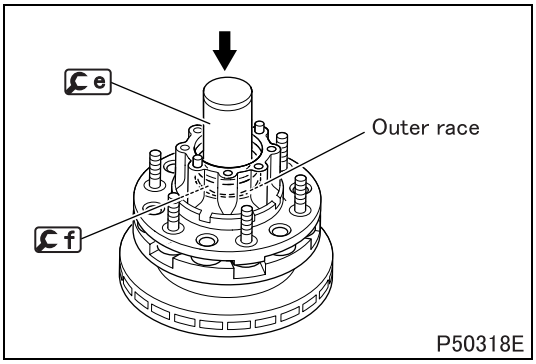


■ **Installation: Hub bolt**

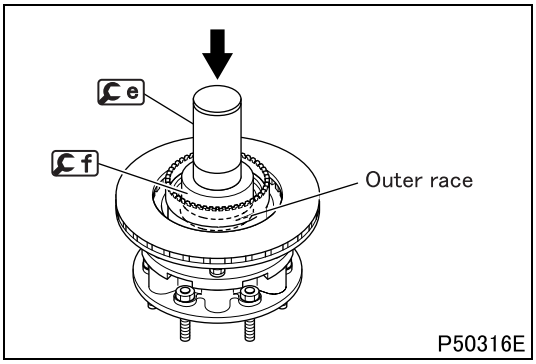
- Screw the nuts into the hub bolt until they are almost flush with the flange.
- Drive the hub bolt into the wheel hub vertically by hitting the end face of the nut with a brass punch, or similar tool.



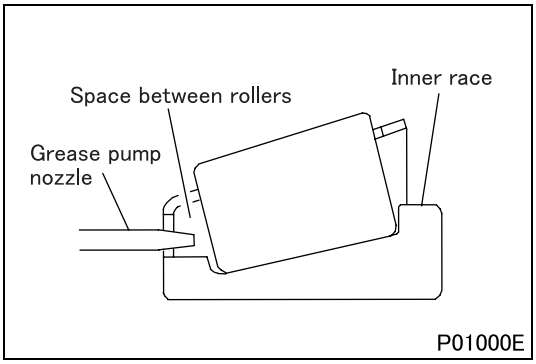
- After tightening the nut to the specified torque, use a punch to lock it in place.



■ **Installation: Outer bearing outer race**

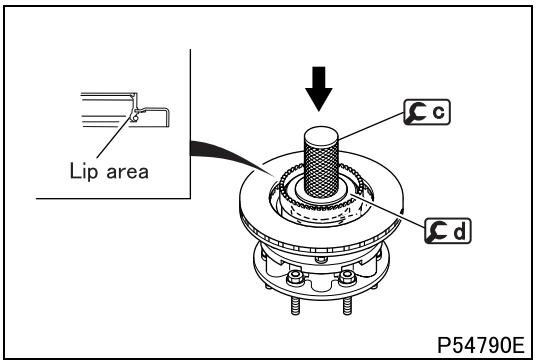


■ **Installation: Inner bearing outer race**



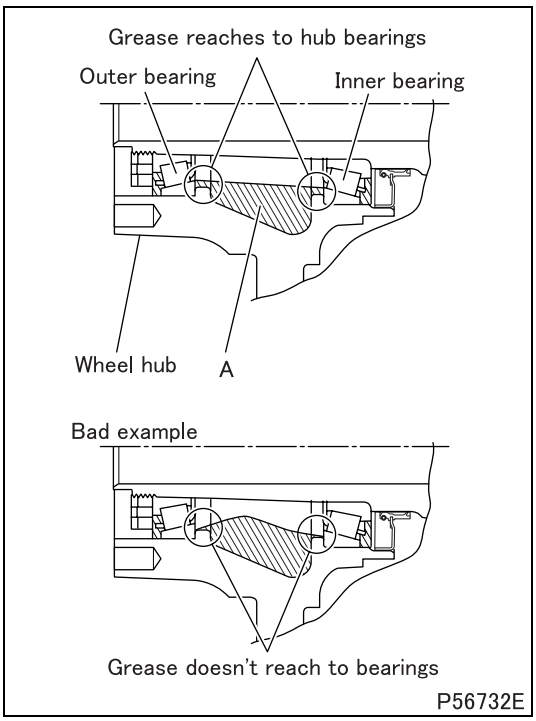
■ **Installation: Packing grease in inner bearing inner race**

- Insert the nozzle of the grease pump into the space between rollers of the inner bearing inner race to pack grease sufficiently.



■ **Installation: Oil seal**

- Apply grease to the lip area of the oil seal and install it on the wheel hub in the illustrated direction.

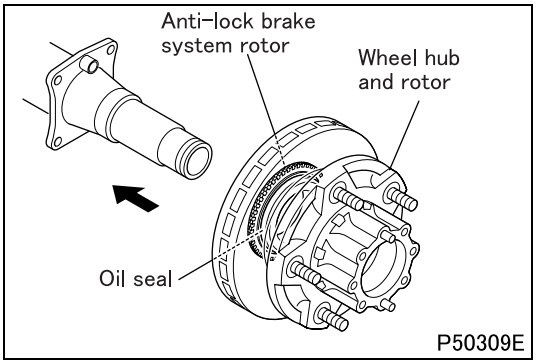


■ **Installation: Wheel hub and rotor**

- Apply the specified amount of grease to area A of wheel hub. The grease must reach to both the inner and outer bearing as shown in the illustration.

CAUTION ⚠

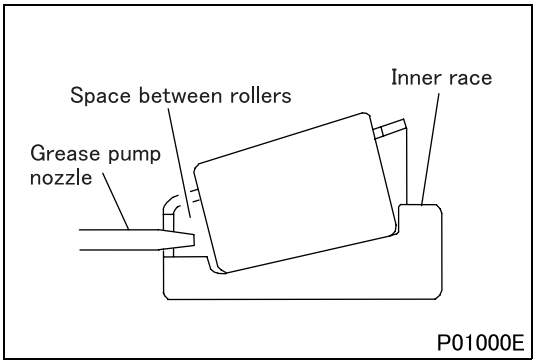
- **Applying grease as shown in the "bad example" causes the wheel hub bearing to seize.**



- Slowly install the wheel hub and rotor assembly so as not to cause damage to the oil seal and antilock brake system rotor.

CAUTION ⚠

- **If the antilock brake system rotor is damaged, wheel speed sensor signals become abnormal, causing the antilock brake system to malfunction.**

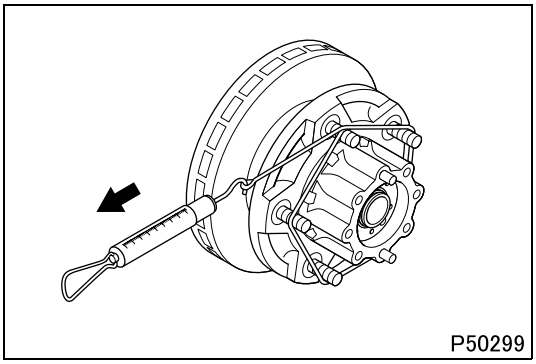


■ Installation: Packing grease in outer bearing inner race

- Insert the nozzle of the grease pump into the space between rollers of the inner bearing inner race to pack grease sufficiently.

■ Installation: Locknut

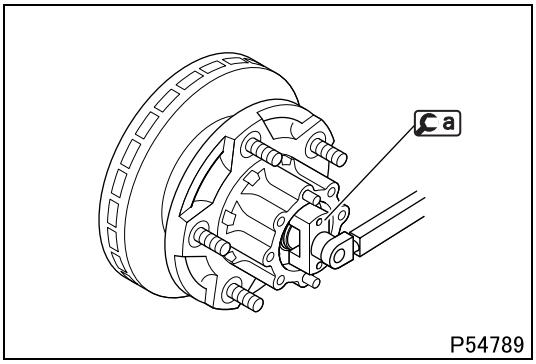
- Install the locknut, as removed. (See **■ Removal: Locknut**.)



■ Inspection: Starting torque of wheel hub bearing

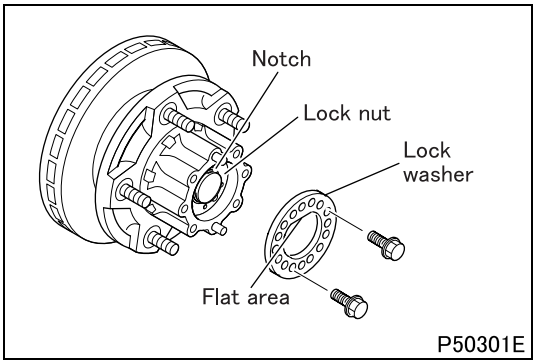
[Inspection]

- After installing the lock washer, carry out the following inspections.
- Measure the inertial force at the hub bolt position using a spring balance.
- If the inertial force is within the specified value, the starting torque conforms to the standard value. If the measured value deviates from the specified value, do the adjustment below.

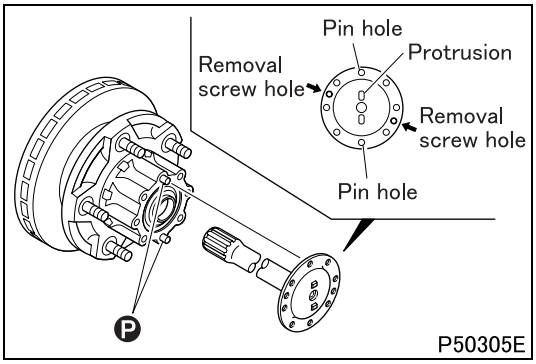


[Adjustment]

- Tighten the locknut to the specified torque (primary tightening) while turning the wheel hub and rotor, and then loosen it completely.
- Turn the wheel hub and rotor back and forth several times until it operates smoothly. Then tighten the locknut to the specified torque (secondary tightening).



- Insert the flat area of the lock washer and align it with the notch in the axle housing. Fasten the locknut with two bolts installed across from each other.
- If the locknut does not align with one of the holes in the lock washer, adjust the locknut until it aligns. Make sure that there is no play in the axial direction.
- Do the measurement again after the adjustment. If any problem is found, replace the outer and inner bearings.

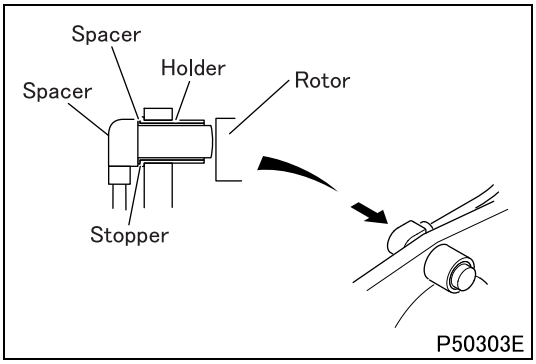


■ Installation: Axle shaft

- Align the pin hole of the locating pin with that of the axle shaft to install the axle shaft.

NOTE

- **The pin holes do not necessarily line up with the protrusions on the axle shaft flange as shown in the illustration. To locate a pin hole, go clockwise to the second hole from a removal screw hole.**

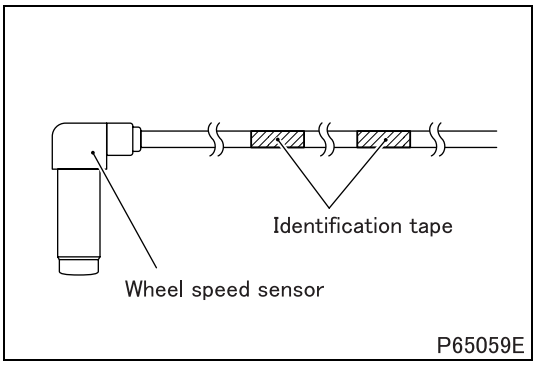


■ Installation: Wheel speed sensor

- Install the wheel speed sensor so that it securely contacts the sensor holder together with the spring spacer.

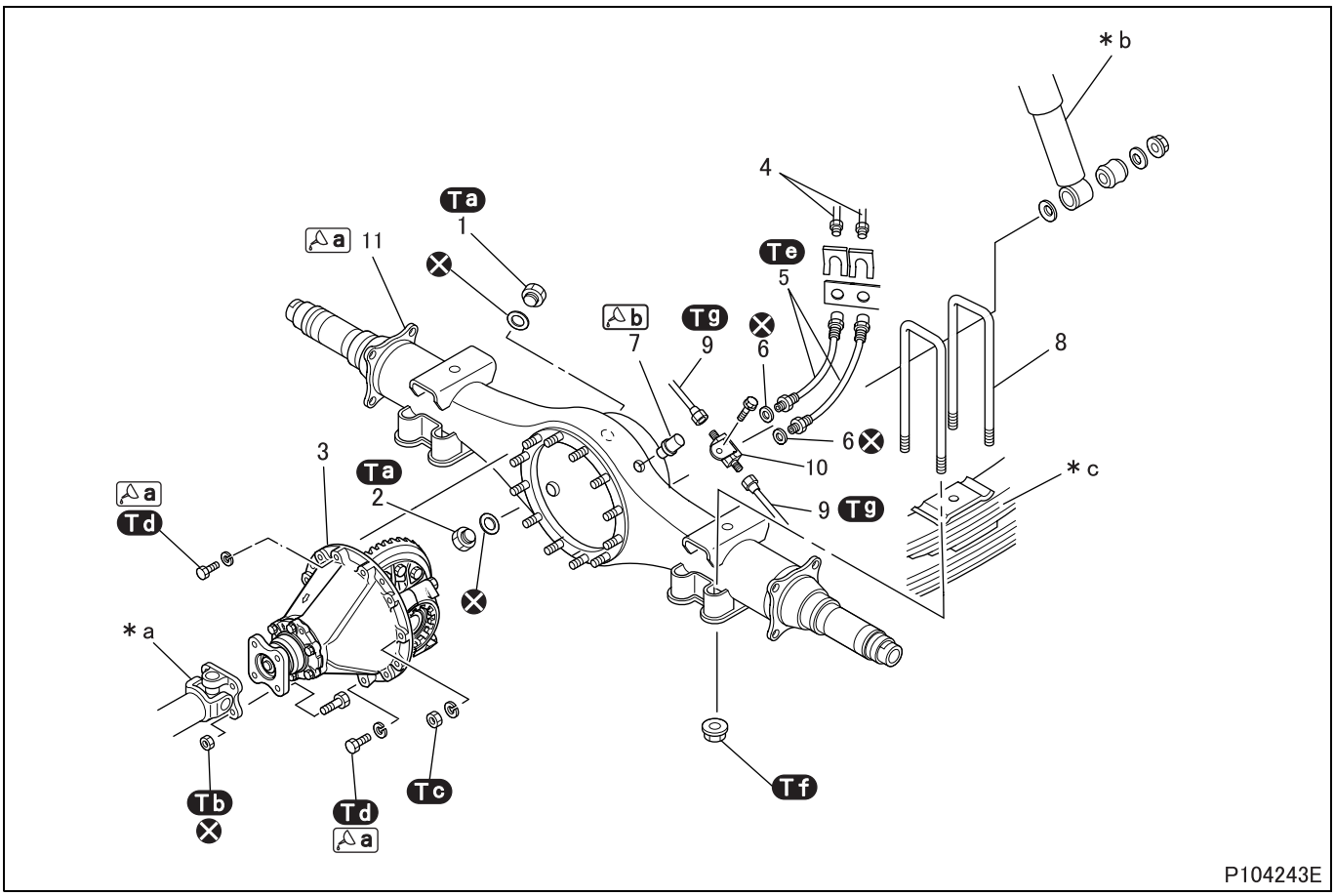
CAUTION ⚠

- **When installing the wheel speed sensor, never apply force to it, such as tapping it with a hammer, prying it with a screwdriver, or yanking on the harness. This could cause the wire to break.**



- Use clips to secure the wheel speed sensor harness at the identification tape portions. Ensure that the harness is free of kinks, slack, and/or interference with other parts.

AXLE HOUSING



● Removal sequence

1 Inspection plug
2 Drain plug
3 Reduction and differential (see later sections)
4 Brake pipe
5 Brake hose
6 Packing <COE 45/50>
7 Vent plug
8 U-bolt
9 Brake pipe
10 Connector
11 Axle housing

∗a: Propeller shaft
∗b: Shock absorber
∗c: Leaf spring

⊗: Non-reusable parts

CAUTION ⚠

- **Plug the brake hose and brake line to prevent the entry of dust and dirt into the brake system.**

NOTE

- **Do not remove the axle housing unless a problem is found.**

● Installation sequence

Follow the removal sequence in reverse.

Service standards: mm {in}

Location	Maintenance item		Standard value	Limit	Remedy
7	Injection-valve opening pressure of vent plug		4.9 kPa {0.7 psi} or less	–	Replace
11	Axle housing	Runout at outer bearing portion	0.5 {0.020} or less	1 {0.039}	Replace
		Difference between before and after rotation at center <drive axle>	1 {0.039} or less	5 {0.20}	

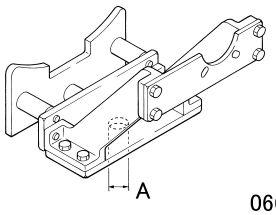
Torque value: N·m (lbf·ft)

Mark	Component		Torque value	Remarks
Ta	Inspection plug		98 ± 120 (72 ± 89)	–
	Drain plug			
Tb	Nut (propeller shaft mounting)		100 to 120 (74 to 89)	M12
Tc	Nut (reduction and differential mounting)		69 to 93 (51 to 69)	–
Td	Bolt (reduction and differential mounting)		83 to 108 (61 to 80)	–
Te	Brake hose	<COE 40>	25.5 to 34.3 (18.8 to 25.3)	–
		<COE 45/50>	20.6 to 31.4 (15.2 to 23.2)	–
Tf	Nut (U-bolt mounting)		292 to 394 (215 to 290)	M18
Tg	Brake pipe		12.7 to 16.7 {9.4 to 12, 1.3 to 1.7}	–

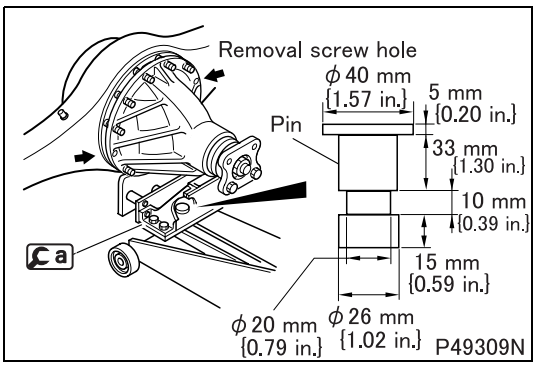
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Thread area of bolt	ThreeBond 1215	As required
	Reduction and differential mounting surface of axle housing		
b	Axle housing mounting surface of vent plug	ThreeBond 1216	As required

Special tools (Unit: mm {in})

Mark	Tool name and shape	Part No.	Application
Ca	Differential carrier base A: ϕ28 {1.10}  06679	MB999102	Removal and installation of reduction and differential

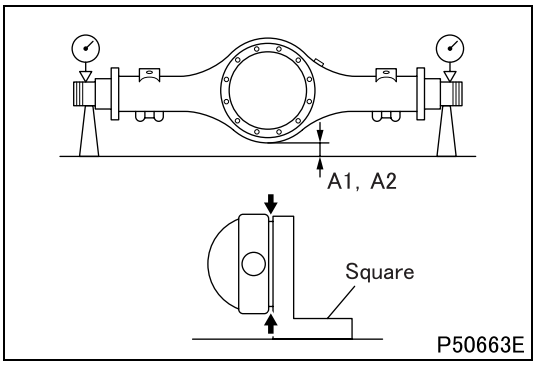
◆Removal procedure◆



■Removal: Reduction and differential

- Lower the garage jack and place the differential carrier base [a] on it. Use a pin fabricated to the dimensions in the illustration. Insert the pin and fasten it.
- Screw two bolts evenly into the reduction and differential removal screw holes (as shown in illustration), Use them as handles to remove the reduction and differential.
  Bolt size: M12 × 1.25 mm

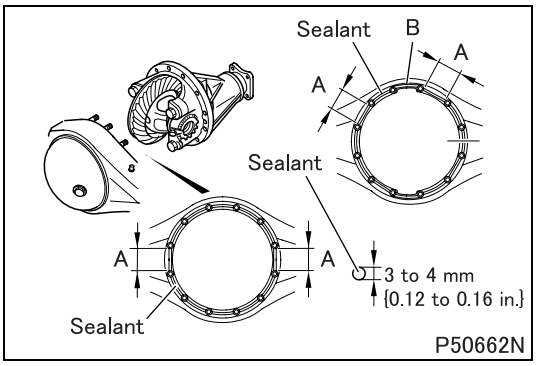
◆Inspection procedure◆



■Inspection: Axle housing

- Horizontally support the inner bearing fittings at both ends of the housing spindle of the axle housing.
- Apply a dial gauge to the outer bearing fitting and turn it 360 degrees to measure runout.
- For measurement of dimensions **A1** and **A2**, place the axle housing at right angles using a square and measure dimension **A1**. Then, turn it 180 degrees and measure dimension **A2**.
- If the measured value exceeds the limit, replace the axle housing.

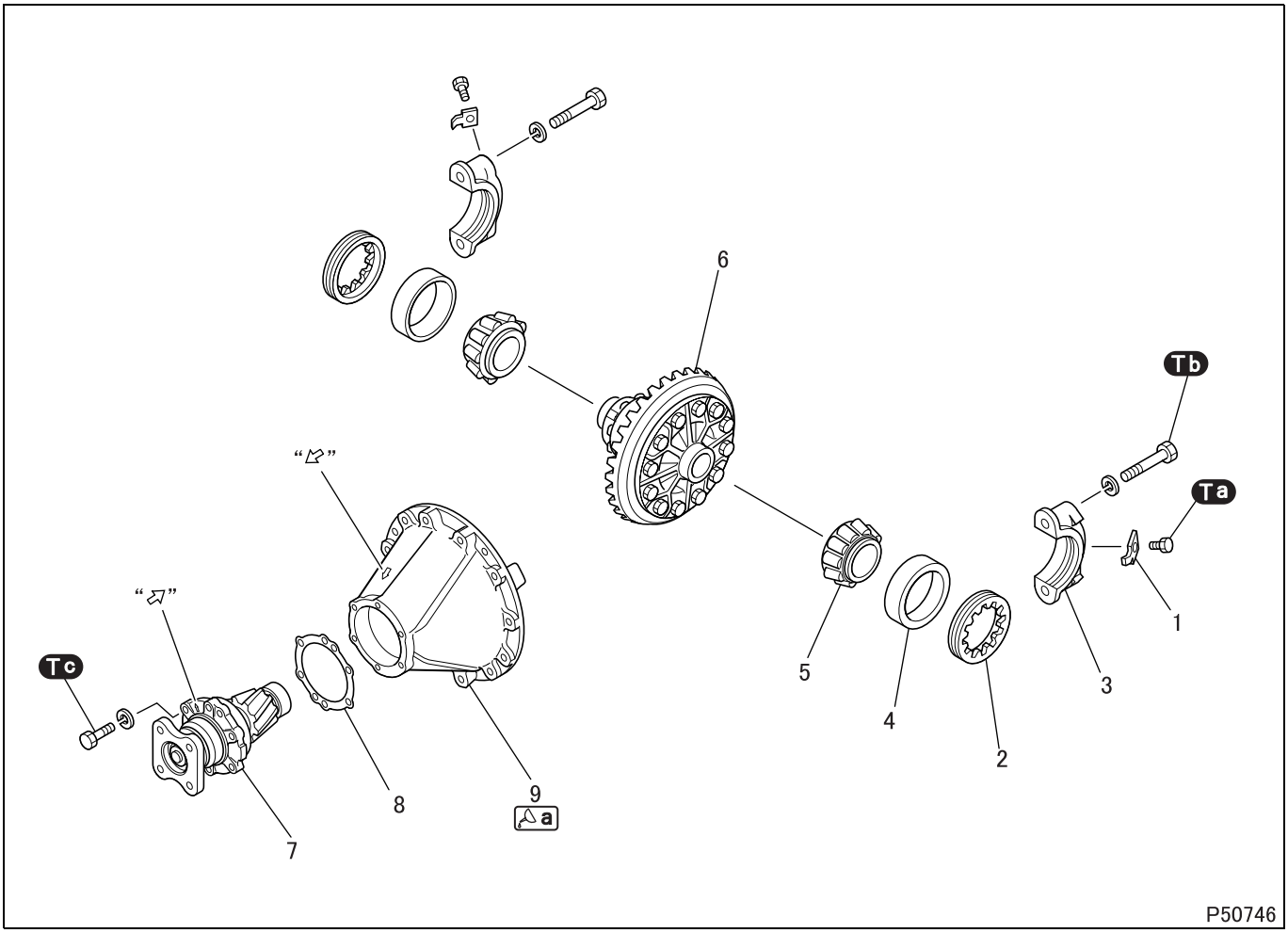
◆Installation procedure◆



■Installation: Reduction and differential

- Clean a seal surface of each part.
- Apply sealant to the reduction and differential mounting surface of the axle housing evenly and without breaks. Apply sealant in a straight line direction for illustrated position **A** and along the outer periphery for notches of illustrated position **B**.

M E M O



● Disassembly sequence

1 Lock plate
2 Side bearing nut
3 Bearing cap
4 Side bearing outer race
5 Side bearing inner race
6 Differential (see later sections)
7 Reduction pinion (see later sections)
8 Shim
9 Differential carrier

CAUTION ⚠

- **Keep side bearings that have been removed separated from each other and ensure that during installation each one is correctly placed.**
- **Be sure to replace the bearing cap, differential carrier and bolts as a differential carrier set.**
- **Be sure to replace the reduction pinion and the reduction gear of the differential as a reduction gear set.**

NOTE

- **Record the number and thickness of shims to use them as reference at assembly.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
7, 8	Starting torque of side bearing	2.0 to 2.9 N·m {1.4 to 2.2 ft.lbs}	–	Adjust
9	Wobble at back face of reduction gear	0.1 {0.0039} or less	–	Replace
9, 11	Backlash between reduction gear and reduction pinion	0.20 to 0.28 {0.0079 to 0.011}	0.5 {0.020}	Adjust or replace

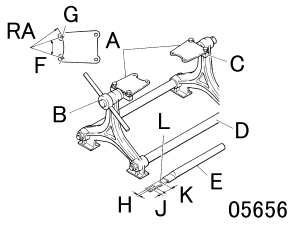
Torque value: N·m (lbf·ft)

Mark	Fastener	Torque value	Remarks
Ta	Bolt (lock plate mounting)	20 to 26 (15 to 19)	–
Tb	Bolt (bearing cap mounting)	200.9 (150)	–
Tc	Bolt (pinion mounting)	67 to 90 (49 to 67)	–

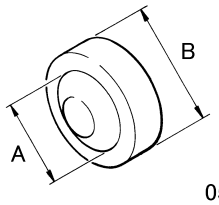
Lubricant and/or sealant

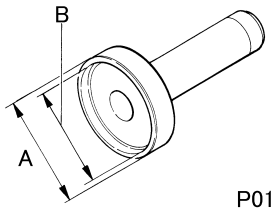
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Pinion pilot bearing mounting surface of differential carrier	Loctite 601	As required

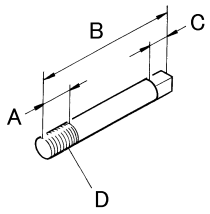
Special tools (Unit: mm {in})

<table>
<tr><th>Mark</th><th>Tool name and shape</th><th>Part No.</th><th>Application</th></tr>
<tr><td>a</td><td>
Differential working base


05656
<table>
<tr><th colspan="4">Component</th><th>Part No.</th></tr>
<tr><td rowspan="2">A</td><td colspan="3">Attachment</td><td>–</td></tr>
<tr><td>RA</td><td>F</td><td>G</td><td>–</td></tr>
<tr><td>R158 {6.22}</td><td>30°</td><td>ϕ13 {0.51}</td><td>MB999040</td></tr>
<tr><td>B</td><td colspan="3">Holder</td><td>MB999036</td></tr>
<tr><td>C</td><td colspan="3">Holder</td><td>MB999037</td></tr>
<tr><td>D</td><td colspan="3">Working base</td><td>MB999035</td></tr>
<tr><td>E</td><td colspan="3">Flange stopper</td><td>MB999096</td></tr>
</table>
<table>
<tr><th>H</th><th>J</th><th>K</th><th>L</th></tr>
<tr><td>11 {0.43}</td><td>20 {0.79}</td><td>40 {1.57}</td><td>ϕ11 {0.43}</td></tr>
</table>
</td><td>MB999034</td><td>Workbench for reduction and differential

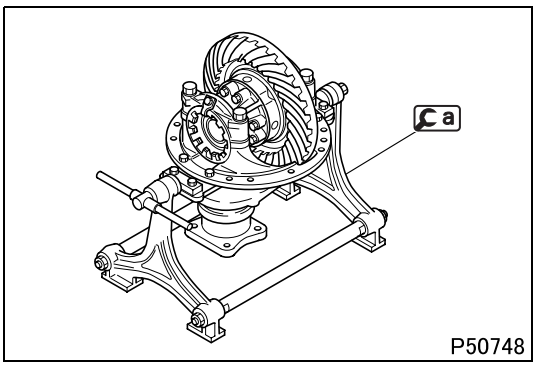
(flange stopper is unused)</td></tr>
<tr><td>b</td><td>
Adapter
<table>
<tr><th>A</th><th>B</th></tr>
<tr><td>ϕ45 {1.77}</td><td>ϕ59 {2.32}</td></tr>
</table>


05658
</td><td>MB999076</td><td>Removal of side bearing inner race (to be used in combination with commercial bearing puller)</td></tr>
<tr><td>c</td><td>
Bearing installer
<table>
<tr><th>A</th><th>B</th></tr>
<tr><td>ϕ80 {3.15}</td><td>ϕ70 {2.76}</td></tr>
</table>


P01039
</td><td>MH061748</td><td>Installation of side bearing inner race</td></tr>
<tr><td>d</td><td>
Bearing retainer guide pin


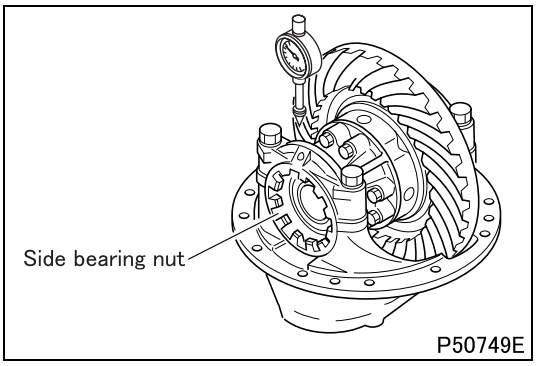
P01041
<table>
<tr><th>A</th><th>B</th><th>C</th><th>D</th></tr>
<tr><td>18 {0.71}</td><td>85 {3.35}</td><td>12 {0.47}</td><td>M12 × 1.25</td></tr>
</table>
</td><td>MH061745</td><td>Installation of reduction pinion (two pieces are used)</td></tr>
</table>

◆Work before removal◆



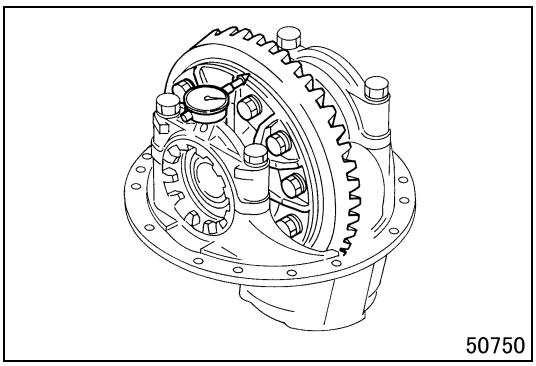
■ **Preparatory work: Installation of differential working base assembly**

- Install the reduction and differential on the differential working base a.



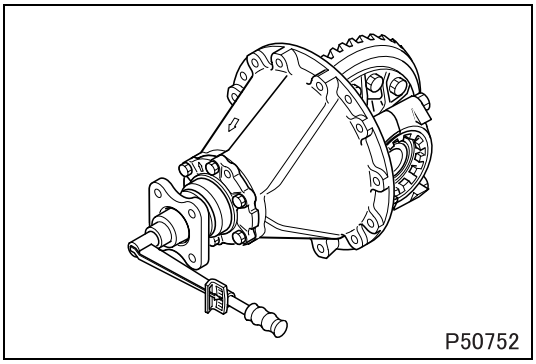
■ **Inspection: Backlash between reduction gear and reduction pinion**

- If backlash is found faulty, the tightening amount of the side bearing nut is probably inappropriate.



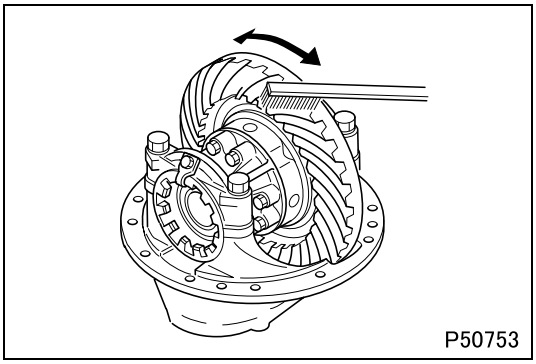
■ **Inspection: Wobble at back face of reduction gear**

- Measure wobble at the illustrated position of the reduction gear.



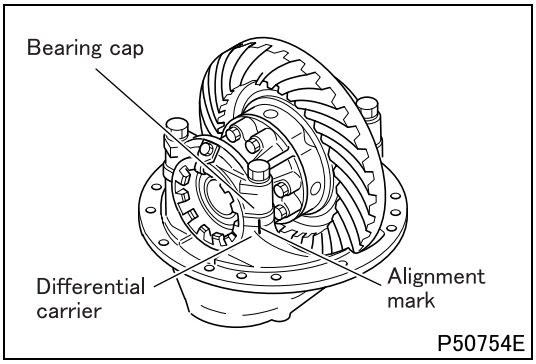
■ **Inspection: Starting torque of side bearing**

- Measure starting torque of the pinion assembly using a torque wrench and calculate the starting torque of the side bearing using the following formula.
  (Total starting torque – Pinion bearing starting torque (See later section.)) × Final ratio = Side bearing starting torque


P50753

■ **Inspection: Tooth contact of reduction gear**

- Apply red lead to three to four teeth at three equally spaced points of the reduction gear.
- Turn the reduction gear several times to check for tooth contact.

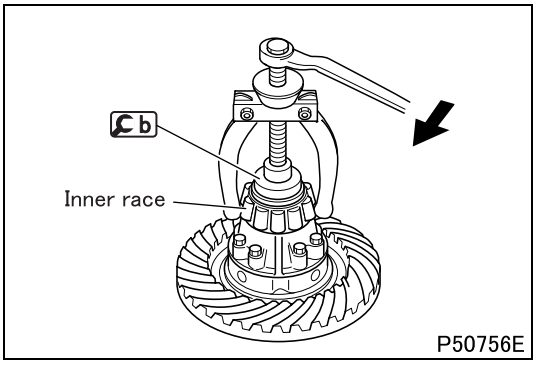


P50754E

■ **Alignment marks: Bearing cap and differential carrier**

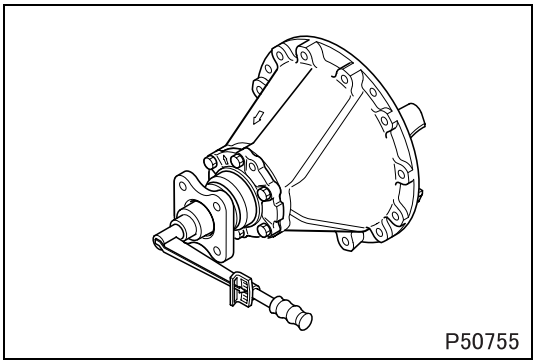
- Put alignment marks on the bearing cap and differential carrier for correct identification of right and left parts.

◆Removal procedure◆



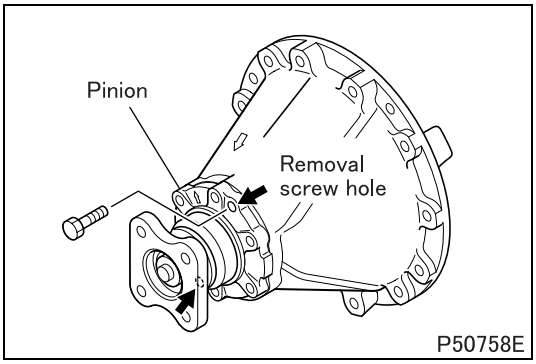
P50756E

■ **Removal: Side bearing inner race**


P50755

■ **Inspection: Starting torque of pinion bearing**

- After removing the differential, measure the starting torque of the pinion bearing.

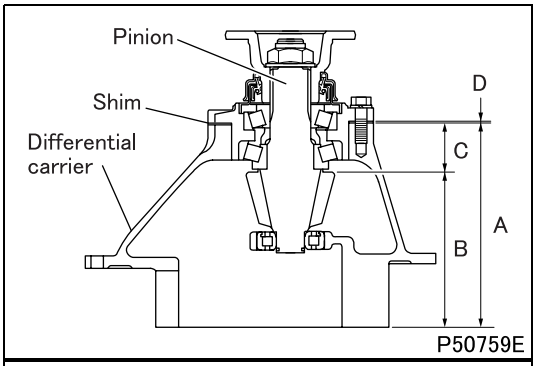


P50758E

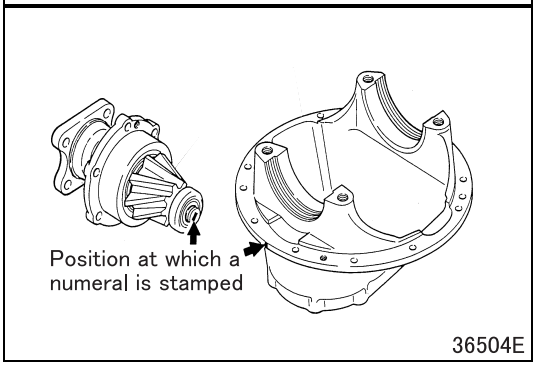
■ **Removal: Pinion**

- Screw two bolts evenly into the pinion removal screw holes to remove the pinion.

◆Adjustment procedure◆



P50759E



36504E

■ Adjustment: Reduction pinion

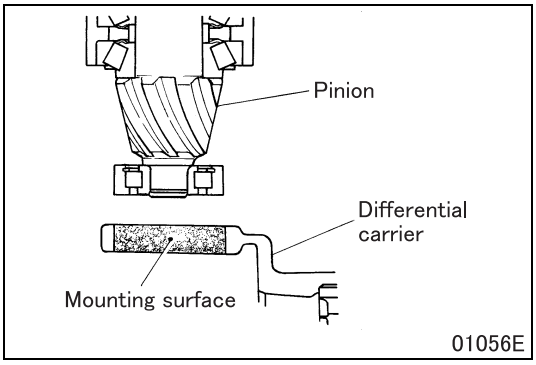
- Perform the following steps to adjust dimensions **A**, **B** and **C**.
- Calculate shim thickness (dimension **D**) by using the following formula based on the machining error data stamped on pinion assembly and differential carrier.
- Formula:
  D = 0.5 mm {0.020 in} – a + b + c
  a = Deviation from standard dimension **A**
  b = Deviation from standard dimension **B**
  c = Deviation from standard dimension **C**

Unit: mm {in}

Location	Standard dimension	How to calculate deviation
Shim thickness	0.5 {0.020}	–
A	203 {7.99}	A numeral, multiplied by 100, is stamped on the outer periphery of the flange of the differential carrier.
B	157 {0.18}	A numeral is stamped on the top of the pinion assembly.
C	46.5 {1.8}	Measure deviation from dimension **C** using a dial gauge. Taking measurement is usually not feasible and assume a value from 0 to 0.2 mm.

- Select a shim based on shim thickness **D**.
  Thickness of shims available
  0.1 mm {0.0039 in}, 0.2 mm {0.0079 in} (two thickness)

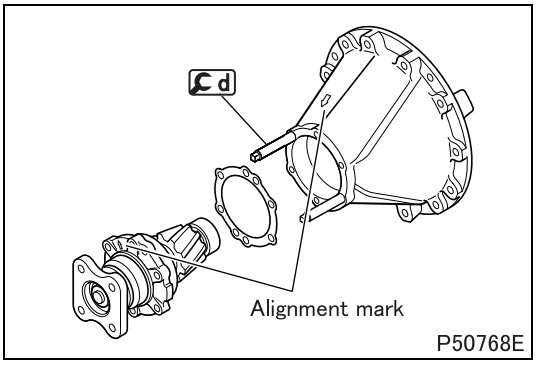
◆Installation procedure◆



01056E

■ Installation: Reduction pinion

- Apply sealant to the pilot bearing mounting surface of the differential carrier.

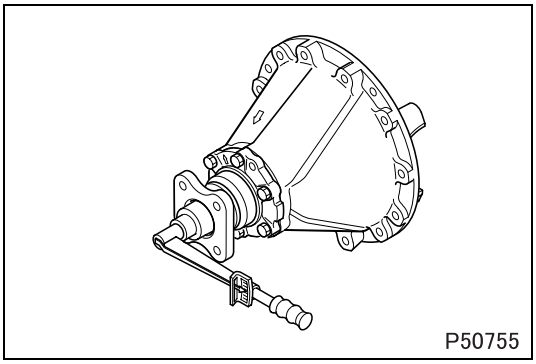


P50768E

- Aligning the embossed alignment mark on the bearing retainer of the pinion assembly with that on the differential carrier, mount the pinion assembly.

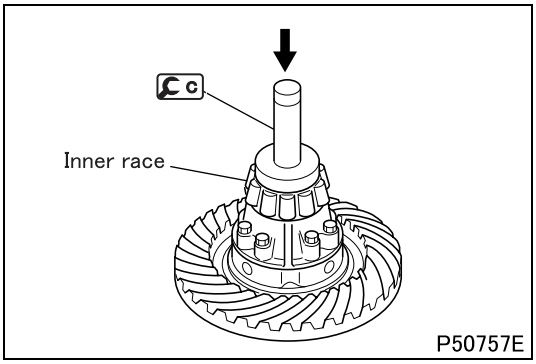
CAUTION ⚠

- **Leave for 30 minutes to 2 hours after installation to let the sealant harden.**
- **Wait at least three hours or, if feasible 24 hours, before running the vehicle to let the sealant harden.**


P50755

■ **Inspection: Starting torque of pinion bearing**

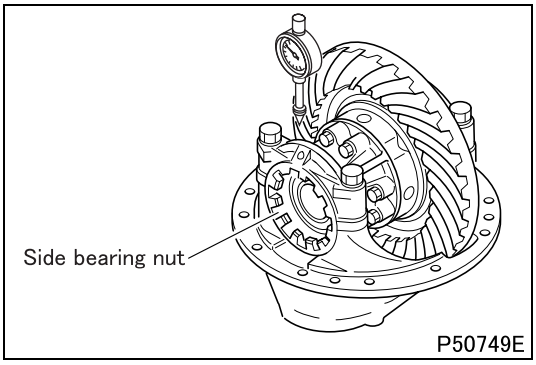
- After installing the pinion, measure the starting torque of the pinion bearing.
- If the measured value deviates from the standard value, adjust.



P50757E

■ **Installation: Side bearing inner race**

◆**Work after installation**◆



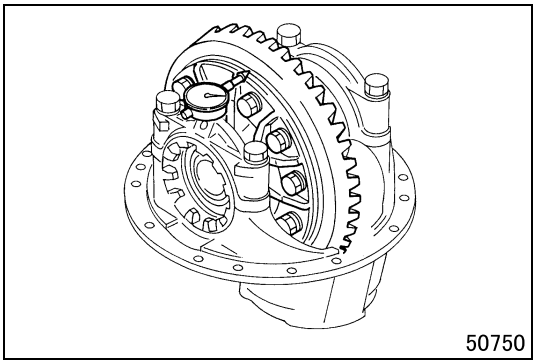
P50749E

■ **Adjustment: Backlash between reduction gear and reduction pinion**

- Adjust backlash with the side bearing nut, using care not to allow the side bearing starting torque to change.

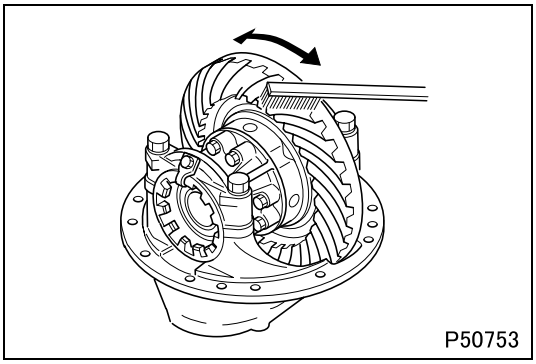
CAUTION ⚠

- **When one side bearing nut is loosened, be sure to tighten the other one the same amount to prevent the side bearing starting torque from changing.**


50750

■ **Inspection: Wobble at back face of reduction gear**

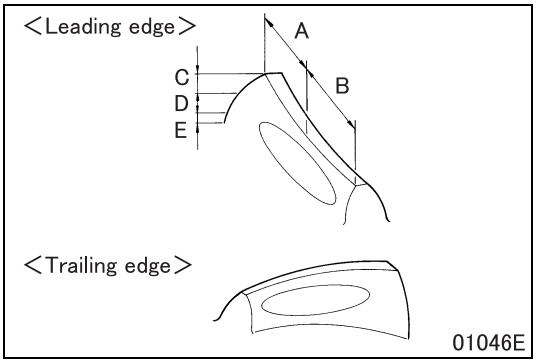
- Measure wobble at the illustrated position of the reduction gear.
- If the measured value deviates from the standard value, replace the reduction gear and reduction pinion of the differential as a set.



■ **Inspection: Tooth contact of reduction gear**

[Inspection]

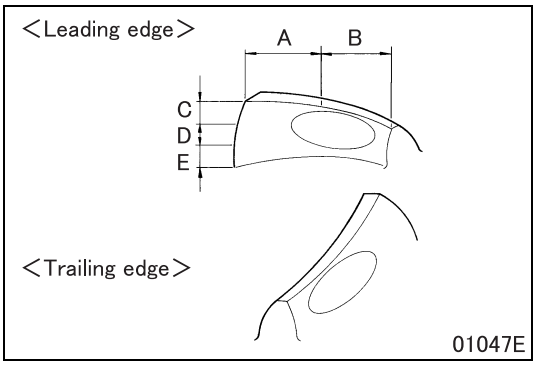
- Apply red lead to three to four teeth at three equally spaced points of the reduction gear.
- Turn the reduction gear several times to check for tooth contact.
- Adjust tooth contact if it is remarkably offset.



● **Correct tooth contact at no load**

<Reduction gear>

A: Heel
B: Toe
C: Face
D: Flank
E: Clearance



<Reduction pinion>

A: Heel
B: Toe
C: Face
D: Flank
E: Clearance

Maintenance item			Assembly standards
At no load	Tooth contact position	Lengthwise direction of tooth	From center towards toe
		Vertical direction	From center towards top of tooth for reduction gear and center for reduction pinion
	Tooth contact shape	Length	Approximately 50 to 70% of tooth width
		Width	Approximately 50 to 70% of tooth depth
	Degree of tooth contact		It becomes weaker as it nears tooth root and tooth tip

NOTE

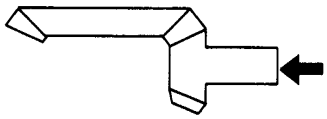
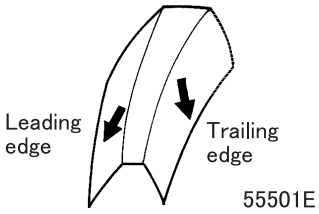
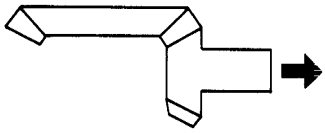
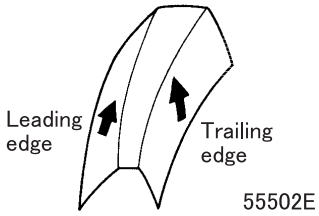
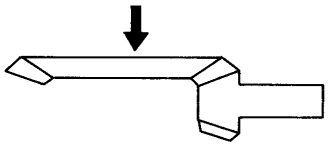
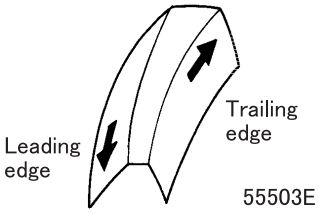
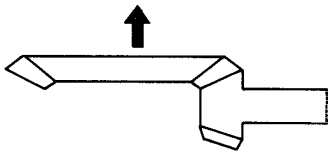
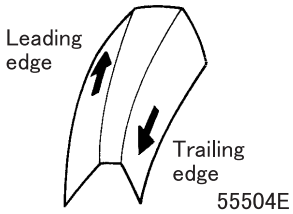
- **When tooth contact is near the toe at no load, it becomes middle area contact at load.**

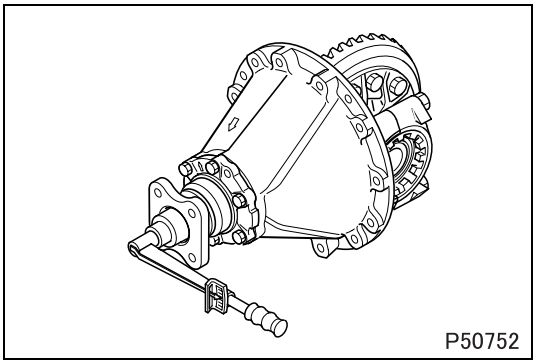
[Adjustment]

- Adjust by backlash between reduction gear and reduction pinion (to be adjusted with the side bearing nut) and addition or reduction of rear bearing shims.

CAUTION ⚠

- **Make sure you replace as a reduction gear set (reduction gear and reduction pinion), when you replace the gear because of excessive teeth wear.**

	Method of adjustment	Moving direction	
Tooth contact by addition or reduction of shims	Advance reduction pinion to reduction gear (shims are reduced)  55497	 55501E	Tooth contact moves towards tooth root
	Retard reduction pinion from reduction gear (shims are added)  55498	 55502E	Tooth contact moves towards tooth tip
Tooth contact by adjustment with side bearing nut	Advance reduction gear to reduction pinion center (less backlash)  55499	 55503E	Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to toe and slightly nearer to root of tooth Trailing edge: Nearer to heel and slightly nearer to top of tooth
	Retard reduction gear from reduction pinion center (more backlash)  55500	 55504E	Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to heel and slightly nearer to top of tooth Trailing edge: Nearer to toe and slightly nearer to root of tooth


P50752

■ **Inspection: Starting torque of side bearing**

[Inspection]

- Measure starting torque of the pinion assembly using a torque wrench and calculate the starting torque of the side bearing using the following formula.
  (Total starting torque – Pinion bearing starting torque (See later section.)) × Final ratio = Side bearing starting torque

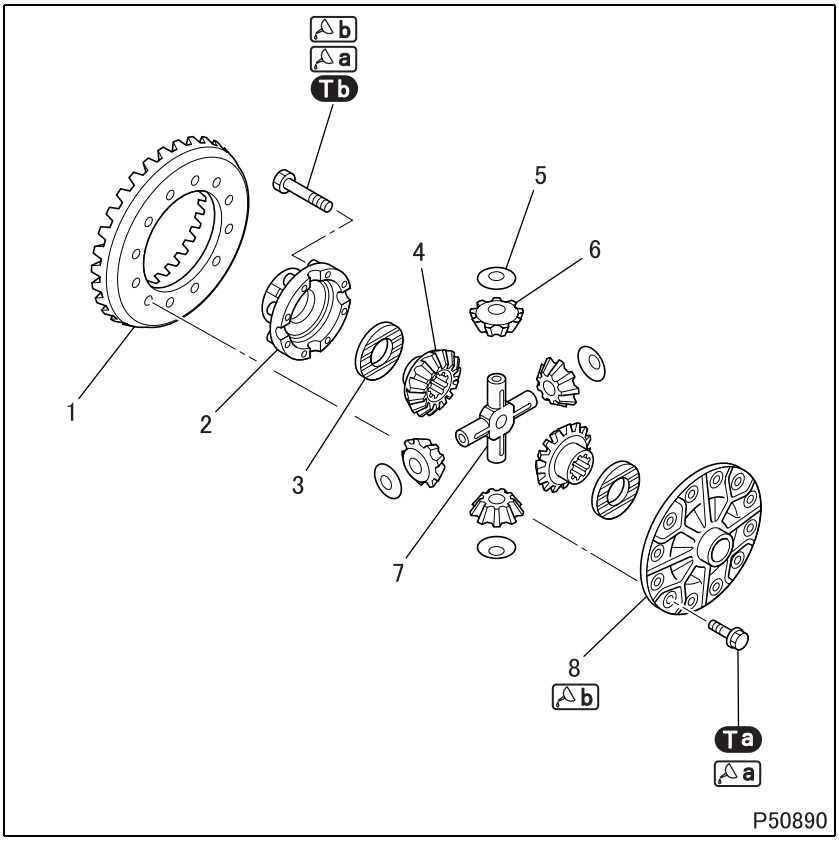
[Adjustment]

- Adjust by means of the right- and left-hand adjusting screws.

CAUTION ⚠

- **Always adjust both adjusting screws by the same amount.**
- **The starting torque must be adjusted without causing the backlash between the reduction gear and reduction pinion out of the standard value.**

Differential



● Disassembly sequence

1 Reduction gear
2 Differential case, R/H
3 Side gear washer
4 Side gear
5 Pinion washer
6 Differential pinion
7 Pinion spider
8 Differential case, L/H

CAUTION ⚠

- **Be sure to replace the R/H differential case and the L/H differential case as a differential case set.**
- **Be sure to replace the side gear and the differential pinion as a side gear set.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
4	Backlash between side gear and spline of axle shaft	0.05 to 0.15 {0.0020 to 0.0059}	0.5 {0.020}	Replace
4, 6	Backlash between side gear and differential pinion	0.15 to 0.20 {0.0059 to 0.0079}	0.5 {0.020}	Replace
6, 7	Clearance between differential pinion and pinion spider	0.17 to 0.27 {0.0067 to 0.011}	0.5 {0.020}	Replace

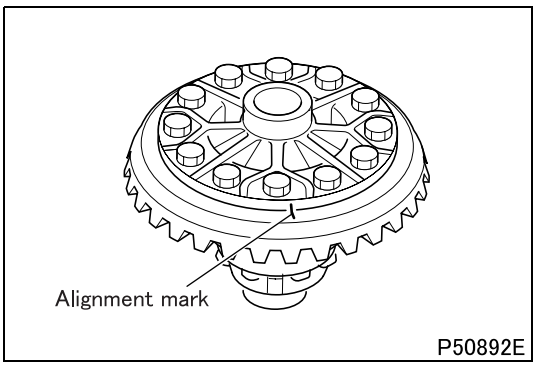
Torque value: N·m (lbf·ft)

Mark	Fastener	Torque value	Remarks
Ta	Bolt (reduction gear mounting)	166.6 to 225.4 (120 to 165)	–
Tb	Bolt (R/H and L/H differential case mounting)	83.3 to 112.7 (61 to 83)	–

Lubricant and/or sealant

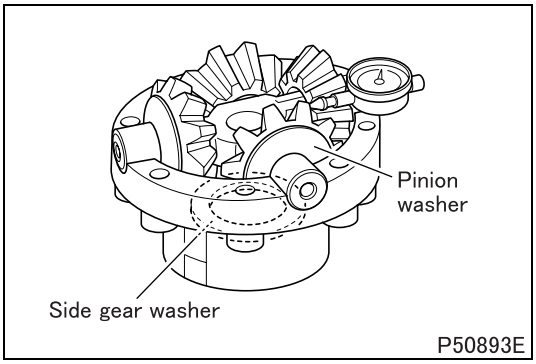
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Entire bolt	Rust preventive	As required
b	Thread area of bolt	Loctite 271	As required
	Bolt tip of L/H differential case		

◆Work before removal◆



■ **Alignment marks: Reduction gear and L/H differential case**

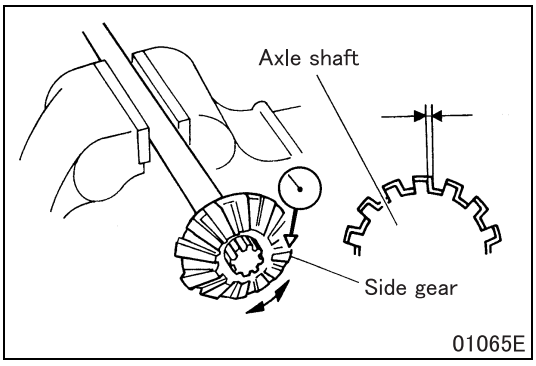
- Put alignment marks on the reduction gear and L/H differential case.



■ **Inspection: Backlash between side gear and differential pinion**

- If backlash is found faulty, thickness of the side gear washer and pinion washer is probably inappropriate.

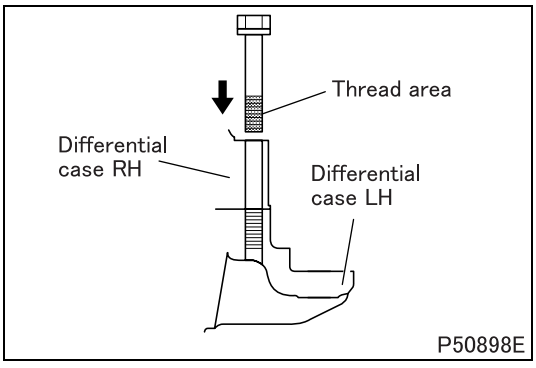
◆Inspection procedure◆



■ **Inspection: Backlash between side gear and axle shaft**

- If the measured value exceeds the limit, replace defective parts.

◆Installation procedure◆

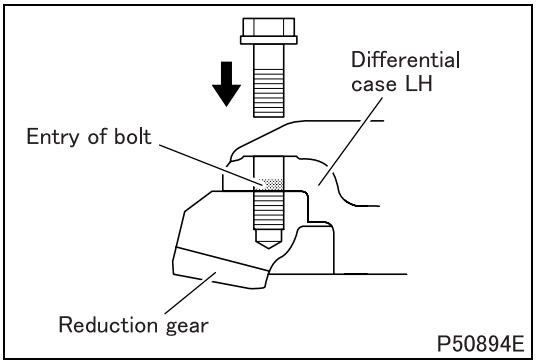


■ **Installation: Differential case, R/H and L/H**

- Apply rust preventive to the entire surface of the bolt. After applying it, blow off the excess rust preventive on the bolt by compressed air.
- Apply thread lock cement to the bolt threads.
- Tighten the bolt to the specified torque.

CAUTION ⚠

- **Make sure to apply rust preventive when tightening the bolt to the specified torque.**
- **Wait at least one hour after installation before actually running the vehicle to let the thread lock cement harden.**
- **Wait at least four hours after installation before operating the vehicle at full torque to let the thread lock cement harden.**



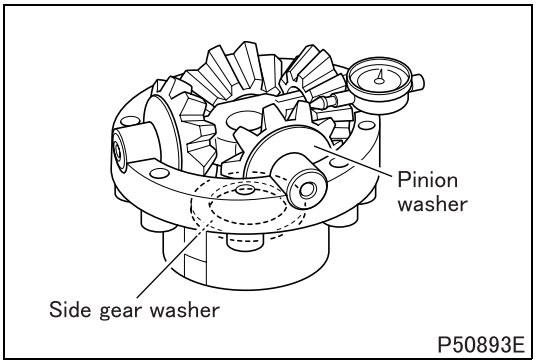
■ **Installation: Reduction gear and L/H differential case**

- Apply rust preventive to the entire surface of the bolt. After applying it, blow off the excess rust preventive on the bolt by compressed air.
- Apply thread lock cement at the entry of bolt holes on the L/H differential case.
- Tighten the bolt to the specified torque.

CAUTION ⚠

- **Make sure to apply rust preventive when tightening the bolt to the specified torque.**
- **Wait at least one hour after installation before actually running the vehicle to let the thread lock cement harden.**
- **Wait at least four hours after installation before operating the vehicle at full torque to let the thread lock cement harden.**

◆Work after installation◆



■ **Inspection: Backlash between side gear and differential pinion**

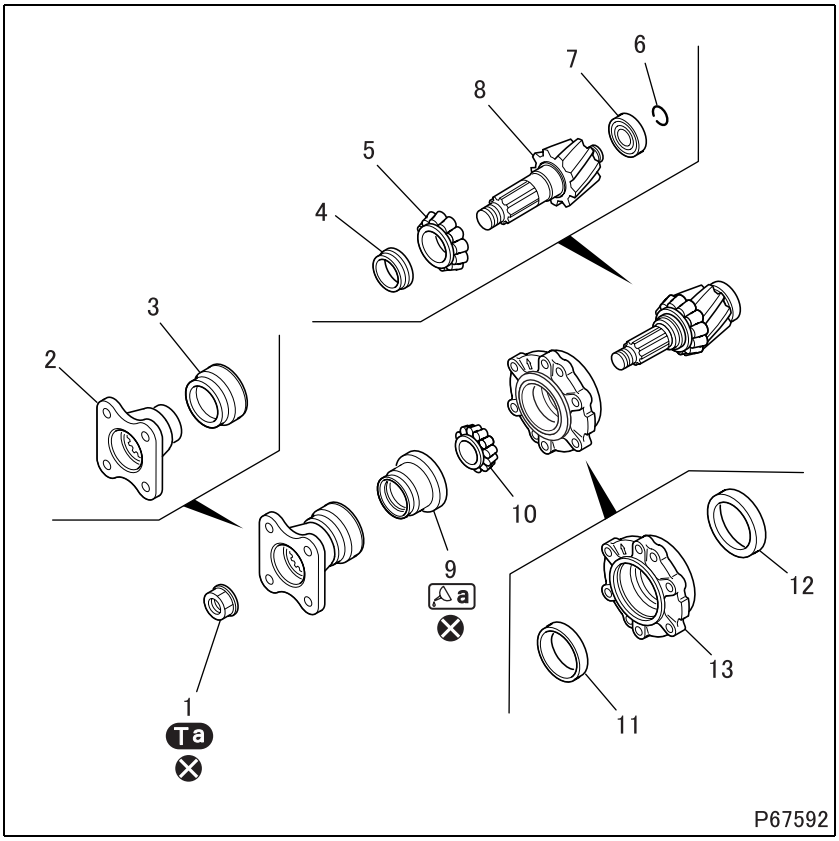
- If the measured value deviates from the standard value, replace the side gear washer and pinion washer.
  Thickness of side gear washers available
  3.0 mm {0.11 in} (one thickness)
  Thickness of pinion washers available
  1.6 mm {0.063 in} (one thickness)

CAUTION ⚠

- **Use side gear washers of the same thickness for the right and left sides.**
- **Use pinion washers of the same thickness at four locations.**

M E M O

Pinion



● Disassembly sequence

1 Locknut
2 Companion flange
3 Dust cover
4 Collar
5 Rear bearing inner race
6 Lock ring
7 Pinion pilot bearing
8 Reduction pinion
9 Oil seal
10 Front bearing inner race
11 Front bearing outer race
12 Rear bearing outer race
13 Bearing retainer

⊗: Non-reusable parts

NOTE

- **Record the height of the collar to use it as reference at assembly.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards: mm {in}

Location	Maintenance item		Standard value	Limit	Remedy
–	Starting torque of pinion bearing (inertial force at outer periphery point of bearing retainer)	When new bearing is used	2.0 to 2.9 N·m {1.4 to 2.2 lbf·ft} (inertial force: 34 to 52 N {7.6 to 11 lb})	–	Adjust or replace
		When old bearing is reused	1.6 to 2.4 N·m {1.2 to 1.7 lbf·ft} (inertial force: 27 to 41 N {6.1 to 9.2 lb})	–	Adjust or replace

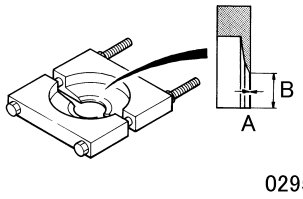
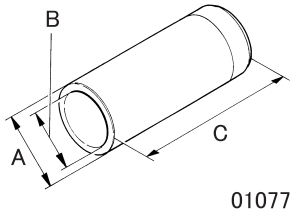
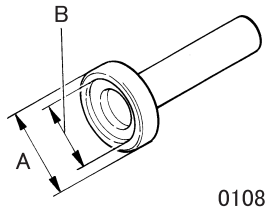
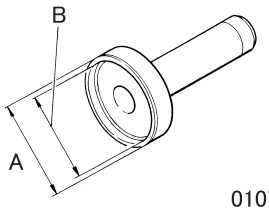
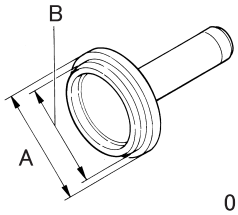
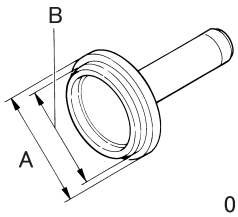
Torque value: N·m (lbf·ft)

Mark	Fastener	Torque value	Remarks
Ta	Locknut (companion flange mounting)	372.4 to 470.4 (275 to 345)	–

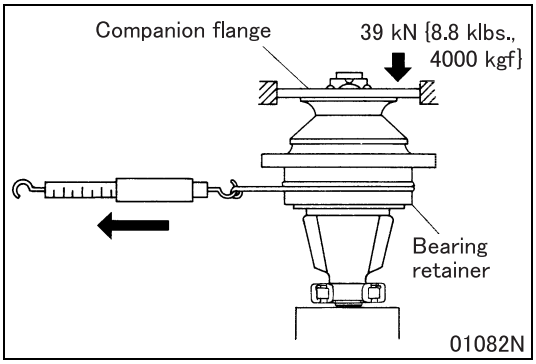
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Lip area of oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

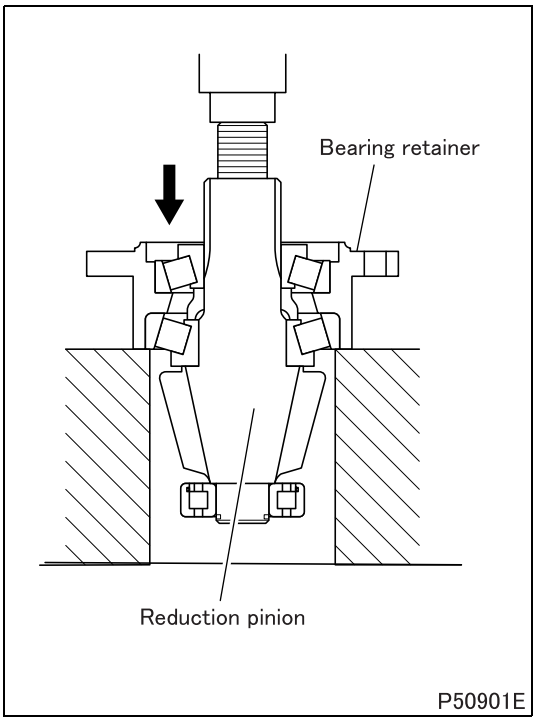
Special tools (Unit: mm {in})

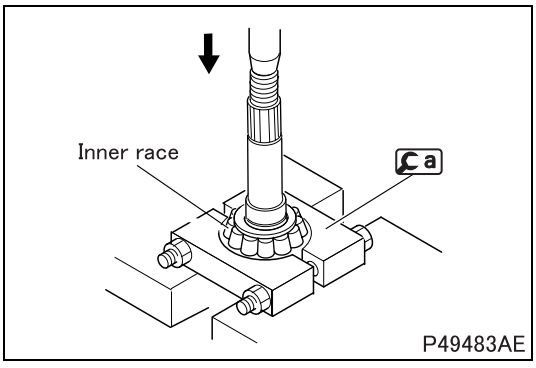
Mark	Tool name and shape	Part No.	Application
a	Pinion bearing remover A: 0.5 {0.020}, B: 25.6 {1.00}  02956	MB999045	Removal of rear bearing inner race
b	Pinion bearing installer A: ϕ62 {2.44}, B: ϕ52 {2.05}, C: 125 {4.92}  01077	MH061005	Installation of rear bearing inner race and front bearing inner race
c	Pinion pilot bearing installer A: ϕ45.2 {1.78}, B: ϕ39.2 {1.54}  01081	MH061976	Installation of pinion pilot bearing
d	Oil seal installer A: ϕ112 {4.41}, B: ϕ88 {3.46}  01076	MH061750	Installation of oil seal
e	Pinion bearing installer A: ϕ89 {3.50}, B: ϕ78 {3.07}  01078	MH061977	Installation of front bearing outer race
f	Pinion bearing installer A: ϕ99 {3.90}, B: ϕ88 {3.46}  01078	MH061264	Installation of rear bearing outer race

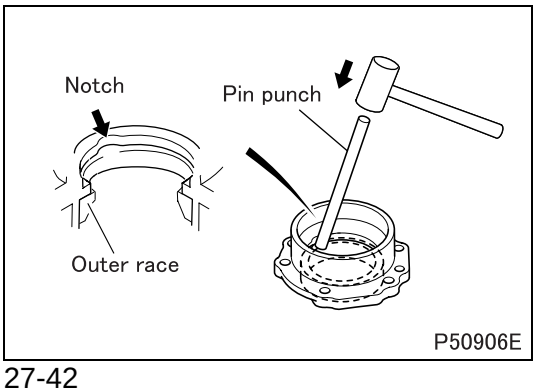
◆Work before removal◆



◆Removal procedure◆







■ Inspection: Starting torque of pinion bearing

- Apply the specified load to the companion flange or tighten the locknut to the specified torque.
- Measure the inertial force at outer periphery point of the bearing retainer using a spring balancer.

CAUTION ⚠

- **Securely fix the companion flange to measure.**

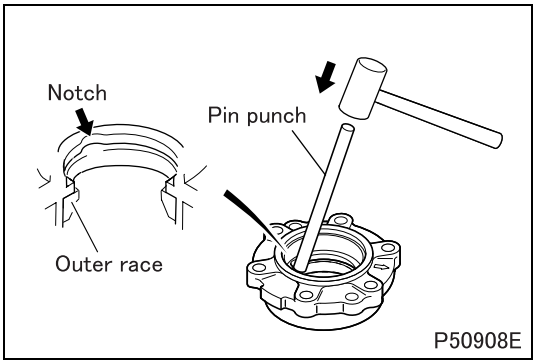
- If the measured inertial force is within the specified value, the starting torque conforms to the standard value.

■ Removal: Reduction pinion

■ Removal: Rear bearing inner race

■ Removal: Front bearing outer race

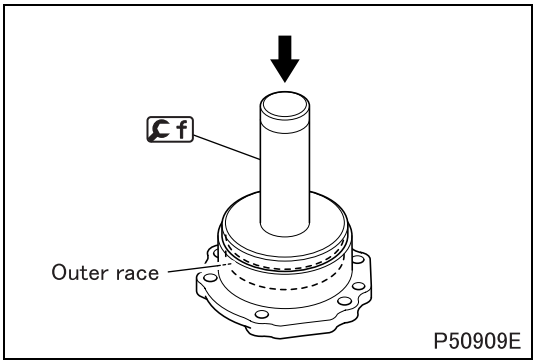
- Drive out the front bearing outer race by tapping at each of the three indentations in the bearing retainer. Keep the race level as it is being removed.



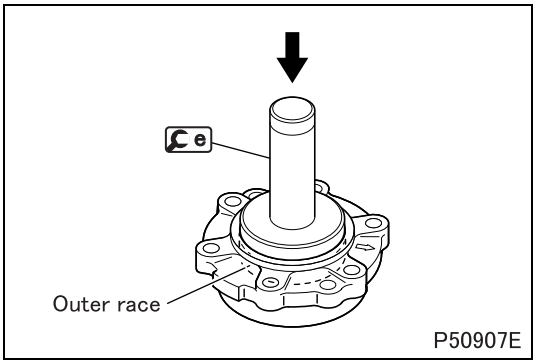
■ **Removal: Rear bearing outer race**

- Drive out the rear bearing outer race by tapping at each of the three indentations in the bearing retainer. Keep the race level as it is being removed.

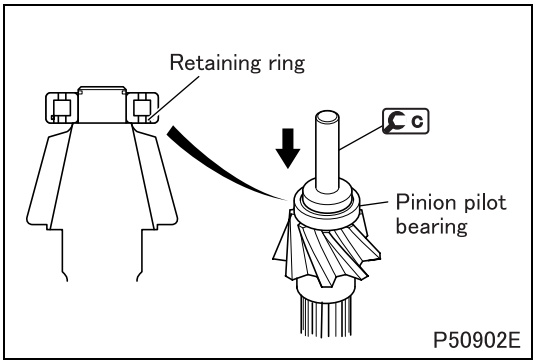
◆**Installation procedure**◆



■ **Installation: Rear bearing outer race**

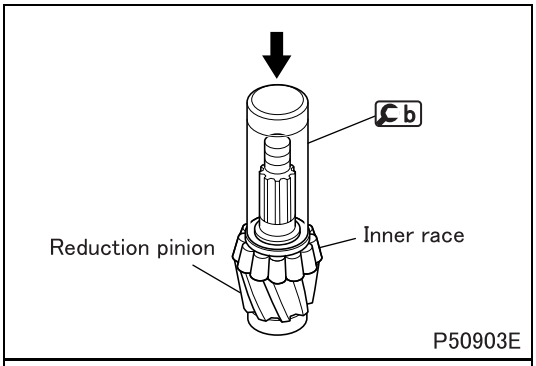


■ **Installation: Front bearing outer race**

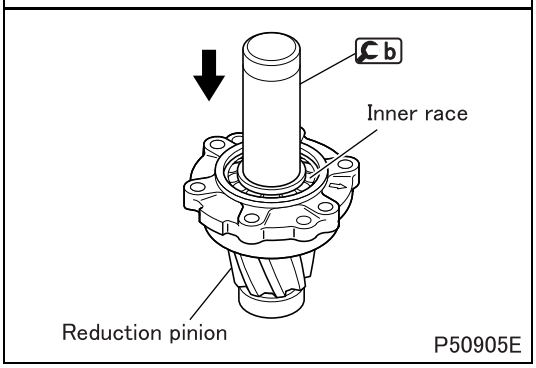


■ **Installation: Pinion pilot bearing**

- Install the pinion pilot bearing with its retaining ring placed on the gear.

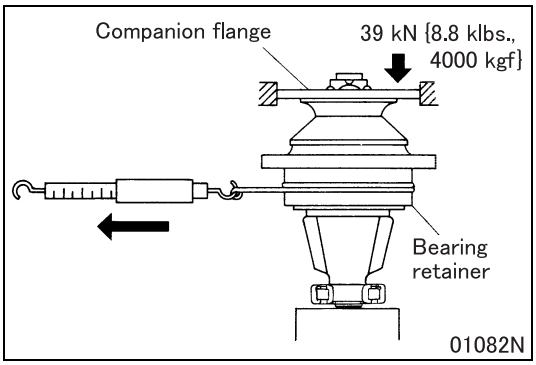


■ **Installation: Rear bearing inner race**



■ **Installation: Front bearing inner race**

- Install the front bearing inner race with the pinion assembled into the bearing retainer.



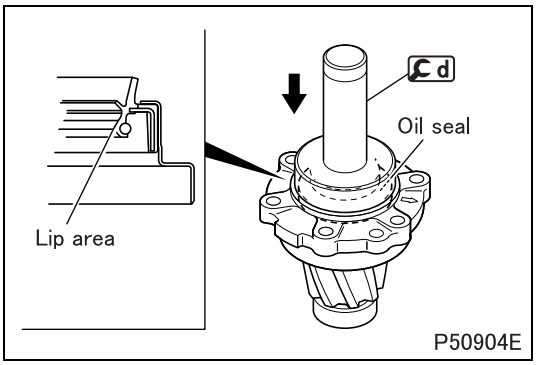
■ **Inspection: Starting torque of pinion bearing**

- Apply the specified load to the companion flange or tighten the locknut to the specified torque.
- Measure the inertial force at outer periphery point of the bearing retainer using a spring balance.

CAUTION ⚠

- **Securely fix the companion flange to measure.**
- **Do not assemble the oil seal when measuring the inertial force.**

- If the measured inertial force is within the specified value, the starting torque conforms to the standard value.
- If the measured value deviates from the standard value, adjust by changing a collar.
  Thickness of collars available
  15.600 to 16.200 mm {0.61 to 0.64 in} (25 thickness in 0.025 mm {0.00098 in} increments)

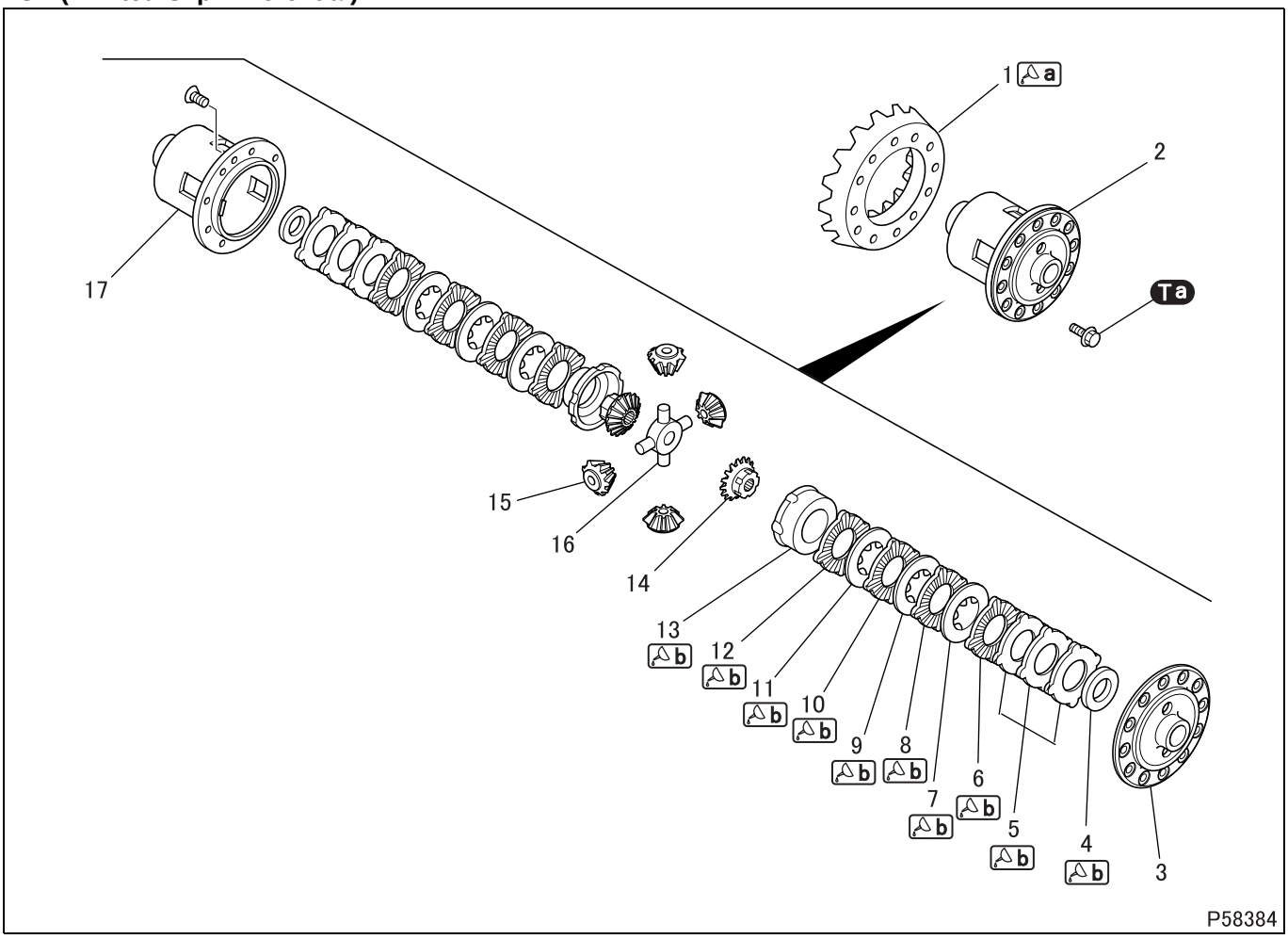


■ **Installation: Oil seal**

- Apply grease to the lip area of the oil seal and install it on the bearing retainer in the illustrated direction.

M E M O

LSD (Limited-Slip Differential)



● Disassembly sequence

1 Reduction gear
2 LSD (limited-slip differential)
3 Differential case, L/H
4 Side gear washer
5 Spring plate
6 Friction plate
7 Friction disc
8 Friction plate
9 Friction disc
10 Friction plate
11 Friction disc
12 Friction plate
13 Pressure ring
14 Side gear
15 Differential pinion
16 Pinion spider
17 Differential case, R/H

CAUTION ⚠

- **Make sure to replace the side gear and the differential pinion as a side gear set.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards: mm {in}

Location	Maintenance item			Standard value	Limit	Remedy
2	LSD	Rotation torque of clutch plate	When new clutch plate is assembled	201 to 298 N·m {150 to 220 ft.lbs}	–	Replace
			When old clutch plate is reassembled	117 to 298 N·m {86 to 220 ft.lbs}	–	
		Clearance in side gear axial direction		0.05 to 0.20 {0.0020 to 0.0079}	–	
		Clearance in differential case axial direction		0.05 to 0.20 {0.0020 to 0.0079}	–	
4, 11 to 14	Difference in dimensions from side gear washer end face to pressure ring back face between right and left			0 to 0.05 {0 to 0.0020}	–	Replace
7 to 10	Friction disc and friction plate		Distortion	–	0.08 {0.0031}	Replace
			Wear	–	0.1 {0.0039}	
			Difference in thickness of right and left combination	0 to 0.05 {0 to 0.0020}	–	Adjust

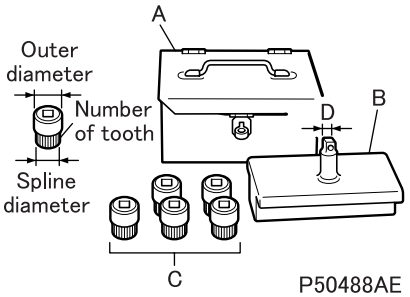
Torque value: N·m (lbf·ft)

Mark	Fastener	Torque value	Remarks
Ta	Bolt (reduction gear mounting)	167 to 225 (120 to 165)	–

Lubricant and/or sealant

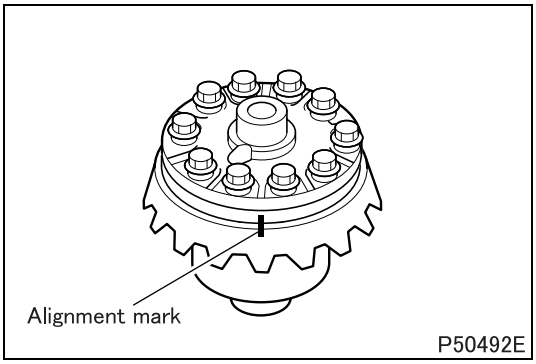
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads of reduction gear	Loctite 271	As required
b	Each part	Limited slip differential oil API GL-5 SAE 90	As required

Special tools (Unit: mm {in})

<table>
<tr><th>Mark</th><th>Tool name and shape</th><th>Part No.</th><th>Application</th></tr>
<tr><td>a</td><td>
Side gear holding tool se
<table>
<tr><th>D</th></tr>
<tr><td>20
{0.79}</td></tr>
</table>


P50488AE
<table>
<tr><th colspan="2">Component</th><th>Part No.</th><th>Applied type</th></tr>
<tr><td>A</td><td>Gauge case</td><td>MB990551</td><td>–</td></tr>
<tr><td>B</td><td>Side gear holding base</td><td>MB999141</td><td>–</td></tr>
<tr><td rowspan="5">C</td><td>Side gear holding tool</td><td>–</td><td>–</td></tr>
<tr><td>Outer diameter / Number of teeth / Spline diameter</td><td>–</td><td>–</td></tr>
<tr><td>ϕ39 {1.54} / 16 {0.63} / ϕ35.6 {1.40}</td><td>MH063422</td><td>–</td></tr>
<tr><td>ϕ42 {1.65} / 18 {0.71} / ϕ39.6 {1.56}</td><td>MB999142</td><td>D033H</td></tr>
<tr><td>ϕ42 {1.65} / 20 {0.79} / ϕ42 {1.65}</td><td>MH063423</td><td>D035H</td></tr>
</table>
</td><td>MB999140</td><td>Measure rotation torque of LSD clutch plate</td></tr>
</table>

◆Work before removal◆

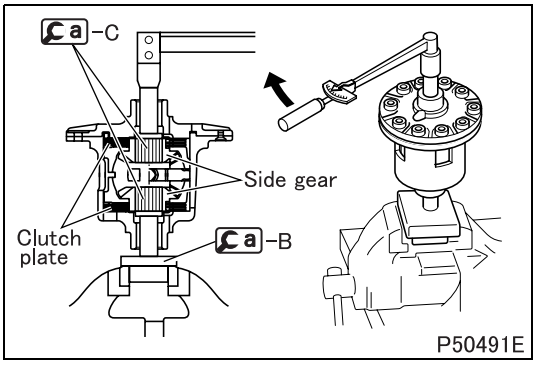


P50492E

■ Alignment marks: Reduction gear and limited slip differential

- Put alignment marks on the reduction gear and limited slip differential.

◆Inspection procedure◆



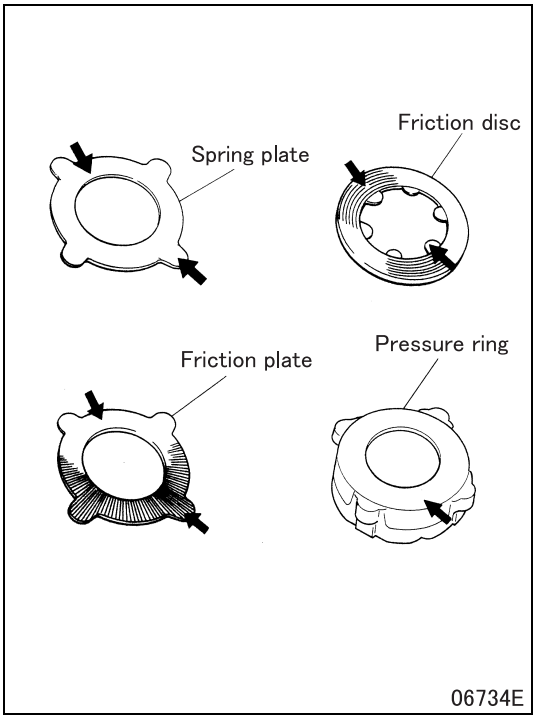
P50491E

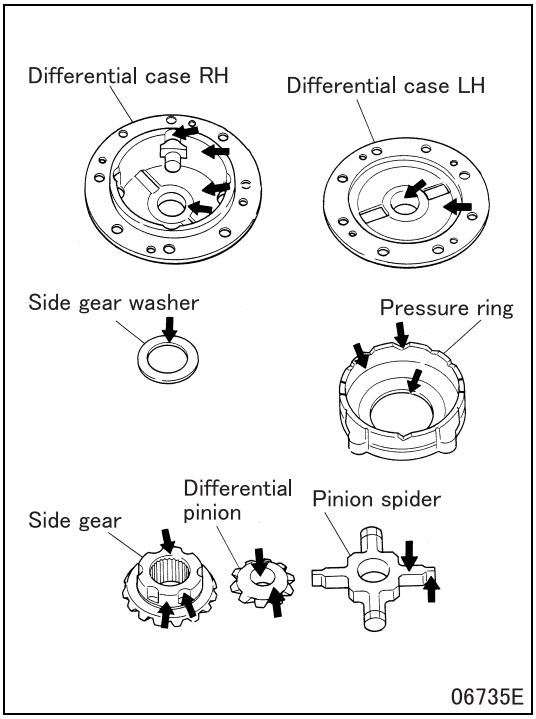
■ Inspection: Rotation torque of LSD clutch plate

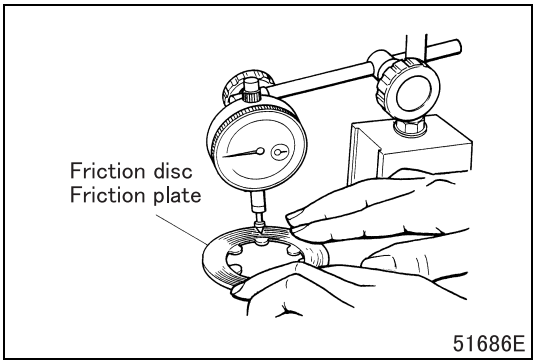
- After removing the reduction gear, carry out the following inspection.
- Measure the rotation torque to check for the friction force of the clutch plate.

NOTE

- **For measurement of rotation torque, rotate the side gears to sufficiently smooth their operation and measure the value during their rotation.**







■ **Inspection: Limited slip differential**

(1) Inspection of contacting and sliding surfaces

- If heat discoloration and remarkable wear are found on friction surfaces and sliding surfaces of the spring plates, spring discs, friction discs and friction plates, replace defective parts.

NOTE

- **Strong contact on the inner periphery of friction surfaces is caused by the spring force of each plate and disc. Do not mistake that it is caused by abnormal wear.**

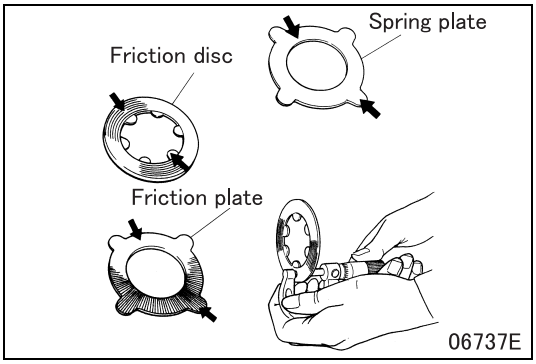
- If cracks and damage are found on protrusions on the inside and outside periphery of the spring plates, friction discs and friction plates, replace defective parts.
- If dents and damage are found on the friction surfaces and sliding surfaces of the pressure rings to friction discs, polish them with an oilstone, and lap and correct them with a compound on a surface plate.

NOTE

- **Strong contact on the inner periphery of friction surfaces is caused by the spring force of each plate and disc. Do not mistake that it is caused by abnormal wear.**
- Inspect contacting and sliding areas ⬅ of the L/H differential case, side gear washers, pressure rings, side gears, differential pinion, pinion spider and R/H differential case, and correct burrs and dents with an oilstone.

(2) Inspection of distortion

- Apply a dial gauge to the friction disc and friction plate on a surface plate and measure their distortion (flatness) while turning them. If the measured value exceeds the limit, replace.



(3) Inspection of thickness

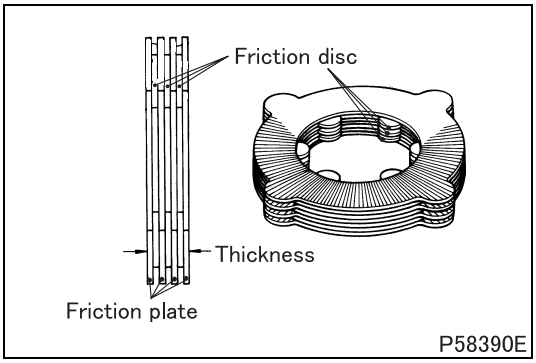
- Measure thickness of the friction surfaces and protrusions ⬅ of the spring plate, friction disc and friction plate, and find the difference. If it exceeds the limit, replace defective parts.

NOTE

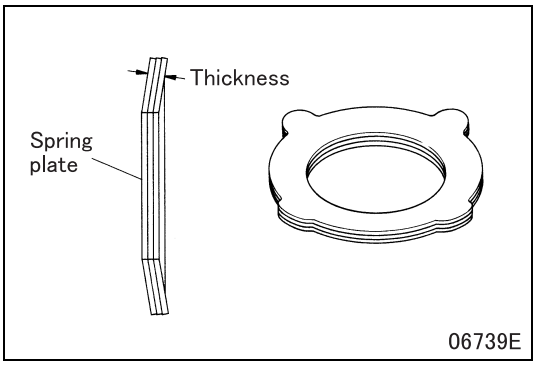
- **Take measurement at several points for each part.**

◆Work before assembly◆

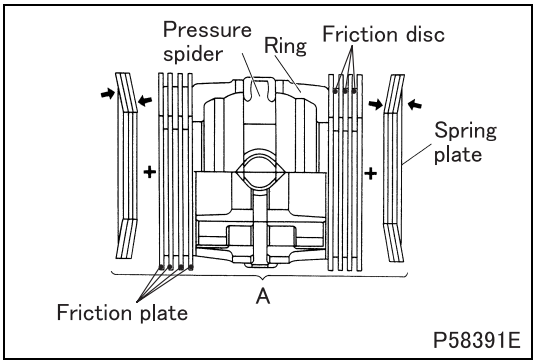
- Before assembling the limited slip differential, adjust the dimensional difference (friction force of clutch plate) in the axial direction and the clearance in the side gear axial direction.



- Pile friction discs and friction plates as illustrated and measure thickness with a micrometer. Select the combination so that the difference in thickness between the right and left combination falls within the range of the standard value.
  Thickness of friction discs available
  1.9, 2.0, 2.1 mm {0.075, 0.079, 0.083 in} (three sizes)
  Thickness of friction plates available
  2.0 mm {0.079 in} (one size)



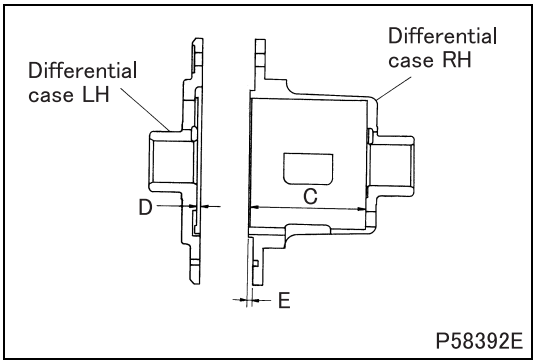
- Pile a spring plate and a spring disc as illustrated and measure thickness with a micrometer. Select the combination so that the difference in thickness between the right and left combination is as small as possible.
  Thickness of spring plates available
  2.0 mm {0.079 in} (one size)



- Assemble the pressure rings, pinion spiders, friction discs, friction plates, spring plates and spring discs and measure overall width **A** with a micrometer.

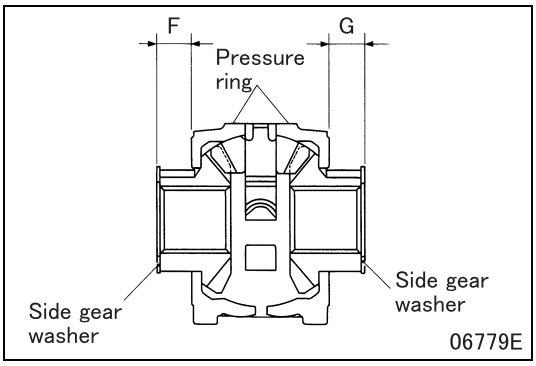
NOTE

- **Measure the overall width with the V-shaped groove of the pressure ring pressed against the pinion spider from both sides to obtain secure contact.**



- Find dimension **B** between spring plate contact faces when the L/H and R/H differential cases are combined.
  B=**C**+**D**–**E**

- If overall width **A** measured in the previous item and the clearance (**B**-**A**) between the L/H and R/H differential cases deviate from the standard value, adjust by changing a friction plate.
  Thickness of friction plates available
  1.9, 2.0, 2.1 mm {0.075, 0.079, 0.083 in} (three sizes)

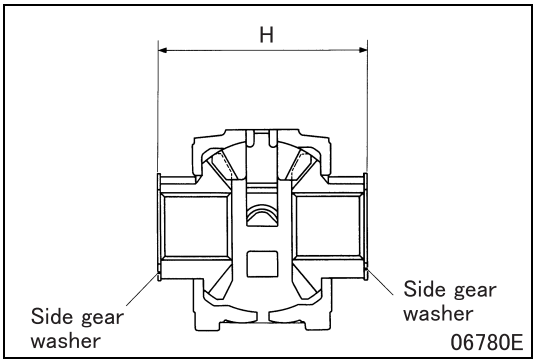


- After installing the side gear washers as illustrated, make sure that the difference between dimensions **F** and **G** from the back face of the pressure rings to the end face of the side gear washers falls within the range of the standard value.

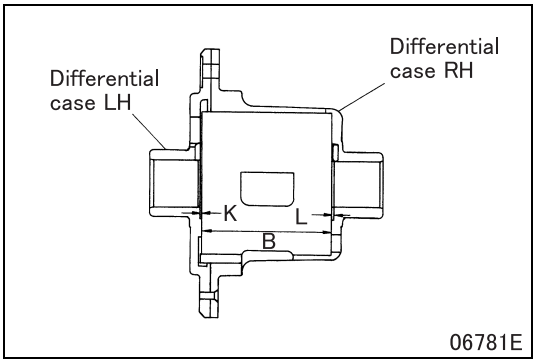
NOTE

- **Measure the dimensions with the V-shaped groove of the pressure ring pressed against the pinion spider from both sides to obtain secure contact.**

- If the difference in dimension deviates from the standard value, adjust by changing the side gear washer.
  Thickness of side gear washers available
  1.5, 1.6, 1.7 mm {0.059, 0.063, 0.067 in} (three sizes)



- Measure overall width **H**.



- Find dimension **J** between side gear washer contact faces when the L/H and R/H differential cases are combined.
  J=**B**+**K**+**L**

NOTE

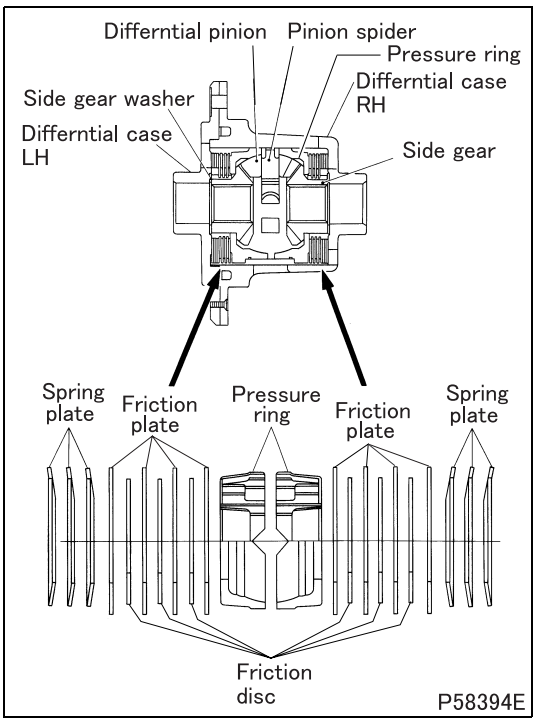
- **For dimension B, refer to the difference between spring plate contact surfaces found in the previous item when the L/H and R/H differential cases are combined.**

- Check that clearance in the side gear axial direction is within the range of the standard value.
- If the clearance deviates from the standard value, adjust by changing the side gear washer.
  Thickness of side gear washer available
  1.5, 1.6, 1.7 mm {0.059, 0.063, 0.067 in} (three sizes)

NOTE

- **Select side gear washers so that the right and left dimensional difference from the back face of the pressure rings to the end face of the side gear washers conforms to the standard value.**

◆Assembly procedure◆

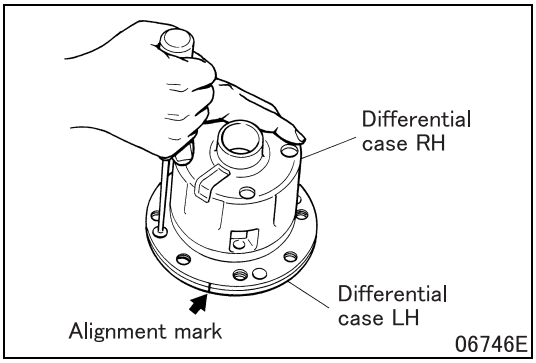


■Assembly: LSD (Limited Slip Differential)

- Assemble each part into the R/H differential case in the illustrated direction.

NOTE

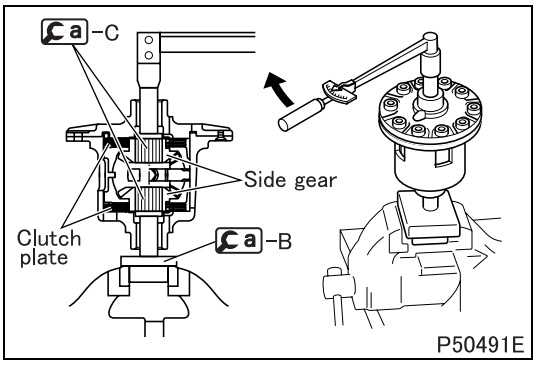
- **Take care not to install the friction discs and friction plates in a wrong sequence and the spring plates in a wrong direction.**
- **When assembling, apply gear oil to each part. Especially, apply gear oil carefully to contact surfaces and sliding surfaces.**



- Aligning the alignment mark (the same Arabic numeral) of the L/h differential case with that of the R/H differential case, tighten screws in the diagonal sequence gradually and evenly.

NOTE

- **If the L/H and R/H differential cases do not contact positively each other even after screws have been tightened fully, improperly assembled side gear washers and spring plates are suspected. In that case, reassemble these parts.**



■Inspection: Rotation torque of limited slip differential clutch plate

- After assembling LSD, carry out the following inspection.
- Measure the rotation torque to check for the friction force of the clutch plate.

NOTE

- **For measurement of rotation torque, rotate the side gears to sufficiently smooth their operation and measure the value during their rotation.**

- If the measured value deviates from the standard value, replace defective parts of the internal components.

INDEX

SPECIFICATIONS 31-2

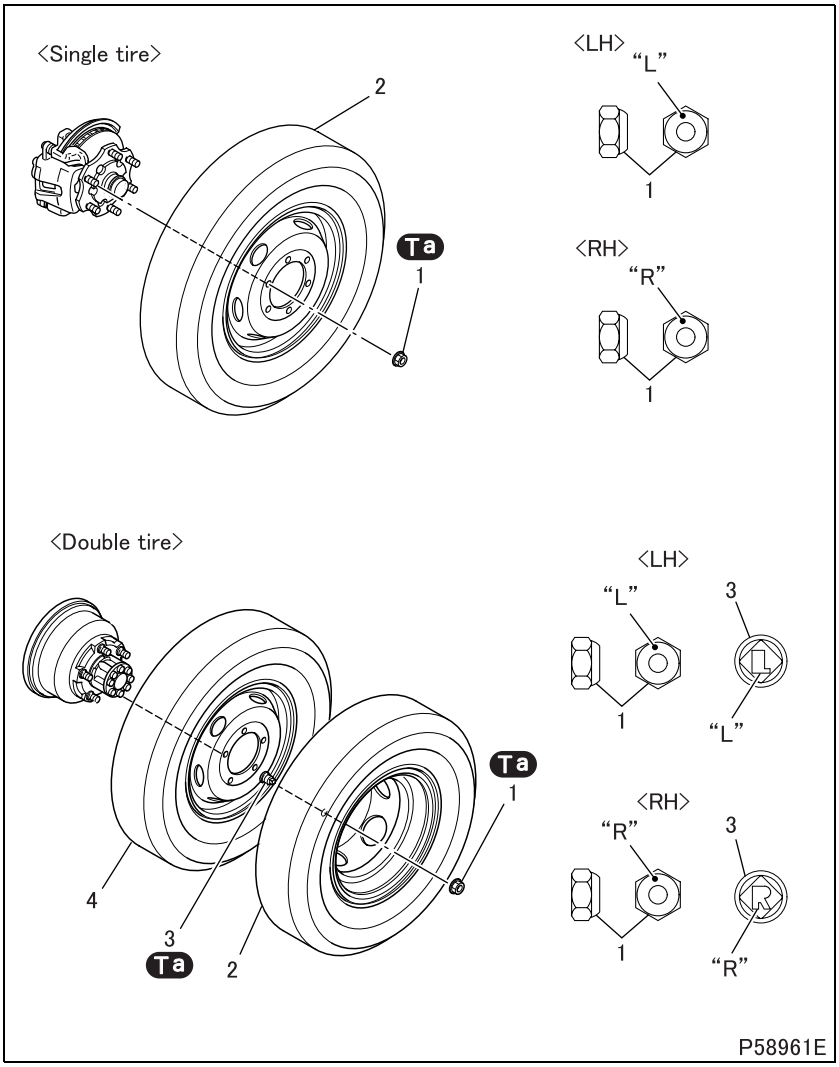
TROUBLESHOOTING 31-3

WHEEL AND TIRE 31-4

Tire size	Wheel type
215/85R16	16 × 6K-127
215/75R17.5	17.5 × 6.00-127

- Tire pressures specified for each tire size are shown on the tire pressure label.

Symptoms / Probable causes			Tire tread wear										Reference Gr
			Both shoulders worn	Center worn	Outside worn	Inside worn	Worn in feather pattern from outside in	Worn in feather pattern from inside out	Worn in wave pattern	Worn in concave (one spot or more)	Worn in pit over the entire periphery	Worn in serration	
Overload			O										
Tire pressure		Too low	O						O	O	O	O	
		Too high		O									
Wheel alignment	Toe-in	Excessive			O		O						Gr26
		Insufficient				O							
	Camber	Excessive			O								
		Insufficient				O							
	Excessive toe-out					O		O					
	Multiple misalignment		O		O	O	O	O	O	O	O		
Knuckle arm bent					O	O	O	O					
Left and right tie-rods different in length							O						
Wheels out of balance									O	O	O	O	
Wheel bearing loose									O	O	O	O	Gr26, 27
Ball joint loose										O			Gr26
Tie-rod end loose										O			Gr37
Brake drum eccentrically mounted <Drum brake>										O	O		Gr35
Axle bent <Rigid axle suspension>									O	O			Gr26, 27
Left and right wheels steered at improper angles												O	Gr26
Hard acceleration, braking, or steering												O	
Specific road surface conditions					O	O							



CAUTION ⚠

- **Use right-hand threaded wheel nuts marked "R" for right side wheels and left-hand threaded wheel nuts marked "L" for left side wheels.**

●Removal sequence

1 Wheel nut <Single tire>
Wheel nut (outer) <Double tire>
2 Tire (See later section.)
3 Wheel nut (inner) <Double tire>
4 Tire <Double tire>
(See later section.)

●Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- **The wheel nuts are designed to be tightened without any coating of grease. Never grease the wheel nuts. Even if tightened to the specified torques, greased wheel nuts can become loose.**

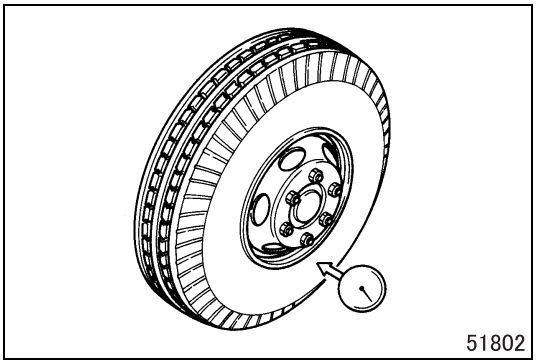
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
2, 4	Tire lateral runout (sideway deflection)	3.5 {0.14} or less	–	Correct or replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

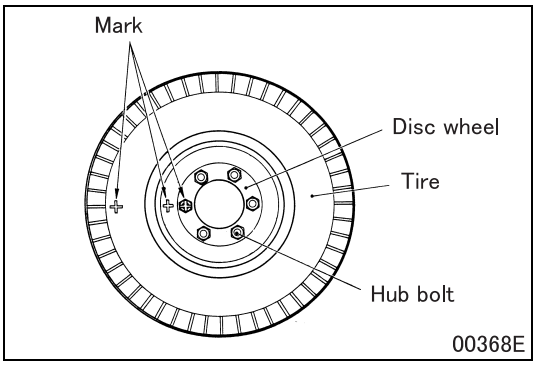
Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Wheel nut	16 × 6K-127 16 × 6K-135 17.5 × 6.00-127	490 ± 49 {360 ± 36, 50 ± 5.0}	–

◆Inspection procedure◆



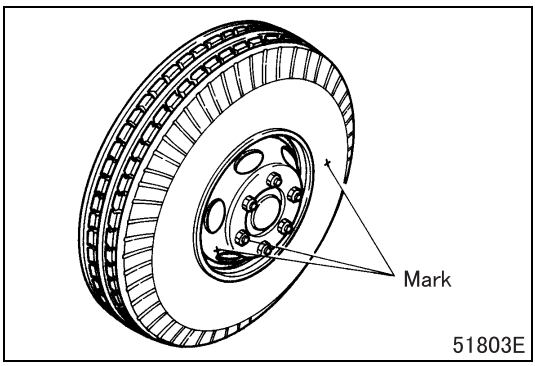
■ Inspection: Tire

- Measure the tire for lateral runout (sideway deflection).
- If the measured value is equal to or exceeds the standard value, correct as follows.



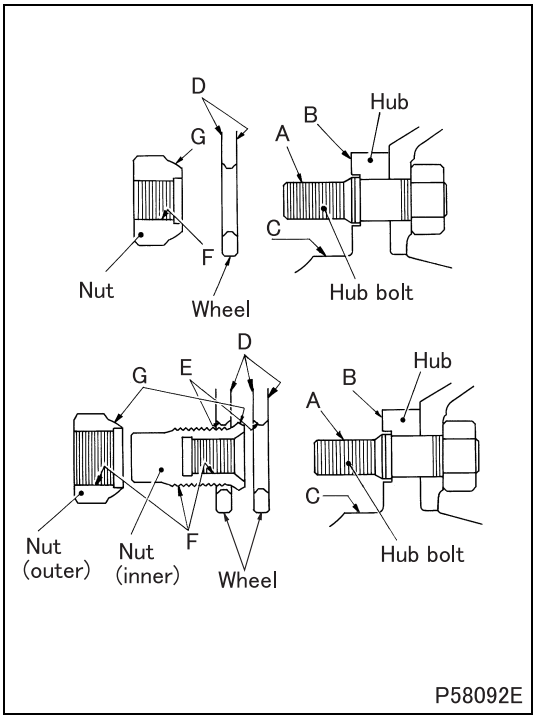
■ Correction: Tire

- Mark the tire, disc wheel, and one of the hub bolts in the illustrated locations.
- Remove the tire from the disc wheel.



- Measure the disc wheel for lateral runout.
- If the disc wheel's maximum runout is located near the mark on the wheel, install the tire such that the mark on the tire is 180° away from the mark on the disc wheel.
- Measure the tire again for lateral runout.
- If the measured value still does not conform to the standard value, replace the tire.

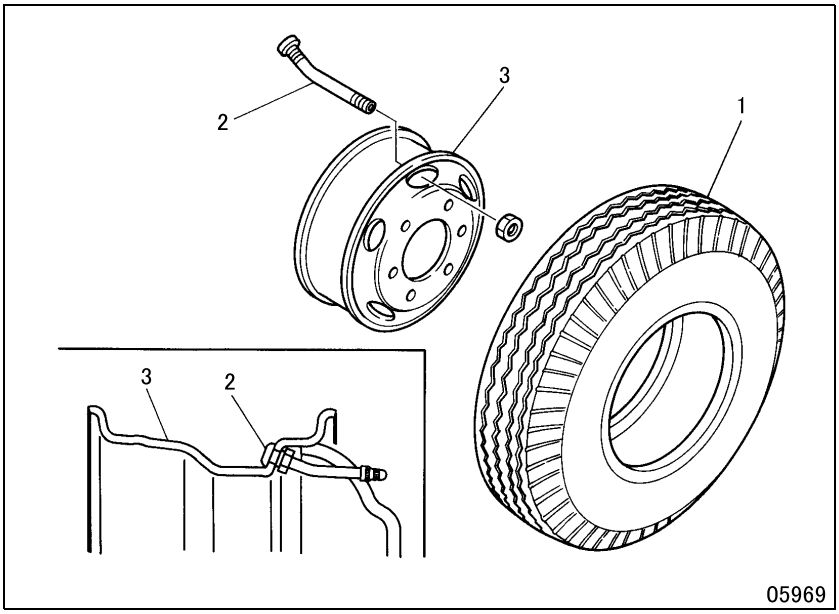
◆Installation procedure◆



■ Installation: Tire

- To prevent hardware and parts from becoming loose and/or damaged, thoroughly clean the following areas, removing rust, dirt, paint and foreign matter, before installing the tire.
  - **A:** Threaded portion of hub bolt
  - **B:** Wheel mounting surface of hub
  - **C:** Wheel alignment area of hub
  - **D:** Mating surfaces of disc wheel
  - **E:** Wheel nut mounting surface of disc wheel
  - **F:** Threaded portion of wheel nut
  - **G:** Spherical portion of wheel nut

Tire



●Disassembly sequence

1 Tire
2 Air valve
3 Disc wheel

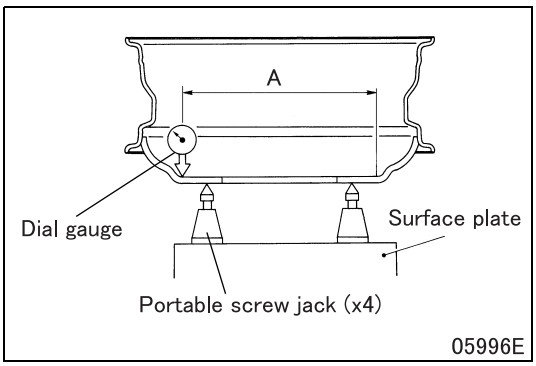
●Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
–	Tire assembly static unbalance tolerance			70 g {2.47 oz} or less	–	Correct
3	Disc wheel	16 × 6K-127 16 × 6K-135 17.5 × 6.00-127	Flatness (at hub surface)	0.3 {0.012} or less	–	Replace
			Lateral runout (sideway deflection)	1.5 {0.059} or less	–	
			Radial runout (vertical deflection)	1.5 {0.059} or less	–	

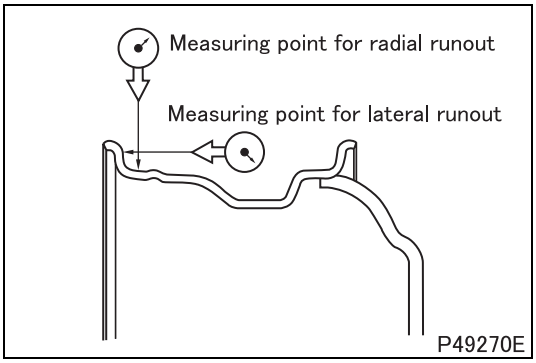
◆Inspection procedure◆



■Inspection: Disc wheel

(1) Flatness

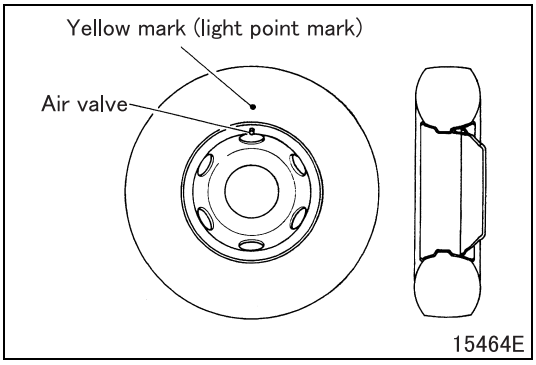
- Using a dial gauge, measure the disc wheel for flatness (difference between the maximum and minimum values measured) at specified distance **A** from the center of the wheel, at 5 locations for 5-stud units and 6 locations for 6-stud units that are equally divided around the specified circumference on the wheel.
  A: ϕ170 mm, 270 mm {6.69, 10.6 in.} 16 × 6K-127
  16 × 6K-135
  ϕ175 mm, 275 mm {6.89, 10.8 in.} 17.5 × 6.00-127
- If the measured flatness is equal to or exceeds the specified value, replace the disc wheel.



(2) Runout

- If the measured value is equal to or exceeds the standard value, replace the disc wheel.

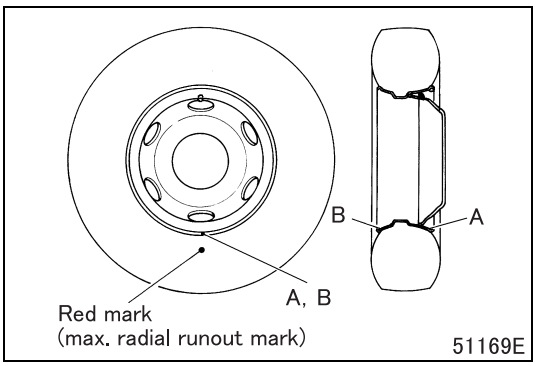
◆Installation procedure◆



■Installation: Tire

<Tire with no red mark>

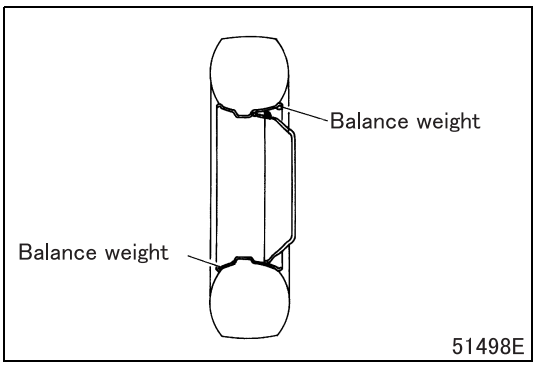
- Install the tire such that the yellow mark (light point mark) on the tire is aligned with the air valve on the disc wheel.



<Tire with red mark>

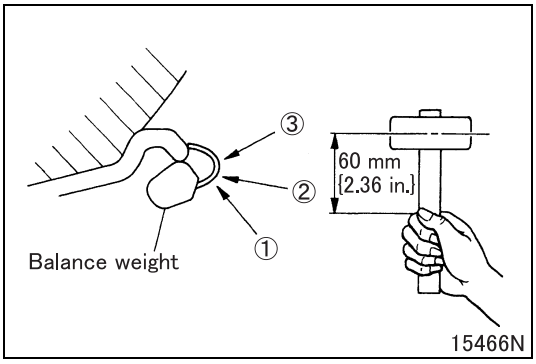
- Install the tire such that the red mark (max. radial runout mark) on the tire is aligned with mark **A** or **B** on the disc wheel.
  A: Front face of disc wheel <All wheels except 17.5-inch wheel>
  B: Back face of disc wheel <17.5-inch wheel>

◆Installation procedure◆

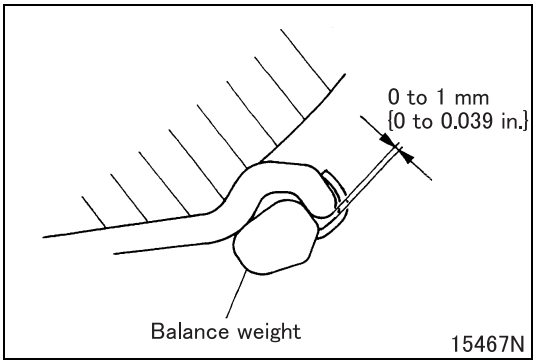


■ Installation: Balance weight

- Install balance weights onto the front and back sides of the disc of the tires on front axle. Ensure that the static unbalance of the tire being balanced remains within the standard value.



- Use a 1-pound resin hammer to drive balance weights into position.
- To install a balance weight, tap the clip of the weight in the center at 1, 2 and 3 in that order.



- Leave a clearance of approx. 0 to 1 mm {0 to 0.039 in.} between the clip and the disc wheel. Ensure that the balance weight is not loose after installation.
- Do not use a balance weight that has been improperly tapped or dropped to the floor during installation attempt.
- When 2 weights are being installed, these weights should be as much equal to each other as possible in weight. Also remember that the center point between the weights will become the support point for a balancer.

GROUP 33 INDEX

STRUCTURE AND OPERATION
1. Front Suspension Elements 33-2

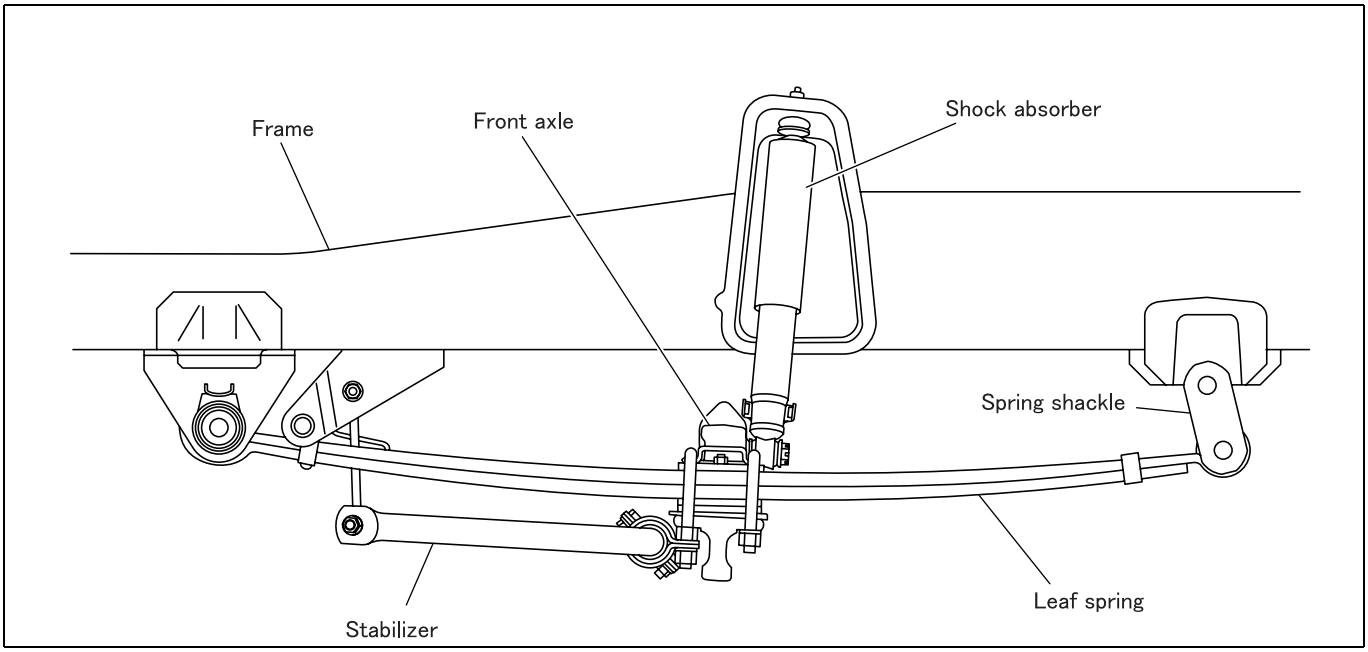
TROUBLESHOOTING 33-3

STABILIZER 33-4

SHOCK ABSORBER 33-6

LEAF SPRING 33-8

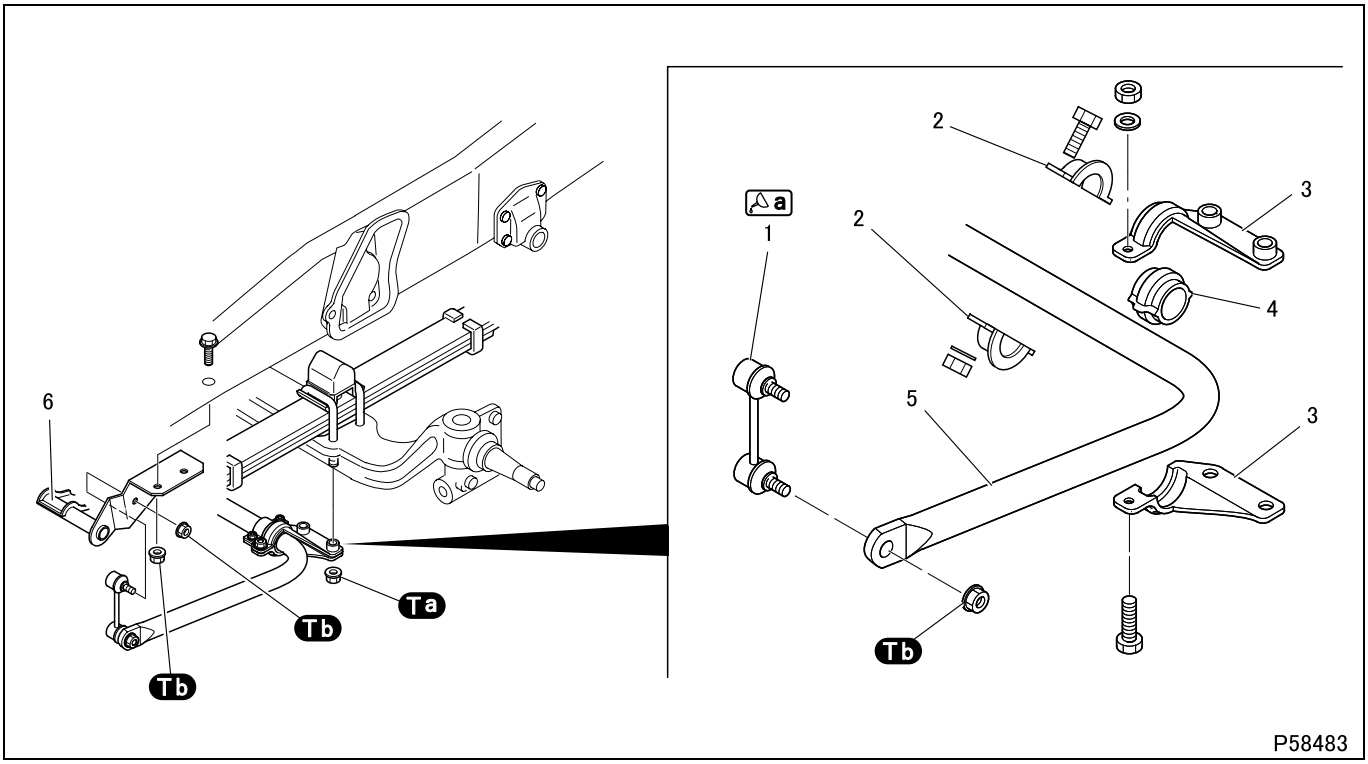
1. Front Suspension Elements



- The front suspensions shown above both use a spring shackle connected to the rear end of the leaf spring (shackle-link type suspension).
- The stabilizer prevents the vehicle from pitching, keeping it parallel with the ground.

Symptoms / Possibe causes		Feels as if floating	Tends to be noisy	Road bumps/pits received as shocks	Heavy rolling	Cyclical shocks from underneath	Vehicle tilted	Poor linearity	Reference Gr
Deformed stabilizer bar or link					O				
Shock absorber	Substantial loss of oil and damping capacity	O							
	Rubber bushing worn		O						
	Loose fitting		O						
Leaf spring	Cracks or other damage			O			O		
	Broken		O				O		
	Loose U-bolt		O				O		
	Spring bushing worn		O				O		
Tire	Uneven wear				O			O	
	Tire and wheel needs balancing					O		O	Gr31
	Excessive tire pressure			O					
Wheels out of alignment								O	Gr26

STABILIZER



●Removal sequence

1 Stabilizer link
2 Stabilizer retainer
3 Stabilizer clamp
4 Stabilizer bushing
5 Stabilizer bar
6 Stabilizer bar bracket

●Installation sequence

Follow the removal sequence in reverse.

Service standards: mm {in}

Location	Maintenance item		Standard value	Limit	Remedy
1	Stabilizer link	Starting torque	0.68 to 1.96 N·m {0.5 to 1.4 lbf·ft}	–	Replace
		Play	0.2 {0.0079} or less	–	

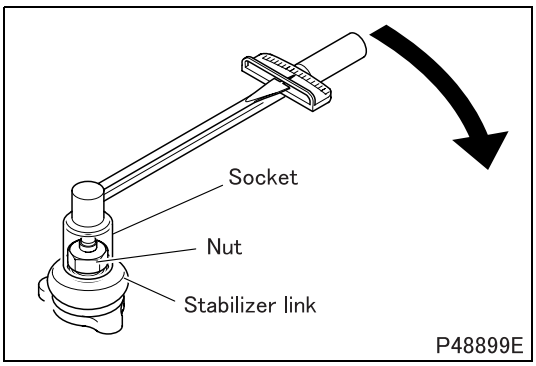
Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
Ta	Nut (U-bolt mounting)	162 ± 15 {120 ± 11}	–
Tb	Nut (stabilizer mounting)	90 to 120 {66 to 89}	–
	Nut (stabilizer link mounting)		
	Nut (stabilizer bar bracket mounting)		

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Dust cover lips on stabilizer link	Mitsubishi wheel bearing grease [NLGI No. 2 (Li soap)]	As required

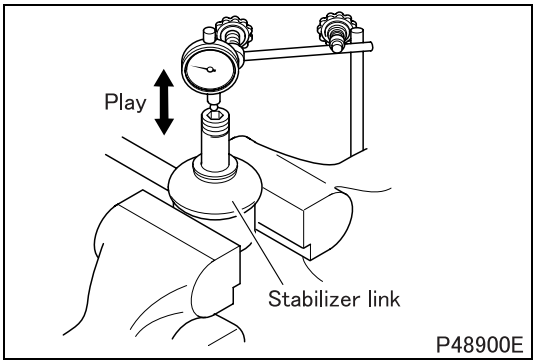
◆Inspection procedure◆



■ **Inspection: Stabilizer link**

(1) Starting torque

- Install a nut onto the stabilizer link.
- Install a socket and a torque wrench onto the nut. Measure the starting torque of the stabilizer link.
- If the measured value does not conform to the standard value, replace the stabilizer link.



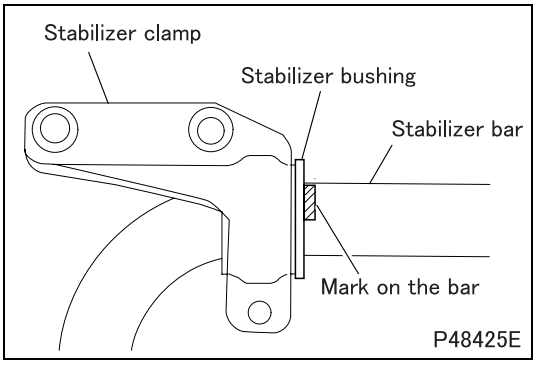
(2) Play

- If the measured value does not conform to the standard value, replace the stabilizer link.

(3) Dust cover

- Check the dust cover for wear, crack, and damage.

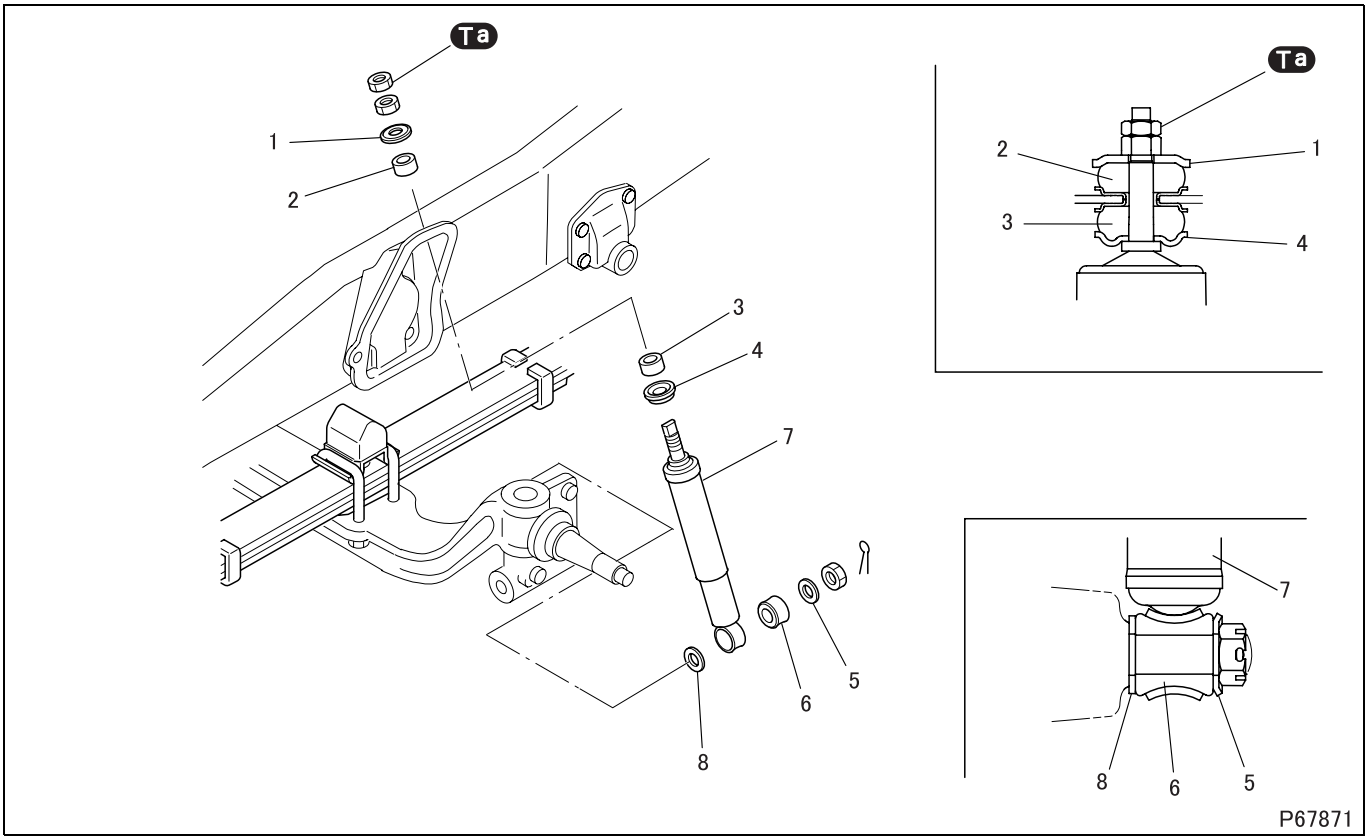
◆Installation procedure◆



■ **Installation: Stabilizer clamp and bushing**

- Position the stabilizer bushing onto the stabilizer bar such that the end of the bushing aligns with the mark on the bar. Clamp them in place with the stabilizer clamp.

SHOCK ABSORBER



●Removal sequence

1 Washer
2 Rubber bushing
3 Rubber bushing
4 Washer
5 Washer
6 Rubber bushing
7 Shock absorber
8 Washer

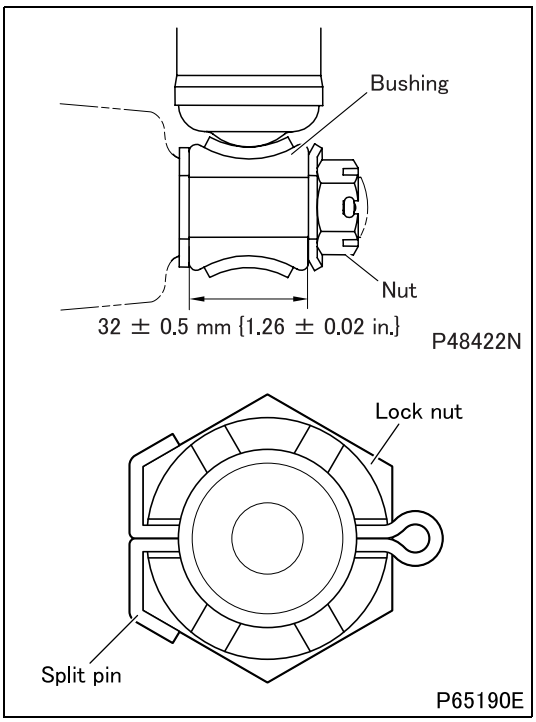
●Installation sequence

Follow the removal sequence in reverse.

Torque: N·m {lbf·ft}

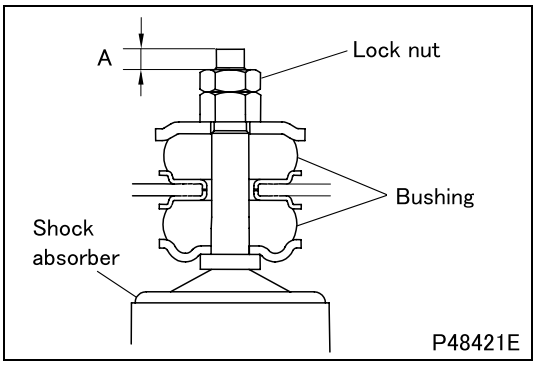
Mark	Fastener	Torque value	Remarks
Ta	Nut (rubber bushing mounting)	13 to 17 {9.6 to 13}	–

◆Installation procedure◆



■ **Installation: Rubber bushing**

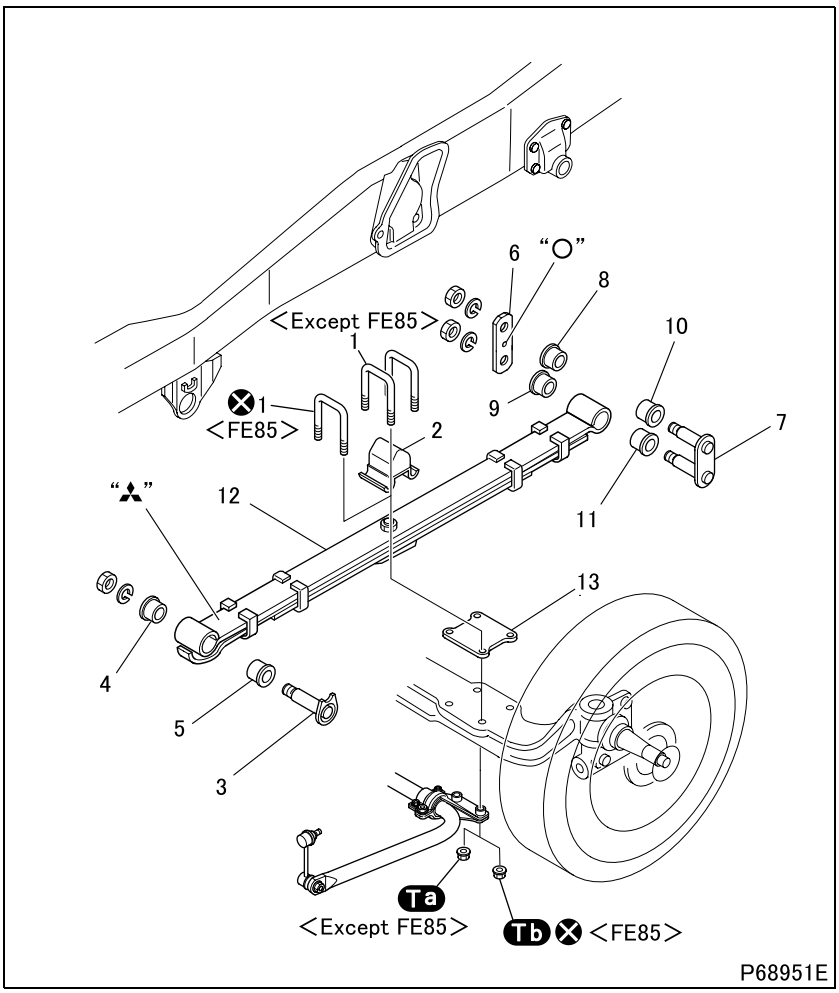
- Tighten the nut until the rubber bushing is squeezed to the illustrated dimension.
- Install the split pin as shown in the illustration.



■ **Installation: Rubber bushing**

- Tighten the nuts until dimension A in the illustration becomes equal to the following value.
  A: 4.7 mm {0.19 in}

LEAF SPRING



●Removal sequence

1 U-bolt
2 Front axle bumper
3 Spring pin
4 Rubber bushing
5 Rubber bushing
6 Shackle plate
7 Spring shackle
8 Rubber bushing
9 Rubber bushing
10 Rubber bushing
11 Rubber bushing
12 Leaf spring (See later section.)
13 Spacer

⊗ ⊗: Non-reusable parts

●Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- **U-bolt and mounting nut are non-reusable. <COE 50>**
- **Make sure to jack the vehicle up when tightening the U-bolt mounting nut to specified torque.**
- **Make sure to tighten the U-bolt mounting nut in dry tightening. If putting any oil or solvent on the nut, never use it.**

NOTE

- **The right-hand and left-hand leaf spring assemblies have different cambers from each other. Ensure that both assemblies are installed correctly. Reversed installation results in a slanted vehicle.**

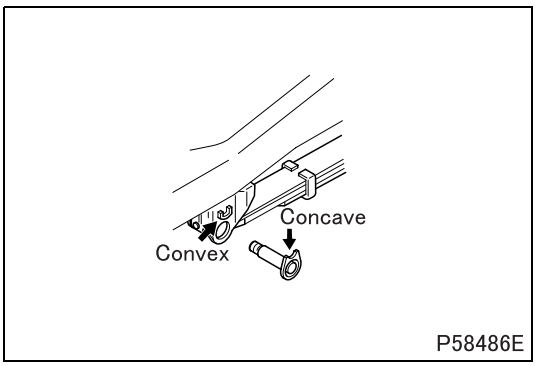
Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
3 to 5	Clearance between spring pin and rubber bushings	0 to 0.03 {0.0012}	–	Replace
7 to 11	Clearance between spring shackle and rubber bushings	0 to 0.03 {0.0012}	–	Replace

Torque: N·m {lbf·ft}

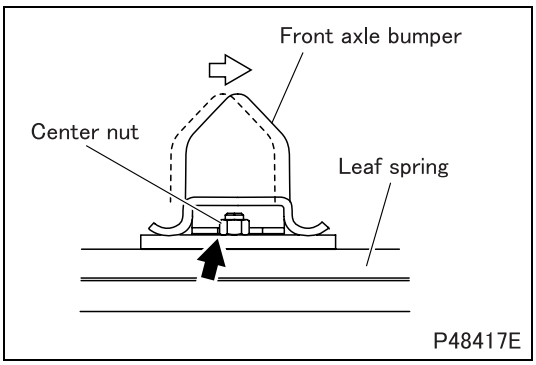
Mark	Fastener	Torque value	Remarks
Ta	Nut (U-bolt mounting)	162 ± 15 {119 ± 11}	Nut color: Yellow
Tb	Nut (U-bolt mounting)	175 ± 5 {129 ± 3.7}	Nut color: Green

◆Installation procedure◆



■ Installation: Spring pin

- Install the spring pin such that the concave on the pin engages with the convex on the frame.

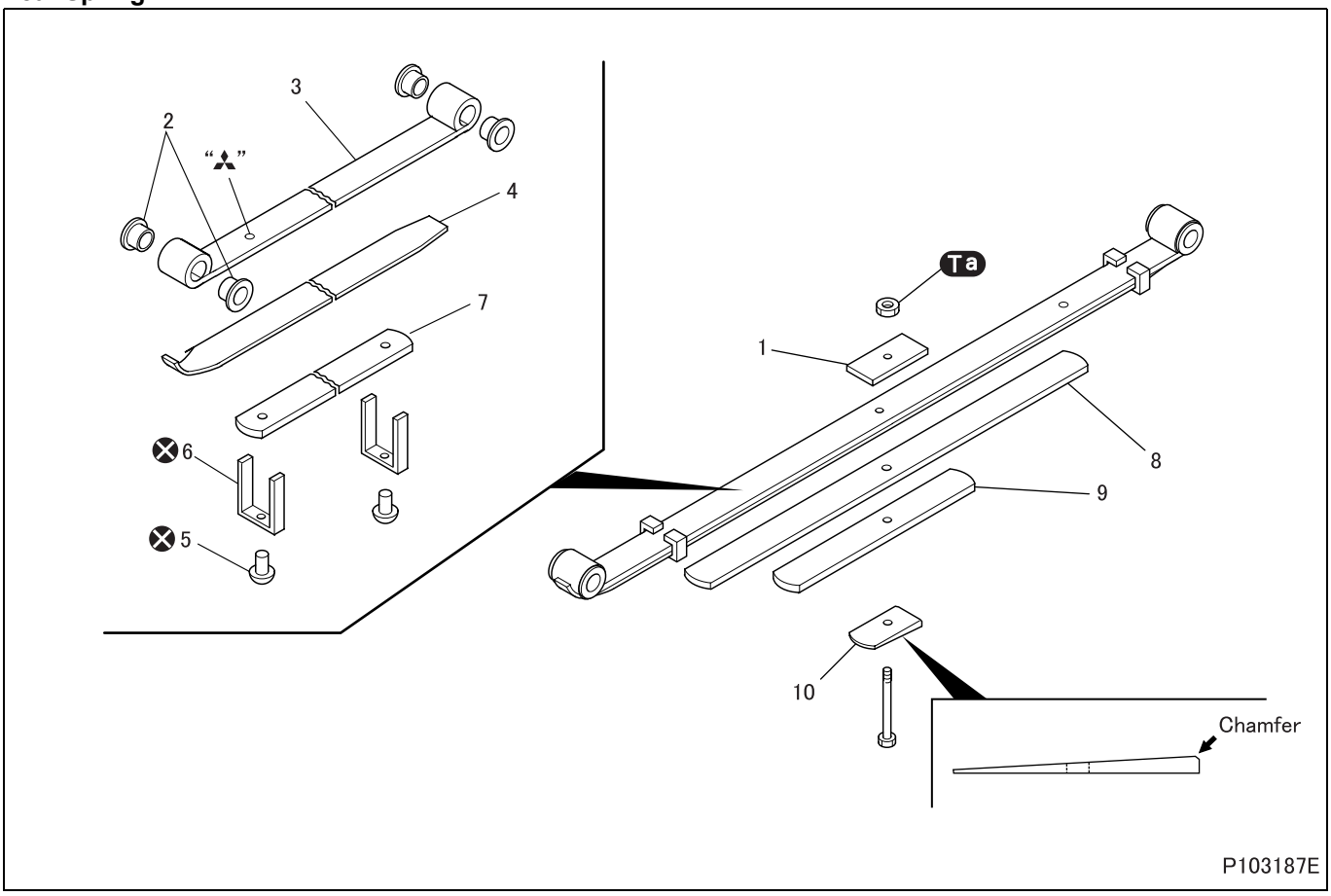


■ Installation: Front axle bumper

- With the unloaded vehicle, slide the front axle bumper on the leaf spring to the rear of the vehicle until it is against the center nut of the leaf spring. Then, install the bumper using U-bolts.

LEAF SPRING

Leaf Spring



- The above schematic is only an example. Details may differ depending on vehicle models, such as the number of spring leaves, spacers, and the parts used.

●Disassembly sequence

1 Sheet (8 mm {0.31 in} thick)
2 Sheet (10 mm {0.39 in} thick)
3 Collar
4 Leaf spring (No. 1)
5 Leaf spring (No. 2)
6 Rivet
7 Clip
8 Leaf spring (No. 3)
9 Leaf spring (No. 4)
10 Leaf spring (No. 5)
11 Sheet (8 mm {0.31 in} thick)
12 Caster shim

⊗: Non-reusable parts

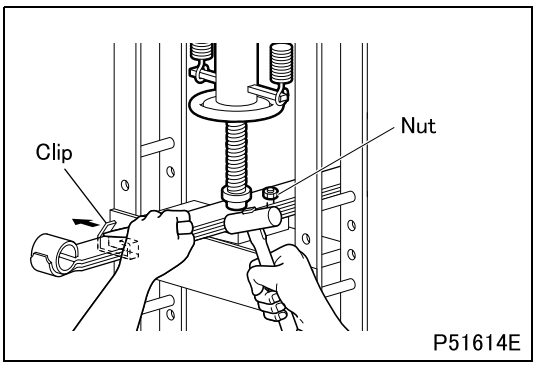
●Assembly sequence

Follow the disassembly sequence in reverse.

Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
Ta	Nut (assembly of leaf spring)	34 to 54 {25 to 40}	–

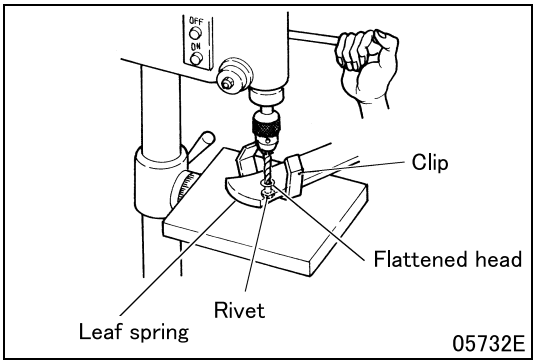
◆Work before removal◆



■ **Compression: Leaf spring**

- Using a press, compress the leaf spring as illustrated for subsequent operations.
- Using a chisel or the like, open the bent ends of the clip.

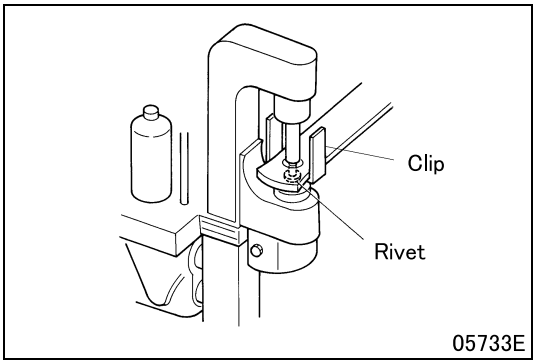
◆Removal procedure◆



■ **Removal: Clip**

- Using a drill press, break the flattened head of the rivet and remove the clip from the leaf spring (No. 3).

◆Installation procedure◆



■ **Installation: Clip**

- Using a riveting machine, rivet a clip onto the leaf spring.

GROUP 34 INDEX

STRUCTURE AND OPERATION
1. Rear Suspension Elements 34-2

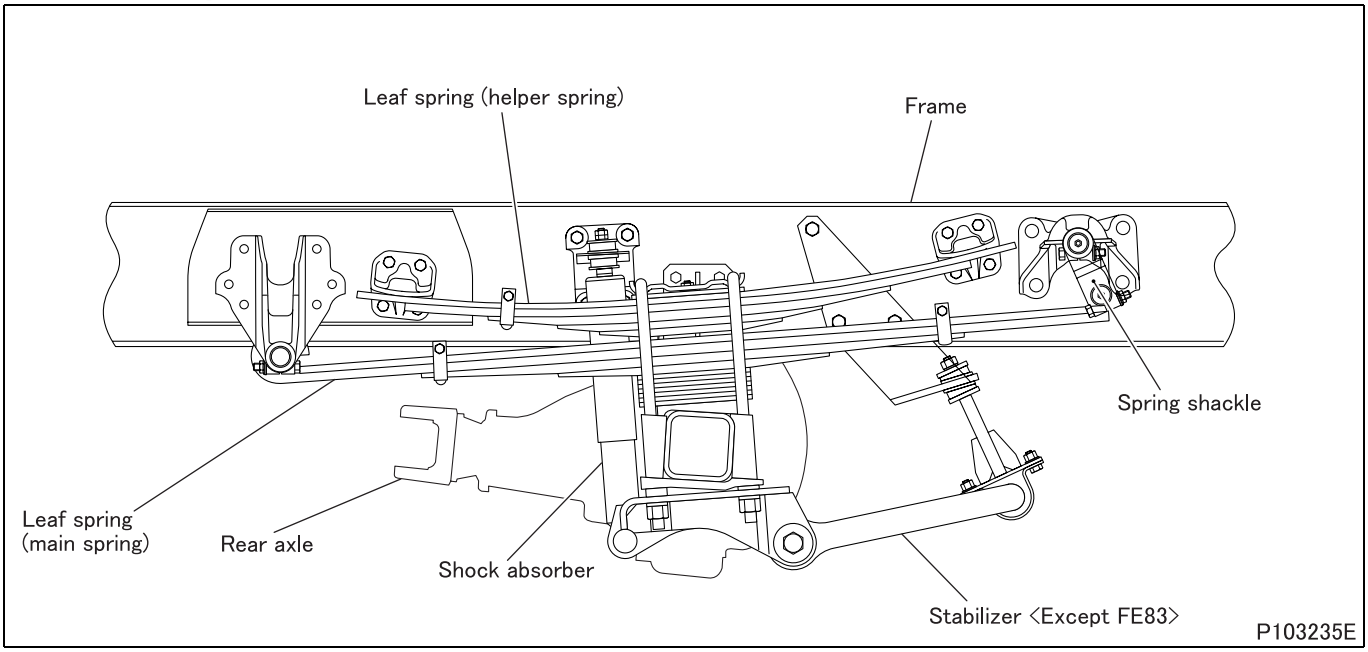
TROUBLESHOOTING 34-3

SHOCK ABSORBER 34-4

LEAF SPRING 34-6

STABILIZER 34-22

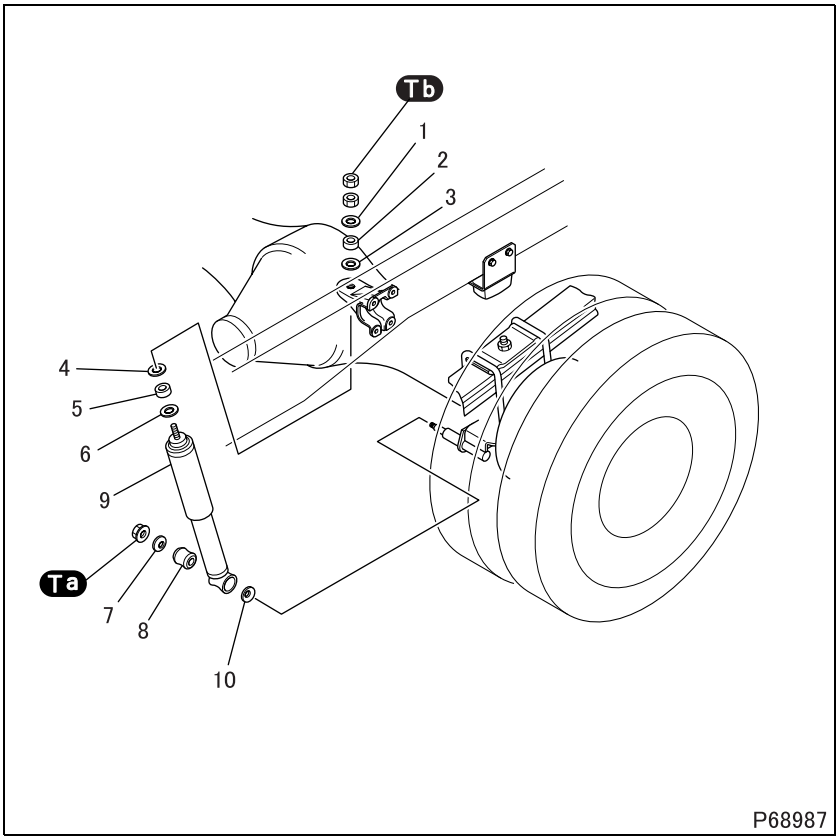
1. Rear Suspension Elements



- The rear suspensions shown above both use a spring shackle connected to the rear end of the leaf spring (shackle-link type suspension).
- The above schematics are only examples. Details may differ depending on vehicle models, including the number of spring leaves, the shape of spring shackle, and the location of the shock absorbers.

Possible causes \ Symptoms		Feels as if floating	Tends to be noisy	Road bumps/pits received as shocks	Heavy rolling	Cyclical shocks from underneath	Excessive rolling while cruising	Reference Gr
Shock absorber	Substantial loss of oil and damping capacity	O						
	Rubber bushing worn		O					
	Loose fitting		O					
Tire	Tire and wheel needs balancing					O		Gr31
	Excessive tire pressure			O				
Leaf spring	Cracks or other damage			O				
	Broken		O					
	Loose U-bolt		O					
	Spring bushing worn		O					
Thrust clearance of metal bushing-type spring pin or shackle pin			O					
Helper rubber or helper spring stopper damaged or broken			O					
Spring pin over-tightened			O					
Stabilizer deformed, bushing worn							O	

SHOCK ABSORBER



●Removal sequence

1 Washer
2 Rubber bushing
3 Washer
4 Washer
5 Rubber bushing
6 Washer
7 Washer
8 Rubber bushing
9 Shock absorber
10 Washer

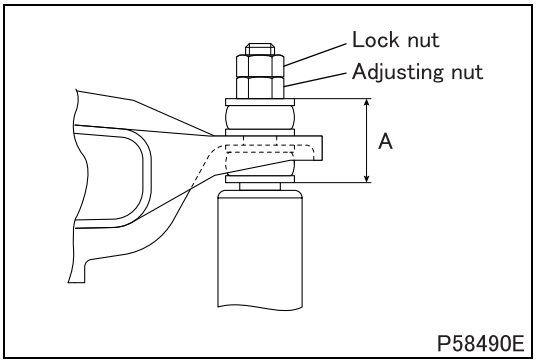
●Installation sequence

Follow the removal sequence in reverse.

Torque: N·m {lbf·ft}

Mark	Parts to be tightened	Torque value	Remarks
Ta	Nut (shock absorber mounting)	90 to 130 {66 to 96}	–
Tb	Lock nut (rubber bushing mounting)	34 to 50 {25 to 37}	–

◆Installation procedure◆



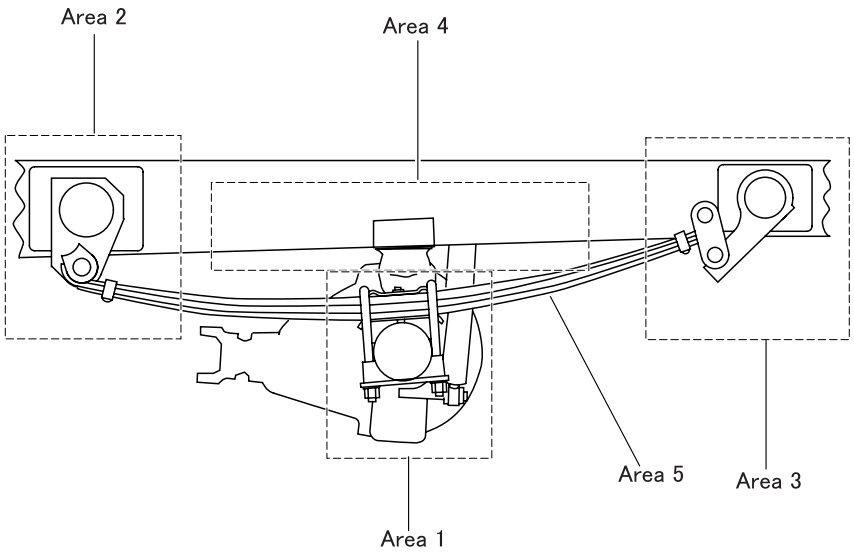
■ Installation: Shock absorber

- Tighten the adjusting nut until the part A in the illustration becomes the following dimension.
  A: 48 mm {1.89 in.}
- Tighten the lock nut to the specified torque.

M E M O

LEAF SPRING

Leaf Spring Assembly Layout

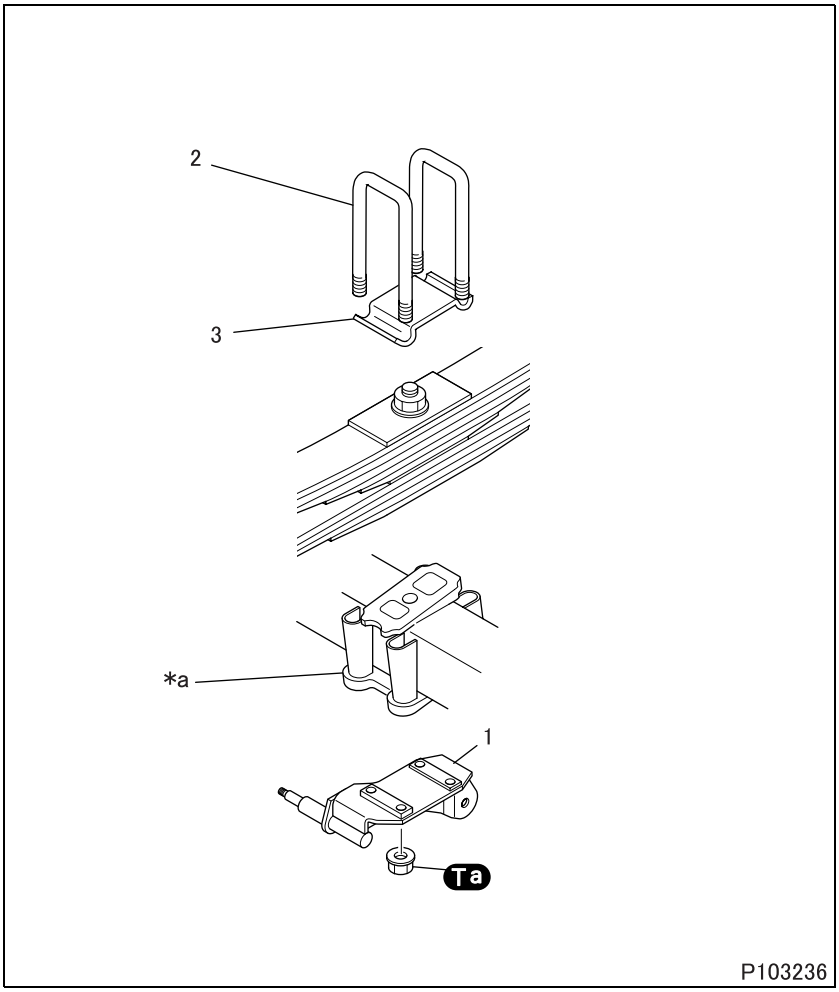


P49758E

- This section divides the leaf spring in 5 areas and describes removal and installation procedures for each area. For information on specific components, see the descriptions for the applicable area.

U-bolt U-bolt nut	Area 1 (center section of leaf spring)
Spring pin Bushing	Area 2 (front section of leaf spring)
Spring shackle Bushing	Area 3 (rear section of leaf spring)
Helper rubber Helper spring stopper	Area 4 (stoppers)
Leaf spring	Area 5 (leaf springs)

Area 1 (center section of leaf spring)



●Removal sequence

1 Stabilizer bracket lower
2 U-bolt
3 Spring pad

***a**: Rear axle

●Installation sequence

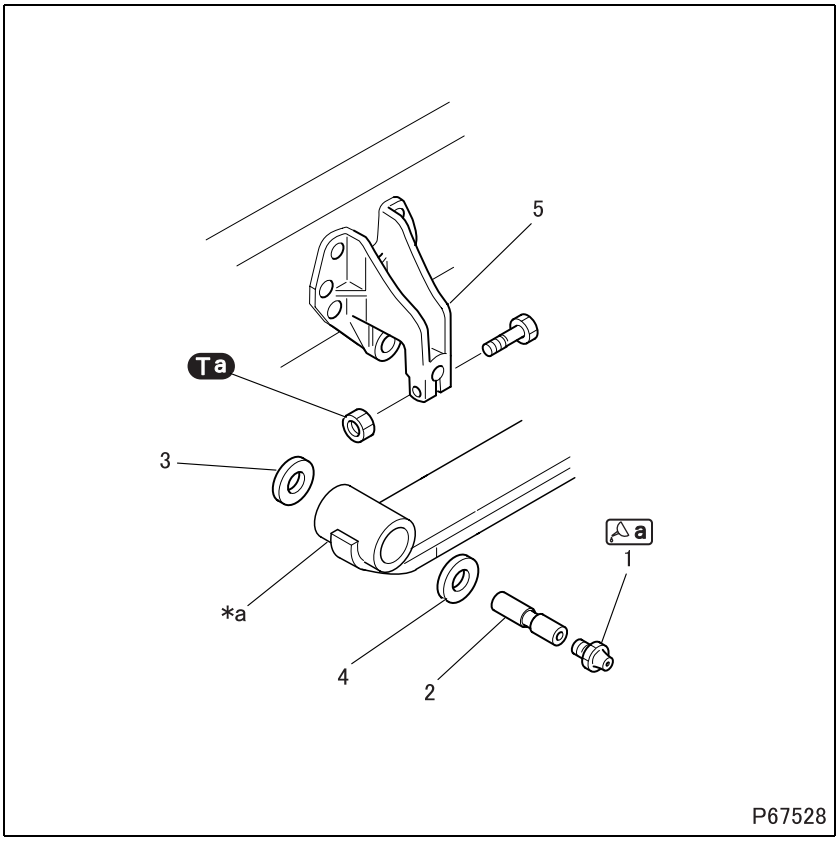
Follow the removal sequence in reverse.

Torque: N·m {lbf·ft}

Mark	Parts to be tightened	Torque value	Remarks
Ta	Nut (U-bolt mounting)	292 to 394 {215 to 290}	–

LEAF SPRING

Area 2 (front section of leaf spring)



●Removal sequence

1 Grease fitting
2 Spring pin
3 Inboard adjustment washer
4 Outboard adjustment washer
5 Rear spring hanger

***a**: Leaf spring

●Installation sequence

Follow the removal sequence in reverse.

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
2, 5	Clearance between spring pin and rear spring hanger	0 to 0.04 {0.0016}	0.3 {0.012}	Replace
2, *a	Clearance between spring pin and leaf spring bushing	0 to 0.12 {0.0047}	0.3 {0.012}	Replace
5, *a	Clearance between rear spring hanger and leaf spring	0.07 to 1.03 {0.0028 to 0.041}	1.3 {0.051}	Adjust or replace

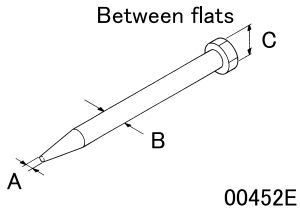
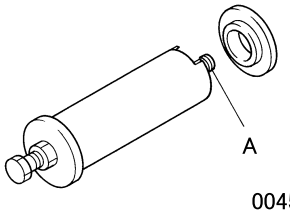
Torque: N·m {lbf·ft}

Mark	Parts to be tightened	Torque value	Remarks
Ta	Nut (spring pin mounting)	80 to 110 {59 to 81}	–

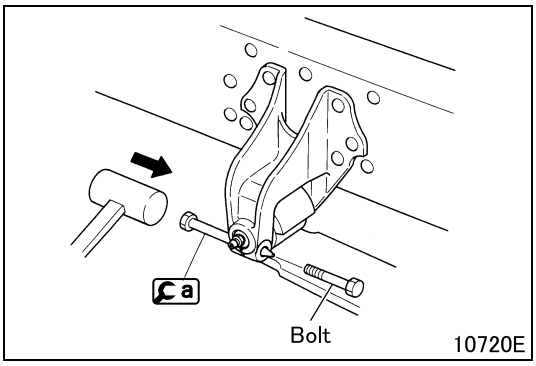
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Supply from grease nipple	Chassis grease [NLGI No. 1 (Li soap)]	As required

Special tools (Unit: mm {in})

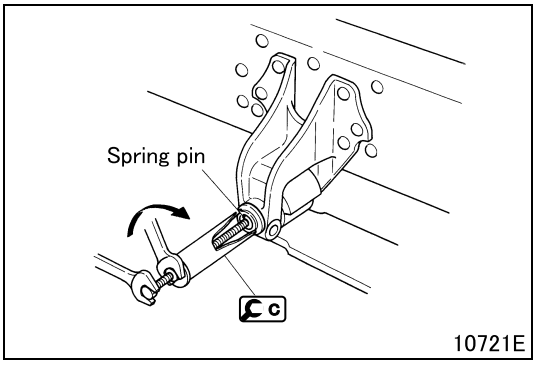
Mark	Tool name and shape	Part No.	Application
a	Shackle pin setting bar A: φ4 {0.16}, B: φ12 {0.47}, C: 17 {0.67}  00452E	MC023419	Removal and installation of spring pin mounting bolt
c	Spring pin remover A: PT 1/8  00453	MH061452	Removal of spring pin

◆Removal procedure◆



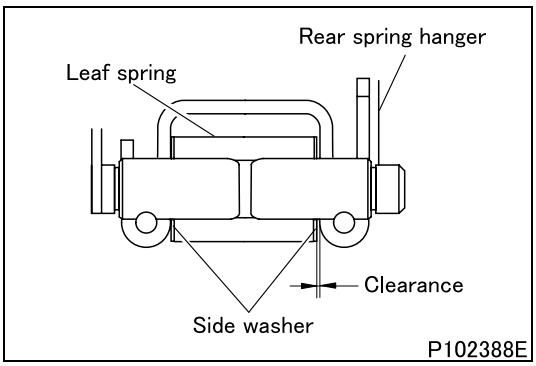
10720E

■ **Removal: Spring pin**



10721E

◆Inspection procedure◆



P102388E

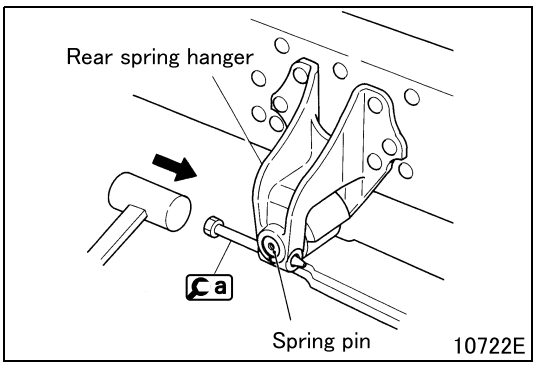
■ **Inspection: Clearance between rear spring hanger and leaf spring**

- Measure the spring-to-hanger clearance using feeler gauge. If the measured value is equal to or exceeds the limit, adjust by means of side washers.

Side washer sizes available (mm {in})

2.8, 3.2, 3.5, 3.8, 4.0 {0.11, 0.13, 0.14, 0.15, 0.16}

◆Installation procedure◆



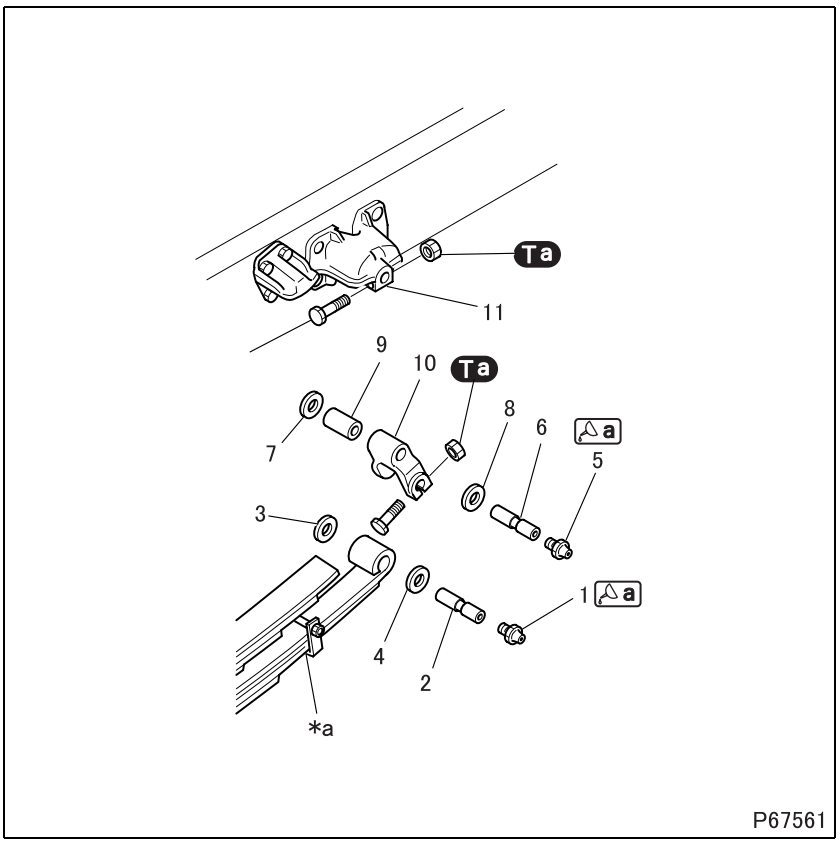
■ **Installation: Spring pin**

- Using a, align the bolt hole in the rear spring hanger with the bolt groove in the spring pin.

M E M O

LEAF SPRING

Area 3 (rear section of leaf spring)



●Removal sequence

1 Grease fitting
2 Spring pin
3 Side washer (for adjustment)
4 Side washer (for adjustment)
5 Grease nipple
6 Spring pin
7 Side washer (for adjustment)
8 Side washer (for adjustment)
9 Bushing
10 Spring shackle
11 Rear shackle hanger

***a**: Leaf spring

●Installation sequence

Follow the disassembly sequence in reverse.

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
2, 10	Clearance between spring pin and spring shackle	0 to 0.04 {0.0016}	0.3 {0.012}	Replace
2, *a	Clearance between spring pin and leaf spring	0 to 0.12 {0.0047}	0.3 {0.012}	Replace
6, 9	Clearance between spring pin and bushing	0.02 to 0.14 {0.00079 to 0.0055}	0.3 {0.012}	Replace
6, 11	Clearance between spring pin and rear shackle hanger	0 to 0.04 {0.0016}	0.3 {0.012}	Replace
10, 11	Clearance between spring shackle and rear shackle hanger	0.07 to 0.73 {0.0028 to 0.029}	1.0 {0.039}	Adjust or replace
10, *a	Clearance between spring shackle and leaf spring	0.07 to 1.03 {0.0028 to 0.041}	1.3 {0.051}	Adjust or replace

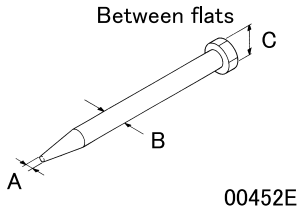
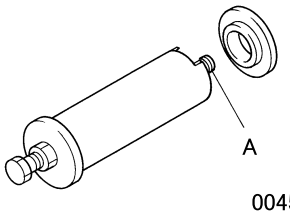
Torque: N·m {lbf·ft}

Mark	Parts to be tightened	Torque value	Remarks
Ta	Nut (spring pin mounting)	80 to 112 {59 to 83}	–

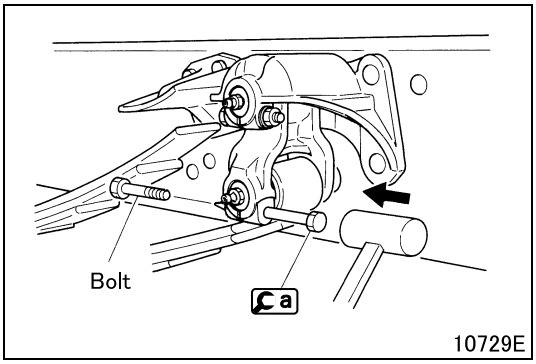
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Supply from grease nipple	Chassis grease [NLGI No. 1 (Li soap)]	As required

Special tools (Unit: mm {in})

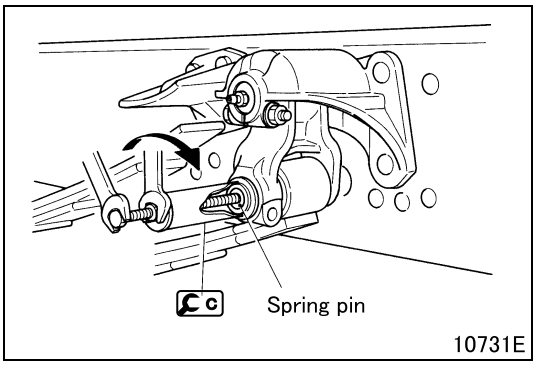
Mark	Tool name and shape	Part No.	Application
a	Shackle pin setting bar A: φ4 {0.16}, B: φ12 {0.47}, C: 17 {0.67}  00452E	MC023419	Removal and installation of spring pin mounting bolt
c	Spring pin remover A: PT 1/8  00453	MH061452	Removal of spring pin

◆Removal procedure◆

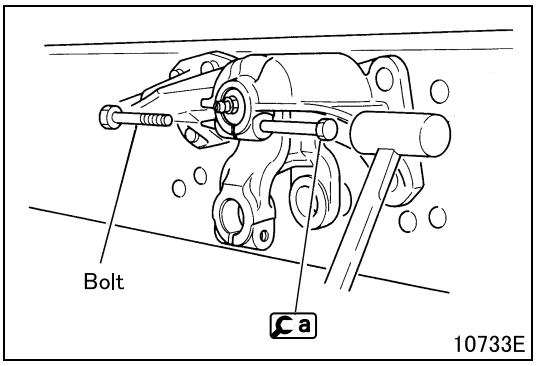


10729E

■ **Removal: Spring pin**

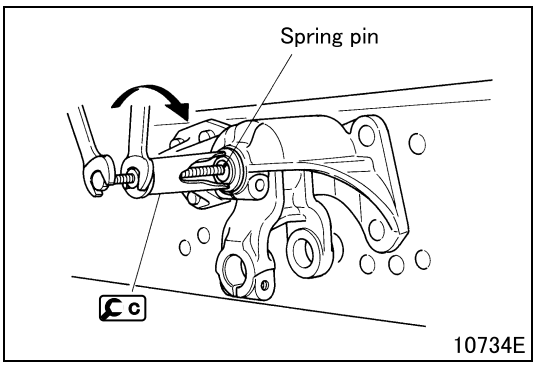


10731E

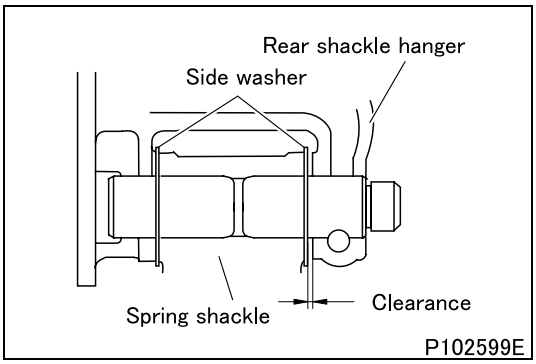


10733E

■ **Removal: Spring pin**



◆Inspection procedure◆

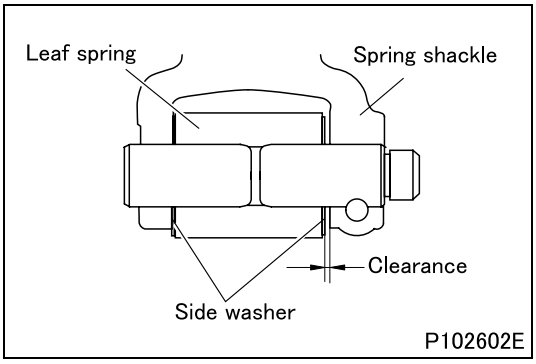


■ **Inspection: Clearance between spring shackle and rear shackle hanger**

- Measure the spring-to-hanger clearance using feeler gauge. If the measured value is equal to or exceeds the limit, adjust by means of side washers.

Side washer sizes available (mm {in})

2.8, 3.2, 3.5, 3.8, 4.0 {0.11, 0.13, 0.14, 0.15, 0.16}



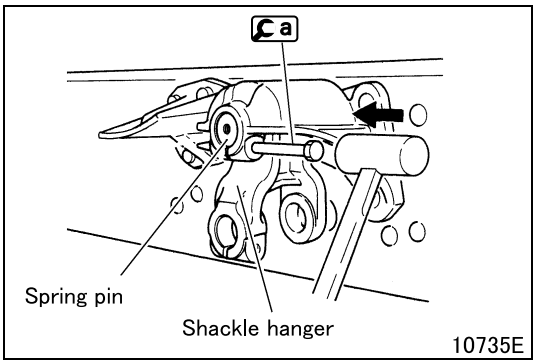
■ **Inspection: Clearance between spring shackle and leaf spring**

- Measure the spring-to-shackle clearance using feeler gauge. If the measured value is equal to or exceeds the limit, adjust by means of side washers.

Side washer sizes available (mm {in})

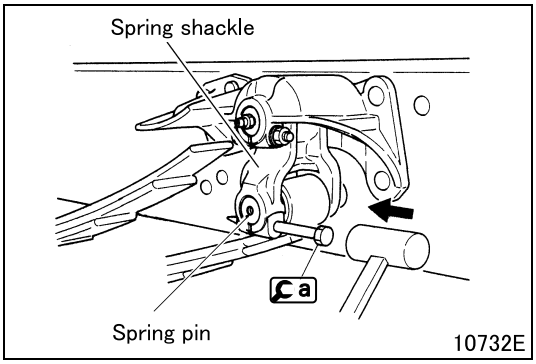
2.8, 3.2, 3.5, 3.8, 4.0 {0.11, 0.13, 0.14, 0.15, 0.16}

◆Installation procedure◆



■ **Installation: Spring pin**

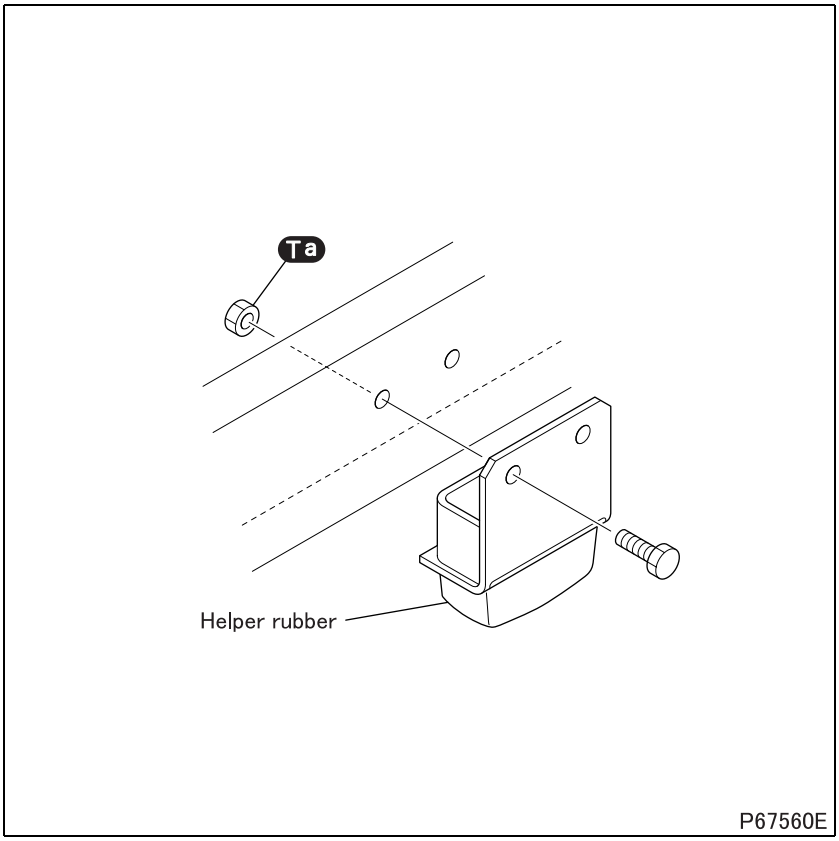
- Using the shackle pin setting bar a, align the bolt hole in the shackle hanger with the bolt groove in the spring pin.



■ **Installation: Spring pin**

- Using the shackle pin setting bar [a], align the bolt hole in the spring shackle with the bolt groove in the spring pin.

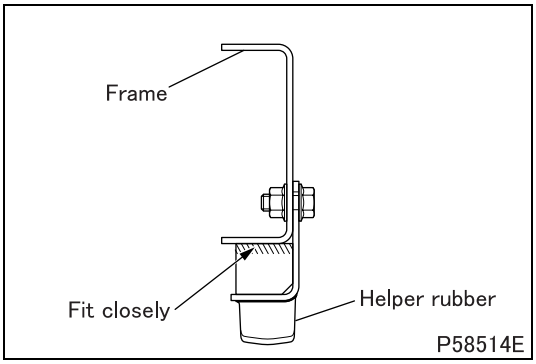
Area 4 (stoppers)



Torque: N·m {lbf·ft}

Mark	Parts to be tightened	Torque value	Remarks
Ta	Nut (helper rubber mounting)	12 to 15 {8.9 to 11}	–

◆Installation procedure◆



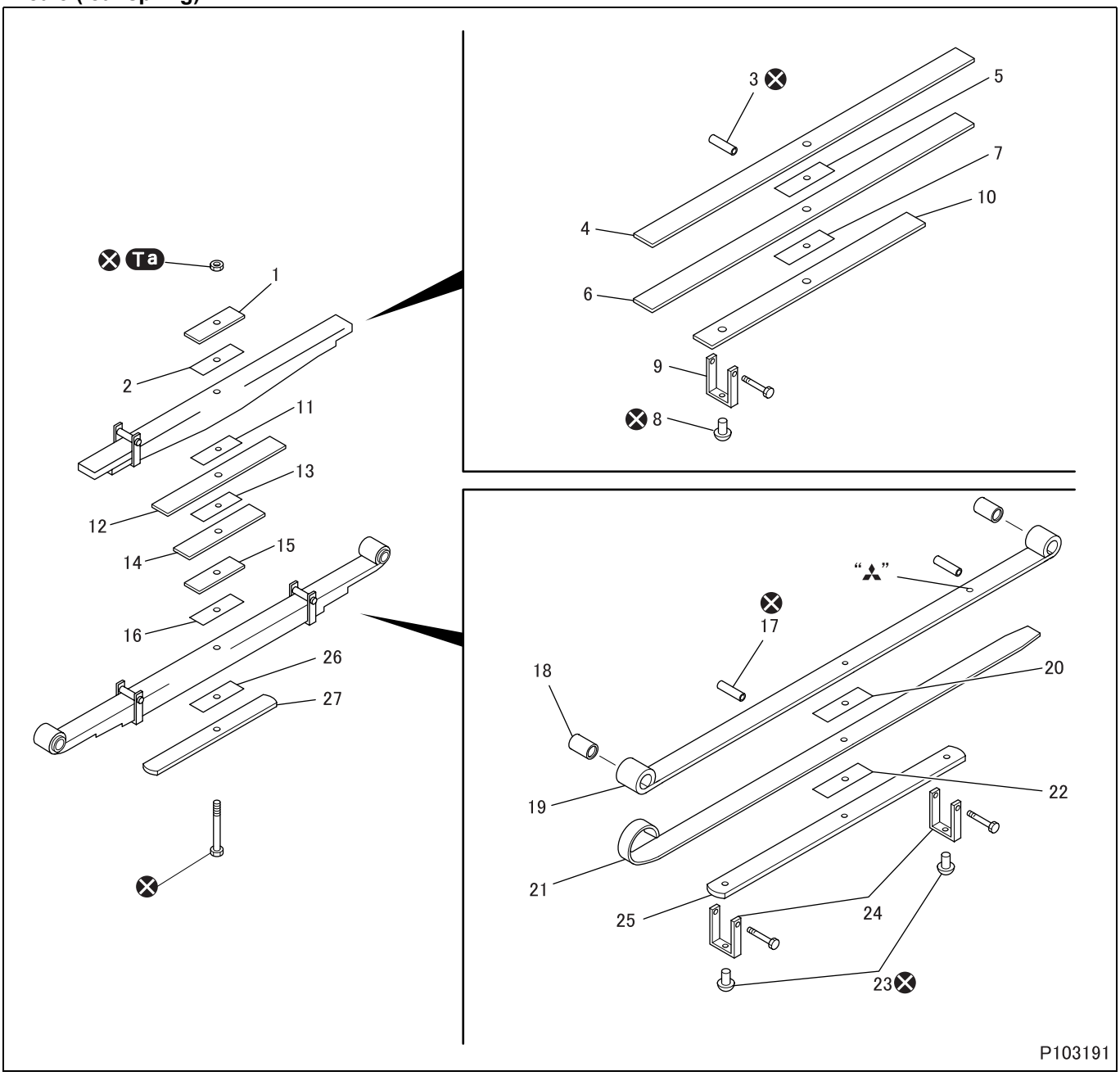
■ Installation: Helper rubber

- Fit helper rubber to the lower face of frame closely as illustrated, then tighten installation bolt and nut.

M E M O

LEAF SPRING

Area 5 (leaf spring)



NOTE

- **The above schematic is only an example. Details may differ depending on vehicle models, such as the number of spring leaves, spacers, and the parts used.**

●Disassembly sequence

1 Spacer
2 Center spacer
3 Pipe
4 Leaf spring (helper)
5 Center spacer
6 Leaf spring (helper)
7 Center spacer
8 Rivet
9 Clip
10 Leaf spring (helper)
11 Center spacer
12 Leaf spring (helper)
13 Center spacer
14 Leaf spring (helper)
15 Spacer
16 Pipe
17 Metal bushing
18 Leaf spring (main)
19 Center spacer
20 Leaf spring (main)
21 Center spacer
22 Rivet
23 Clip
24 Leaf spring (main)
25 Center spacer
26 Leaf spring (main)

⊗: Non-reusable parts

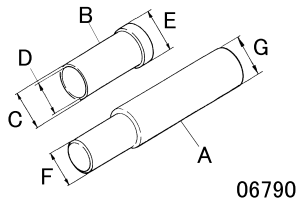
●Assembly sequence

Follow the disassembly sequence in reverse.

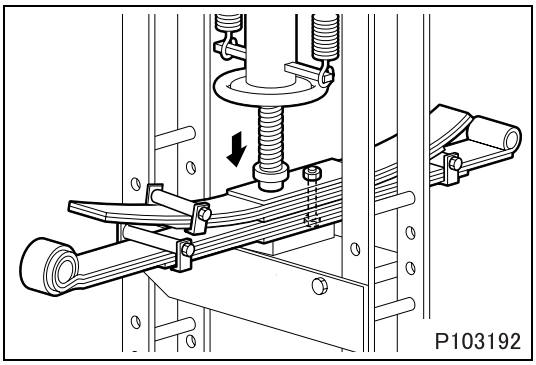
Torque: N·m {lbf·ft}

Mark	Parts to be tightened	Torque value	Remarks
Ta	Nut (assembly of leaf spring)	69 to 93 {51 to 69}	–

Special tools (Unit: mm {in})

Mark	Tool name and shape	Part No.	Application
Ca	Bushing installer **A:** Bushing installer A **B:** Bushing installer B  06790 **C**: φ28 {1.10}; **D**: φ25 {0.98}; **E**: φ32.8 {1.29}; **F**: φ25 {0.98}; **G**: φ30 {1.18}	MB999066 A: MB999067 B: MB999068	Removal and installation of metal bushing

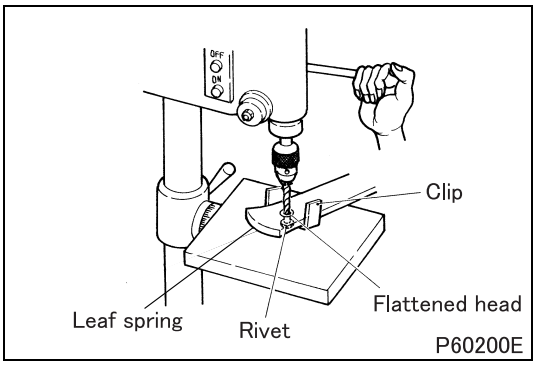
◆Work before removal◆



■ Compression: Leaf spring

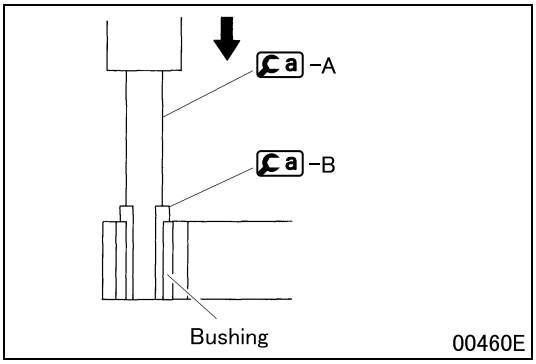
- Using a press, compress the leaf spring as illustrated for subsequent operations.

◆Removal procedure◆



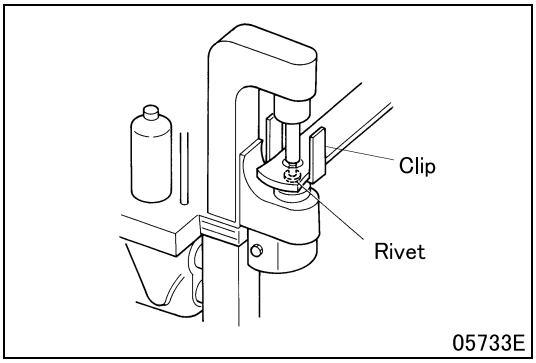
■ Removal: Clip

- Using a drill press, break the flattened head of the rivet and remove the clip from the leaf spring.



■ **Removal: Metal bushing**

◆**Installation procedure**◆

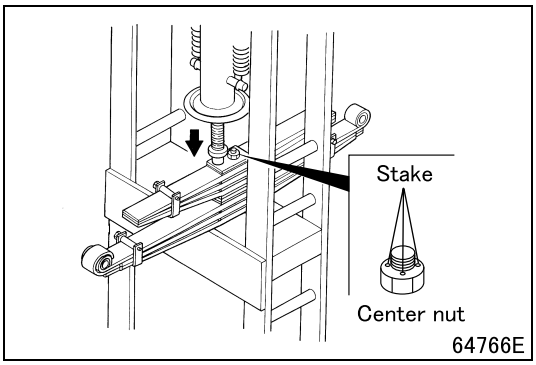


■ **Installation: Clip**

- Using a riveting machine, rivet a clip onto the leaf spring.

■ **Installation: Metal bushing**

- Install the metal bushing in a manner similar to that for removal. (See **"■Removal: Metal bushing"**.)

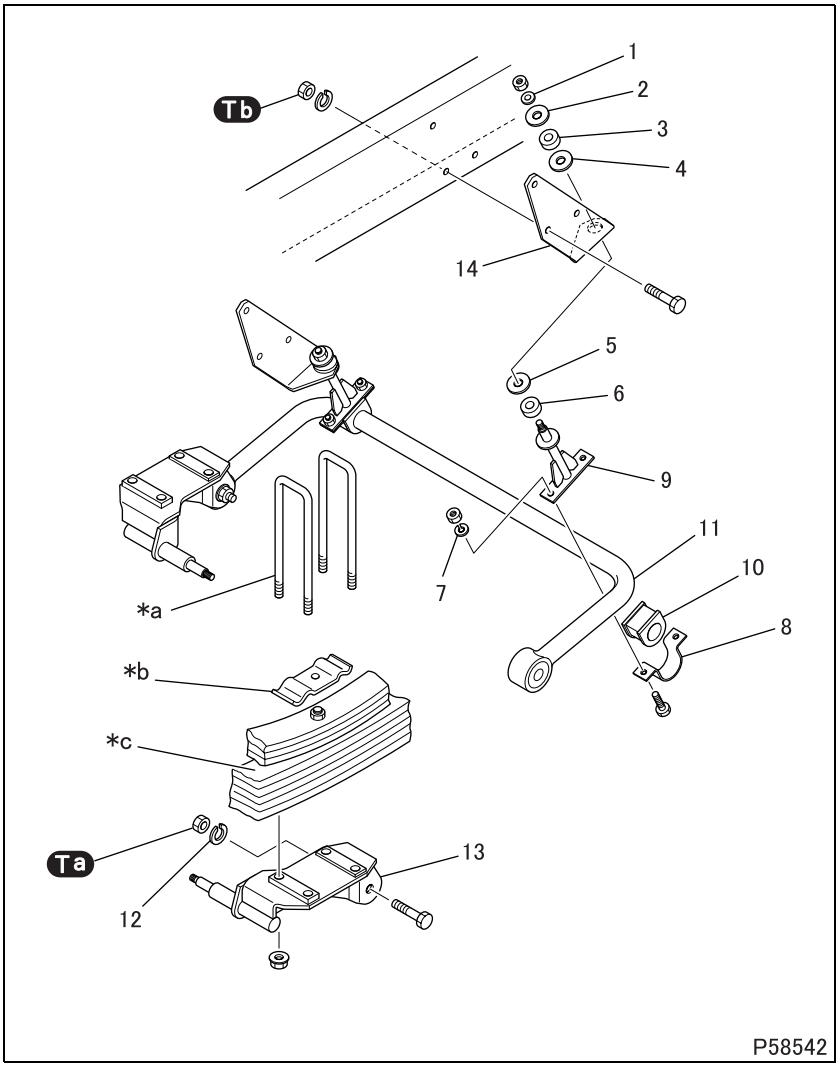


■ **Installation: Leaf spring**

- Pass the bolt to hold the leaf springs together.
- Stack the leaf springs tightly using a press and tighten the nut to the specified torque.
- After installing the nut, stake it at three locations.

M E M O

STABILIZER



●Removal sequence

1 Washer
2 Seat
3 Bushing
4 Seat
5 Seat
6 Bushing
7 Washer
8 Clamp
9 Stabilizer hanger
10 Stabilizer bushing
11 Stabilizer bar
12 Washer
13 Stabilizer bracket lower
14 Stabilizer bracket upper

***a**: U-bolt
***b**: Spring pad
***c**: Leaf spring

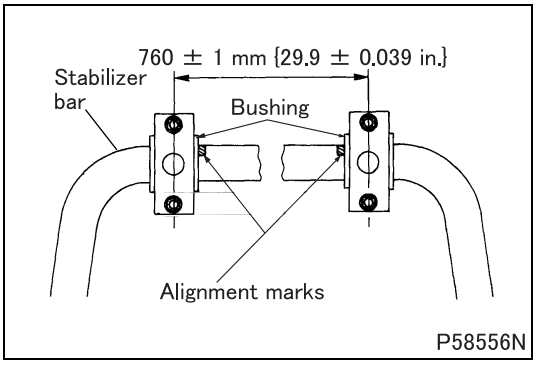
●Installation sequence

Follow the removal sequence in reverse.

Torque: N·m {lbf·ft}

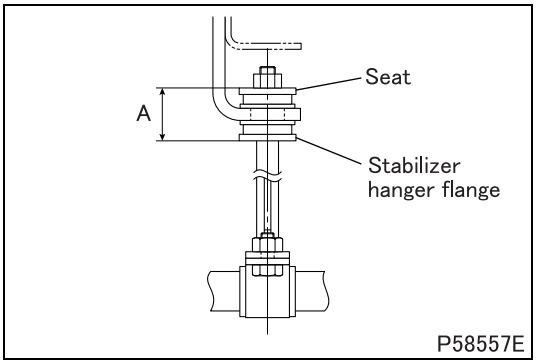
Mark	Parts to be tightened	Torque value	Remarks
Ta	Nut (stabilizer bracket mounting)	410 to 550 {300 to 405}	–
Tb	Nut (stabilizer bracket mounting)	130 to 180 {96 to 130}	–
Tc	Nut (stabilizer hanger mounting)	60 to 80 {44 to 59}	–

◆Installation procedure◆



■ Installation: Stabilizer bushing

- Mount stabilizer bushings with their end surfaces aligned with marks on stabilizer bar.



■ **Installation: Stabilizer hanger**

- Tighten the mounting nut until the part A in the illustration becomes the following dimension.
  A: 48.4 mm {1.89 in.}

GROUP 35A INDEX

SPECIFICATIONS 35A-2

STRUCTURE AND OPERATION
1. Brake System 35A-4
2. Vacuum Pump 35A-7
3. Vacuum Booster and Brake Master Cylinder <Except COE 50> 35A-8
4. Hydraulic Booster and Brake Master Cylinder <COE 50> 35A-14
5. Flow Priority Valve <COE 50> 35A-20
6. Front Disc Brake 35A-21
7. Rear Disc Brake 35A-22
8. Exhaust Brake System 35A-23

TROUBLESHOOTING 35A-24

ON-VEHICLE INSPECTION AND ADJUSTMENT
1. Replacement of Brake Fluid 35A-28
2. Air Bleeding of Brake System 35A-30
3. Inspection and Adjustment of Brake Pedal Free Play 35A-34
4. Inspection and Adjustment of Brake Pedal Pressed Height from Floor 35A-34
5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal 35A-35
6. Inspection and Replacement of Disc Brake Pad 35A-36
7. Measurement of Disc Brake Drag Torque 35A-39
8. Inspection of Check Valve in Vacuum Line Hose 35A-40
9. Inspection of Vacuum Pump 35A-40
10. Inspection of Vacuum Booster <Except COE 50> 35A-42
11. Inspection of Hydraulic Booster <COE 50> 35A-46

VACUUM PUMP 35A-48

BRAKE MASTER CYLINDER
BRAKE MASTER CYLINDER <WITH VACUUM BOOSTER> 35A-50
BRAKE MASTER CYLINDER <WITH HYDRAULIC BOOSTER> 35A-54

BRAKE PEDAL & VACUUM BOOSTER, HYDRAULIC BOOSTER 35A-56

FRONT DISC BRAKE
FRONT DISC BRAKE <f235 mm {9.25 in} DISC> 35A-58
FRONT DISC BRAKE <f235 mm {9.25 in} DISC> 35A-60

REAR DISC BRAKE
REAR DISC BRAKE <f235 mm {9.25 in} DISC> 35A-66
REAR DISC BRAKE <f252 mm {9.92 in} DISC> 35A-68

EXHAUST BRAKE SYSTEM 35A-70

SPECIFICATIONS

Vacuum Booster and Brake Master Cylinder

Item				Specifications
Vacuum booster	Boosting type			Except COE 50
	Diaphragm diameter		inch	ϕ9 + ϕ10
	Manufacturer			Bosch
Brake master cylinder	Inner diameter		mm {in}	ϕ31.75 {1.25}
	Stroke	Front	mm {in}	16.0 {0.63}
		Rear	mm {in}	16.0 {0.63}
	Manufacturer			NISSIN KOGYO

Hydraulic Booster and Brake Master Cylinder

Item				Specifications
				COE 50
Hydraulic booster	Boosting type			Hydraulic type
	Manufacturer			Bosch
Brake master cylinder	Inner diameter		mm {in.}	ϕ33.34 {1.31}
	Stroke	Front	mm {in.}	17.5 {0.69}
		Rear	mm {in.}	16.0 {0.63}
	Manufacturer			Bosch

Front Disc Brake

Item		Specifications	
		COE 40/45	COE 50
Brake type		Twin caliper type	
Effective diameter for braking	mm {in}	ϕ235 {9.25}	ϕ252 {9.92}
Disc rotor outer diameter × thickness	mm {in}	ϕ293 × 40 {11.5 × 1.57}	ϕ310 × 40 {12.2 × 1.57}
Caliper piston inner diameter	mm {in}	ϕ51.1 {2.01}	ϕ54 {2.13}
Thickness of pad	mm {in}	14 {0.55}	14 {0.55}

Rear Disc Brake

Item		Specifications	
		COE 40/45	COE 50
Brake type		Twin caliper type	
Effective diameter for braking	mm {in}	ϕ235 {9.25}	ϕ252 {9.92}
Disc rotor outer diameter × thickness	mm {in}	ϕ293 × 40 {11.5 × 1.57}	ϕ310 × 40 {12.2 × 1.57}
Caliper piston inner diameter	mm {in}	ϕ51.1 {2.01}	ϕ54 {2.13}
Thickness of pad	mm {in}	14 {0.55}	14 {0.55}

Vacuum Pump

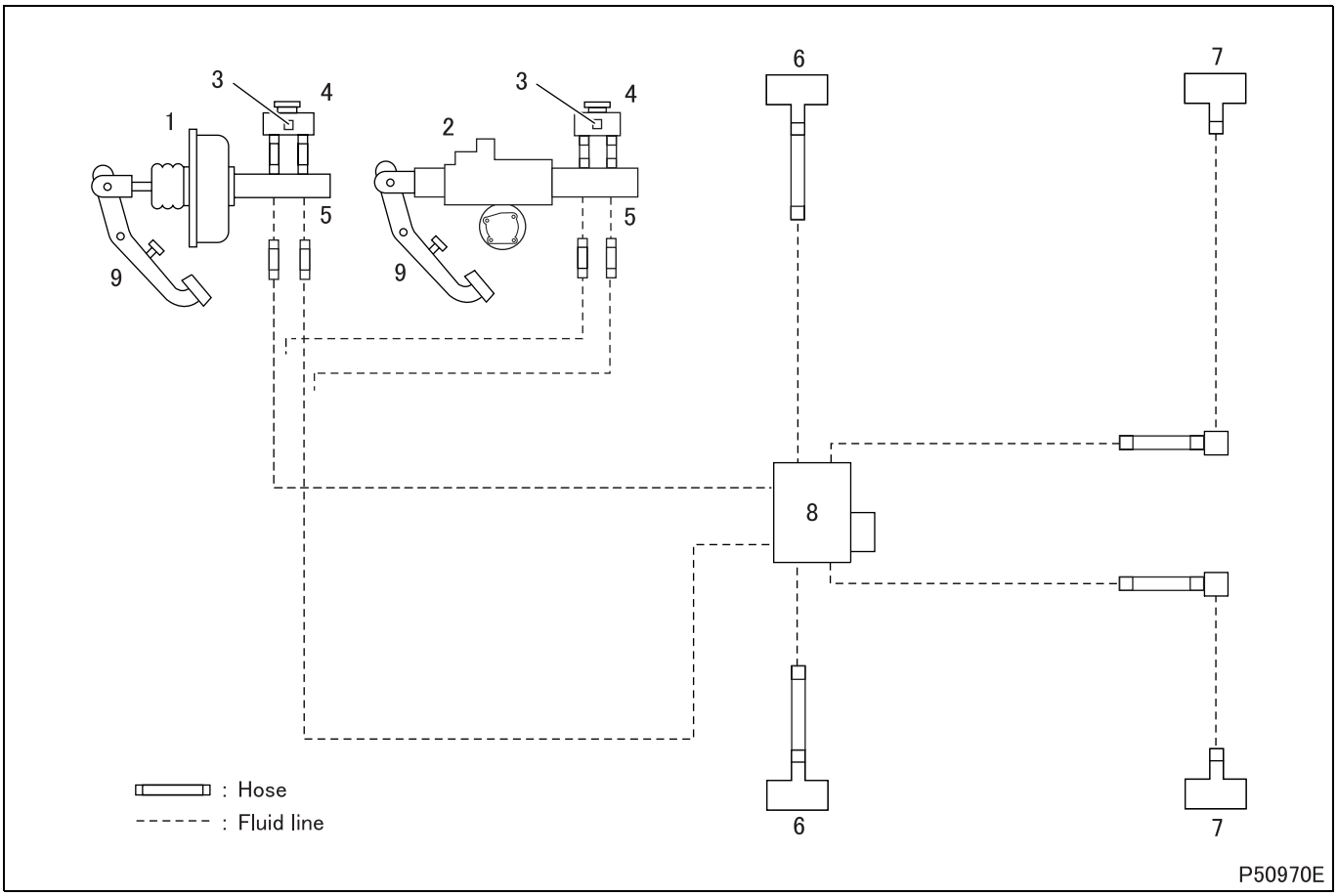
Item		Specifications
Type		Vane type
Output	cm^3 {cu.in}	60 {3.66}
Manufacturer		Mitsubishi Electric

Exhaust Brake

Item	Specifications
Control type	Combined electric and vacuum control
Valve type	Butterfly valve type

1. Brake System

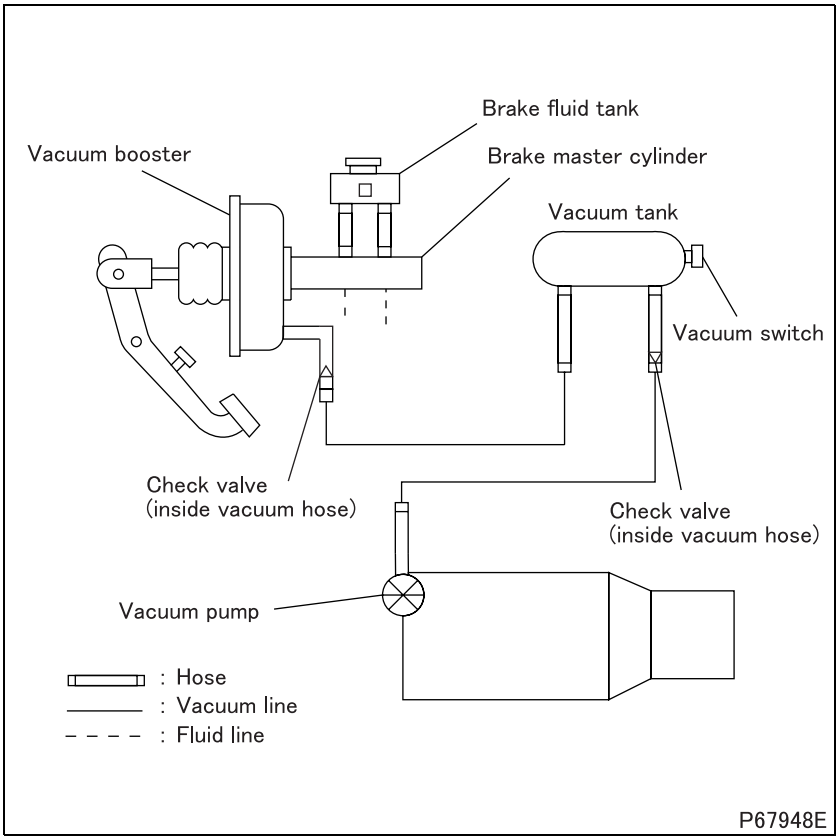
1.1 Brake fluid line



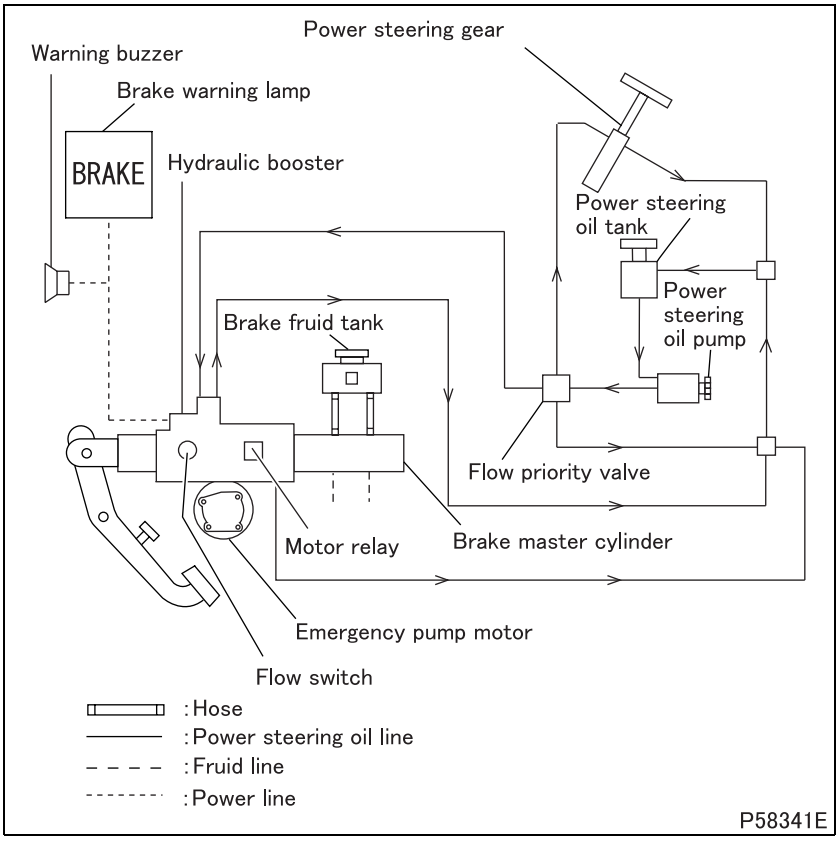
1 Vacuum booster
2 Hydraulic booster
3 Brake fluid level switch
4 Brake fluid tank
5 Brake master cylinder
6 Front wheel brake
7 Rear wheel brake
8 Hydraulic unit (antilock brake system)
9 Stop lamp switch

- The brake system incorporating the vacuum booster uses vacuum to provide servo-assisted braking to all wheels of the vehicle onto which it is mounted. <COE 50>
- The brake system incorporating the hydraulic booster uses the power steering oil pump pressure to provide servo-assisted braking to all wheels of the vehicle onto which it is mounted. <COE 50>

1.2 Vacuum booster line <Except COE 50>



1.3 Hydraulic booster line <COE 50>



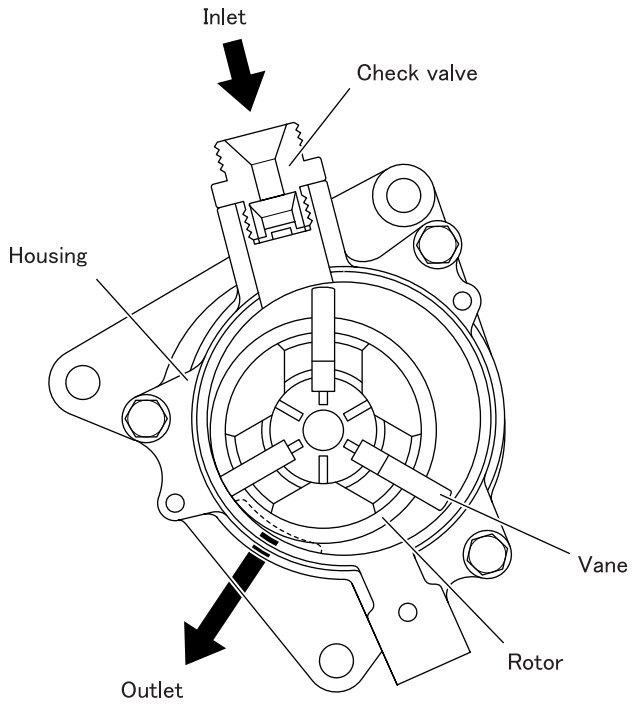
- The stepping force applied on the brake pedal is boosted by the hydraulic booster which operates on the pressure provided by the power steering oil pump.
- When brakes are applied hard while the steering wheel is turned, the associated steering shock is dampened by the flow priority valve in the system.
- When engine stall, power steering oil pump failure, or oil leakage from the power steering line causes oil pressure to drop, the flow switch detects this. This causes the motor relay to switch over, providing power to the emergency pump motor which then turns to generate emergency oil pressure.

- The emergency pump motor operates only when the brake pedal is pressed. The motor has various operating modes, as summarized below.

Starter switch	Engine	Parking switch	Warning		Power steering oil pressure	Emergency pump motor O: ON ×: OFF	Vehicle state
			Brake warning lamp O: ON ×: OFF	Warning buzzer O: ON ×: OFF			
ON	Run	ON (pulled)	O	×	Available	×	Normal
			O	×	Not available	O	* Oil leakage from power steering line
		OFF (released)	×	×	Available	×	Normal
			O	O	Not available	O	* Oil leakage from power steering line
	Stop	ON (pulled)	O	×		O	At engine start
						O	Engine stalled at uphill start
		OFF (released)	O	O		O	Engine stall
OFF		ON (pulled)	×	×		O	Vehicle moved after parked (parking brake lever pulled insufficiently)
		OFF (released)	×	×		O	Engine stopped before vehicle came to complete halt

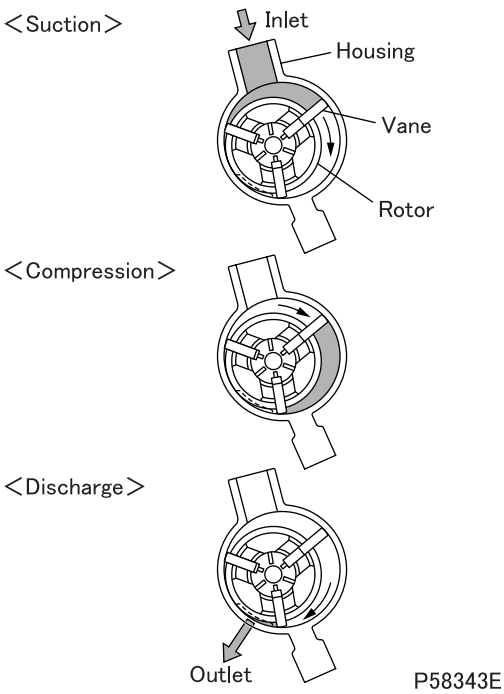
*: The failsafe feature of the hydraulic booster cuts off oil supply to the power steering line to maintain oil pressure.

2. Vacuum Pump



P58342E

- The vacuum pump is mounted onto the timing gear case, and is driven by the idler gear.
- The check valve is provided to ensure that no air or engine oil flow from the vacuum pump back to the vacuum tank when the engine is stationary.

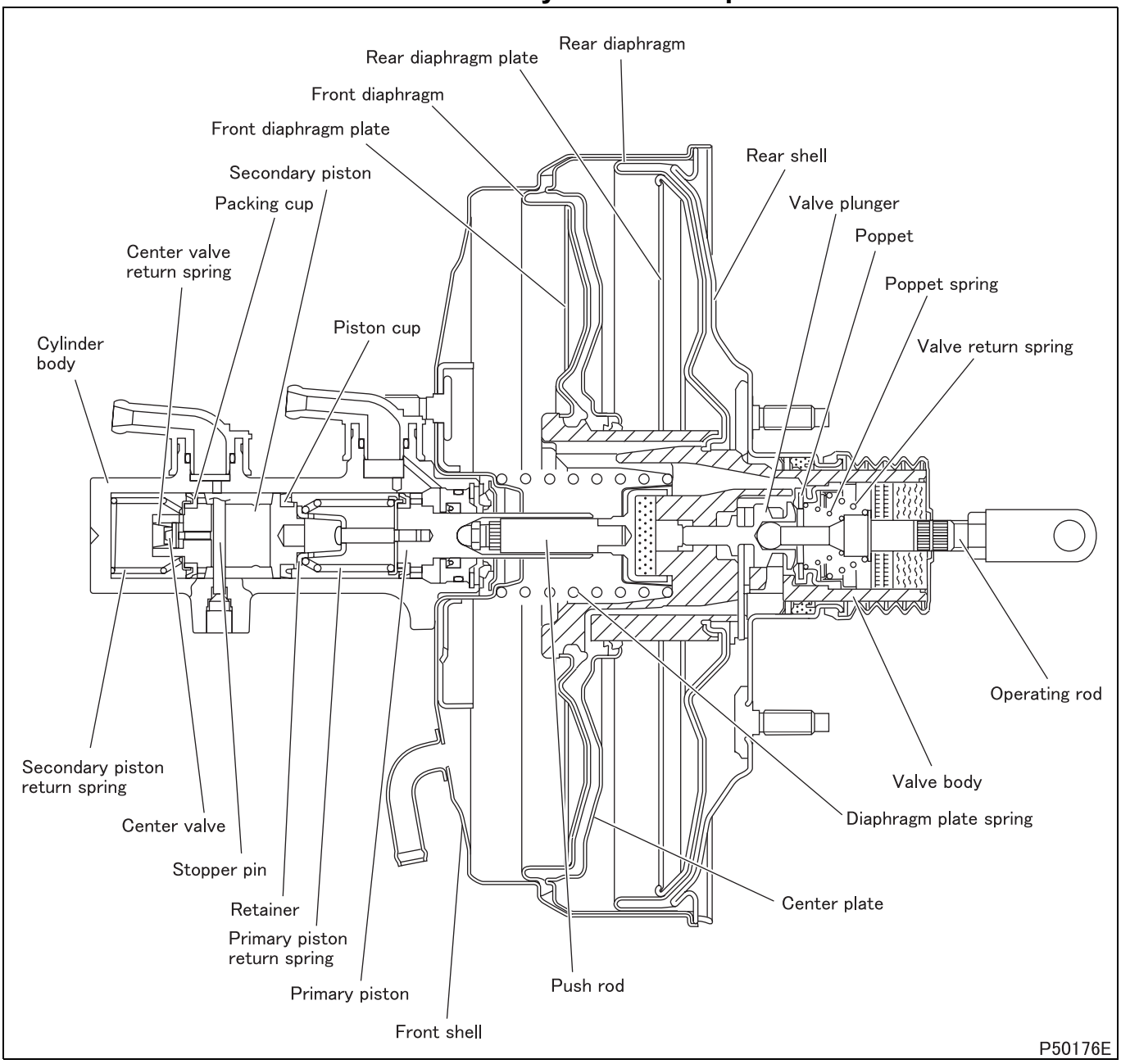


P58343E

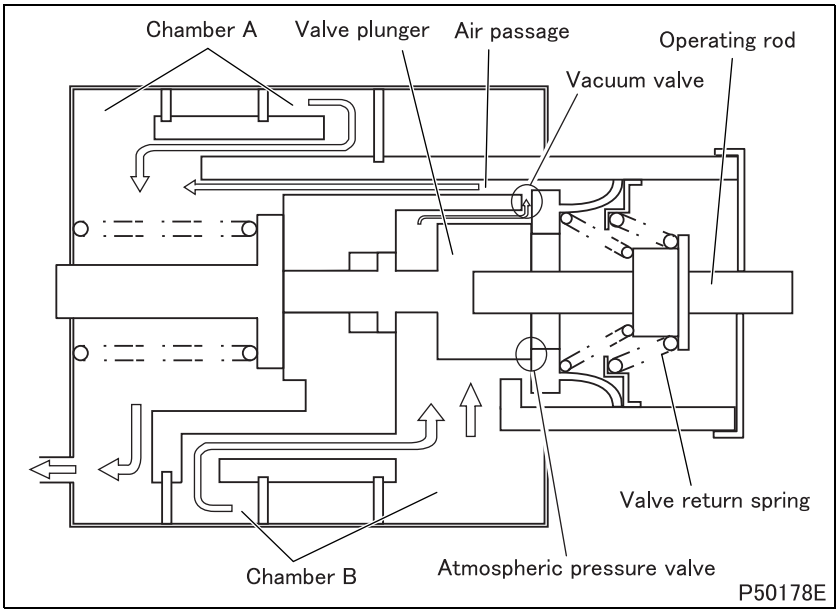
2.1 Operation

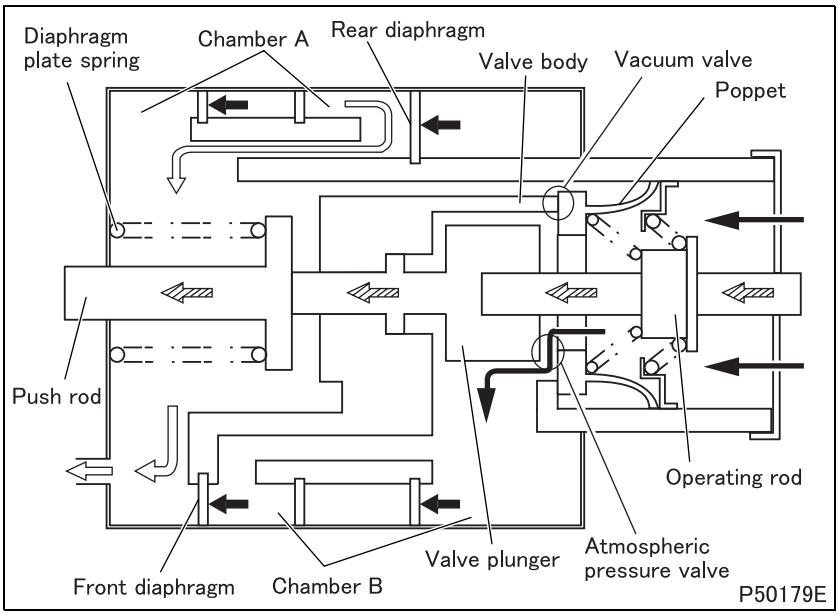
- A rotor with 3 movable vanes is housed in a cylindrical housing. As the rotor rotates, the vanes are pressed against the inner face of the housing by centrifugal force.
- The rotor is eccentrically mounted relative to the housing. As the rotor rotates, air in the vacuum tank is sucked through the pump inlet and then compressed before being discharged through the outlet. The suction-compression-discharge cycle is repeated to generate vacuum in the vacuum tank.
- The inside of the housing is lubricated and cooled by engine oil. After lubrication/cooling, the engine oil together with the compressed air is returned through the pump outlet and into the oil pan.

3. Vacuum Booster and Brake Master Cylinder <Except COE 50>



- The vacuum booster magnifies the stepping force applied onto the brake pedal (therefore reduces the operator's pedal effort) through the utilization of pressure difference between the vacuum it generates and the atmospheric pressure. The system is of a tandem type and has 2 vacuum chambers, achieving size reduction while offering a great capacity for highly efficient boosting performance.
- The brake master cylinder serves both the front and rear brake systems that are independent of each other. Should fluid leakage occur in either the front or rear brake system, stopping power can still be provided by whichever system is intact.

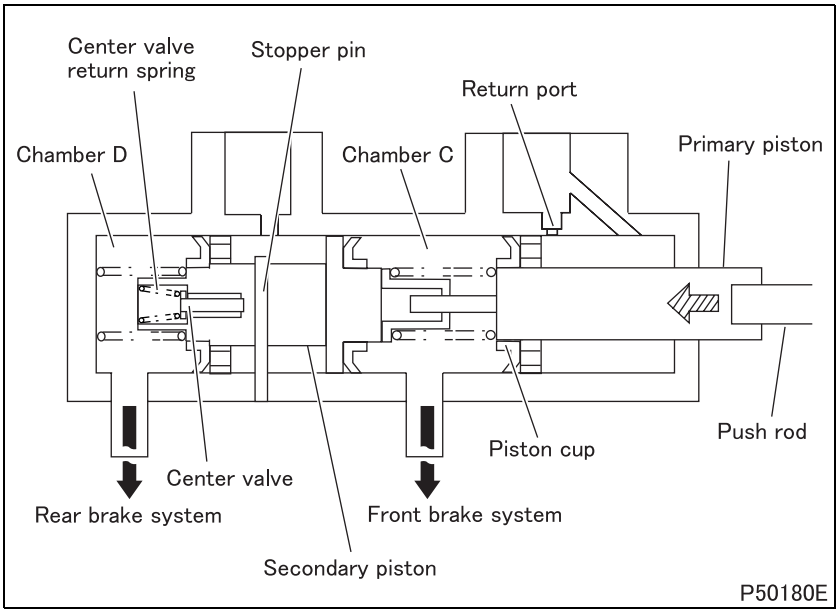




3.1 When brake pedal is pressed

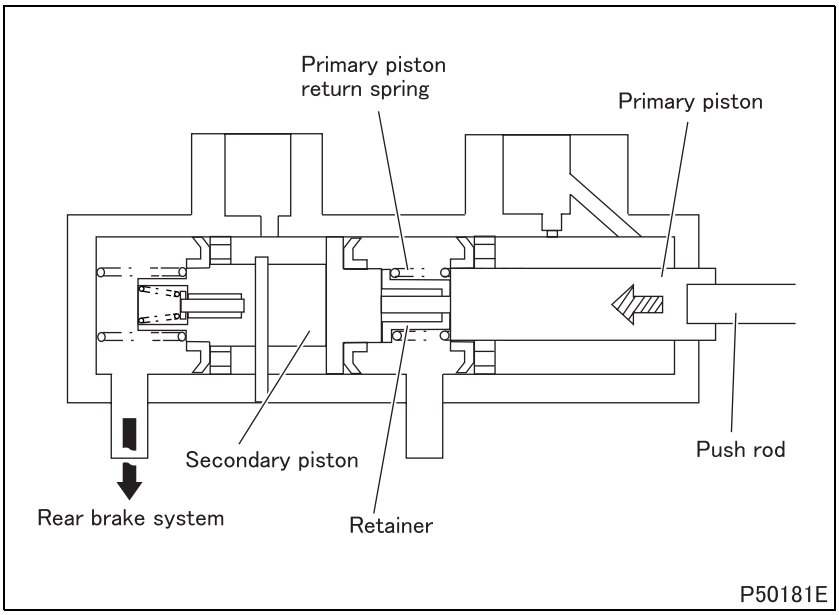
(1) Vacuum booster operation

- With the brake pedal released and no stepping force applied to the brake pedal, the operating rod and the valve plunger are held to the right by the force of the valve return spring. The atmospheric pressure valve remains closed while the vacuum valve remains open.
- The vacuum pump creates vacuum in chamber **A**. As the atmospheric pressure valve is closed, no outside air flows into chamber **B**. Instead, vacuum in chamber **A** flows through the air passage and into chamber **B**. Chambers **A** and **B** are both filled with vacuum, and there is no pressure difference between the chambers. No boosting occurs.
- As the brake pedal is pressed, the stepping force acts on the operating rod. This seats the poppet onto the valve body, closing the vacuum valve and cutting off vacuum supply into chamber **B**. As the brake pedal is pressed further, the valve plunger separates from the poppet. This opens the atmospheric pressure valve, allowing outside air into chamber **B**. There is now a pressure difference between chambers **A** and **B**.
- The stepping force, boosted as a result of the pressure difference between chambers **A** and **B**, overcomes the force of the diaphragm plate spring, pushing the front and rear diaphragms and the push rod to operate the brake master cylinder.



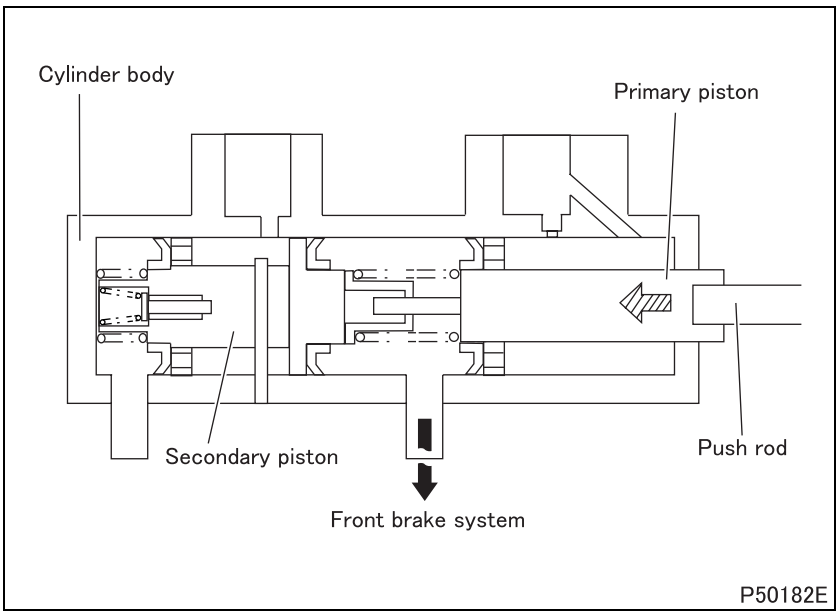
(2) Brake master cylinder operation

- As the push rod pushes the primary piston, the return port is closed by the piston cup. Fluid pressure now builds up in chamber **C**.
- The pressure buildup is sent to the front brake system and at the same time pushes the secondary piston.
- The center valve in front of the secondary piston separates from the stopper pin. The center valve return spring now closes the center valve, seating it onto the secondary piston.
- Fluid pressure now builds up in chamber **D** in front of the secondary piston, and the pressure is sent to the rear brake system.



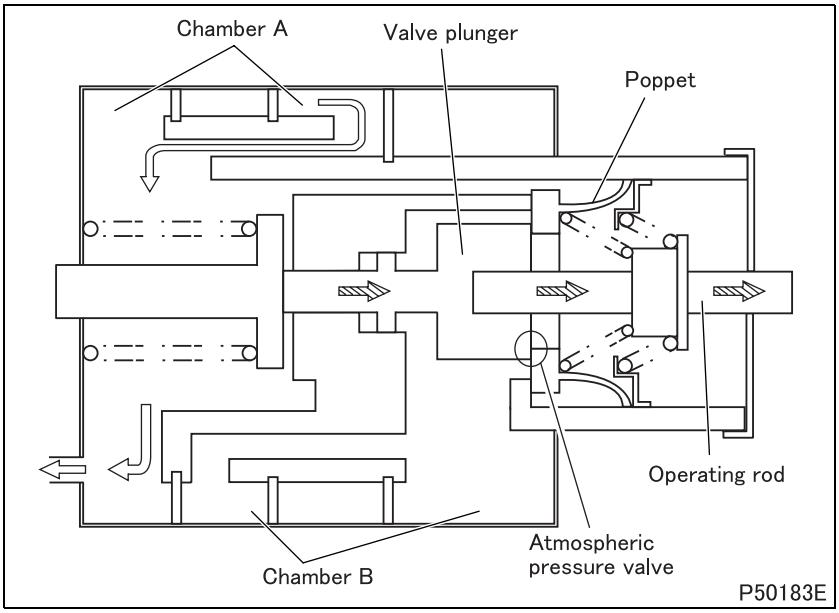
3.2 Fluid leakage in front brake system

- As the brake pedal is pressed, the push rod moves to push the primary piston. As there is fluid leakage in the front brake system, no fluid pressure builds up in that system.
- As the brake pedal is pressed further, the primary piston overcomes the force of the primary piston return spring and, via the retainer, pushes the secondary piston. Fluid pressure is now sent to the rear brake system.



3.3 Fluid leakage in rear brake system

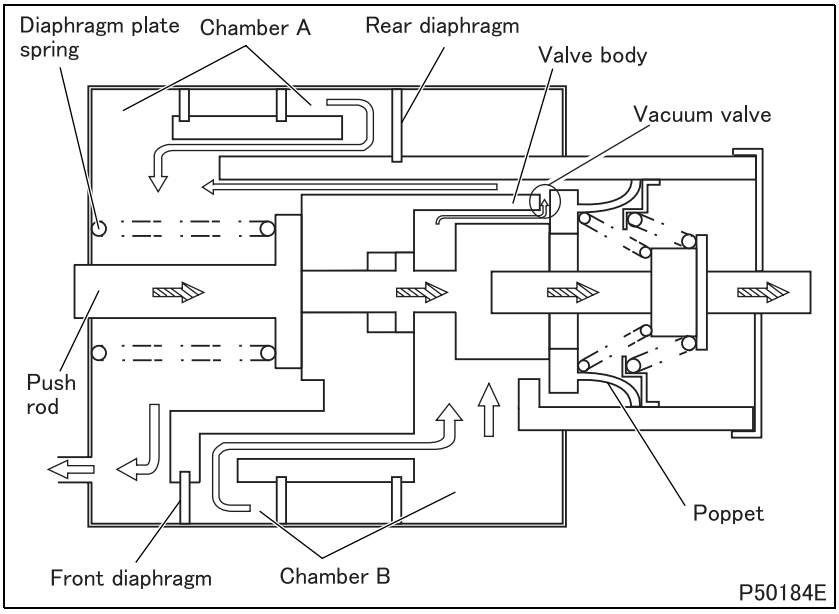
- As the brake pedal is pressed, the push rod moves to push the primary and secondary pistons. As there is fluid leakage in the rear brake system, no pressure builds up in that system.
- As the brake pedal is pressed further, the tip of the secondary piston contacts the cylinder body while the primary piston continues to be pushed. Fluid pressure builds up further in the front brake system.



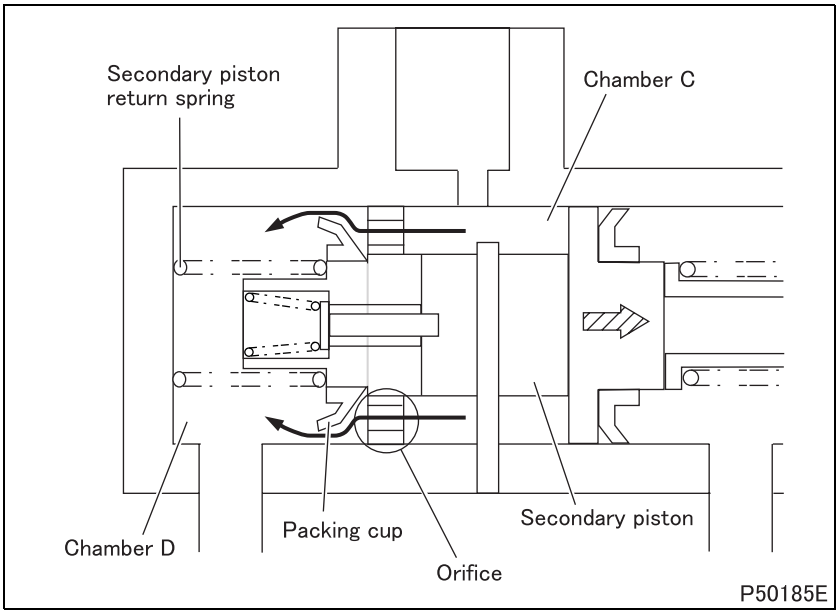
3.4 When brake pedal is released

(1) Vacuum booster operation

- With the brake pedal pressed, chamber **A** is filled with vacuum generated by the vacuum pump while chamber **B** is open to the atmosphere. When the brake pedal is released, the stepping force no longer acts on the operating rod. This causes the valve plunger to seat on the poppet, closing the atmospheric pressure valve and cutting off air flow into chamber **B**.

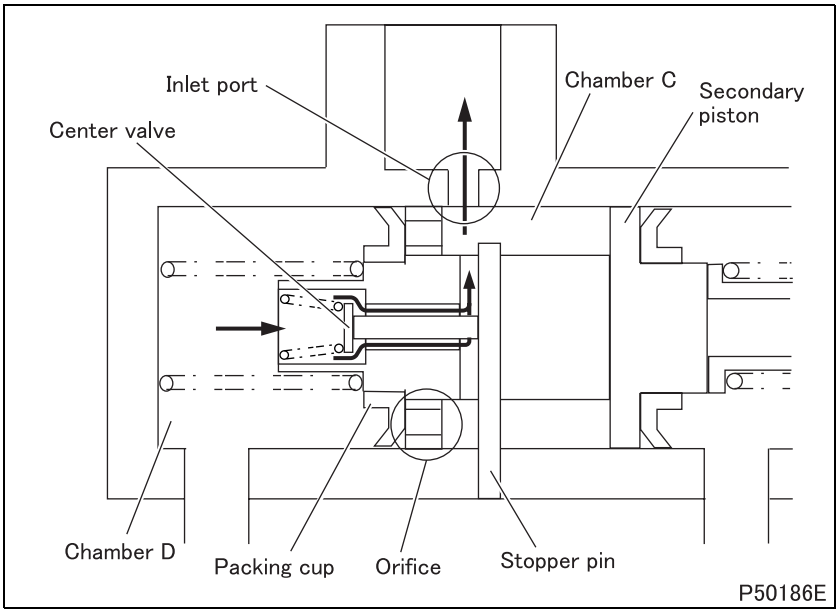


- In further progression, the poppet separates from the valve body. This opens the vacuum valve, allowing vacuum from the vacuum pump to flow into chamber **B**. As there is now no pressure difference between chambers **A** and **B**, the diaphragm plate spring pushes back the front and rear diaphragms and also the push rod to their original positions.

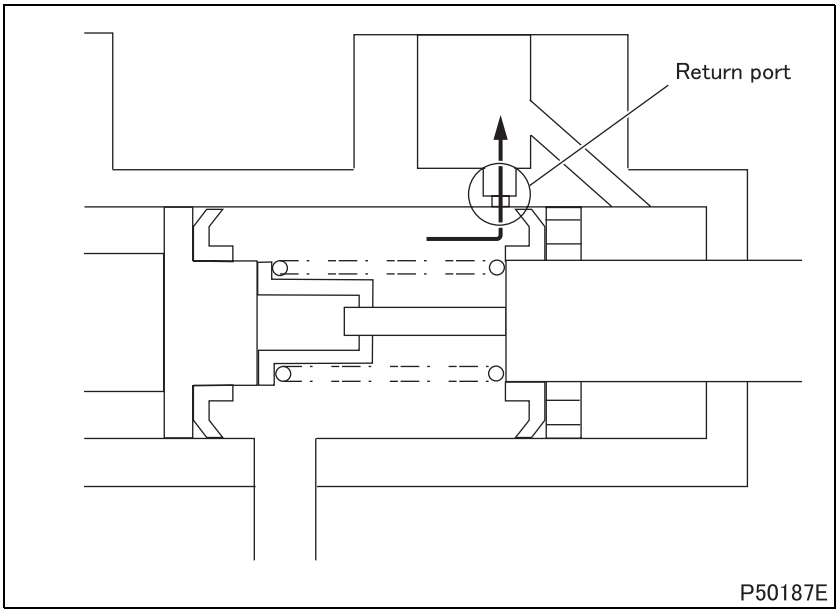


(2) Brake master cylinder operation

- As the push rod returns to its original position, the secondary piston immediately starts to be pushed back by the force of the secondary piston return spring. The speed of return is gradual as there is no difference between chambers **C** and **D** in fluid pressure supplied by the brake master cylinder.
- As the secondary piston starts to return to its original position, the pressure in chamber **D** becomes lower than the pressure in chamber **C**. The pressure difference causes the packing cup to buckle, allowing the fluid pressure in chamber **C** to flow through the orifices and into chamber **D**.



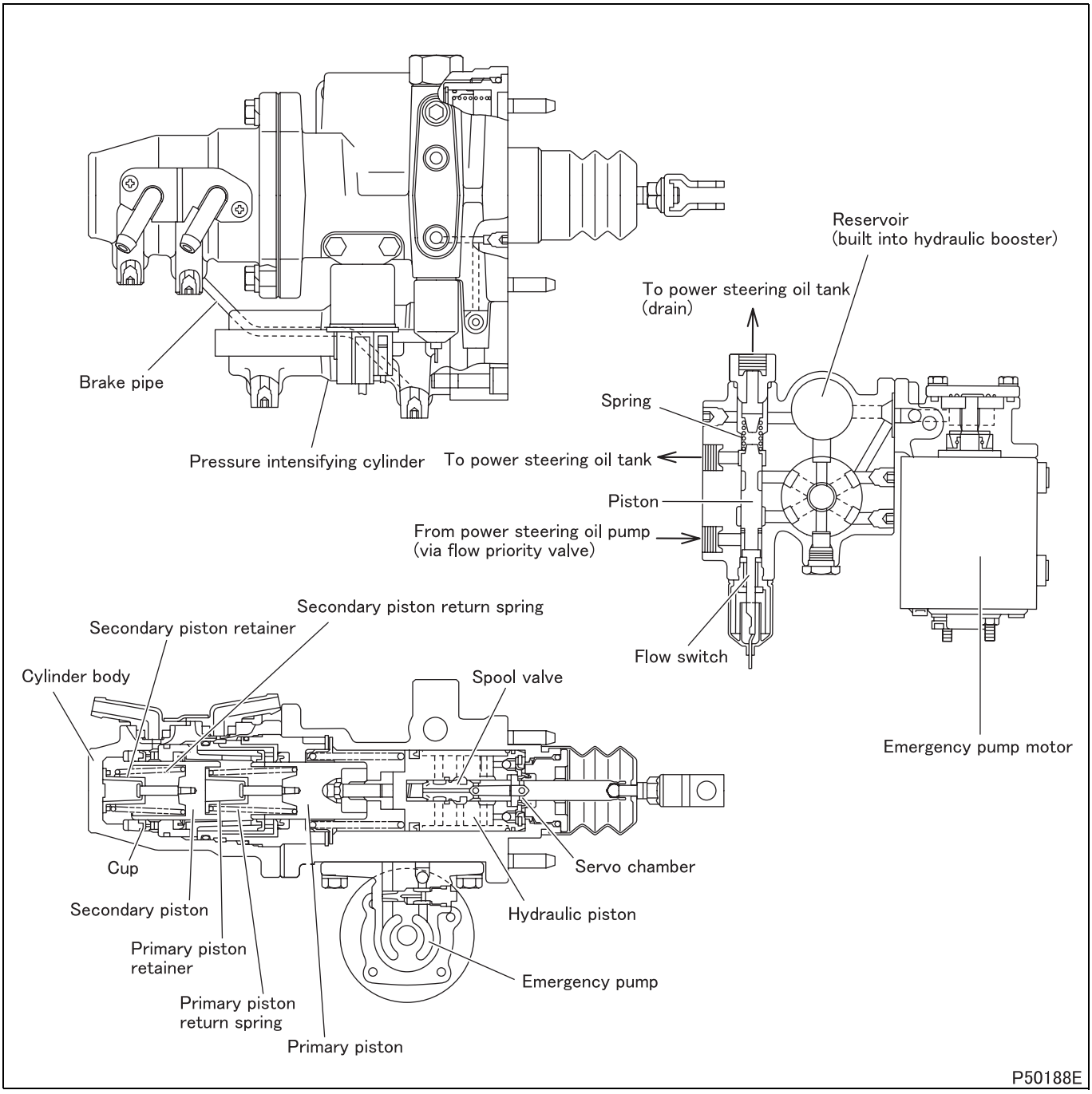
- With the secondary piston back in its original position, there is no difference in fluid pressure between chambers **C** and **D**. The packing cup restores its original shape, blocking the orifices. The liquid pressure in the brake line now flows through the center valve, which has been open since hitting the stopper pin. The liquid pressure then returns through the inlet port to the brake fluid tank.



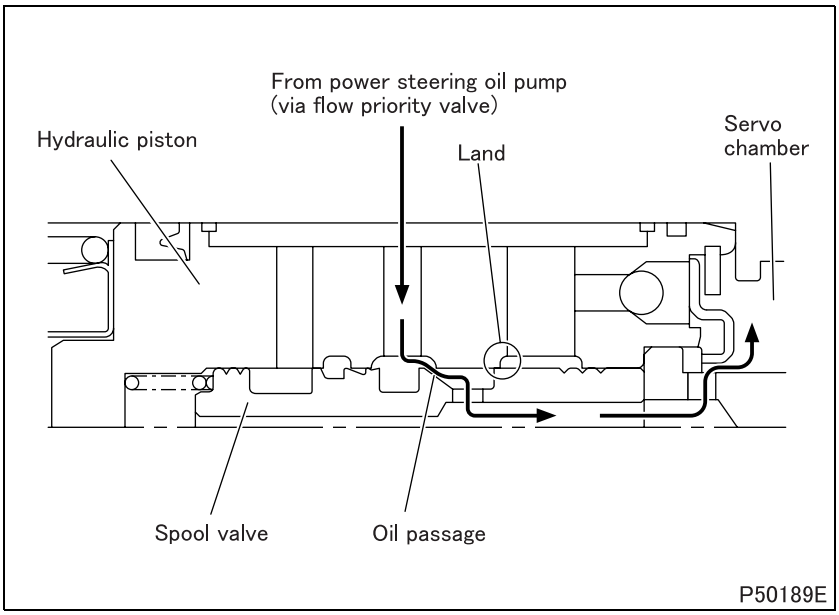
- The fluid pressure in the primary (front) brake line returns through the return port to the brake fluid tank.

M E M O

4. Hydraulic Booster and Brake Master Cylinder <COE 50>



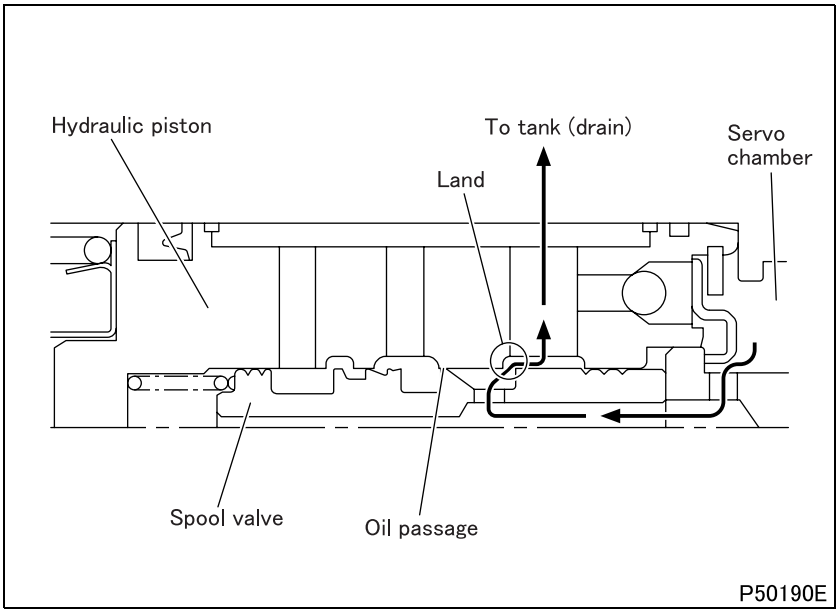
- The hydraulic booster magnifies the stepping force applied onto the brake pedal (therefore reduces the operator's pedal effort) through the utilization (via the flow priority valve) of the steering pump pressure.
- The brake master cylinder serves both the front and rear brake systems that are independent of each other. Should fluid leakage occur in either the front or rear brake system, stopping power can still be provided by whichever system is intact.
- The spool valve is connected to the brake pedal, and generates oil pressure proportional to the pedal stepping force.
- The hydraulic piston, which is connected to the brake master cylinder, operates to store oil supplied via the spool valve into the servo chamber for pressure boost.
- Should oil pressure is lost, the piston is pushed to the left by the force of the spring, blocking oil flow from the power steering oil pump and to the power steering oil tank. At the same time, the flow switch is turned ON, providing power to the emergency pump motor. The emergency pump generates oil pressure for the hydraulic booster to continue to operate.



4.1 Spool valve

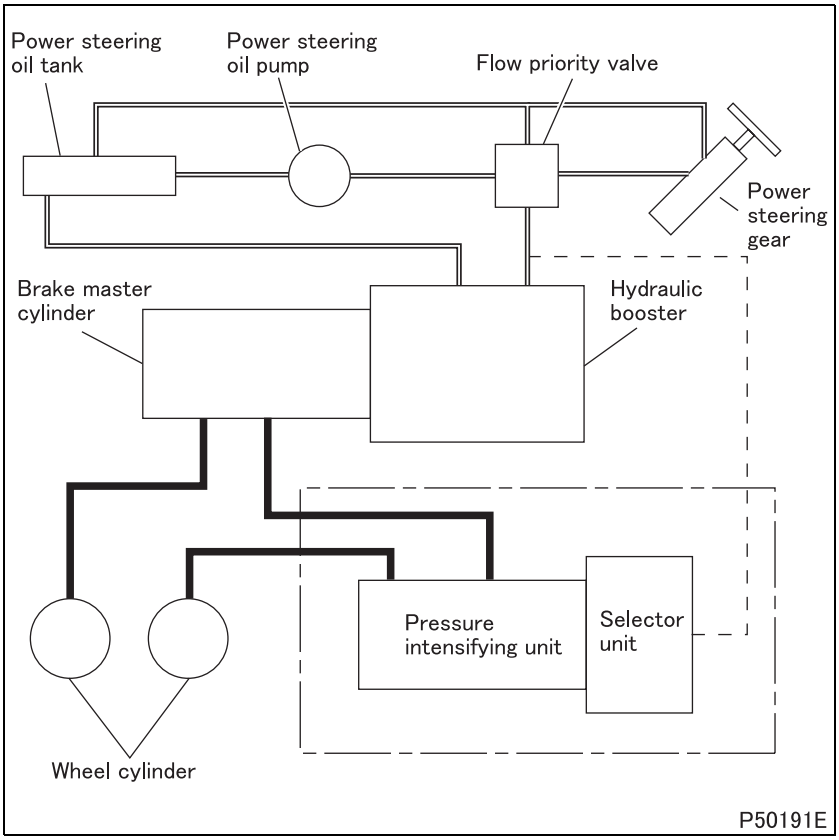
(1) When brake pedal is pressed

- As the brake pedal is pressed, the spool valve moves to the left, closing the land.
- Oil pressure from the flow priority valve builds up.
- The high pressure oil flows through the oil passage and into the servo chamber.
- The hydraulic piston is pushed to the left.
- The pistons in the brake master cylinder are moved, supplying pressure for brake application.



(2) When brake pedal is released

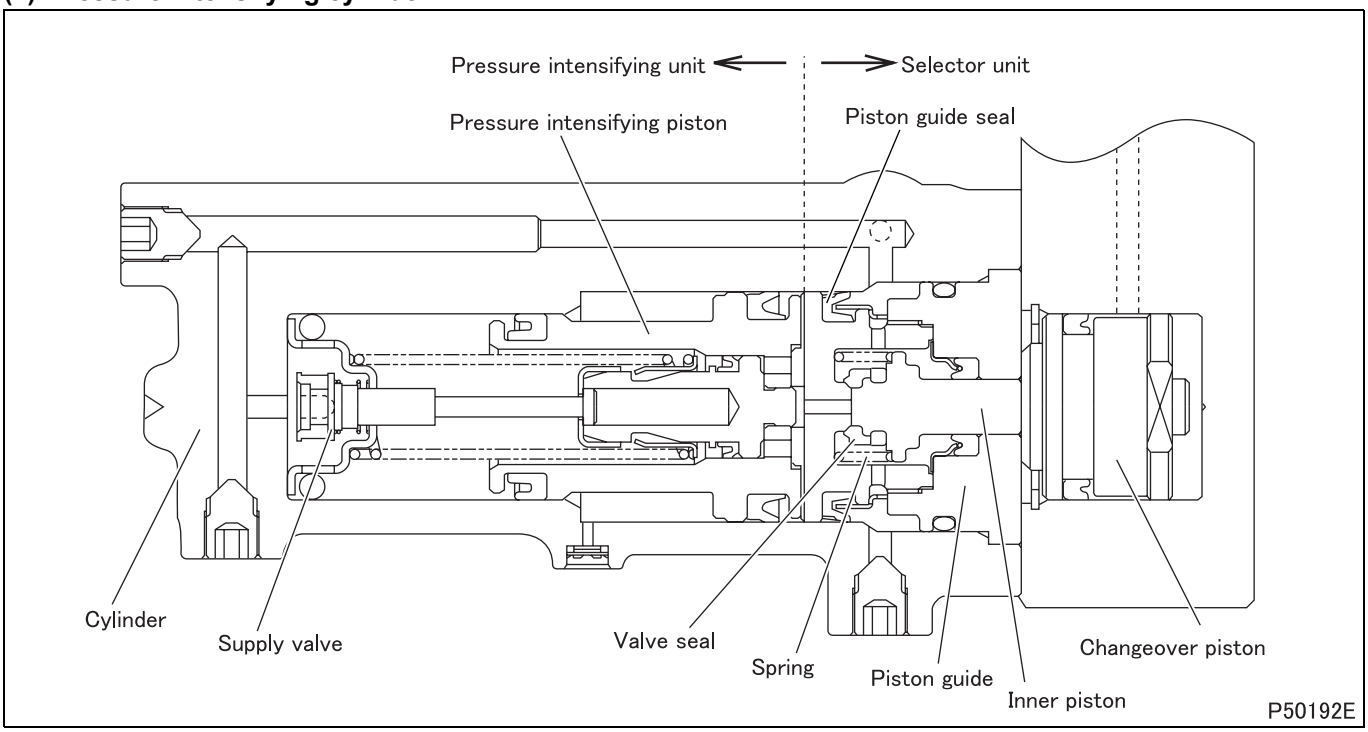
- As the brake pedal is released, the spool valve moves to the right. This opens the land while the oil passage is closed.
- Oil pressure from the flow priority valve drops.
- The oil in the servo chamber drains to the tank as well as to the reservoir.
- The hydraulic piston returns to its original position.
- Pressure acting on the pistons in the brake master cylinder is released.



4.2 Pressure intensifying cylinder system

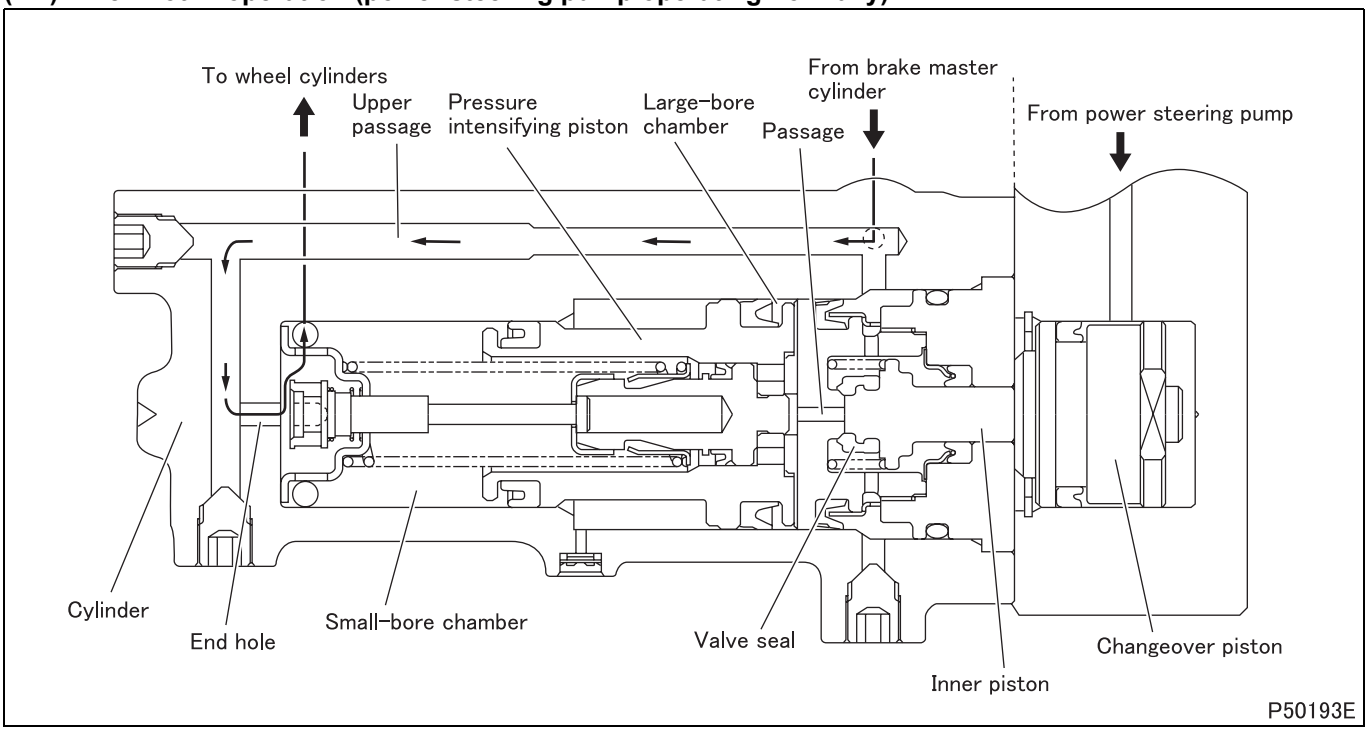
- The pressure intensifying cylinder system is attached onto the hydraulic booster which operates on the power steering oil pump pressure.
- Should the pump fail, pressing the brake pedal causes the system to boost the fluid pressure from the brake master cylinder and send it to the wheel cylinders.

(1) Pressure intensifying cylinder



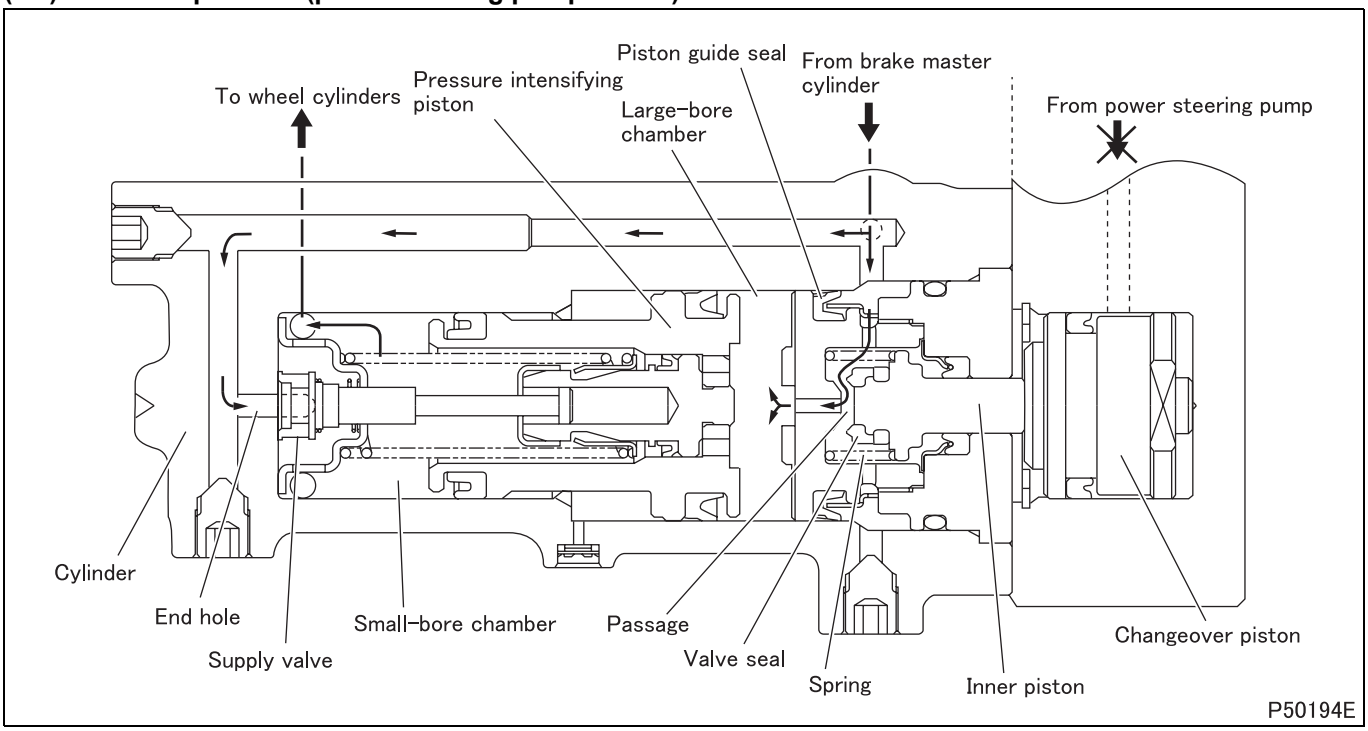
- Should the power steering pump fail to discharge oil, the selector unit detects this. The unit also ensures that pressure not be intensified when the power steering pump is functioning normally.
- Should the power steering pump fail, the pressure intensifying unit comes into action, boosting the fluid pressure from the brake master cylinder before sending it to the wheel cylinders.

(1.1) When not in operation (power steering pump operating normally)



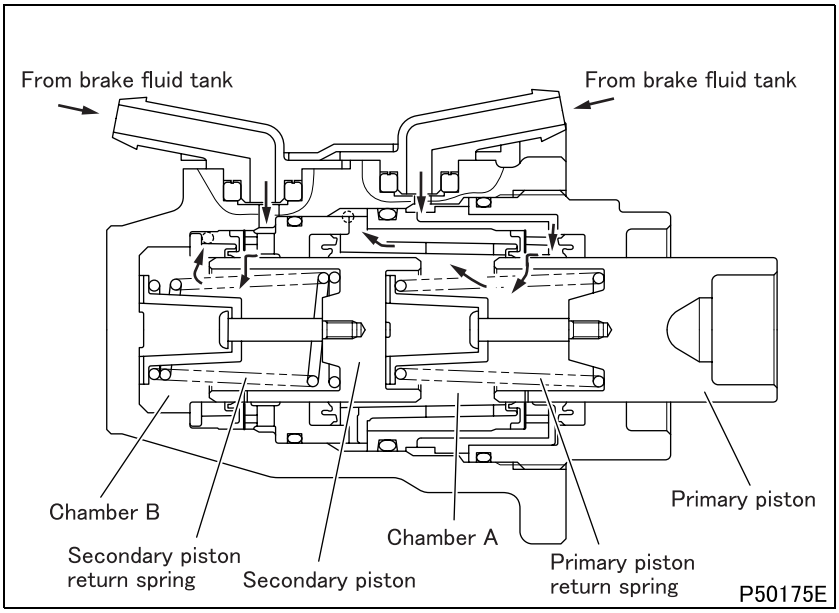
- Power steering oil pump pressure pushes the changeover piston, which then moves the inner piston. As a result, the passage to the large-bore chamber is blocked by the valve seal. Fluid pressure from the brake master cylinder flows through the upper passage, the end hole, the small-bore chamber, and into the wheel cylinders. As fluid pressure acts only on the small-bore end of the pressure intensifying piston, the piston remains in the same position.

(1.2) When in operation (power steering pump failure)



- When the power steering oil pump fails to discharge oil, the spring at the end of the inner piston pushes back the inner and changeover pistons. This opens up the passage through the valve seal into the large-bore chamber.
- Fluid pressure from the brake master cylinder flows into both the large- and small-bore chambers. As the large-bore end of the pressure intensifying piston has a larger area than the small-bore end, the piston moves to the left. As a result, the end hole is blocked by the supply valve.

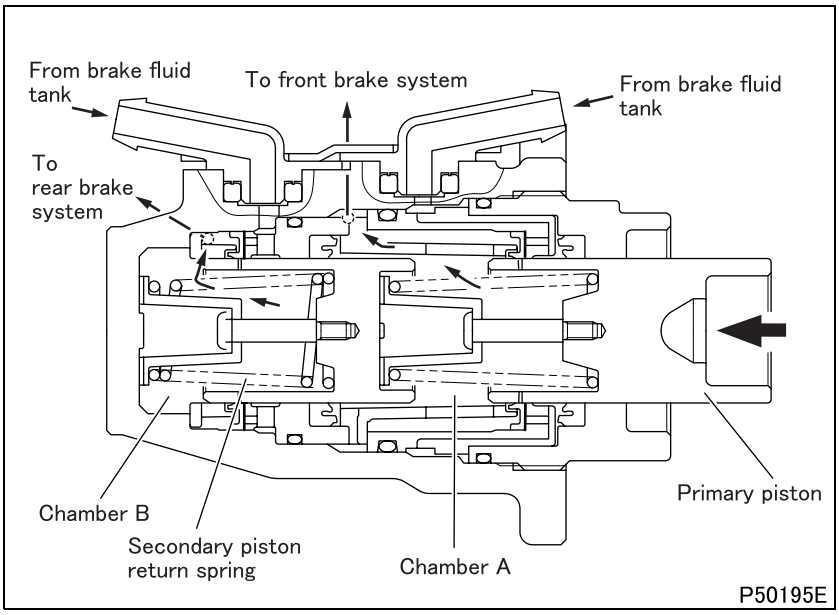
- The brake master cylinder continues to supply fluid into the pressure intensifying cylinder, which in turn sends the increasing pressure to the wheel cylinders.
- When the brake pedal is released, pressure fluid in the large-bore chamber flows through the valve seal, the back of the piston guide seal, and to the brake master cylinder.



4.3 Brake master cylinder

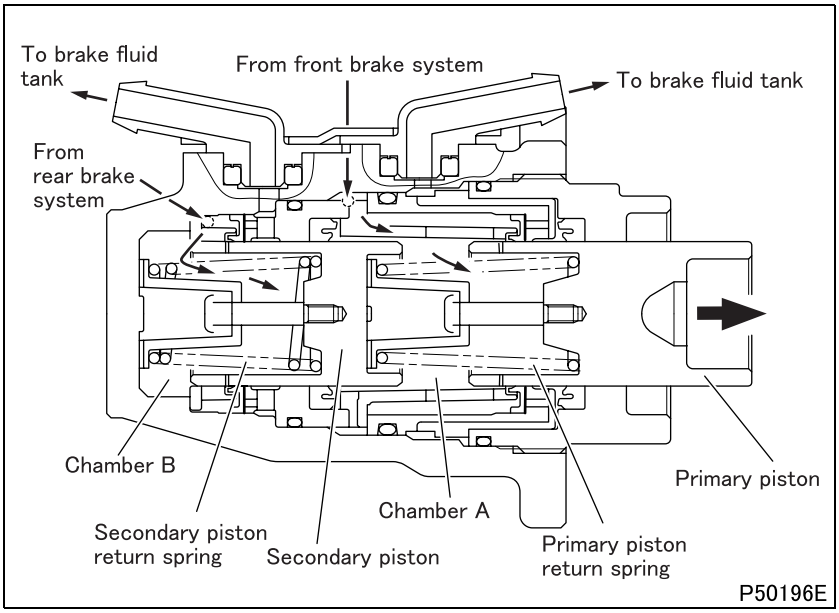
(1) When not in operation

- With the brake pedal released, the primary and secondary pistons are held to the right by the forces of the primary and secondary piston return springs respectively.
- Chambers **A** and **B** are open to the brake fluid tank.



(2) When brake pedal is pressed

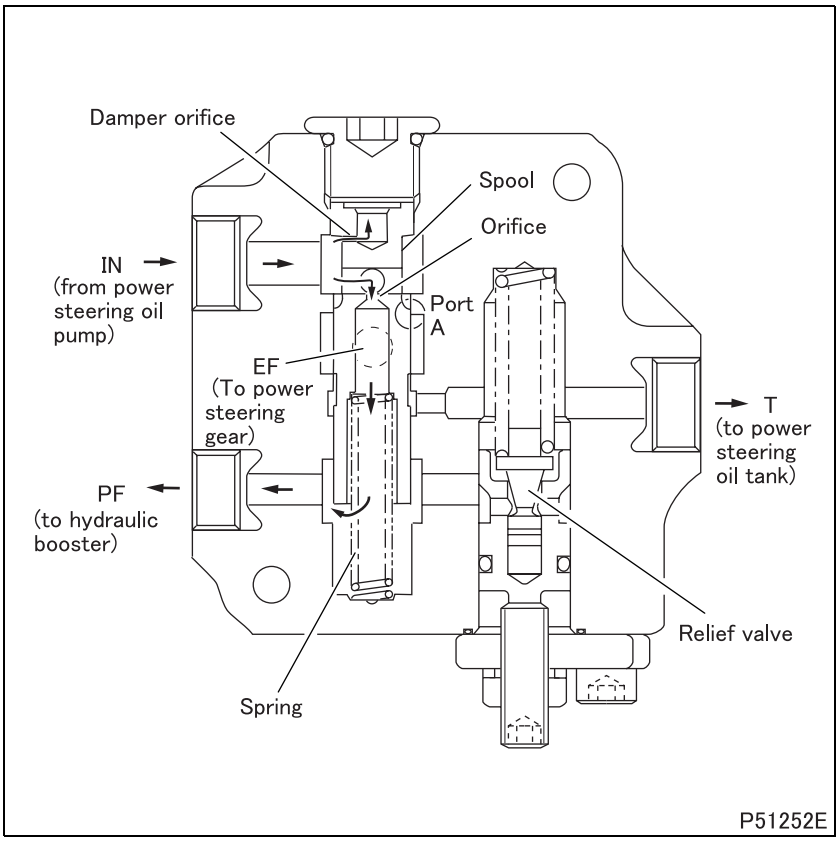
- As the brake pedal is pressed, the primary piston is pushed via the push rod.
- The secondary piston return spring is compressed, and the passages from chambers **A** and **B** to the brake fluid tank are blocked.
- As the brake pedal is pressed further, the primary piston is pushed. Fluid pressure builds up in chambers **A** and **B**, and is sent to the front and rear brake systems respectively.
- When fluid leakage occurs in either the front or rear brake system, the master cylinder operates basically in the same manner as the master cylinder with the vacuum booster.



(3) When brake pedal is released

- As the brake pedal is released and the push rod returns to the original position, the primary piston return spring pushes back the primary piston. Chamber **A** restores the original volume and the pressure in the chamber drops accordingly.
- The secondary piston return spring pushes back the secondary piston. Chamber **B** restores the original volume and pressure.
- Chambers **A** and **B** open up to the brake fluid tank.
- Pressure fluid in the front and rear brake lines flows back into chambers **A** and **B**.

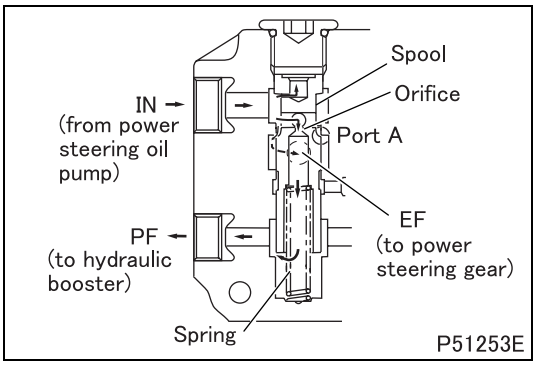
5. Flow Priority Valve <COE 50>



- When brakes are applied hard while the steering wheel is turned, the flow priority valve dampens the associated steering shock by appropriately distributing the flow from the power steering oil pump between the hydraulic booster and the power steering gear.

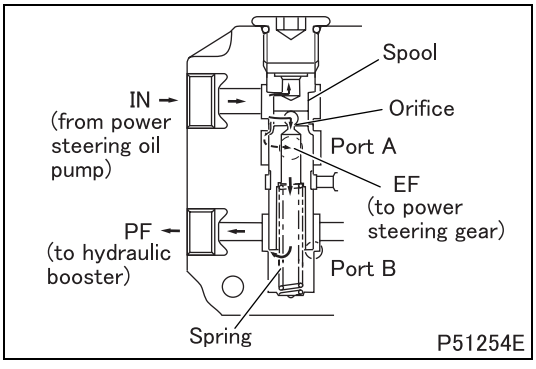
5.1 When pump output is at or below regulated flow rate

- The power steering oil pump output flows through the orifice and to the hydraulic booster.
- The pressure difference across the orifice acts on the spool which is then pushed down against the spring. However, port **A** remains blocked by the spool. As a result, the full flow from the pump is directed to PF.



5.2 When pump output exceeds regulated flow rate

- When the pump output exceeds the regulated flow rate, the pressure difference across the orifice becomes greater and acts on the spool such that the spool is pushed down against the spring until port **A** opens. Excess flow is directed through port **A** and into EF.
- In this state, if the hydraulic booster is operated and a greater flow is demanded by PF line (PF pressure > EF pressure), the spool moves to reduce the opening of port **A** so that the required pressure and the regulated flow rate are both achieved.



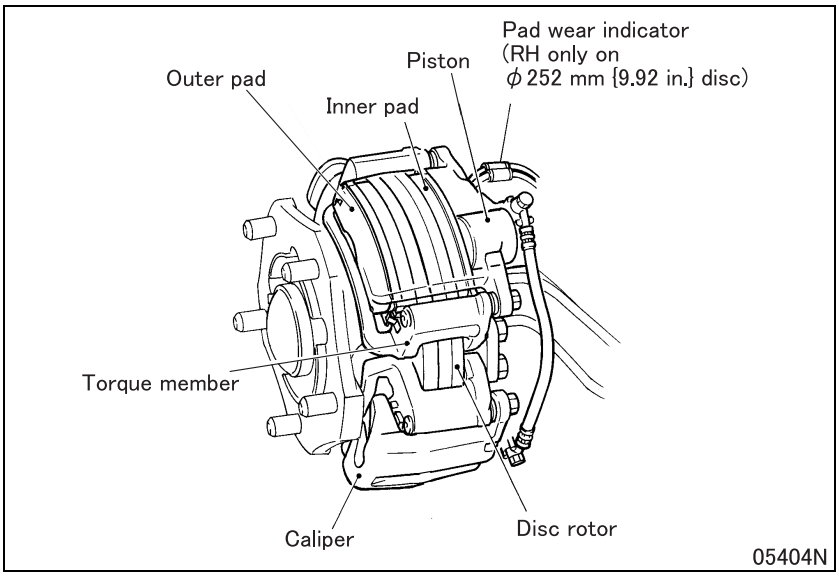
5.3 When power steering gear (EF line) is operated

- When power steering gear (EF line) is operated and a greater flow is demanded by EF line (PF pressure < EF pressure), the pressure difference across the orifice acts on the spool such that the spool is pushed down against the spring until the opening of port **B** is reduced. As a result, the required pressure and the regulated flow rate are both achieved.

5.4 When hydraulic booster (PF line) and power steering gear (EF line) are both operated

- When the hydraulic booster (PF line) and the power steering gear (EF line) are both operated and greater flows are demanded by these lines, the spool is moved against the spring such that the openings of ports **A** and **B** are appropriately balanced to achieve the regulated flow rate.

6. Front Disc Brake

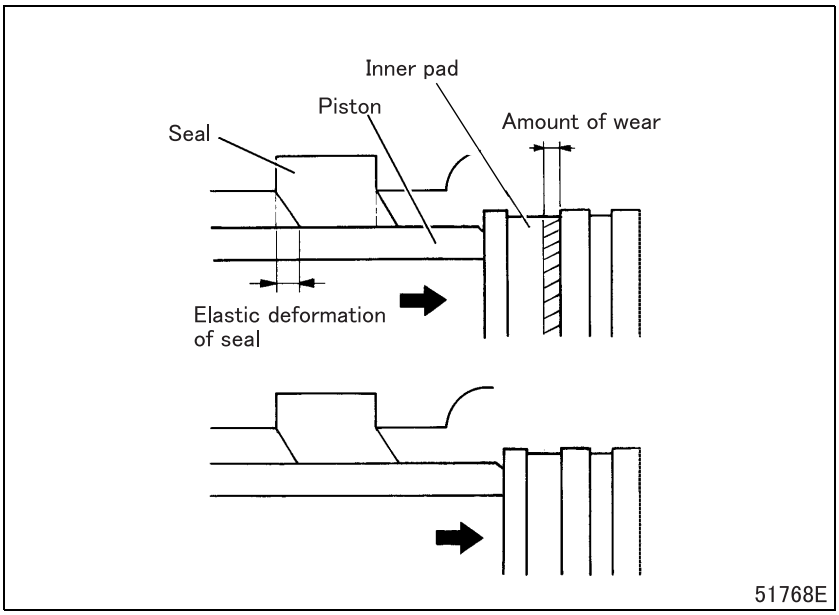


- The front disc brake uses a twin floating-type calipers.
- The caliper houses one each of cylinder and piston. Stopping power is generated by squeezing the disc rotor between the pads, with the outer pad pressed against the disc rotor by reaction.
- The inner pad is equipped with wear indicator which serves to indicate replacement timing for both the inner and outer pads.
- The front disc brake is equipped with a self-adjusting mechanism to compensate for pad wear and maintain the correct clearances between the disc rotor and the inner and outer pads. The adjustment is made each time braking is performed.

6.1 Self-adjusting mechanism

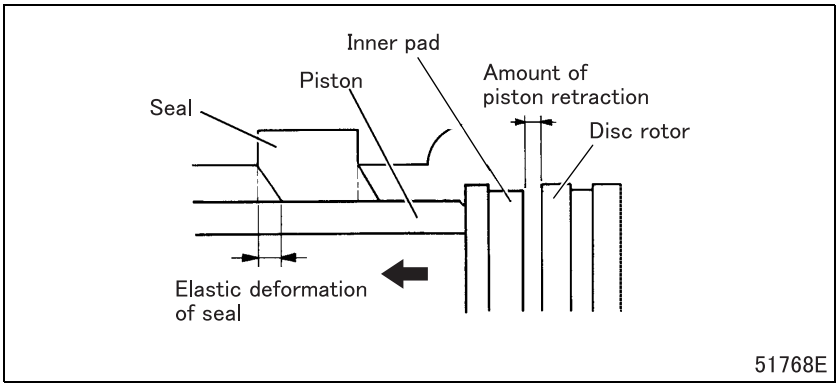
(1) Operation

(1.1) When brake pedal is pressed



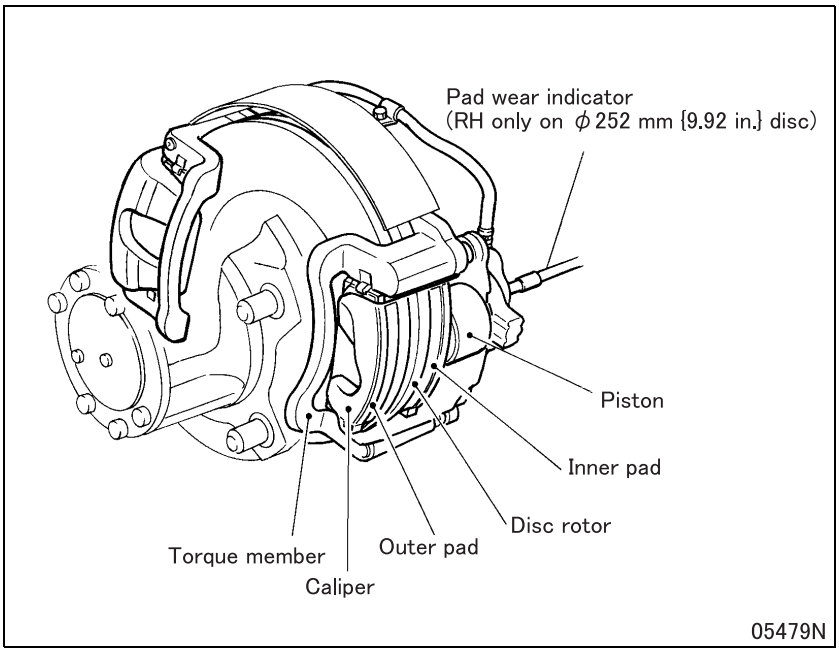
- The piston extends in excess of the seal's elastic deformation by the amount of inner pad wear (shown hatched).

(1.2) When brake pedal is released



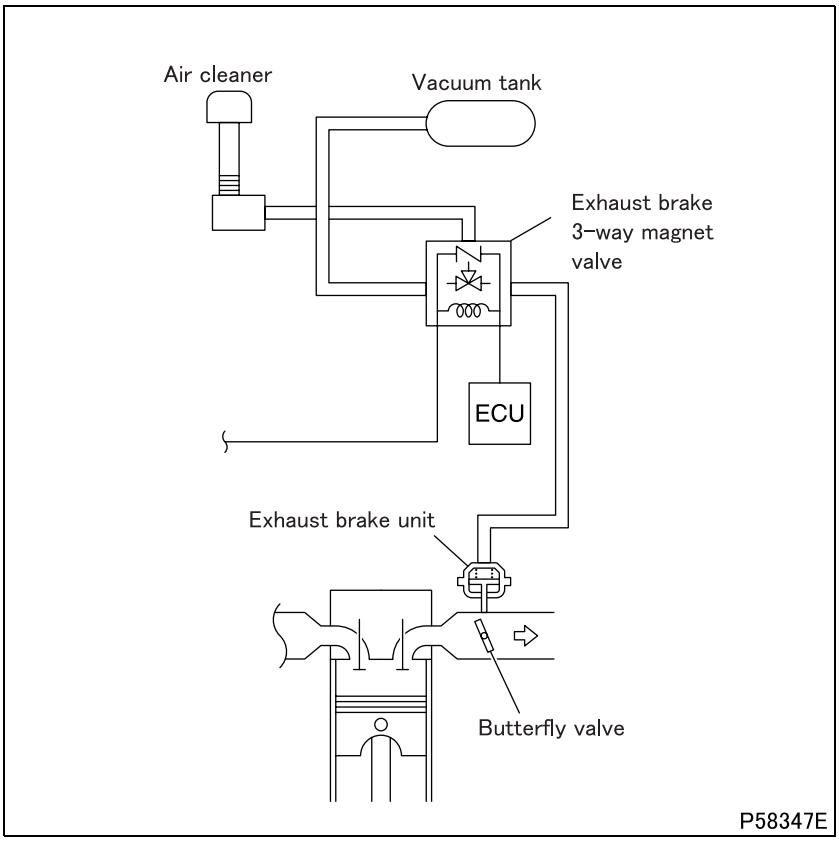
- The piston retracts as much as the amount of the seal's elastic deformation, thus maintaining the correct clearance between the disc rotor and the inner pad.

7. Rear Disc Brake



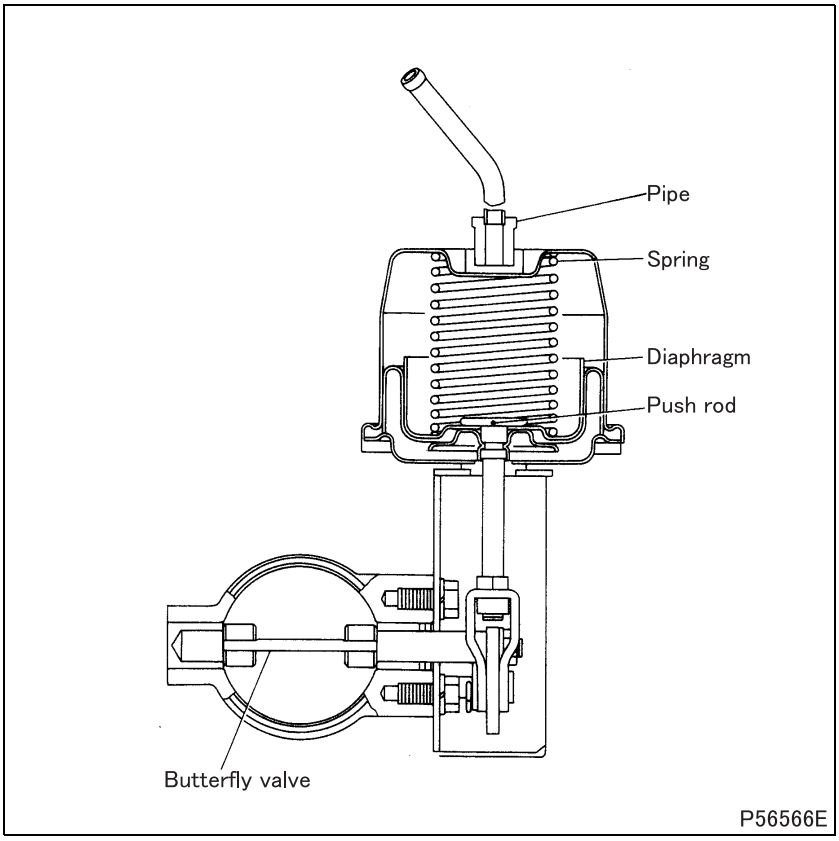
- The rear disc brake uses a twin floating-type calipers.
- The caliper houses one each of cylinder and piston. Stopping power is generated by squeezing the disc rotor between the pads, with the outer pad pressed against the disc rotor by reaction.
- The inner pad is equipped with wear indicator which serves to indicate replacement timing for both the inner and outer pads.
- The rear disc brake is equipped with a self-adjusting mechanism to compensate for pad wear and maintain the correct clearances between the disc rotor and the inner and outer pads. The adjustment is made each time braking is performed.
- The self-adjusting mechanism operates in the same manner as that of the front disc brake.

8. Exhaust Brake System



- The exhaust brake system provides stopping power by closing the exhaust piping. Specifically, pressure builds up in the blocked exhaust piping, which then is used to resist the pistons as they move to discharge exhaust in the exhaust stroke.
- The exhaust brake system supplements the foot brake. It is equipped with the exhaust brake unit incorporating a butterfly valve.
- When the exhaust brake switch is turned ON, the excitation winding within the exhaust brake 3-way magnet valve is magnetized. This closes the atmospheric pressure valve while opening the vacuum valve. Vacuum in the vacuum tank acts on the exhaust brake unit, closing the butterfly valve and bringing the exhaust braking in operation.

8.1 Exhaust brake unit (power chamber)



Wheel Brake

Possible causes	Symptoms	Brake application one sided							Noise and shock when brake pedal pressed		Reference Gr
		Brake drag (slow disengagement after pedal release)	Stopping power different from right to left	Unstable stopping power	Locking point varies	Other	Insufficient stopping power	Reduced pedal travel	Continuous noise during brake application (at low vehicle speed)	Other	
Wheel brake	Backing plate surface rough	O		O							
	Backing plate deformed or incorrectly installed			O							
	Lubricant or moisture on brake pad surface		O		O						
	Deterioration or incorrect material used for brake pad		O								
	Brake pad unevenly worn or with rough surface		O								
	Fade (pad surface deterioration)				O						
	Brake pad worn to limit								O		
	Incorrect contact of brake pad		O		O		O				
	Disc rotor worn unevenly		O								
	Disc rotor deformed			O							
	Disc rotor worn				O						
	Disc rotor surface rough						O				
	Disc rotor inaccurately machined									O	
	Movable parts insufficiently lubricated									O	

Possible causes \ Symptoms		Brake application one sided							Noise and shock when brake pedal pressed		Reference Gr
		Brake drag (slow disengagement after pedal release)	Stopping power different from right to left	Unstable stopping power	Locking point varies	Other	Insufficient stopping power	Reduced pedal travel	Continuous noise during brake application (at low vehicle speed)	Other	
Brake pedal	Incorrect pedal travel						O				
	Incorrectly adjusted, too much play							O			
Brake fluid	Fluid level low							O			
	Fluid leakage							O			
	Air ingress							O			
	Vapor lock							O			
Vacuum system	Vacuum drop						O				
Vacuum booster	Faulty						O	O			
Hydraulic booster	Faulty hydraulic booster						O	O			
	Faulty piston cup							O			
Tire	Tire pressure uneven between wheels					O					Gr31
	Different tire sizes from left to right					O					
Axle	Wheel hub bearing incorrectly adjusted					O			O		Gr26, 27
	Wheelbase different from left to right					O					
	Incorrect wheel alignment					O					Gr26

Possible causes / Symptoms		Brake noise			Judder	Abnormal brake pedal return	Brake drag	Reference Gr
		Noisy when vehicle is new, or after brake lining/pad replacement	Brakes used under severe conditions	Other				
Wheel brake	Lubricant or moisture on brake pad surface		O					
	Wear powder attached on brake pad			O				
	Brake pad worn			O				
	Incorrect contact of brake pad	O						
	Disc rotor glazed		O					
	Disc rotor thickness uneven				O			
Brake pedal	Pedal play insufficient						O	
	Linkage rusted or deformed					O		
	Return spring fatigued or broken					O		
	Vacuum/hydraulic booster operating rod thrust					O		
Brake master cylinder	Faulty piston cup						O	
Axle	Wheel hub bearing incorrectly adjusted			O	O			Gr26, 27
	King pin bushing worn				O			Gr26

Exhaust Brake

Symptoms / Possible causes		Exhaust brake not effective	Exhaust brake does not disengage	Reference Gr
Vacuum system	Insufficient vacuum	O		
	Collapsed piping	O		
Faulty 3-way magnet valve		O	O	Gr54
Exhaust brake unit	Faulty valve	O	O	
	Stuck valve shaft	O	O	
	Faulty valve chamber	O		
Faulty electric system		O	O	Gr54

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Replacement of Brake Fluid

- Brake fluid is shared by the brake and clutch systems, and is divided in the brake fluid tank into the two systems. This section describes the replacement of the brake fluid for the brake system. In order to completely replace the brake fluid, the brake fluid in the clutch system should also be replaced.

Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
–	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Brake fluid tank	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required

WARNING ⚠

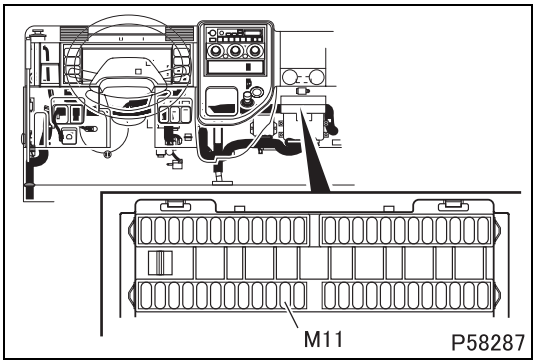
- **Be sure to use new brake fluid. Do not mix it with brake fluid of different properties or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.). This will alter the original properties of FUSO Brake Fluid, causing the boiling point to drop as well as the brake rubber parts to swell. Faulty operation of the brake will result.**
- **Ensure that no foreign matter or water enter into the brake fluid when refilling it, as they will cause faulty brake operation.**
- **Use a mug exclusively kept for the specified brake fluid. This ensures that no brake fluid of different properties or mineral oil enter into the system.**

CAUTION ⚠

- **Brake fluid is corrosive on paint work. Be careful not to spill it onto the paint work. If brake fluid is spilled onto the paint work, immediately wipe it off.**

NOTE

- **During brake fluid replacement operation, a change in color of the brake fluid being discharged indicates that the old brake fluid in the system has been replaced with new brake fluid.**
- **During the replacement, be sure to keep the brake fluid level at the “MAX” mark on the tank.**



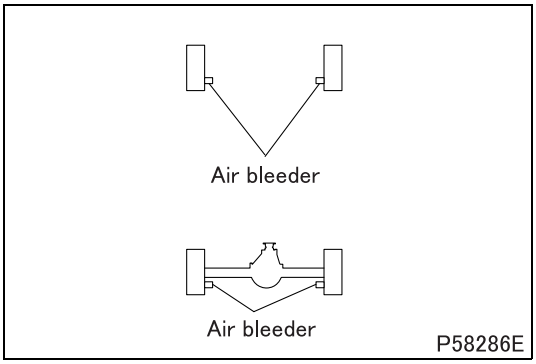
1.1 Work before replacement

- Remove the power fuse (M11) for the electronic control unit of antilock brake system.

WARNING ⚠

- **Do not install the power fuse until after the brake fluid replacement is completed. Otherwise, the initial system check starts, possibly causing air to enter into the secondary system (antilock brake system operating circuit).**

- On vehicles equipped with a vacuum booster, in order to ensure that the vacuum booster function properly, start the engine and keep it running at idle until the replacement is completed.
- On vehicles equipped with a hydraulic booster, the emergency pump is used for the replacement operation. Therefore, shut down the engine and turn the ignition switch ON.
- Install one end of a vinyl pipe onto each air bleeder. Place the loose end into a container.



1.2 Replacement of brake fluid

- Loosen each bleeder screw, and press and release the brake pedal repetitively until brake fluid is no longer discharged from the pipes.
- While filling the brake fluid tank with new brake fluid up to the “MAX” mark, cycle the brake pedal repetitively until the old brake fluid being discharged is replaced with new brake fluid. Tighten each air bleeder to the specified torque.
- Proceed to Air Bleeding of Brake System.

2. Air Bleeding of Brake System

- Brake fluid is shared by the brake and clutch systems, and is divided in the brake fluid tank into the two systems. This section describes the air bleeding of the brake system.

Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
–	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Brake fluid tank	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required

WARNING ⚠

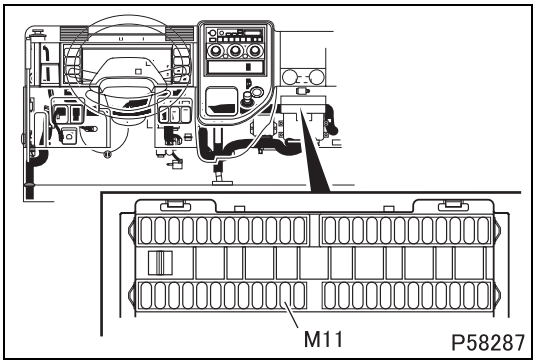
- **Be sure to use new brake fluid. Do not mix it with brake fluid of different properties or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.). This will alter the original properties of FUSO Brake Fluid, causing the boiling point to drop as well as the brake rubber parts to swell. Faulty operation of the brake will result.**
- **Ensure that no foreign matter or water enter into the brake fluid when refilling it, as they will cause faulty brake operation.**
- **Use a mug exclusively kept for the specified brake fluid. This ensures that no brake fluid of different properties or mineral oil enter into the system.**

CAUTION ⚠

- **Brake fluid is corrosive on paint work. Be careful not to spill it onto the paint work. If brake fluid is spilled onto the paint work, immediately wipe it off.**

NOTE

- **Brake fluid level drops during the air bleeding operation. Be sure to keep the brake fluid level at the "MAX" mark on the tank.**



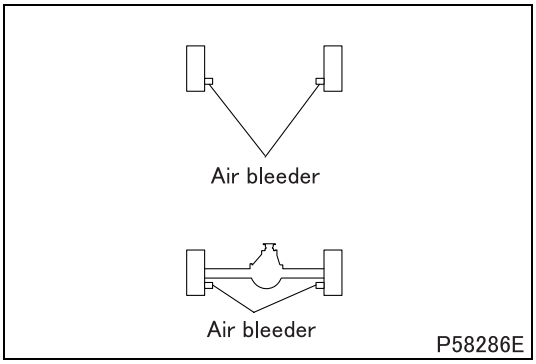
2.1 Work before replacement

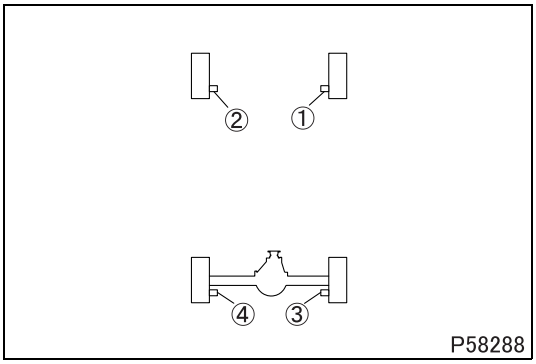
- Remove the power fuse (M11) for the electronic control unit of antilock brake system.

WARNING ⚠

- **Do not install the power fuse until after the air bleeding of the primary brake system (normal circuit) is completed. Otherwise, the initial system check starts, possibly causing air to enter into the secondary system (antilock brake system operating circuit).**

- On vehicles equipped with a vacuum booster, in order to ensure that the vacuum booster function properly, start the engine and keep it running at idle until the replacement is completed.
- On vehicles equipped with a hydraulic booster, the emergency pump is used for the replacement operation. Therefore, shut down the engine and turn the ignition switch ON.
- Install one end of a vinyl pipe onto each air bleeder. Place the loose end into a container.





2.2 Air bleeding of brake system

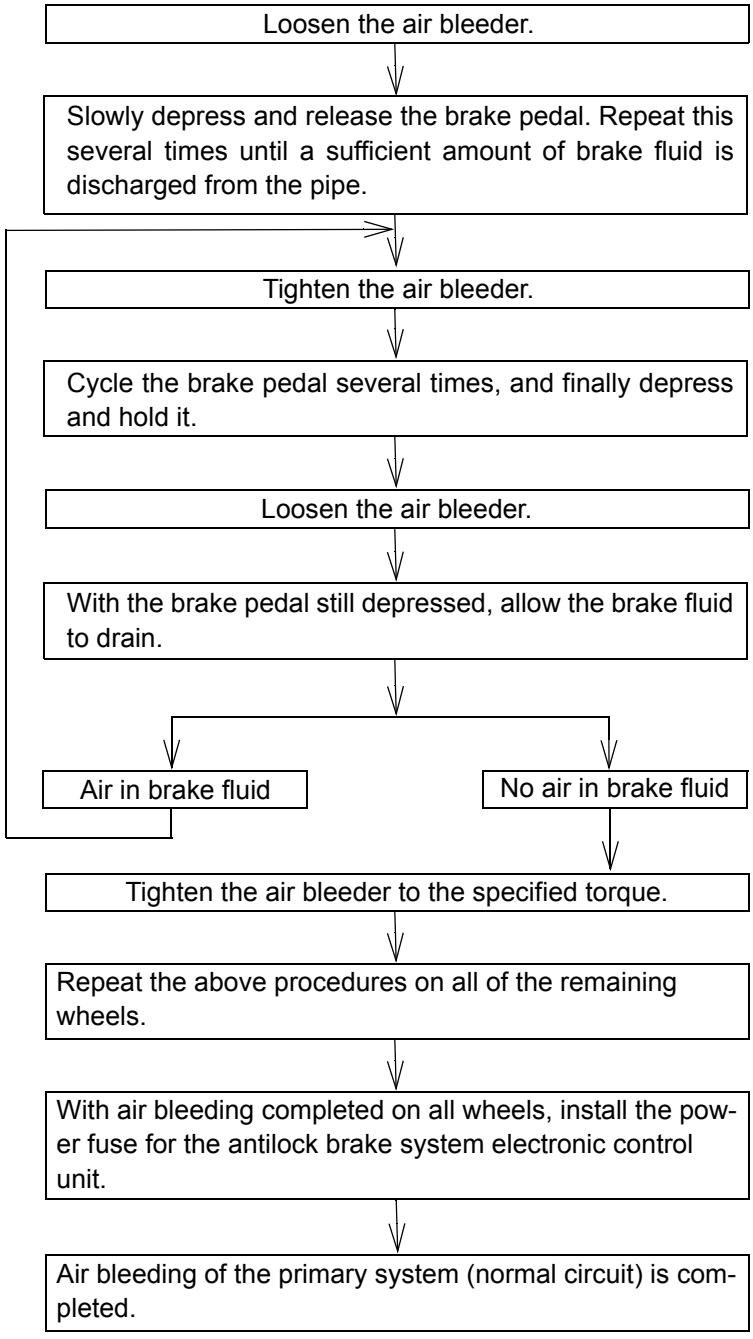
(1) Air bleeding of primary brake system (normal circuit)

- Perform the air bleeding sequence described below on each of the 4 wheels in the order of the following table.

Order of air bleeding	Brake system	Wheel
(1)	Front	Front right
(2)		Front left
(3)	Rear	Rear right
(4)		Rear left

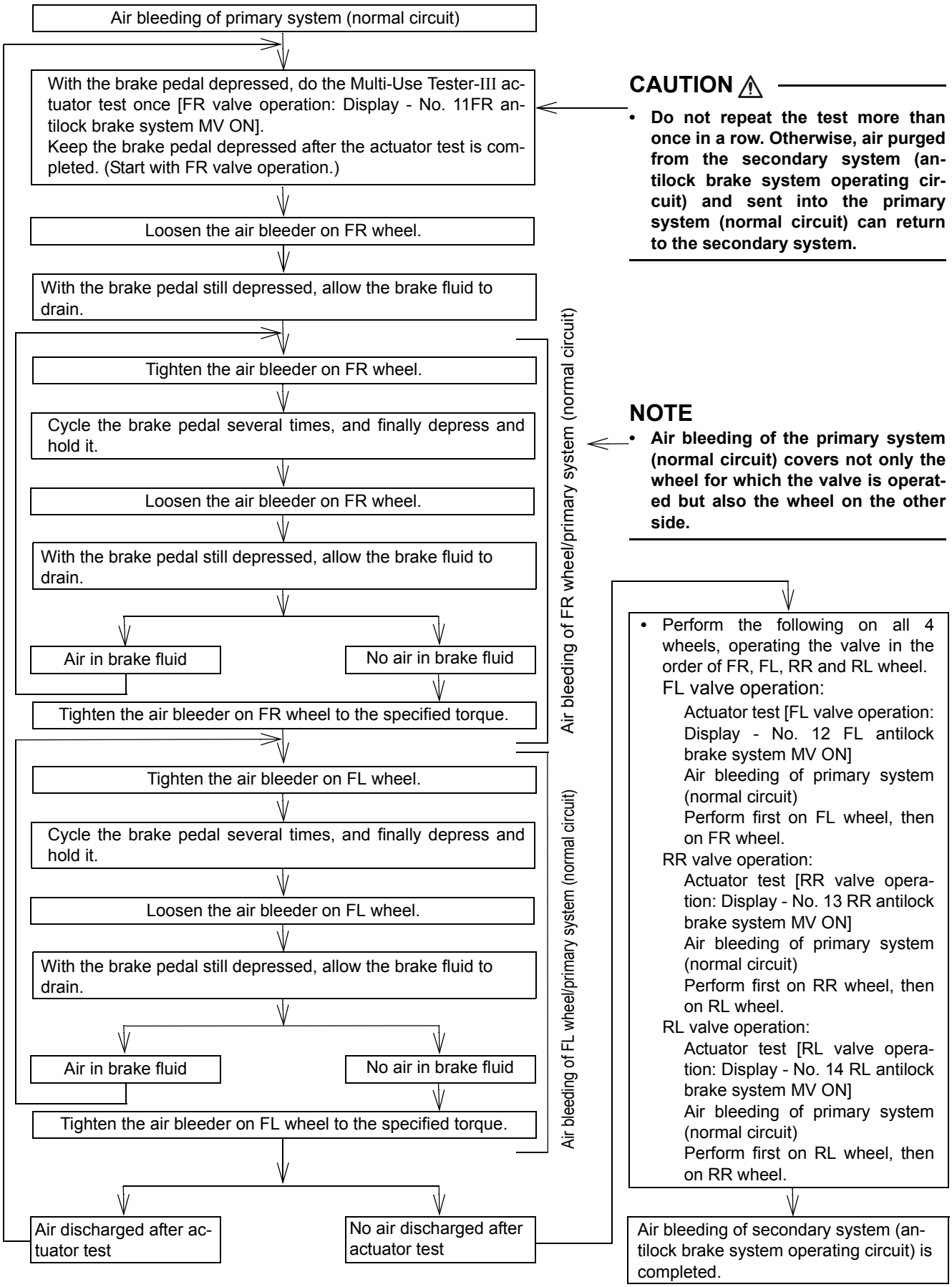
NOTE

- **If air has entered into the secondary brake system (antilock brake system operating circuit), bleed air from the secondary system after completing the air bleeding of the primary system (normal circuit).**
- **Normally, during air bleeding or hydraulic unit replacement operation, air cannot enter into the secondary system (antilock brake system operating circuit) which is filled with brake fluid and is closed off. Therefore, only the primary system (antilock brake system operating circuit) needs to be bled of air.**



(2) Air bleeding of secondary brake system (antilock brake system operating circuit)

- If the antilock brake system is operated with air still remaining in the primary brake system (normal circuit), air can enter into the secondary brake system (antilock brake system operating circuit).
- If air has entered into the secondary system (antilock brake system operating circuit), that air can also flow into the primary system (normal circuit) when the antilock brake system is operated, possibly causing the brake pedal stroke to extend.
- Multi-Use Tester-II or Multi-Use Tester-III actuator test (antilock brake system operating mode) is performed as part of the air bleeding procedures.



CAUTION ⚠

- **Do not repeat the test more than once in a row. Otherwise, air purged from the secondary system (antilock brake system operating circuit) and sent into the primary system (normal circuit) can return to the secondary system.**

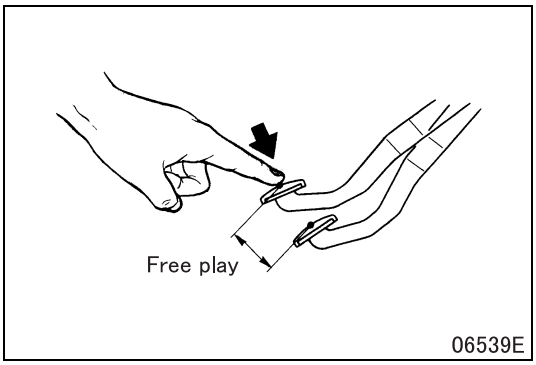
NOTE

- **Air bleeding of the primary system (normal circuit) covers not only the wheel for which the valve is operated but also the wheel on the other side.**

3. Inspection and Adjustment of Brake Pedal Free Play

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
–	Pedal free play	0.1 to 3 {0.0034 to 0.12}	–	Adjust



[Inspection]

- With the engine stationary, ensure that the pedal play conforms to the standard value.
- If the measured value does not conform to the standard value, adjust the installed height of the brake pedal.

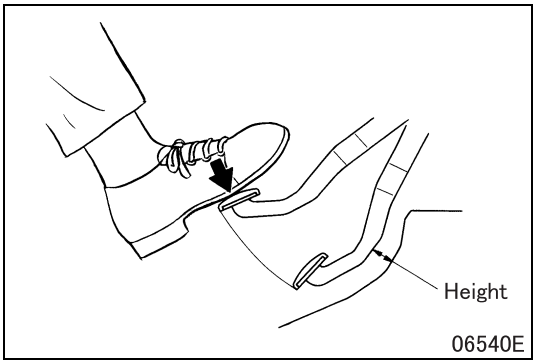
[Adjustment]

- For adjustment procedures, see “5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal.”

4. Inspection and Adjustment of Brake Pedal Pressed Height from Floor

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
–	Brake pedal height from floor (when pressed with a force of 490 N {110 lbf}	20 {0.79} or above	–	Adjust



[Inspection]

- With the engine running at idle, press the brake pedal with a force of 490 N {110 lbf} and measure the brake pedal height from the floor.
- If the measured value does not conform to the standard value, adjust the installed height of the brake pedal.

[Adjustment]

- For adjustment procedures, see “5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal.”

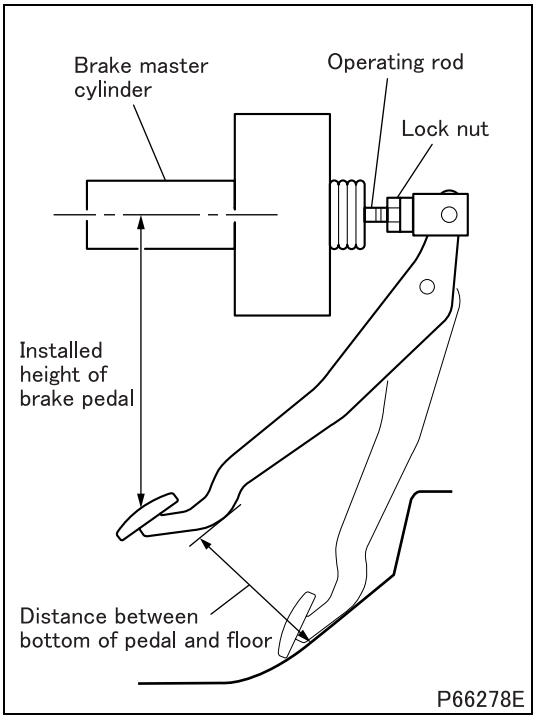
5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal

Service standards: mm {in}

Location	Maintenance item		Standard value	Limit	Remedy
–	Pedal full stroke (distance between bottom of pedal and floor with brake pedal released)	Except COE 50	170 to 177 {6.68 to 6.97}	–	Adjust
		COE 50	173 to 181 {6.82 to 7.11}	–	
	Installed height of brake pedal (pedal pad center to brake master cylinder center)	Except COE 50	233 ± 3 {9.17 ± 0.12}	–	Adjust
		COE 50	230.2 ± 3 {9.06 ± 0.12}	–	

Torque: N·m {lbf·ft}

Mark	Fastener		Torque value	Remarks
–	Lock nut	Except COE 50	21.6 ± 2.94 {16 ± 2.2}	–
		COE 50	9.8 to 15.7 {7.2 to 12}	–



5.1 Inspection of pedal stroke

- With the brake pedal released, measure the distance between the bottom of pedal and the floor. If the measurement conforms to the standard value, the pedal full stroke is correctly adjusted.
- If the above measurement does not conform to the standard value, adjust the installed height of the brake pedal.

5.2 Adjustment of installed height of brake pedal

- After loosening the lock nut, turn the operating rod of the vacuum booster/hydraulic booster until the distance from the pedal pad center to the axis of brake master cylinder conforms to the standard value.
- Tighten the lock nut to the specified torque.
- With the lock nut correctly tightened, adjust the stop lamp switch and inspect the brake pedal play.

CAUTION ⚠

- **When the pedal is fully depressed, the vacuum booster/hydraulic booster operating rod functions as a stopper for the brake pedal.**
- **To prevent brakes from dragging, ensure that the threaded end of the stop lamp switch does not touch the brake pedal stopper.**

6. Inspection and Replacement of Disc Brake Pad

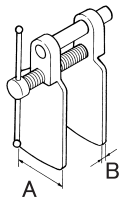
Service standards: mm {in}

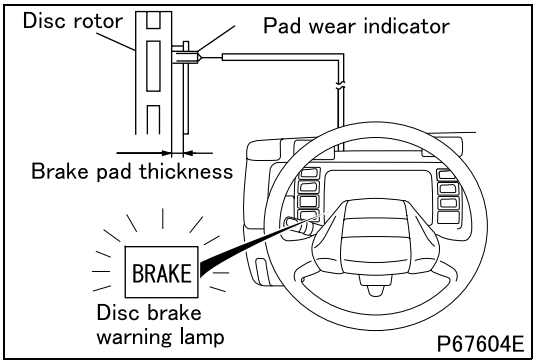
Location	Maintenance item	Standard value	Limit	Remedy
–	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
–	Pin bolt	40 to 50 {30 to 37}	–

Special tools: mm {in}

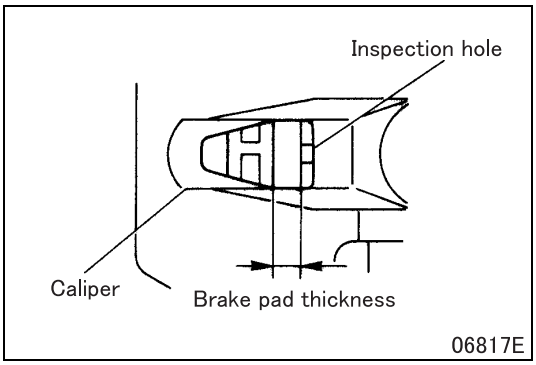
Mark	Tool name and shape	Part No.	Application
a	Piston expander A: 50 {1.97}, B: 5 {0.20}  06815	MB990520	Pressing piston during brake pad replacement



P67604E

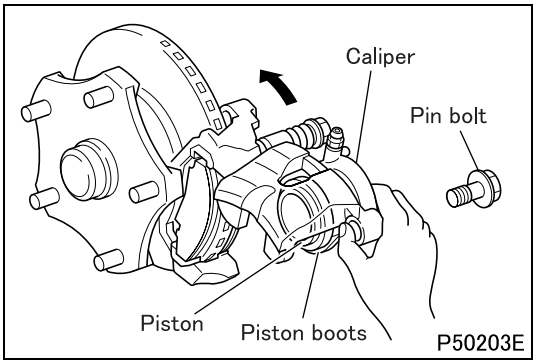
[Inspection]

- When a brake pad has worn down to a thickness of approximately 4 mm {0.16 in}, the pad wear indicator contacts the disc rotor. This breaks the circuit, illuminating the disc brake warning lamp on the meter cluster to tell the operator that the brake pads need replacement.



06817E

- Through the inspection hole in the caliper, measure the brake pad thickness. If the measured value is less than the limit, replace all of the brake pads on that axle with a new kit.



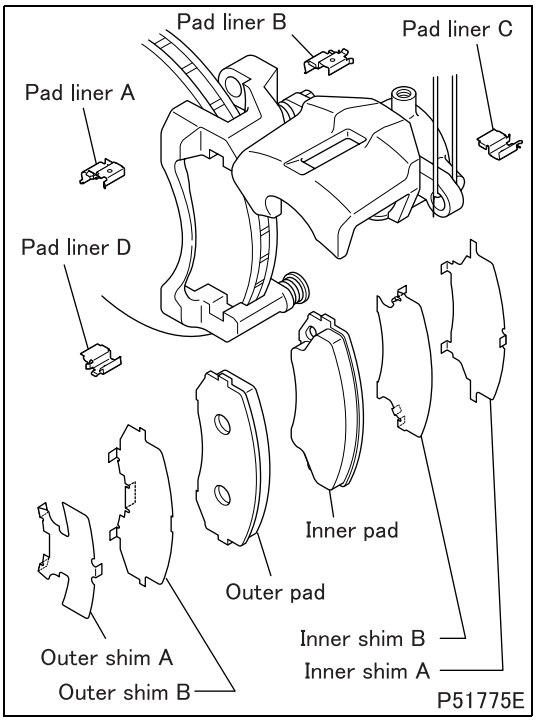
[Replacement]

- Remove the lower pin bolt. Flip the caliper upwards and suspend it in place using a wire or the like.

CAUTION ⚠

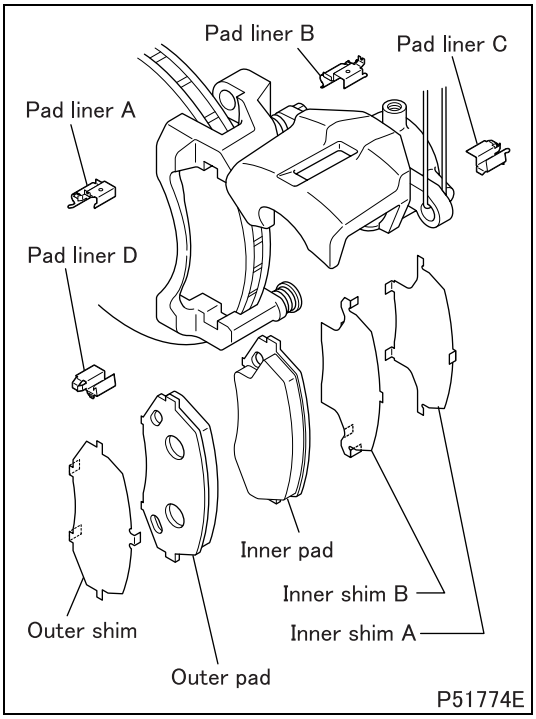
- **Suspend the caliper firmly in place so that it does not drop, which could result in stretching, squeezing or otherwise damaging the brake plumbing or harness.**

- Inspect the piston for fluid leakage. Inspect the piston boots for damage. Faulty parts must be replaced.
- Remove the following parts. Installation follows the removal procedure in reverse. When installing shims onto the pads, be sure to face them in the illustrated directions.



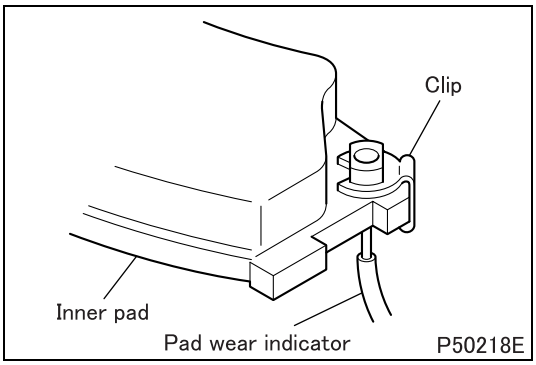
<ϕ235 mm {9.25 in} disc>

- The inner pad on the R/H wheel and the inner pad on the L/H wheel are both equipped with a pad wear indicator.



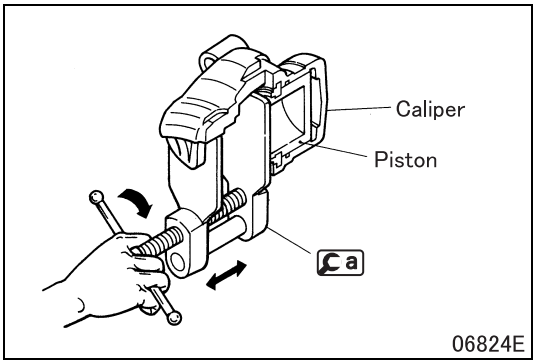
<ϕ252 mm {9.92 in} disc>

- The inner pad on the R/H wheel and the inner pad on the L/H wheel are both equipped with a pad wear indicator.

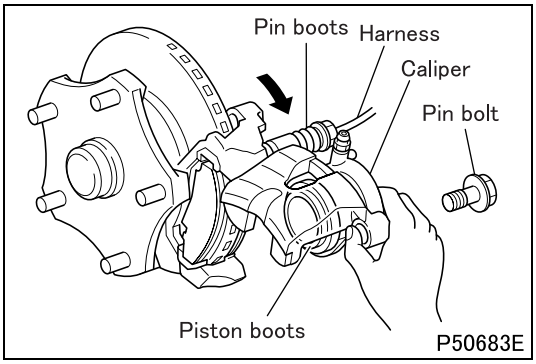


- Install a pad wear indicator onto the inner pad (included in the pad kit) using a clip (included in the pad wear indicator kit).

Pad wear indicator to be installed on	Inner pads on R/H and L/H wheels



- Using the piston expander [a], screw in the piston of the caliper until it bottoms on the back of the caliper.



- Move the caliper back to the original place while taking care not to damage the piston boots.
- Bleed the pin boots of air.
- Ensure that the pin boots are firmly attached into the groove on the slide pin.
- Tighten the pin bolt to the specified torque.
- Correctly route the harness(es) for the pad wear indicator(s).
- Measure the drag torque of the disc brake.
- Cycle the brake pedal several times, and check the brake fluid level in the tank. The fluid level should be at the “MAX” mark on the tank. Add brake fluid as required.

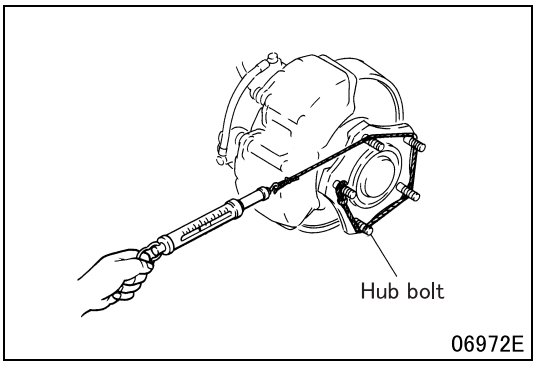
7. Measurement of Disc Brake Drag Torque

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Drag torque of disc brake (inertial force at hub bolts)	Approx. 5 sec. after releasing brake pedal	9.8 N·m {7.2 lbf·ft} or less	–	Inspect
		After turning disc rotor 10 revolutions	6.9 N·m {5.1 lbf·ft} or less	–	

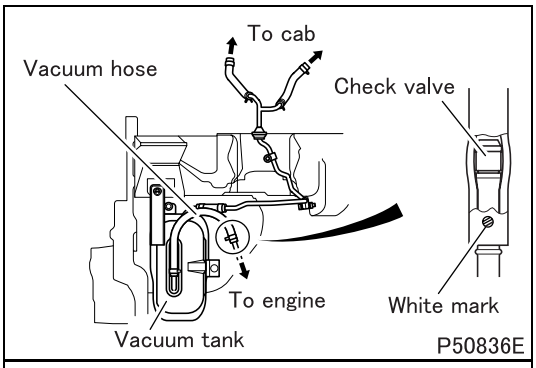
Table of inertial forces

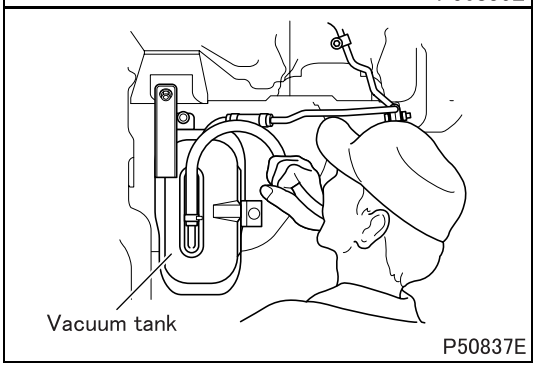
	Approx. 5 sec. after releasing brake pedal	After turning disc rotor 10 revolutions
Front	81 N {18.2 lbf}	57 N {12.8 lbf}
Rear	83 N {18.7 lbf}	59 N {13.3 lbf}



- Ensure that the starting torque of the wheel hub bearings conforms to the standard value.
- Using a spring balance, measure the inertial force at the hub bolts.
- The inertial force is calculated by the following formula.
  Inertial force = Dragging torque / (hub bolt P.C.D. / 2)
- If the measured inertial force conforms to the specified value, this means that the drag torque of the disc brake conforms to the standard value.
- If the measured value does not conform to the specified torque, check the sliding portions of the piston and piston seal.

8. Inspection of Check Valve in Vacuum Line Hose





NOTE

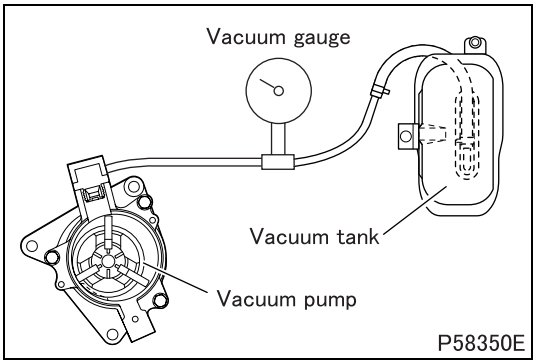
- **Be careful not to allow moisture into the check valve.**
- **During the inspection, ensure that the check valve opens as well as closes correctly.**
- **Do not attempt to remove the check valve from the vacuum hose.**

- Perform the following inspections. If the check valve does not pass both inspections, replace the check valve complete with the vacuum hose.
  - Blow into the hose. The check valve should close, preventing the breath from passing it.
  - Suck on the hose. The check valve should open, allowing air to pass.

9. Inspection of Vacuum Pump

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Time to reach vacuum of 80 kPa {23.6 inHg}	At 1500 rpm	Within 20 sec.	–	Replace
		At 3000 rpm	Within 12 sec.	–	



- Install a vacuum gauge between the vacuum tank and the vacuum pump.
- Start the engine and measure the time taken to reach the specified degree of vacuum.
- If the measured time does not conform to the standard value, disassemble and service the vacuum pump.

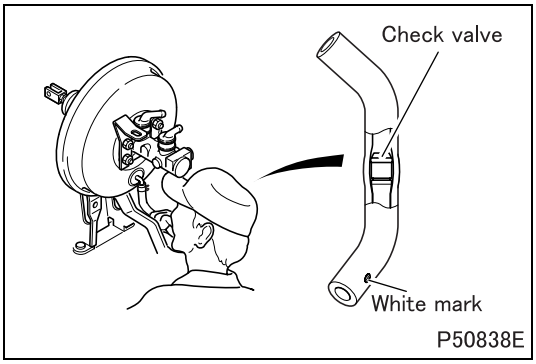
M E M O

10. Inspection of Vacuum Booster <Except COE 50>

- The vacuum booster can be inspected in 2 ways: one without using any tester and the other using a simplified tester. In either way, ensure that the brake piping and hosing and their connections are free of leakage, damage, or other faults.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Precision inspection (vacuum loss) (vacuum of 67 kPa {19.8 inHg}, 15 sec. after engine shutdown)	3.3 kPa {0.97 inHg} or less	–	Replace
–	Fluid pressure at vacuum of 67 kPa {19.8 inHg}	4360 kPa {630 psi} (pedal pressed with a force of 98 N {22.0 lbf})	–	Replace
		8800 kPa {1280 psi} (pedal pressed with a force of 295 N {66.3 lbf})	–	
–	Fluid pressure at vacuum of 0 kPa {0 inHg}	315 kPa {46 psi} (pedal pressed with a force of 98 N {22.0 lbf})	–	Replace
		1550 kPa {225 psi} (pedal pressed with a force of 295 N {66.3 lbf})	–	



10.1 Inspection of check valve in vacuum hose

CAUTION ⚠

- **Be careful not to allow moisture into the check valve.**
- **During the inspection, ensure that the check valve opens as well as closes correctly.**
- **Do not attempt to remove the check valve from the vacuum hose.**

- Start the engine and charge the vacuum tank with vacuum.
- Shut down the engine, and immediately remove the clamp that attaches the vacuum hose to the vacuum line.
- Blow into the hose. The check valve should close, preventing any air from passing through it.
- Apply suction to the hose while pressing the brake pedal. The check valve should immediately open, allowing air to pass.
- If any problem is discovered during these inspections, replace the check valve and vacuum hose.

10.2 Operational check of vacuum booster

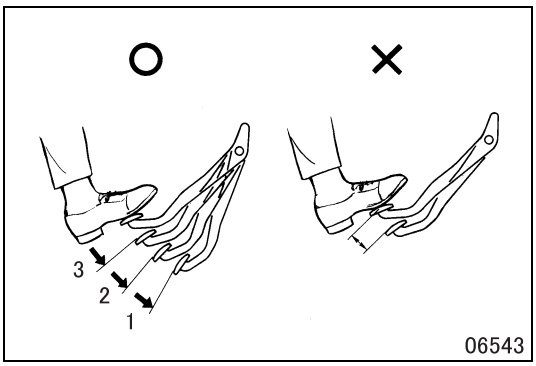
CAUTION ⚠

- **The vacuum booster operational checks described below are preliminary. If the vacuum booster continues to malfunction, remove the vacuum booster from the vehicle.**
- **If the vacuum booster is found to be faulty during the more detailed testing, return it to the manufacturer for repairs.**

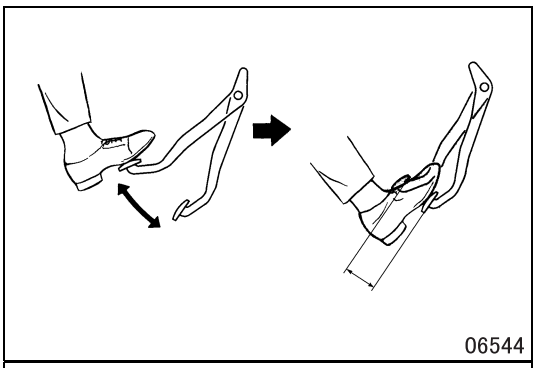
(1) Operational check without any tester

- Inspect the check valve in the vacuum hose for normal operation.

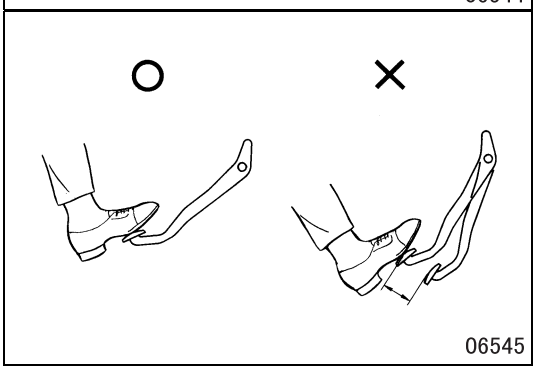
- Perform the checks described below. If any fault is found during these checks, inspect the following parts.
  - Vacuum booster
  - Vacuum pump



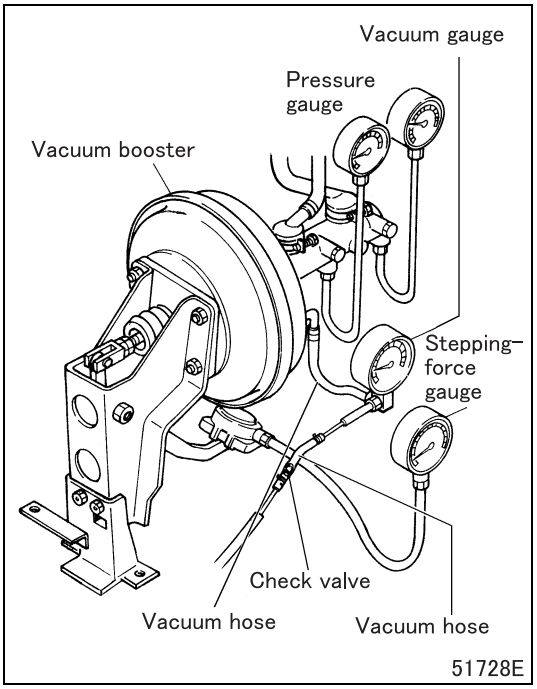
[Check 1]
- Start the engine and run it for 1 to 2 minutes. Shut down the engine.
- Press the brake pedal repetitively with the normal stepping force.
- The pedal stroke should become smaller each time the pedal is pressed.



[Check 2]
- With the engine stationary, press the brake pedal several times.
- With the brake pedal pressed, start the engine. The pedal should sink slightly.



[Check 3]
- With the engine running and the brake pedal pressed, shut down the engine.
- The brake pedal should maintain the same height for approximately 30 seconds.



(2) Operational check with a simplified tester

(2.1) Airtightness check

- Inspect the check valve in the vacuum hose for normal operation.
- Remove the vacuum hose from the vacuum booster and connect it to the vacuum gauge.
- Connect another hose (not equipped with a check valve) onto the vacuum booster and the vacuum gauge.
- Install 2 pressure gauges and 1 stepping-force gauge as illustrated. Bleed the pressure gauges of air.
- Perform the following checks. If any fault is encountered during these checks, inspect the vacuum booster.

[Check 1]

- Start the engine. When the reading on the vacuum gauge has reached 67 kPa {19.8 inHg}, shut down the engine.
- The vacuum lost in approximately 15 seconds of the engine stop should conform to the standard value.

[Check 2]

- Start the engine, and press the brake pedal. When the reading on the vacuum gauge has reached 67 kPa {19.8 inHg}, shut down the engine.
- The vacuum lost in approximately 15 seconds of the engine stop should conform to the standard value.

(2.2) System characteristics check

- Perform the following system characteristics checks after the airtightness check described above is completed.
- Perform the following checks. If any fault is encountered during these checks, inspect the vacuum booster.

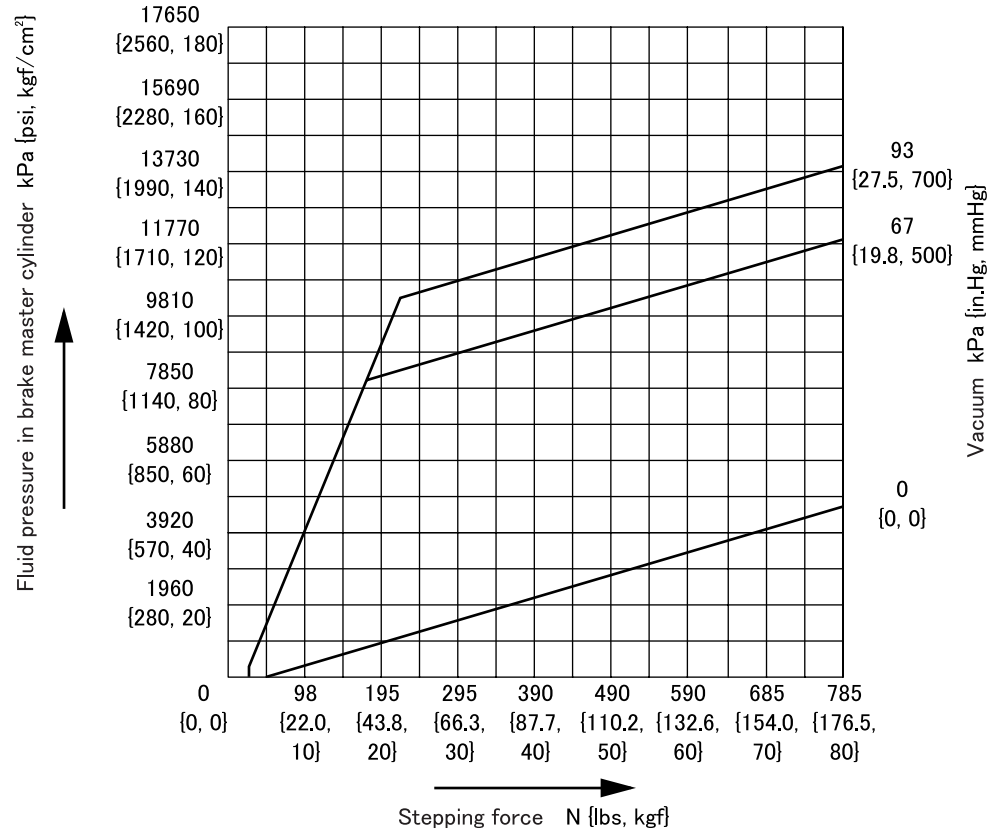
[Check 1]

- Start the engine. When the reading on the vacuum gauge has reached 67 kPa {19.8 inHg}, press the brake pedal with the specified stepping forces.
- The fluid pressures indicated on the pressure gauges should conform to the specified values.

[Check 2]

- Start the engine. When the reading on the vacuum gauge shows zero pressure, press the brake pedal with the specified stepping forces.
- The fluid pressures indicated on the pressure gauges should conform to the specified values.

(2.3) Vacuum booster performance graph



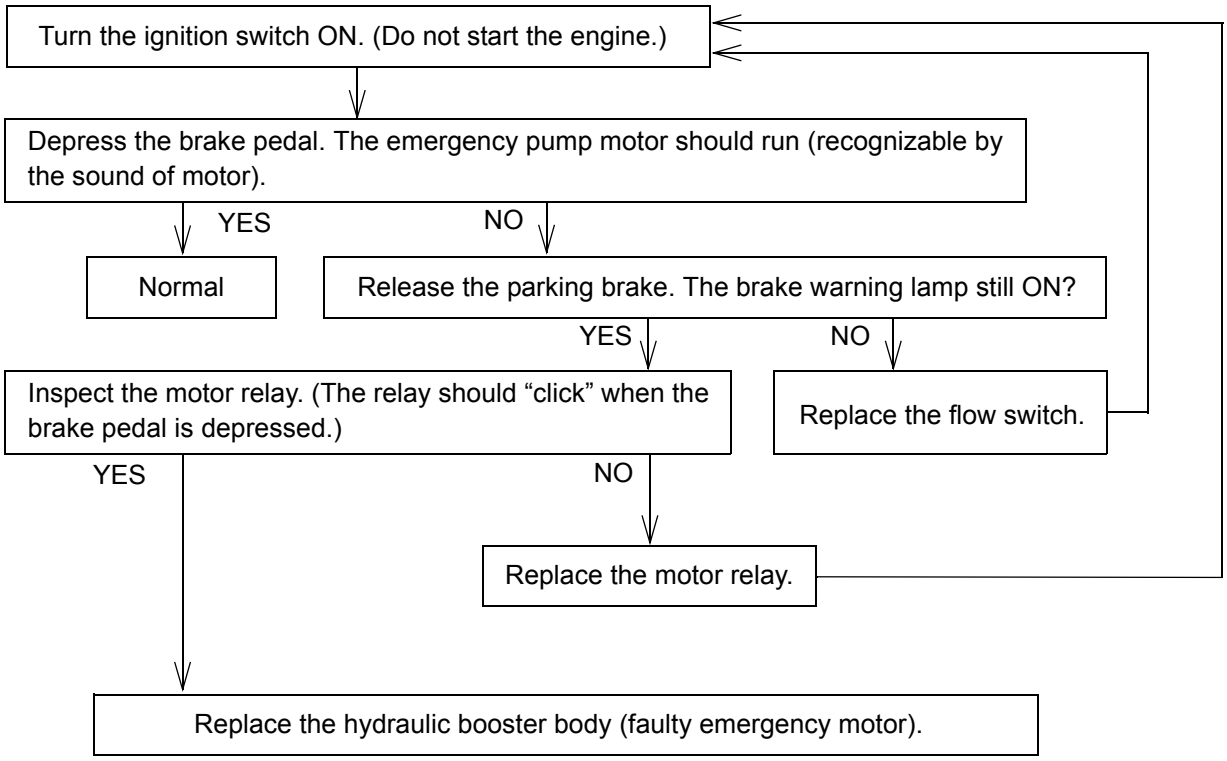
11. Inspection of Hydraulic Booster <COE 50>

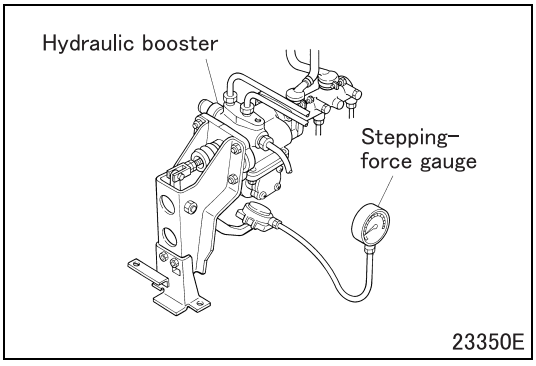
Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Fluid pressure at power steering oil temperature of 60°C {140°F} or below	Pedal pressed with a force of 98 N {22.0 lbf)	4620 kPa {670 psi)	–	Replace
		Pedal pressed with a force of 295 N {66.3 lbf}	13600 kPa {1970 psi}	–	

11.1 Inspection of electric equipment

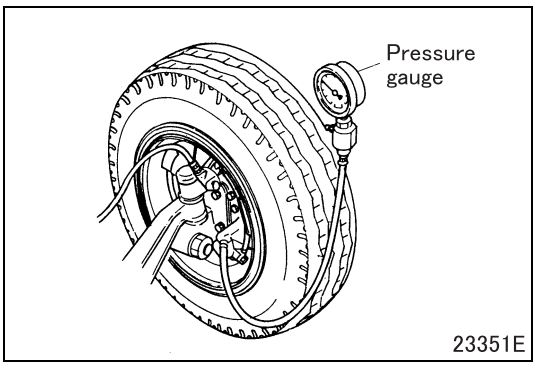
- Inspect in accordance with the following flow chart.
- Before inspection, park the vehicle on a flat surface, apply the parking brake firmly, and chock the wheels.





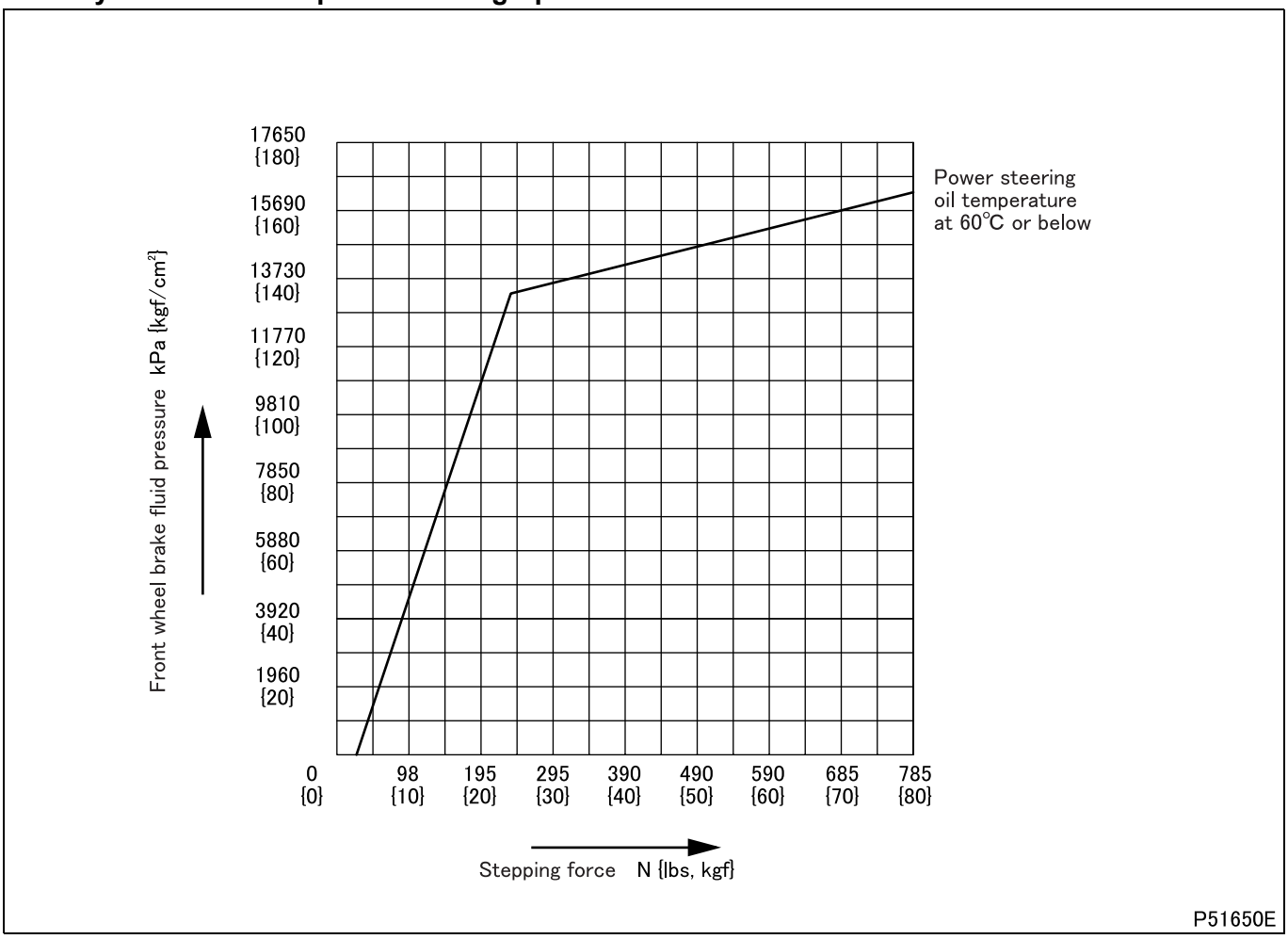
11.2 Functional check

- Install a stepping-force gauge onto the brake pedal. Remove an air bleeder from the front wheel brake, and install a pressure gauge. Bleed the gauge of air.
- Carry out performance test on the power steering system. Ensure that the system pressure is to specification.
- After confirming that the electric equipment has passed the inspection described above, press the brake pedal with varying forces. The reading of the front wheel brake fluid pressure should follow the pressure line of the graph.

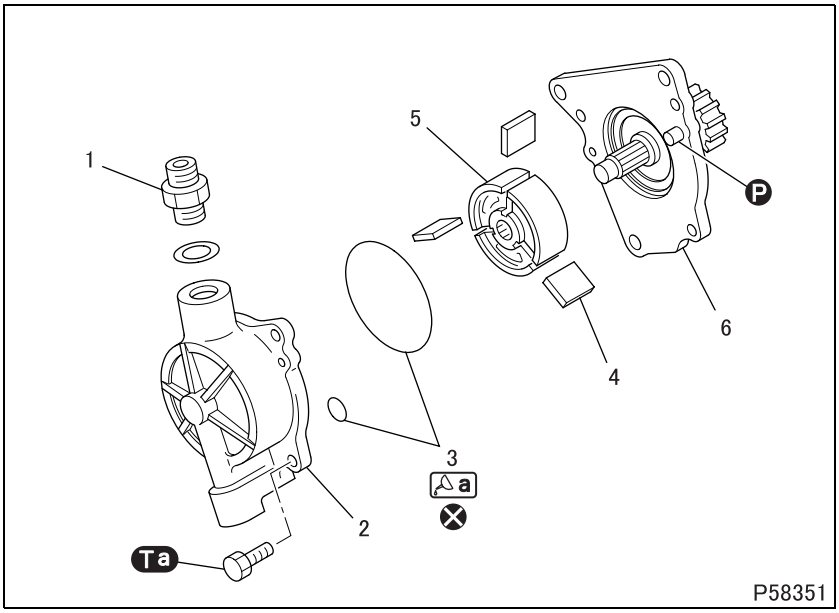


- If any fault is observed during these checks, replace the hydraulic booster.

11.3 Hydraulic booster performance graph



VACUUM PUMP



● Disassembly sequence

1 Check valve
2 Housing
3 O-ring
4 Vane
5 Rotor
6 Bracket

Ⓟ: Locating pin
⊗: Non-reusable parts

NOTE

- **For removal and installation procedures, see Gr11.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Time to reach vacuum of 80 kPa {23.6 inHg} (vacuum tank capacity: 10 L {11 qt})	At 1500 rpm	Within 20 sec.	–	Replace
		At 3000 rpm	Within 12 sec.	–	

Torque: N·m {lbf·ft}

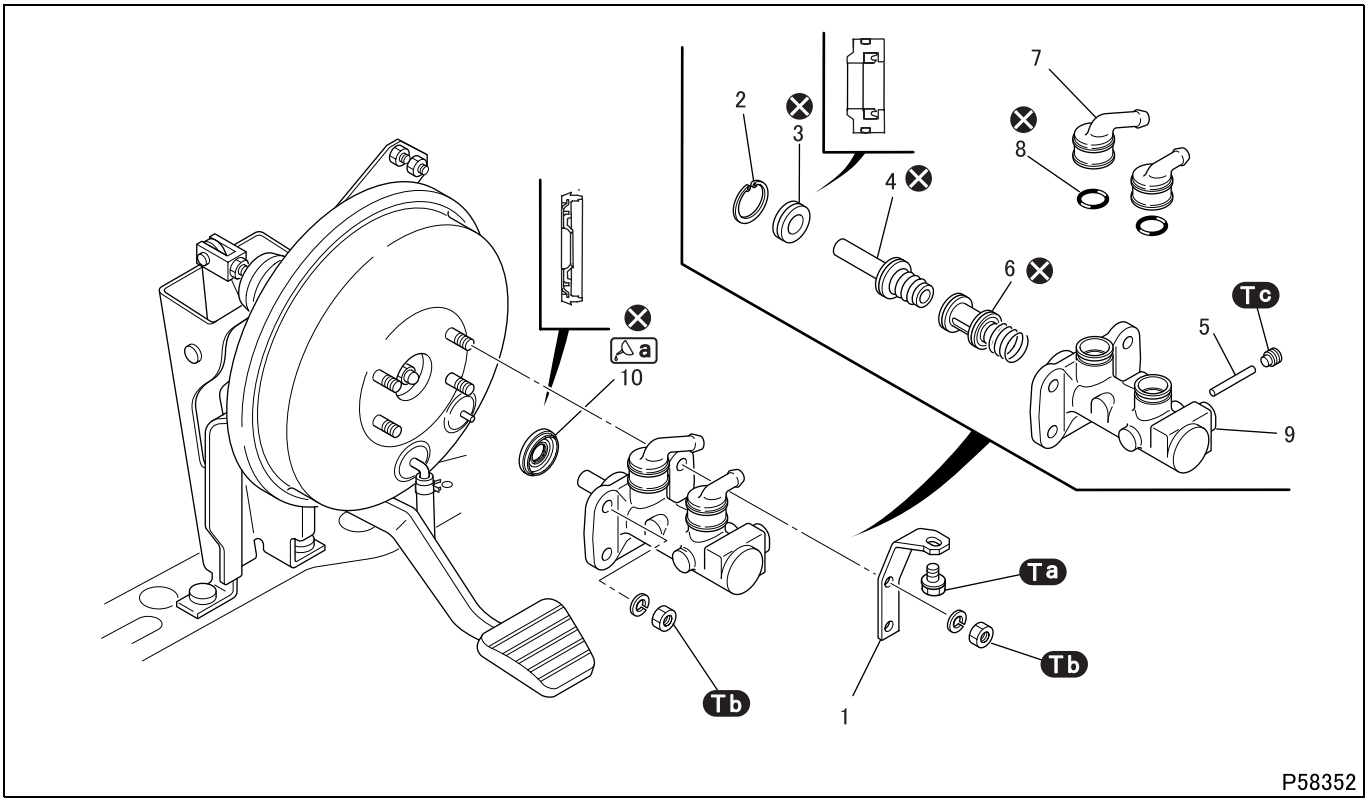
Mark	Fastener	Torque value	Remarks
Ta	Bolt (housing and bracket assembling)	8.8 ± 2 {6.5 ± 1.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

M E M O

BRAKE MASTER CYLINDER <WITH VACUUM BOOSTER>



● **Disassembly sequence**

1 Bracket
2 Retaining ring
3 Piston guide
4 Primary piston
5 Set pin
6 Secondary piston
7 Connector
8 O-ring
9 Cylinder body
10 Seal

⊗: Non-reusable parts

CAUTION ⚠

- **For cleaning, use brake fluid.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Master cylinder repair kit

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
4	Primary piston spring load	113.7 to 125.4 N {26 to 28 lbf}	110.7 N {25 lbf}	Replace
4, 6, 9	Clearance between primary and secondary pistons and cylinder body	0.02 to 0.10 {0.00079 to 0.0039}	0.2 {0.0079}	Replace
6	Secondary piston spring load	81.3 to 91.1 N {18 to 20 lbf}	79.4 N {18 lbf}	Replace

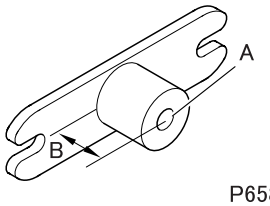
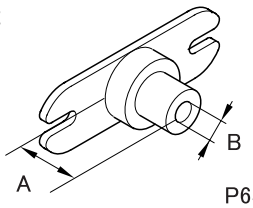
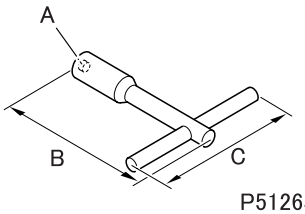
Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
Ta	Bolt (bracket mounting)	9 to 14 {6.6 to 10}	–
Tb	Nut (brake master cylinder mounting)	9.8 to 15.7 {7.2 to 12}	–
Tc	Screw (set pin mounting)	8.8 to 11.8 {6.5 to 8.7}	–

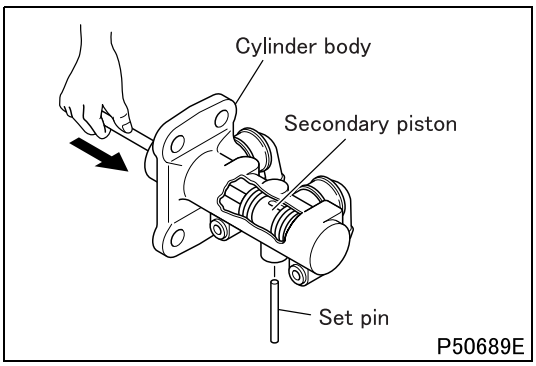
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Seal lips and outer periphery	Rubber grease	As required
	Seal ring groove		

Special tools: mm {in}

Mark	Tool name and shape	Part No.	Application
a	Support tool A: No. of splines: 23 B: 30 {1.18}  P65860	MK528895	Adjustment of vacuum booster push rod
b	Support tool for measurement A: 36 {1.42} B: ϕ11.5 {0.45}  P65861	MK528896	
c	Box spanner A: Width across flats: 8 B: 120 {4.72} C: 120 {4.72}  P51263	MB999062	

◆Removal procedure◆

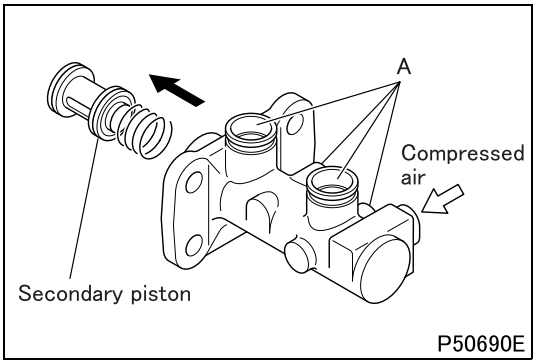


■ **Removal: Secondary piston**

- Position the cylinder body such that the set pin faces down. Using a rod or the like, compress the secondary piston to ease out the set pin. Be ready to catch the set pin when it falls out. Do not allow it to drop.

CAUTION ⚠

- **Do not allow the set pin to drop on the floor. This may damage the set pin.**

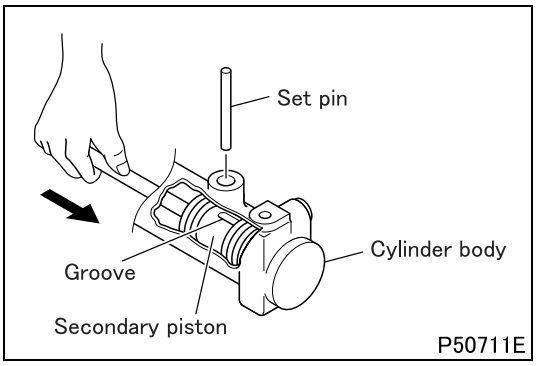


- With the ports marked **A** blocked, feed compressed air in the direction of the arrow, gradually increasing the pressure from zero until the secondary piston is ejected.

WARNING ⚠

- **Do not apply compressed air suddenly and at high pressure. The secondary piston may fly out with great force and cause a personal injury.**

◆Installation procedure◆

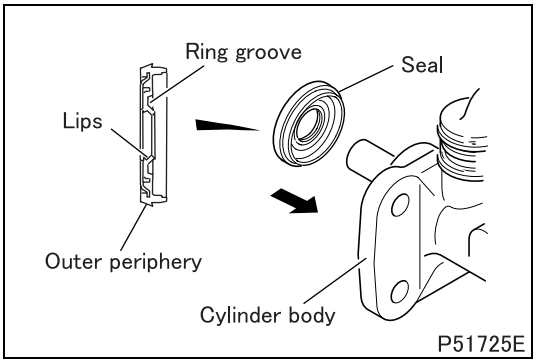


■ **Installation: Secondary piston**

- Position the cylinder body with the set pin hole facing up. Using a thin rod or similar tool, insert the secondary piston into the cylinder body. At the same time, try to insert the set pin.

NOTE

- **If necessary, rotate the secondary piston to align the groove on the piston with the set pin hole.**



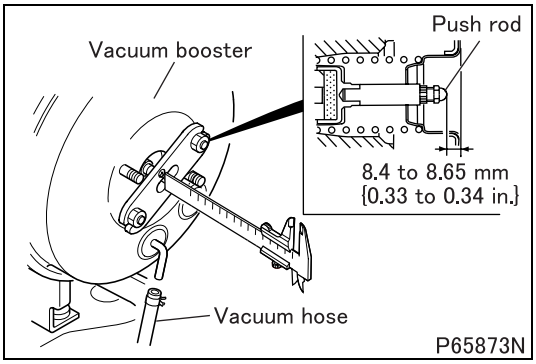
■ **Installation: Seal**

- Apply grease on the lips and outer periphery of the seal. Also, pack grease into the seal's ring groove. Then, face the seal in the illustrated direction before installing it onto the cylinder body.

CAUTION ⚠

- **Ensure that the seal is facing as shown in the illustration and is installed correctly, without roll-up or damage. An improperly installed seal will not hold vacuum.**

◆Work after installation◆



■ **Inspection: Brake pedal & vacuum booster**

NOTE

- **If the brake master cylinder or the primary piston is replaced, be sure to inspect and, if required, adjust the illustrated distance between the push rod and the end of the brake pedal & vacuum booster.**

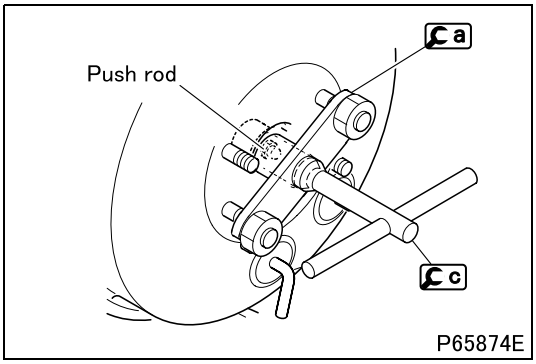
[Inspection]

- Remove the vacuum hose from the brake pedal & vacuum booster to fill the vacuum booster with the atmospheric pressure.

NOTE

- **The vacuum booster must be filled to atmospheric pressure to obtain accurate results from this inspection.**

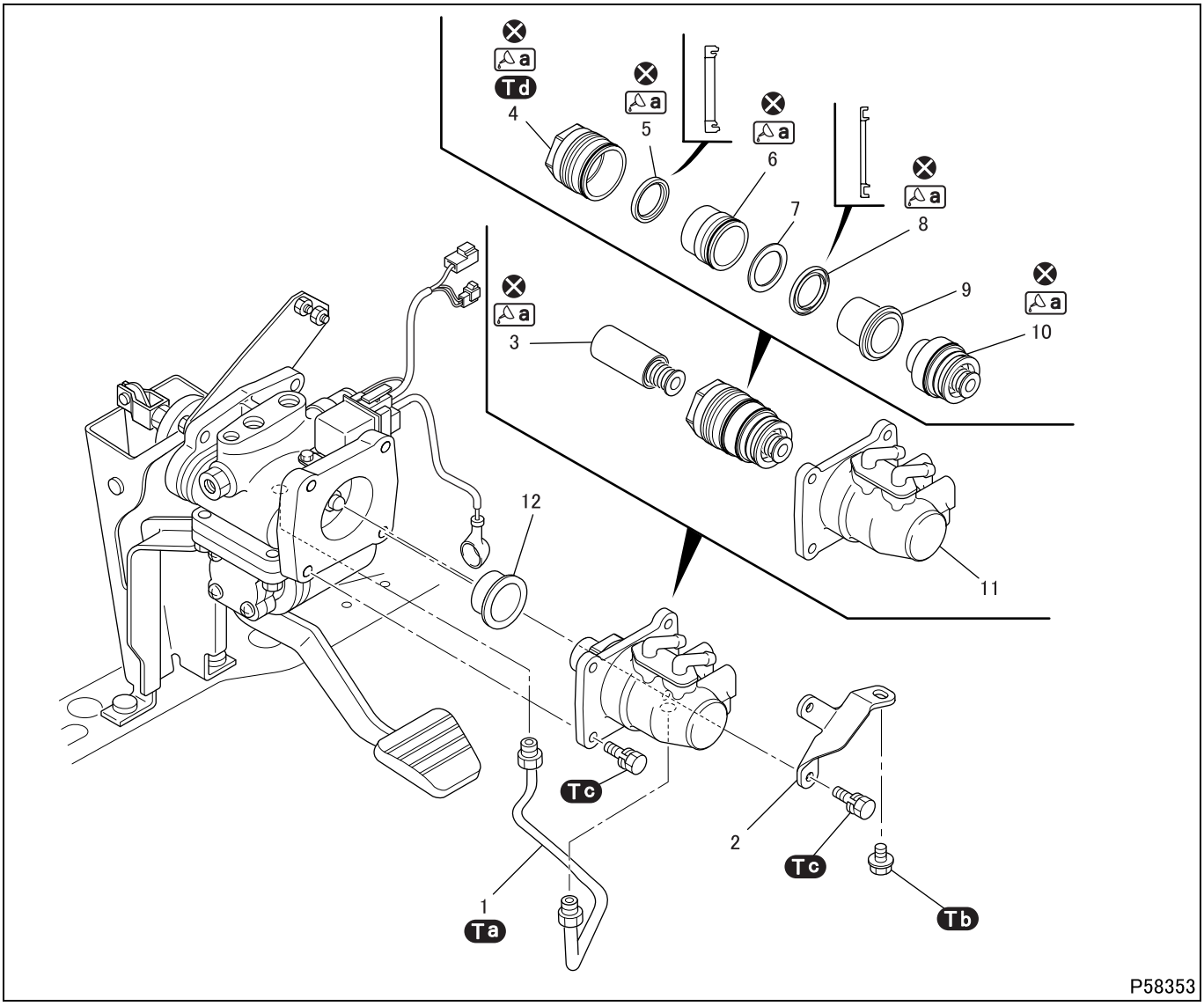
- Measure the distance (as shown in the illustration) between the push rod and the end of the brake pedal & vacuum booster.
- If the measured value does not conform to the specified value, adjust the distance as follows.



[Adjustment]

- Set the distance to the specified value by turning the push rod in or out.

BRAKE MASTER CYLINDER <WITH HYDRAULIC BOOSTER>



● **Disassembly sequence**

1 Brake line
2 Bracket
3 Primary piston
4 Cap
5 Secondary cup
6 Bushing
7 Cup spacer
8 Primary cup
9 Cup retainer
10 Secondary piston
11 Cylinder
12 Piston protector

⊗: Non-reusable parts

CAUTION ⚠

- **For cleaning, use brake fluid.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Master cylinder repair kit, Cap kit

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
3	Primary piston spring load (installed length: 49.7 {1.96})	130 to 140 N {29 to 31 lbf}	125 N {28 lbf}	Replace
3, 10, 11	Clearance between primary and secondary pistons and cylinder	0.065 to 0.125 {0.0026 to 0.0049}	0.13 {0.0051}	Replace
10	Secondary piston spring load (installed length: 44.5 {1.75})	102 to 118 N {23 to 27 lbf}	96 N {22 lbf}	Replace

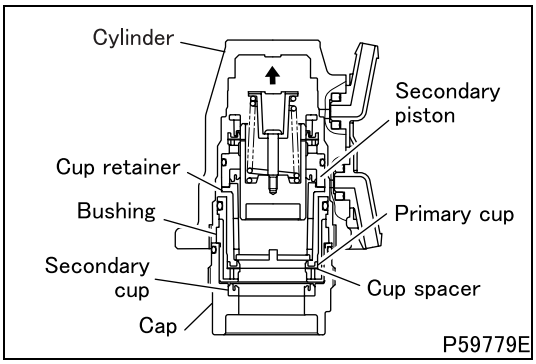
Torque: N·m {lbf·ft}

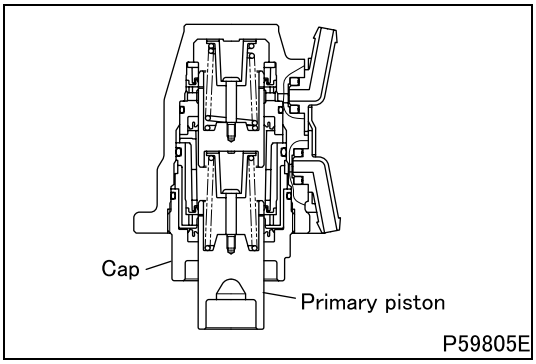
Mark	Component	Torque value	Remarks
Ta	Brake line	17.2 ± 2.5 {13 ± 1.8}	–
Tb	Bolt (bracket mounting)	9 to 14 {6.6 to 10}	–
Tc	Bolt (brake master cylinder mounting)	17.6 to 27.4 {13 to 20}	–
Td	Cap	68.6 to 78.4 {51 to 58}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Sliding face of primary piston	Rubber grease	As required
	O-ring on cap		
	Secondary cup		
	O-ring on bushing		
	Primary cup		
	Sliding face of secondary piston		

◆Installation procedure◆





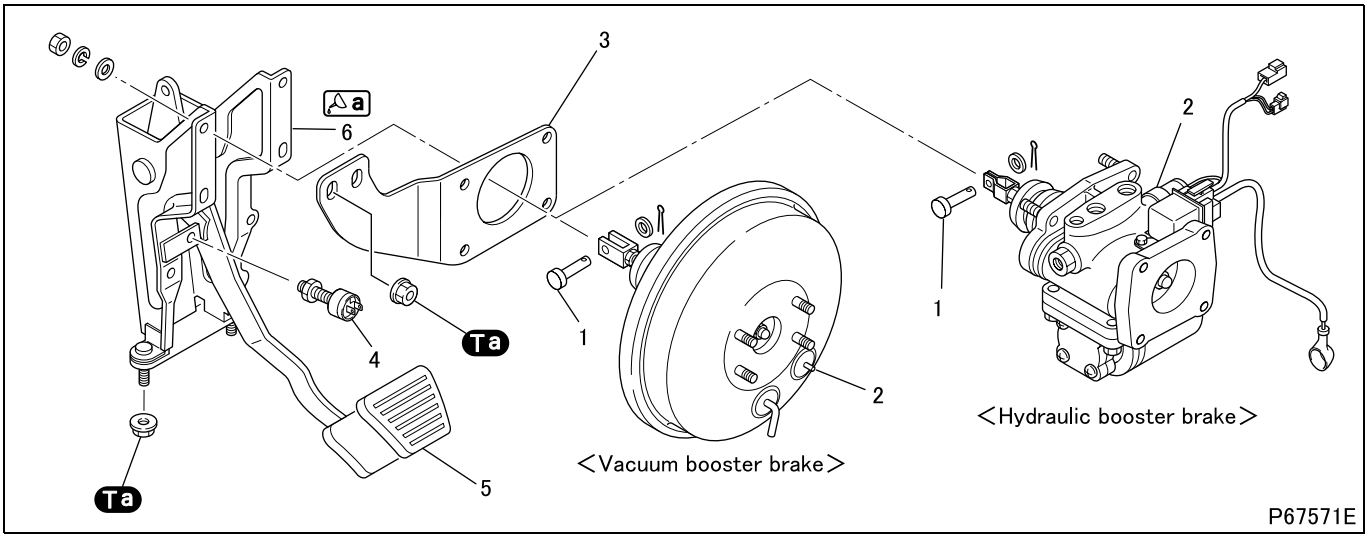
■ **Installation: Cap, secondary cup, cup spacer, primary cup, bushing, cup retainer, secondary cup and primary piston**

- With the end of the cylinder facing upward, insert each assembled part slowly.

CAUTION ⚠

- **To prevent the cup retainer from falling off, hold the cylinder with its end upward until the cap is screwed into the cylinder.**

- After screwing the cap into the cylinder, tighten it to the specified torque.
- Slowly insert the primary piston through the cap.



● Disassembly sequence

1 Clevis pin
2 Vacuum booster
<Vacuum booster brake>
Hydraulic booster (See later section.)
<Hydraulic booster brake>
3 Bracket <Vacuum booster brake>
4 Stop lamp switch
5 Pedal pad
6 Brake pedal & pedal support

CAUTION ⚠

- **Do not attempt to disassemble the vacuum booster.**

● Assembly sequence

Follow the disassembly sequence in reverse.

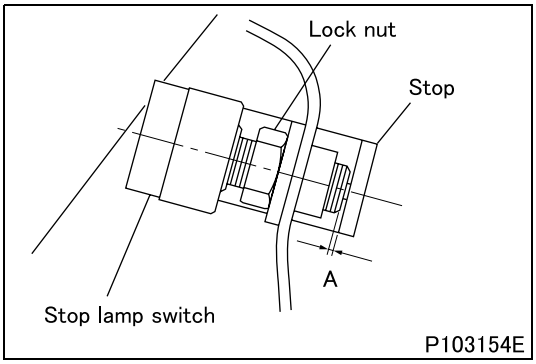
Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
Ta	Nut (bracket mounting)	9 to 14 {6.6 to 10}	–
	Nut (brake pedal & pedal support mounting)		

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Return spring of brake pedal & pedal support; Inner periphery of clevis pin hole	Chassis grease [NLGI No. 1 (Li soap)]	As required

◆Installation procedure◆



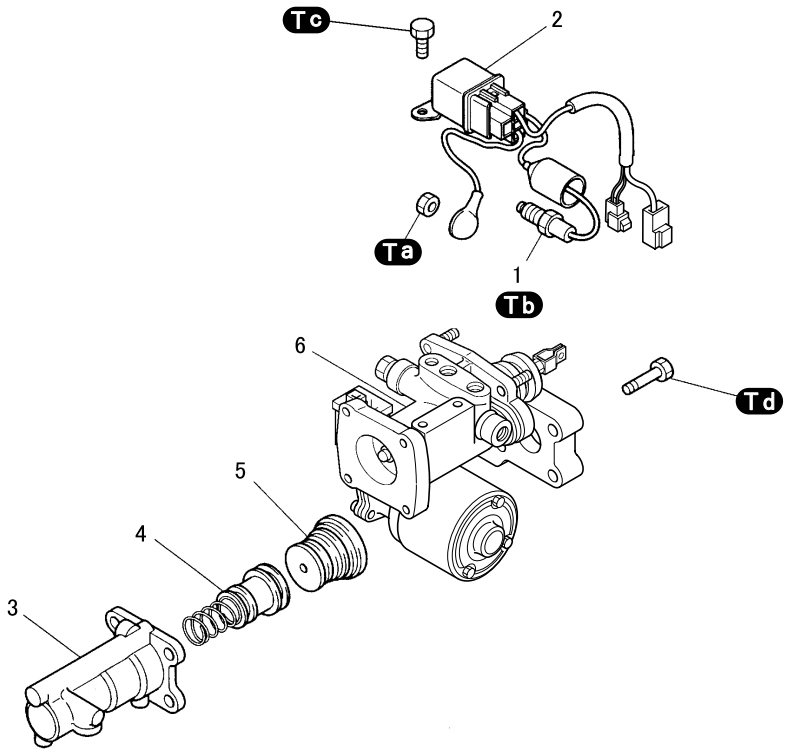
■ Installation: Stop lamp switch

- Set the distance A between the threaded end of the stop lamp switch and the stop for the brake pedal & pedal support to the illustrated value. Then, fix the assembly with the lock nut.
  A: 0.5 to 1.5 mm {0.020 to 0.059 in.} <Without auto cruise>
  1.5 ± 0.5 mm {0.059 ± 0.020 in.} <With auto cruise>

CAUTION ⚠

- **To prevent brake drag, ensure that the threaded end of the stop lamp switch does not interfere with the stop for the brake pedal.**

Hydraulic Booster



● Disassembly sequence

1 Flow switch
2 Motor relay
3 Pressure intensifying cylinder
4 Valve piston guide
5 Pressure intensifying piston
6 Hydraulic booster body

● Assembly sequence

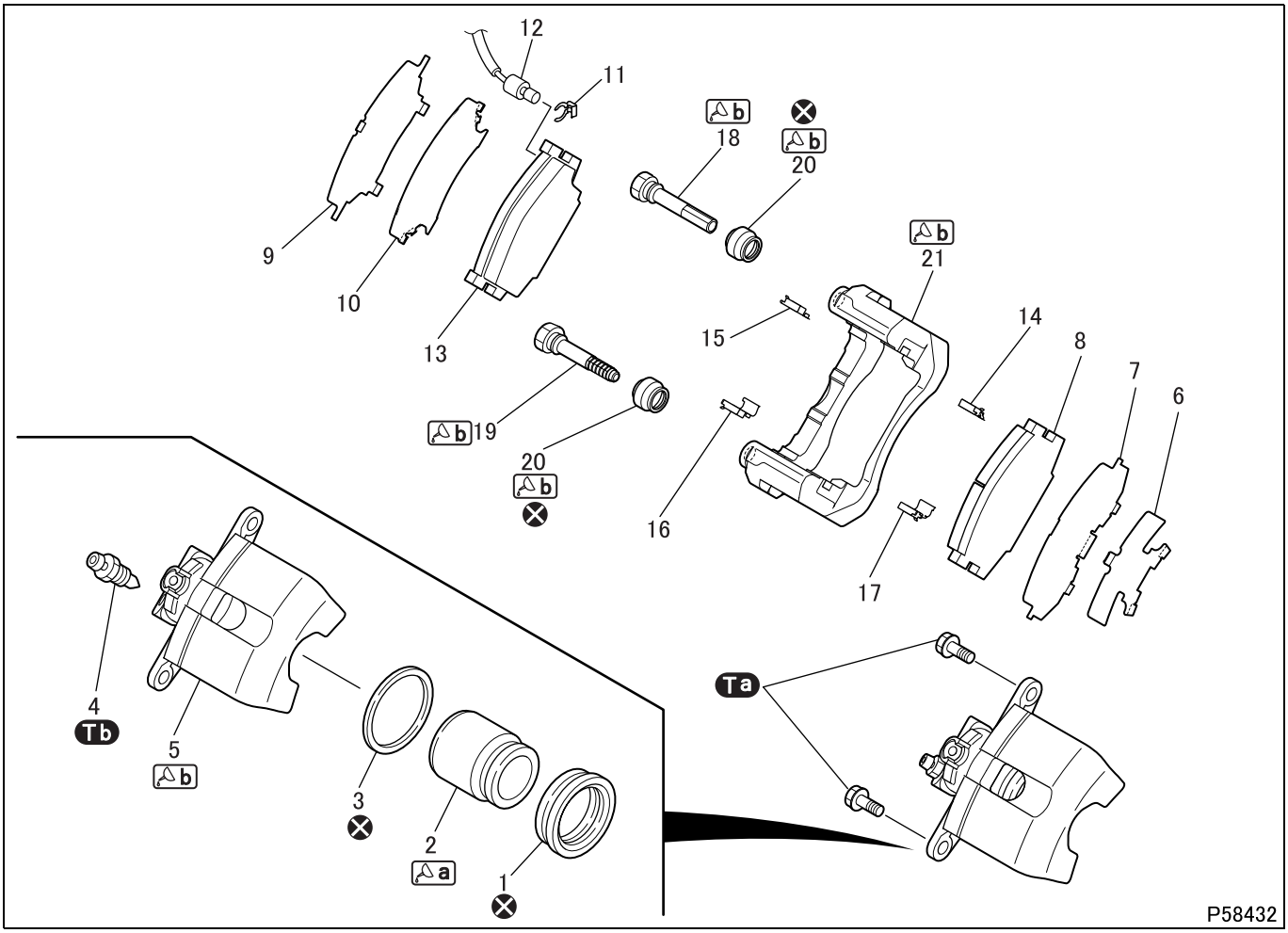
Follow the disassembly sequence in reverse.

Repair kit: Valve piston guide, Pressure intensifying piston

Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
Ta	Nut (motor relay earth mounting)	2.45 to 4.41 {1.8 to 3.3}	–
Tb	Flow switch	24.5 to 34.3 {18 to 25}	–
Tc	Bolt (motor relay mounting)	4.41 to 7.35 {3.3 to 5.4}	–
Td	Bolt (pressure intensifying cylinder mounting)	17.6 to 27.4 {13 to 20}	–

FRONT DISC BRAKE <ϕ235 mm {9.25 in} DISC>



● **Disassembly sequence**

1 Piston boots
2 Piston
3 Piston seal
4 Air bleeder (lower)
5 Caliper
6 Outer shim A
7 Outer shim B
8 Outer pad
9 Inner shim A
10 Inner shim B
11 Clip
12 Pad wear indicator
13 Inner pad
14 Pad liner A
15 Pad liner B
16 Pad liner C
17 Pad liner D
18 Main slide pin
19 Sub slide pin
20 Pin boots
21 Torque member

⊗: Non-reusable parts

NOTE

- **For removal and installation of the front disc brake, see Gr26.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- **Rubber parts that are disassembled must be replaced as a seal kit.**
- **Items included in a seal kit must be lubricated with grease supplied with the kit before installation.**
- **Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.**
- **Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
8, 13	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

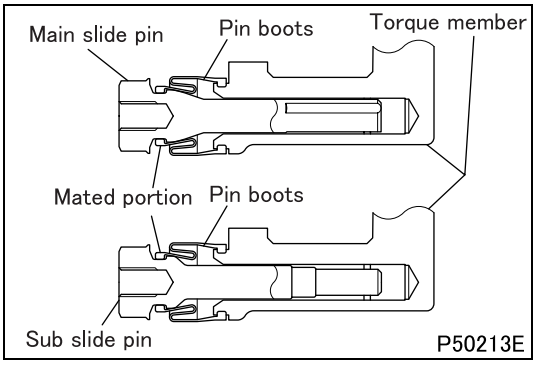
Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
Ta	Pin bolt	40 to 50 {30 to 37}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

Lubricant and/or sealant

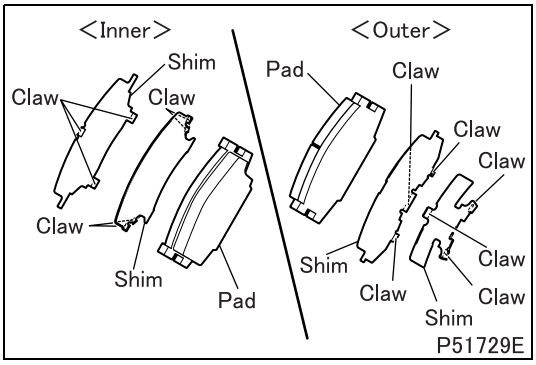
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

◆Installation procedure◆



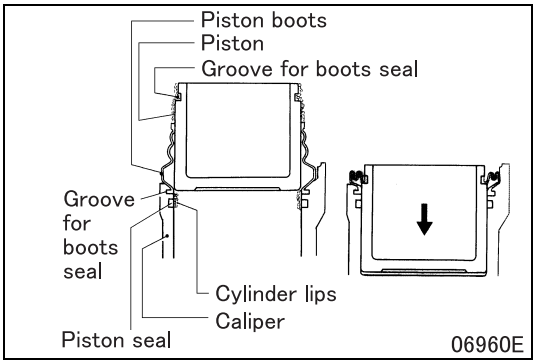
■ **Installation: Main slide pin, sub slide pin, pin boots, and torque member**

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.



■ **Installation: Shims**

- Position shims such that they face the illustrated directions before installing them onto the pads.

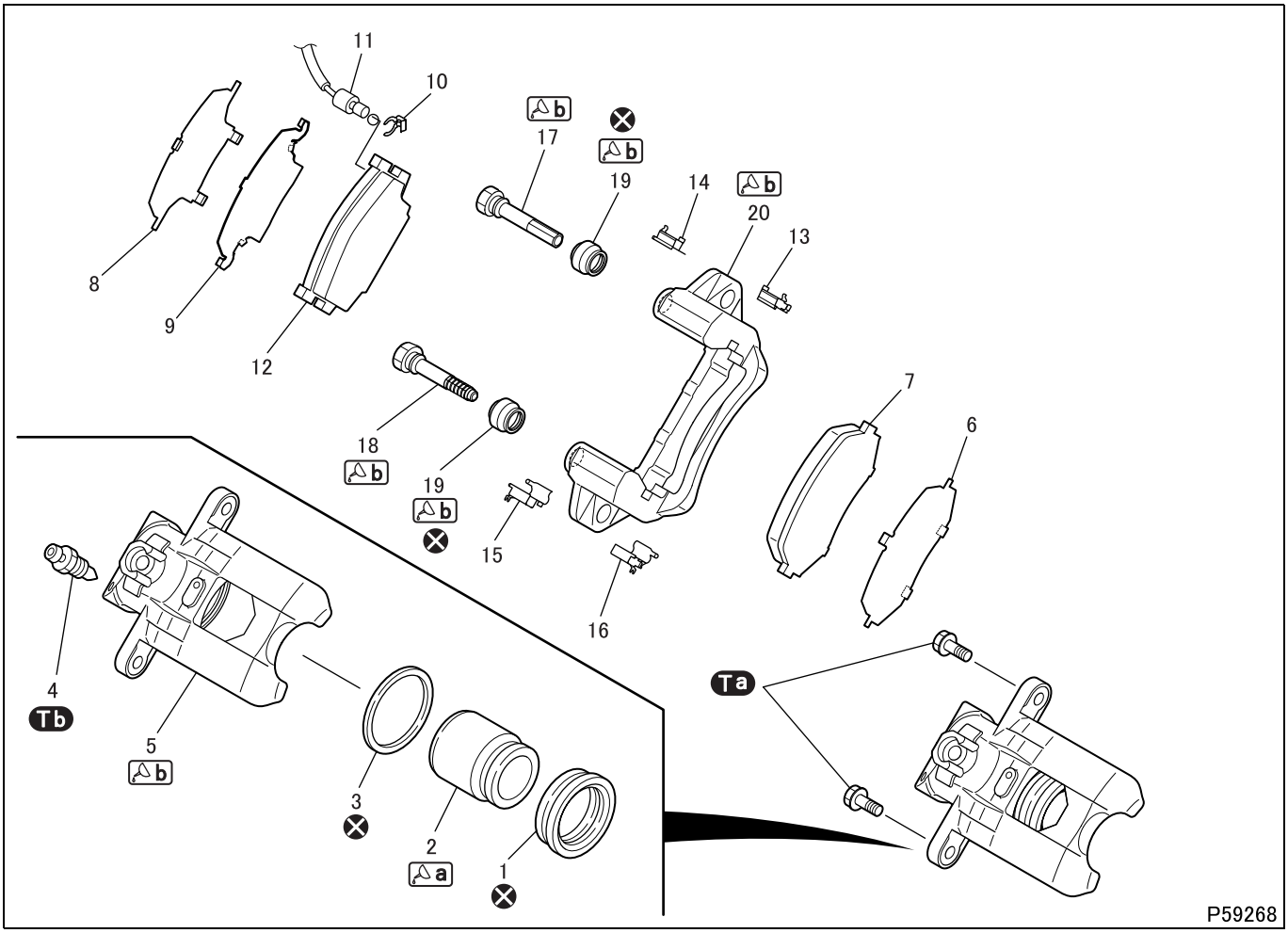


■ **Installation: Piston boots, piston, and piston seal**

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

M E M O

FRONT DISC BRAKE <ϕ252 mm {9.92 in} DISC>



● Disassembly sequence

1 Piston boots
2 Piston
3 Piston seal
4 Air bleeder (lower)
5 Caliper
6 Outer shim
7 Outer pad
8 Inner shim A
9 Inner shim B
10 Clip (upper R/H only)
11 Pad wear indicator (upper R/H only)
12 Inner pad
13 Pad liner A
14 Pad liner B
15 Pad liner C
16 Pad liner D
17 Main slide pin
18 Sub slide pin
19 Pin boots
20 Torque member

⊗: Non-reusable parts

NOTE

- **For removal and installation of the front disc brake, see Gr26.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- **Rubber parts that are disassembled must be replaced as a seal kit.**
- **Items included in a seal kit must be lubricated with grease supplied with the kit before installation.**
- **Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.**
- **Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
7, 10	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

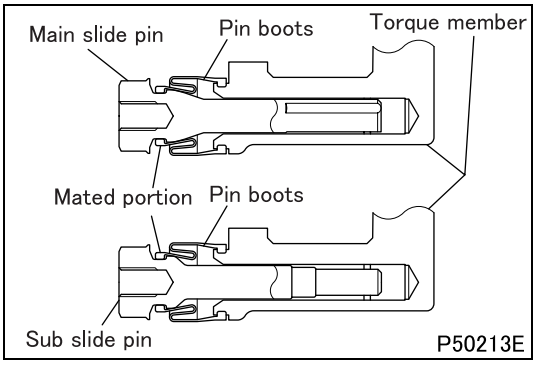
Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
Ta	Pin bolt	40 to 50 {30 to 37}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

Lubricant and/or sealant

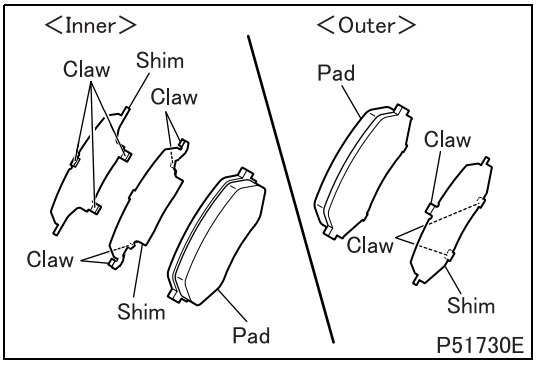
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

◆Installation procedure◆



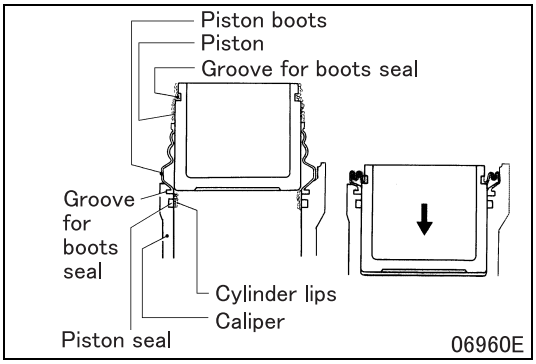
■ Installation: Main slide pin, sub slide pin, pin boots, and torque member

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.



■ Installation: Shims

- Position shims such that they face the illustrated directions before installing them onto the pads.

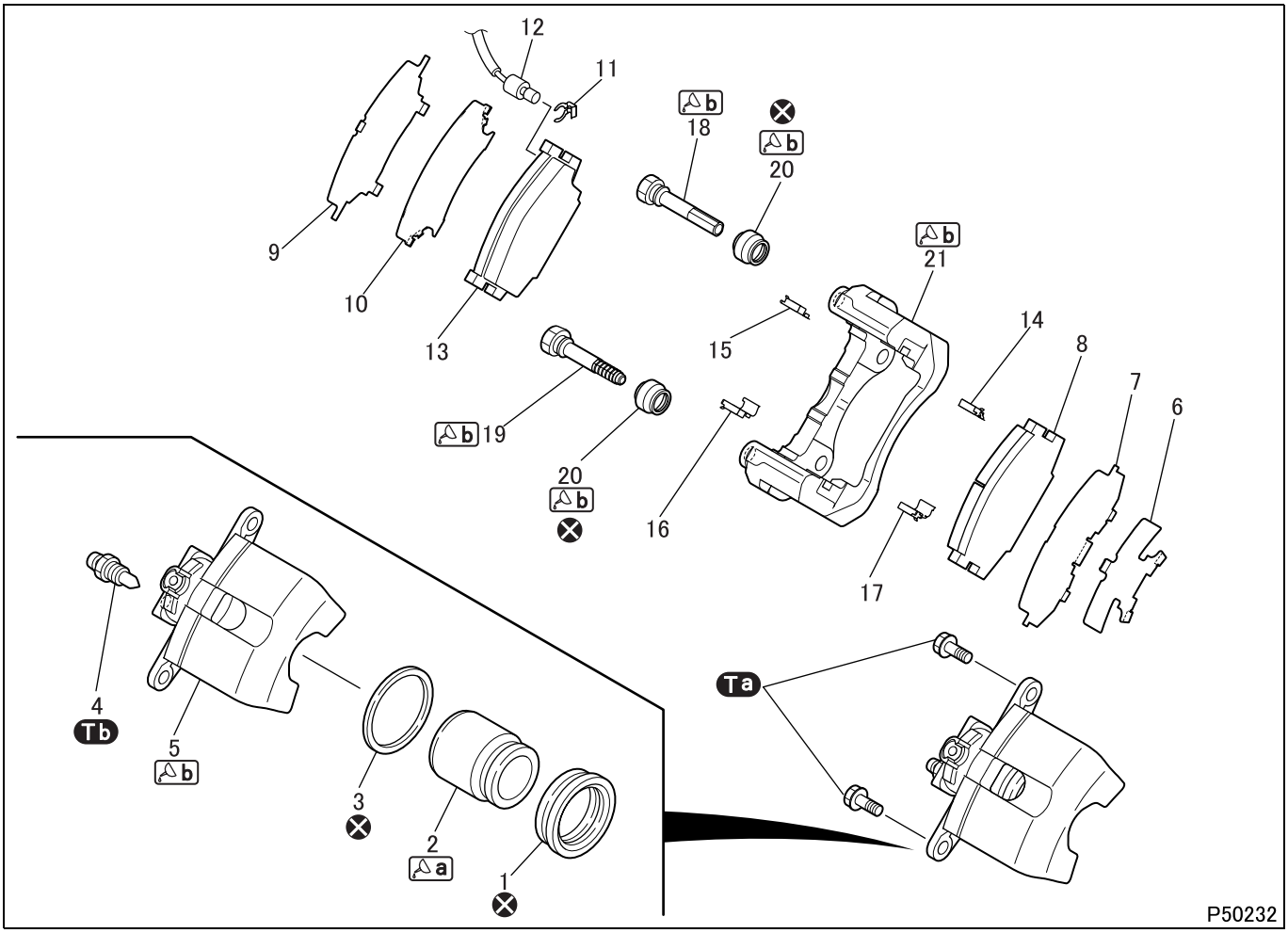


■ **Installation: Piston boots, piston, and piston seal**

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

M E M O

REAR DISC BRAKE <ϕ235 mm {9.25 in} DISC>



● **Disassembly sequence**

1 Piston boots
2 Piston
3 Piston seal
4 Air bleeder (front)
5 Caliper
6 Outer shim A
7 Outer shim B
8 Outer pad
9 Inner shim A
10 Inner shim B
11 Clip (rear)
12 Pad wear indicator (rear)
13 Inner pad
14 Pad liner A
15 Pad liner B
16 Pad liner C
17 Pad liner D
18 Main slide pin
19 Sub slide pin
20 Pin boots
21 Torque member

⊗: Non-reusable parts

NOTE

- **For removal and installation of the rear disc brake, see Gr27.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- **Rubber parts that are disassembled must be replaced as a seal kit.**
- **Items included in a seal kit must be lubricated with grease supplied with the kit before installation.**
- **Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.**
- **Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
8, 13	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

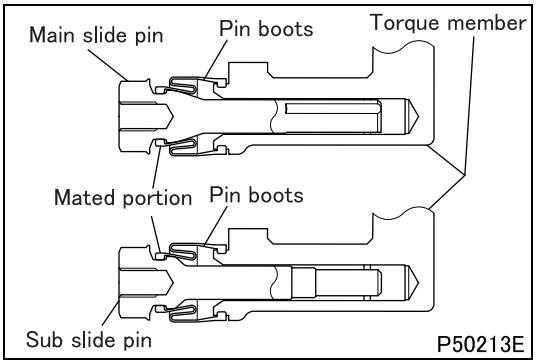
Torque: N·m {lbf·ft}

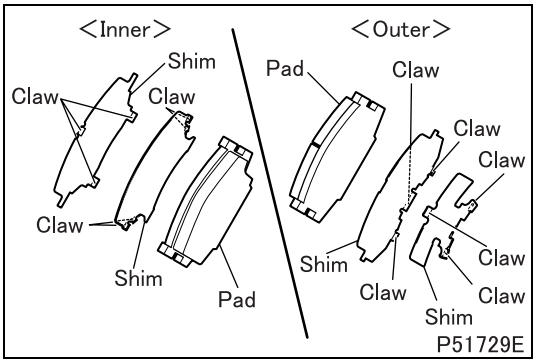
Mark	Component	Torque value	Remarks
Ta	Pin bolt	40 to 50 {30 to 37}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

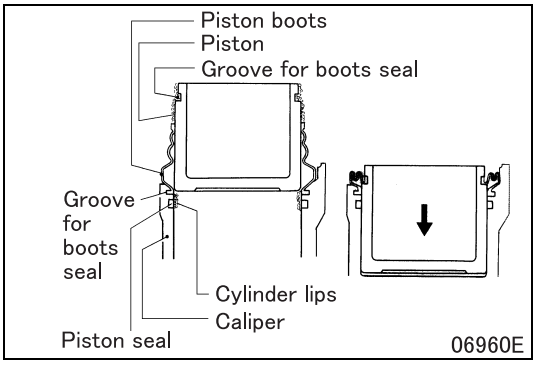
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

◆Installation procedure◆







■ Installation: Main slide pin, sub slide pin, pin boots, and torque member

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.

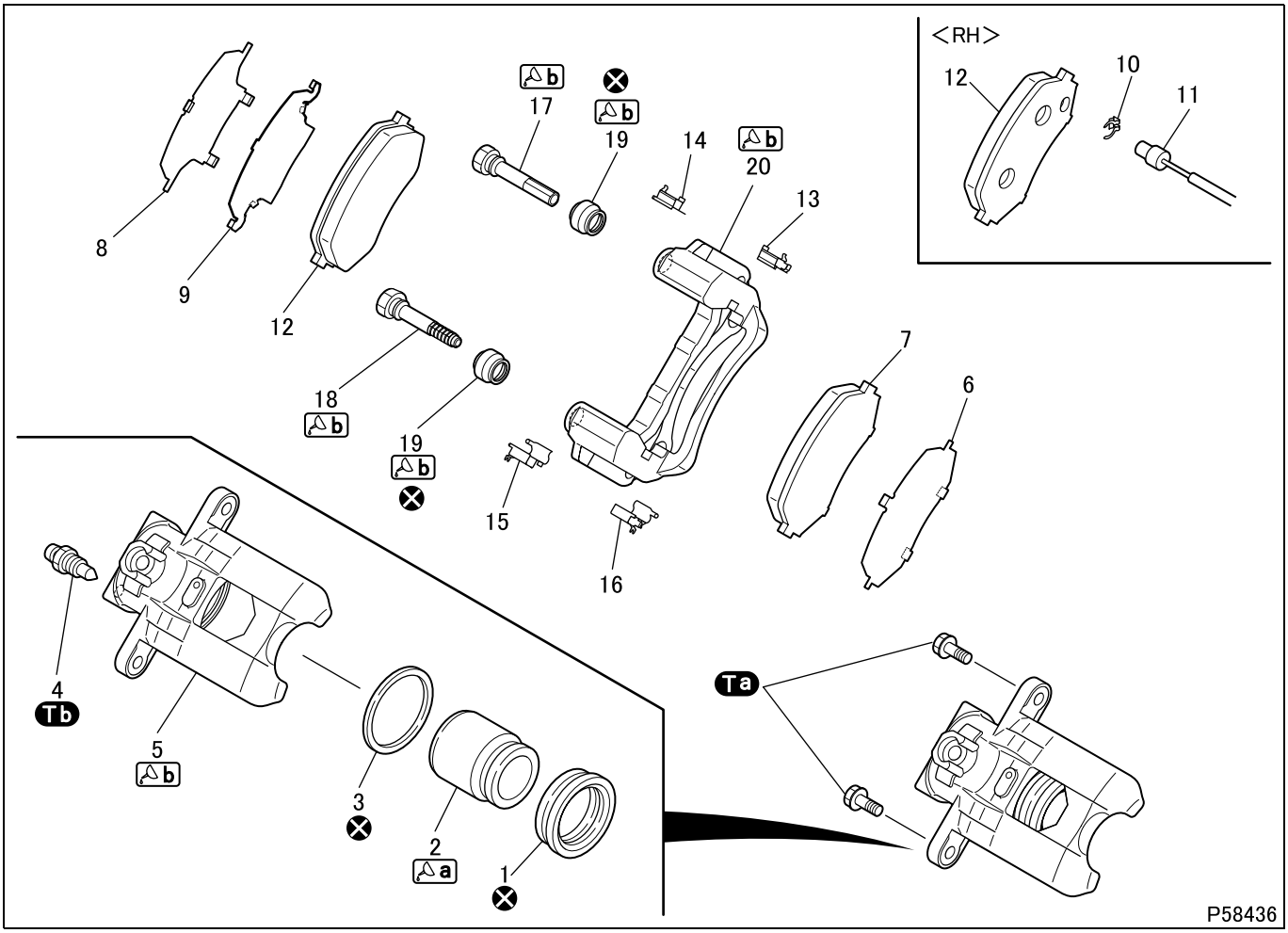
■ Installation: Shims

- Position shims such that they face the illustrated directions before installing them onto the pads.

■ Installation: Piston boots, piston, and piston seal

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

REAR DISC BRAKE <ϕ252 mm {9.92 in} DISC>



● **Disassembly sequence**

1 Piston boots
2 Piston
3 Piston seal
4 Air bleeder (front)
5 Caliper
6 Outer shim
7 Outer pad
8 Inner shim A
9 Inner shim B
10 Clip (rear R/H only)
11 Pad wear indicator (rear R/H only)
12 Inner pad
13 Pad liner A
14 Pad liner B
15 Pad liner C
16 Pad liner D
17 Main slide pin
18 Sub slide pin
19 Pin boots
20 Torque member

⊗: Non-reusable parts

NOTE

- **For removal and installation of the rear disc brake, see Gr27.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- **Rubber parts that are disassembled must be replaced as a seal kit.**
- **Items included in a seal kit must be lubricated with grease supplied with the kit before installation.**
- **Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.**
- **Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
7, 12	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

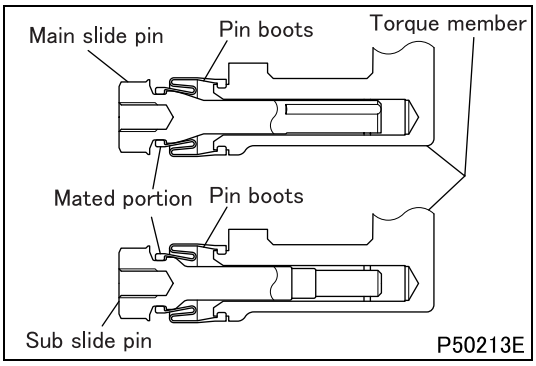
Torque: N·m {lbf·ft}

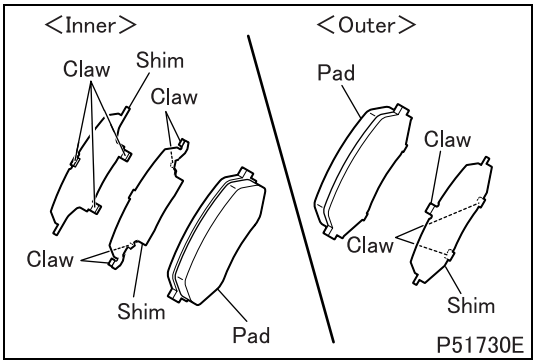
Mark	Component	Torque value	Remarks
Ta	Pin bolt	40 to 50 {30 to 37}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

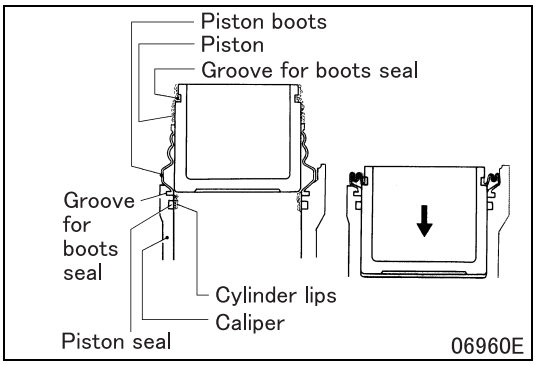
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

◆Installation procedure◆







■ Installation: Main slide pin, sub slide pin, pin boots, and torque member

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.

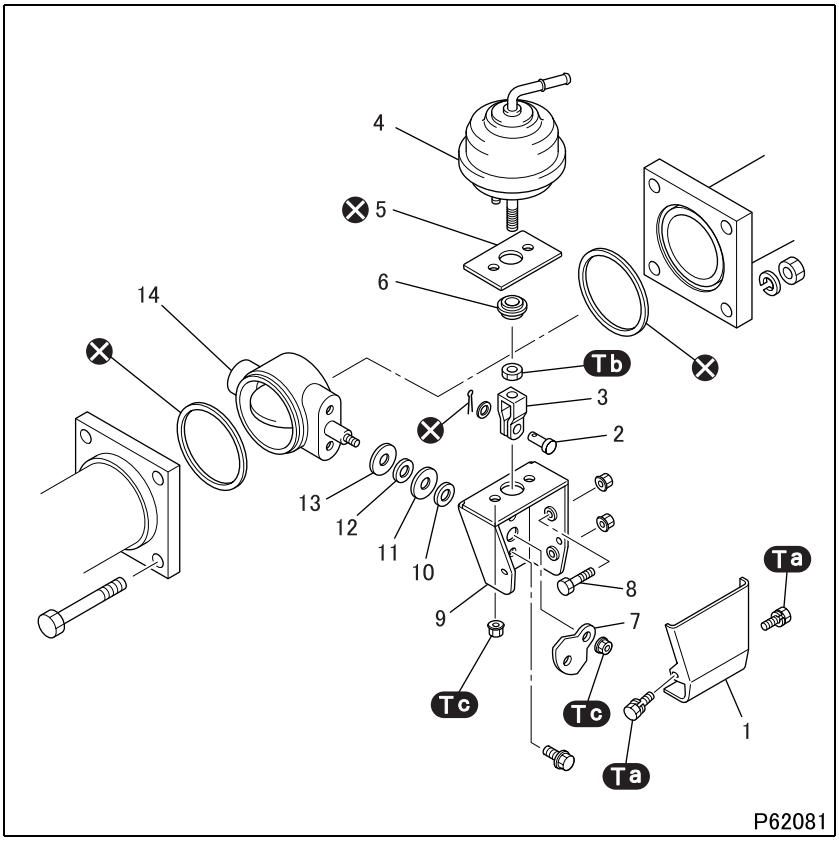
■ Installation: Shims

- Position shims such that they face the illustrated directions before installing them onto the pads.

■ Installation: Piston boots, piston, and piston seal

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

Exhaust Brake Unit



● Disassembly sequence

1 Cover
2 Clevis pin
3 Clevis
4 Power chamber
5 Gasket
6 Bearing
7 Lever
8 Adjust bolt
9 Bracket
10 Seal ring A
11 Seal ring B
12 Seal ring A
13 Seal ring B
14 Valve

⊗: Non-reusable parts

CAUTION ⚠

- **Do not attempt to disassemble the power chamber.**

NOTE

- **For removal and installation procedures of the exhaust brake unit, see Gr15.**

● Assembly sequence

Follow the disassembly sequence in reverse.

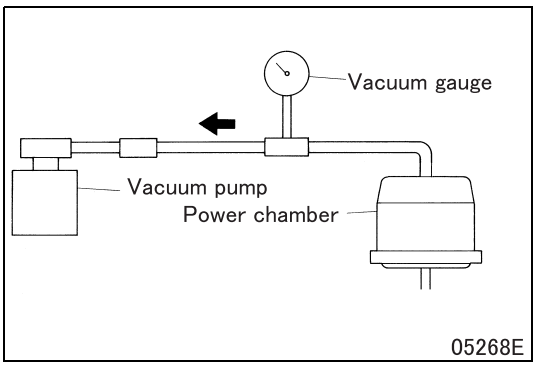
Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
–	Average of top and bottom clearances between butterfly valve and body with valve fully closed (with power chamber vacuum of 87 to 93 kPa {25.7 to 27.5 inHg} or above)	0.10 to 0.25 {0.0039 to 0.0098}	–	Adjust
4	Air-tightness of power chamber (at 15 sec. after vacuum of 67 kPa {19.8 inHg} is achieved in chamber)	63 kPa {18.6 inHg} or above	–	Replace

Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
Ta	Bolt (cover mounting)	4.9 to 6.9 {3.6 to 5.1}	–
Tb	Lock nut (clevis retention)	9.8 to 16 {7.2 to 12}	–
Tc	Nut (power chamber mounting)	11 to 17 {8.0 to 12}	–
	Nut (lever mounting)		

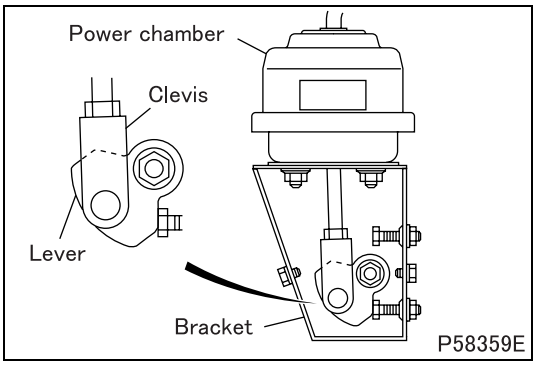
◆Inspection procedure◆



■ **Inspection: Power chamber air-tightness**

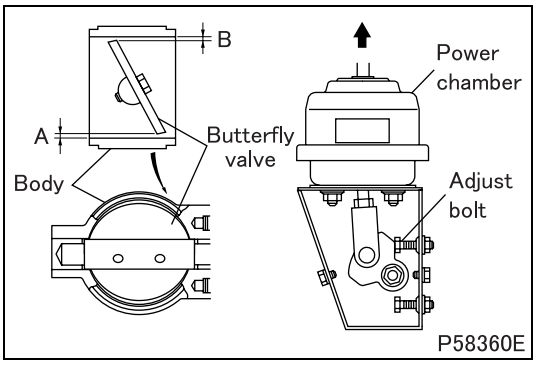
- Connect the components with piping as illustrated. When a vacuum of 67 kPa {19.8 inHg} or above is applied to the power chamber, stop the vacuum pump.
- Fifteen seconds later, the reading on the vacuum gauge should conform to the standard value.
- If not, replace the power chamber.

◆Adjustment after installation◆



■ **Adjustment: Clevis**

- Assemble the power chamber onto the bracket. Then, adjust the location of the clevis such that the hole in the clevis is aligned by half with the hole in the lever.

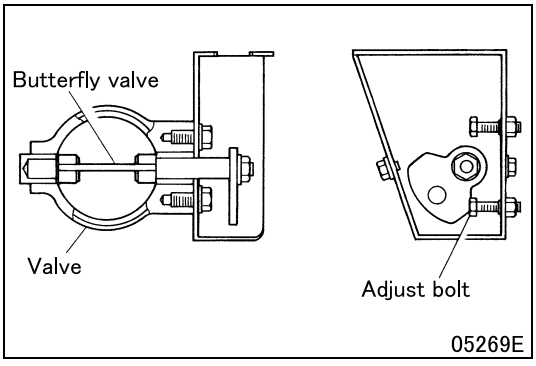


■ **Adjustment: Butterfly valve**

(1) Butterfly valve fully-closed position

- Apply a vacuum of 87 to 93 kPa {25.7 to 27.5 inHg} to the power chamber to fully close the butterfly valve. With the valve fully closed, measure the top and bottom clearances **B** and **A** between the valve and the body, and obtain the average of the two. The average value should conform to the standard value. Adjust with the adjust bolt as required.

$$\text{Average clearance} = \frac{(\mathbf{A} + \mathbf{B})}{2}$$



(2) Valve fully-open position

- Adjust the butterfly valve to the full open position using the adjust bolt.

GROUP 35E INDEX

SPECIFICATIONS 35E-2

STRUCTURE AND OPERATION
1. **Overview 35E-4**
2. **Electronic Control System 35E-14**
3. **Electronic Control Unit Schematic Diagram 35E-17**

TROUBLESHOOTING
1. **Diagnosis Procedure 35E-18**
2. **Diagnostic Precautions 35E-19**
3. **Diagnosis Based on Diagnosis Codes 35E-20**
4. **Multi-Use Tester Service Data 35E-26**
5. **Actuator Test Using Multi-Use Tester 35E-28**
6. **Inspection at Hydraulic Unit (Electronic Control Unit) Connector 35E-29**

ON-VEHICLE INSPECTION AND ADJUSTMENT
1. **Functional Check 35E-32**
2. **Inspection of Hydraulic Unit (Electronic Control Unit) Operation 35E-33**
3. **Inspection after Replacing or Removing/Installing Hydraulic Unit (Electronic Control Unit) 35E-34**
4. **Oscilloscopic Inspection through Wheel Speed Sensor Signal Waveform 35E-35**

HYDRAULIC UNIT CONNECTOR COUPLING AND UNCOUPLING 35E-36

INSPECTION OF ELECTRICAL COMPONENTS 35E-38

COMPONENT LOCATIONS 35E-40

ELECTRICAL WIRING DIAGRAM 35E-42

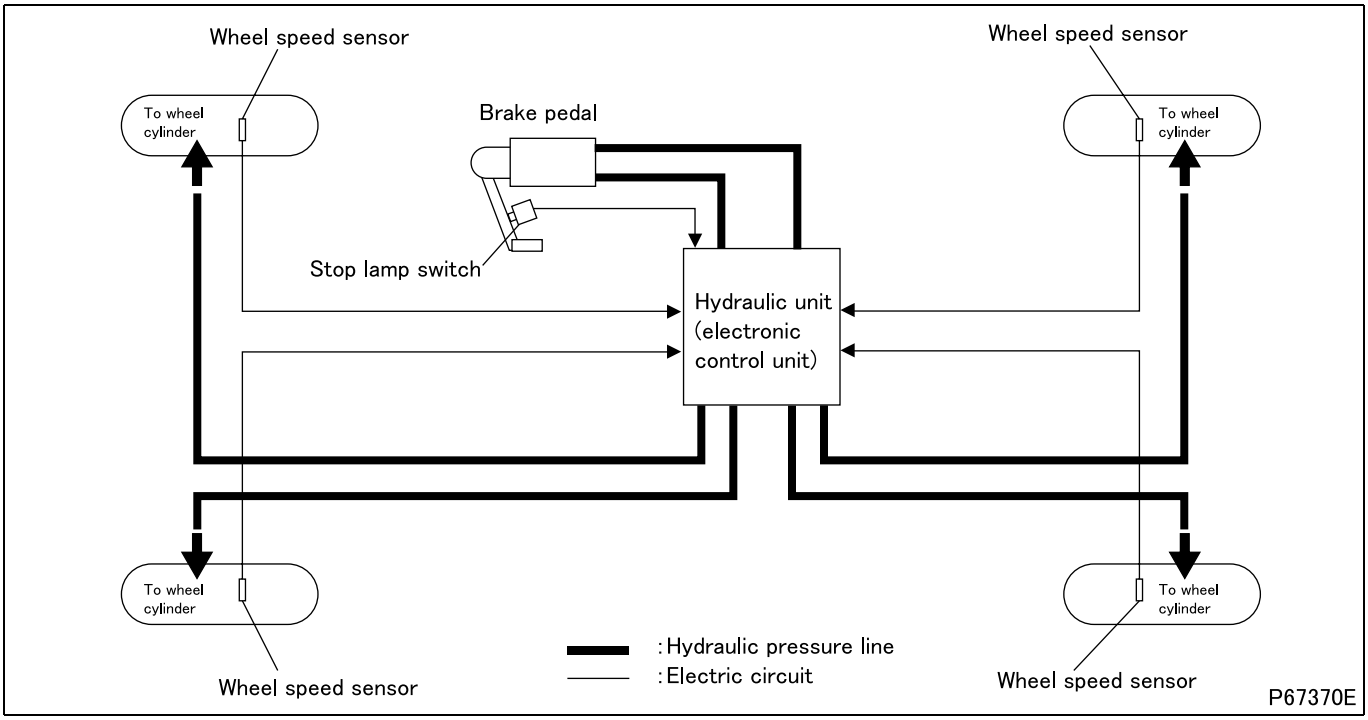
SPECIFICATIONS

Item		Specifications
Hydraulic unit (electronic control unit)	Manufacturer	ADVICS
	Rated voltage V	DC12
	Working voltage range V	DC10 to 18
*Wheel speed sensor	Manufacturer	SUMITOMO ELECTRIC Bosch

*Manufacturers of wheel speed sensor differ depending on the model of the brakes.

M E M O

1. Overview

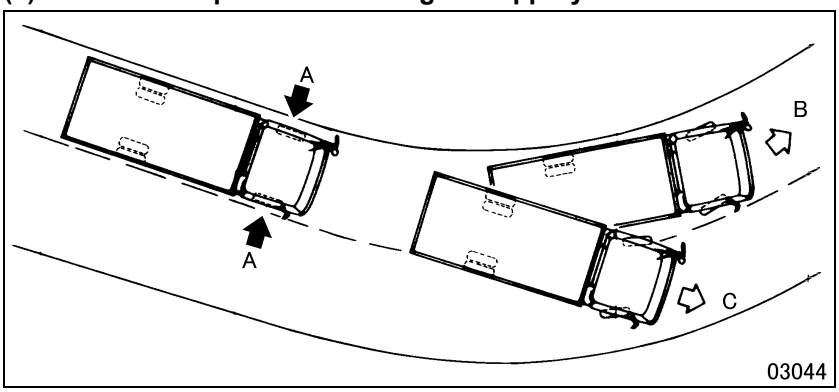


- The antilock brake system (ABS) prevents wheel lock-up and resultant skid when braking hard or on slippery roads, thus maintain vehicle stability and steerability.

1.1 Outline of antilock brake system

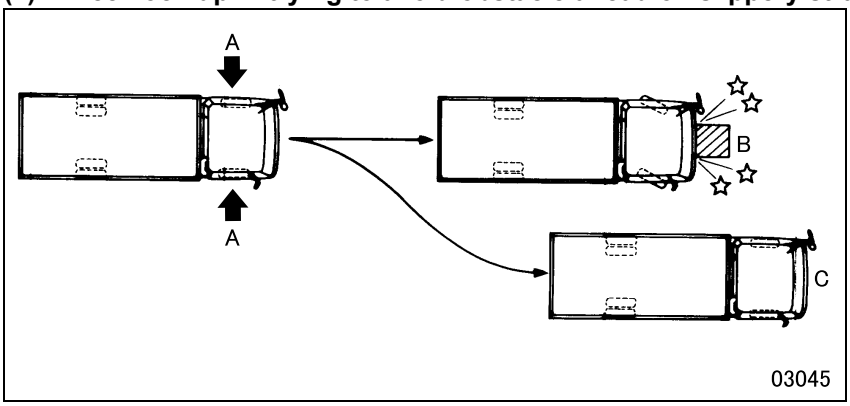
- Wheels will roll along on the road in the direction of their rotation. Therefore, the driver can steer the vehicle as he/she wishes by maneuvering the steering wheel.
  However, on vehicles not equipped with ABS, applying the brakes hard can cause wheel lock-up. Once tires are locked up, they are simply a piece of rubber in contact with the road surface and steering control will be lost. The vehicle will skid in the direction of inertia irrespective of the steering angle.
  In other words, vehicle stability and steerability are lost and the vehicle is beyond the driver's control.
- On vehicles equipped with antilock brake system, the system prevents wheel lock-up by reducing the braking power to the wheel that is about to lock up and, thereby, maintain vehicle stability and steerability.

(1) Wheel lock-up when cornering on slippery road



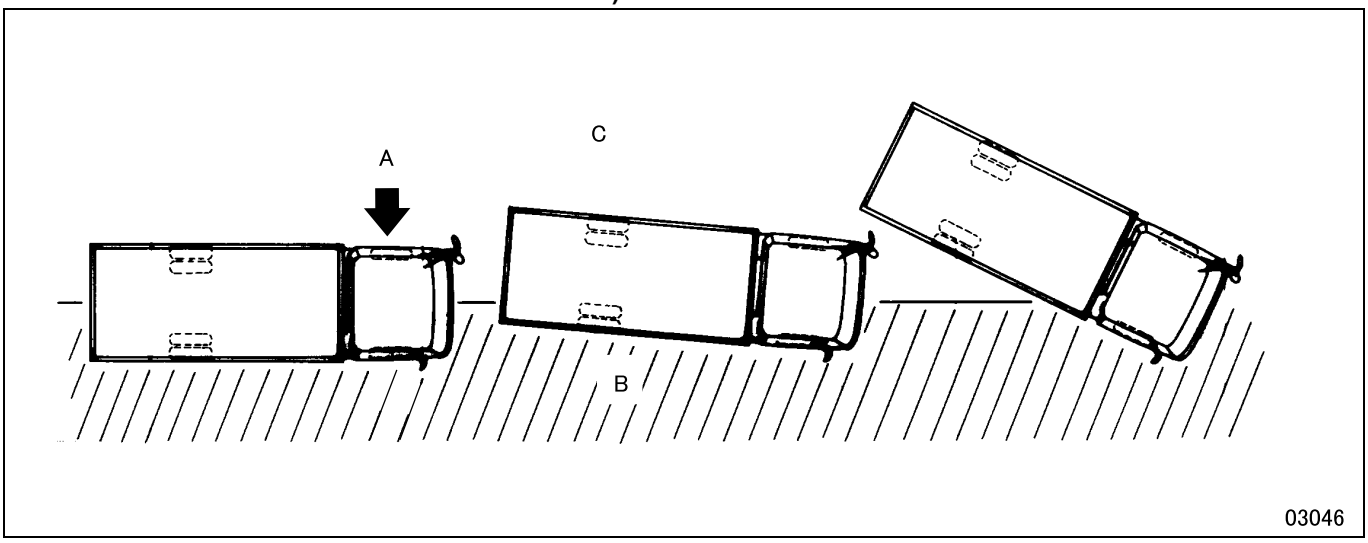
- If wheel lock-up occurs during braking on a slippery curve, steering control will be lost. If this happens, the vehicle may deviate, while skidding, from the intended course no matter how the driver maneuvers the steering wheel.
  - **A:** Application of brakes (wheel lock-up)
  - **B:** Intended course
  - **C:** Go out of course

(2) Wheel lock-up in trying to avoid obstacle ahead on slippery straight road



- If wheel lock-up occurs during hard braking on a slippery straight road in trying to avoid an obstacle ahead, steering control will be lost. If this happens, the vehicle will not be able to avoid the obstacle no matter how the driver maneuvers the steering wheel.
  A: Application of brakes (wheel lock-up)
  B: Obstacle
  C: Intended course

(3) Split μ (Wheel lock-up on asymmetrical road surface, with higher friction of coefficient on one side and lower friction of coefficient on the other side)



- If the front and rear wheels on one side of the vehicle are on the side of the road that has a lower friction of coefficient and therefore is more slippery than the other side of the road, these wheels are more likely to lock up and slip than the wheels on the other side of the vehicle. When the brakes are applied under such conditions, the braking efficiency will be different between the right and left sides of the vehicle and the vehicle will lose stability. Braking hard under such conditions can even cause the vehicle to spin.
  A: Application of brakes (wheel lock-up)
  B: Less slippery road surface
  C: More slippery road surface

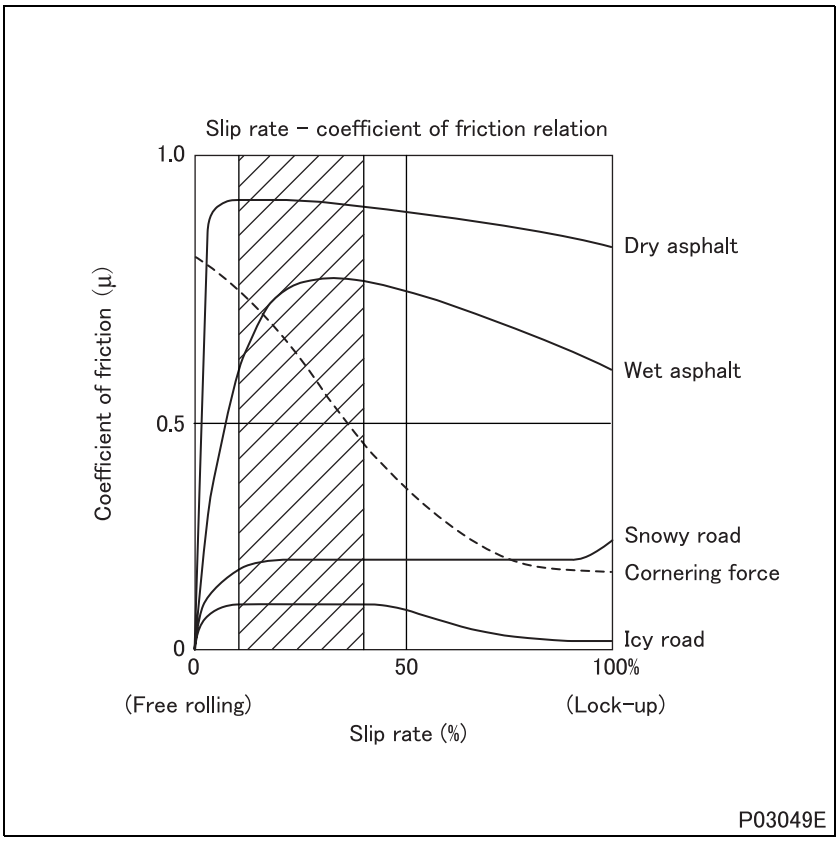
- As mentioned above, the system prevents wheel lock-up by providing controlled braking force to each wheel. This prevents wheel slip and skid and ensures steering control and vehicle stability even during hard braking.

1.2 Antilock brake system control process

- Antilock brake system ensures controlled yet optimum braking in a given road surface condition by placing the braking force within a certain range of slip rate determined by the wheel speed - vehicle speed relation.
- Stepping on the brake pedal causes the wheel speed to slow down and, as a result, the vehicle also slows down. However, the vehicle will still try to move on due to the inertia that has built up. This causes a difference between the wheel speed and the vehicle speed, or, in other words, slip. The amount of slip can be expressed as slip rate, as follows.

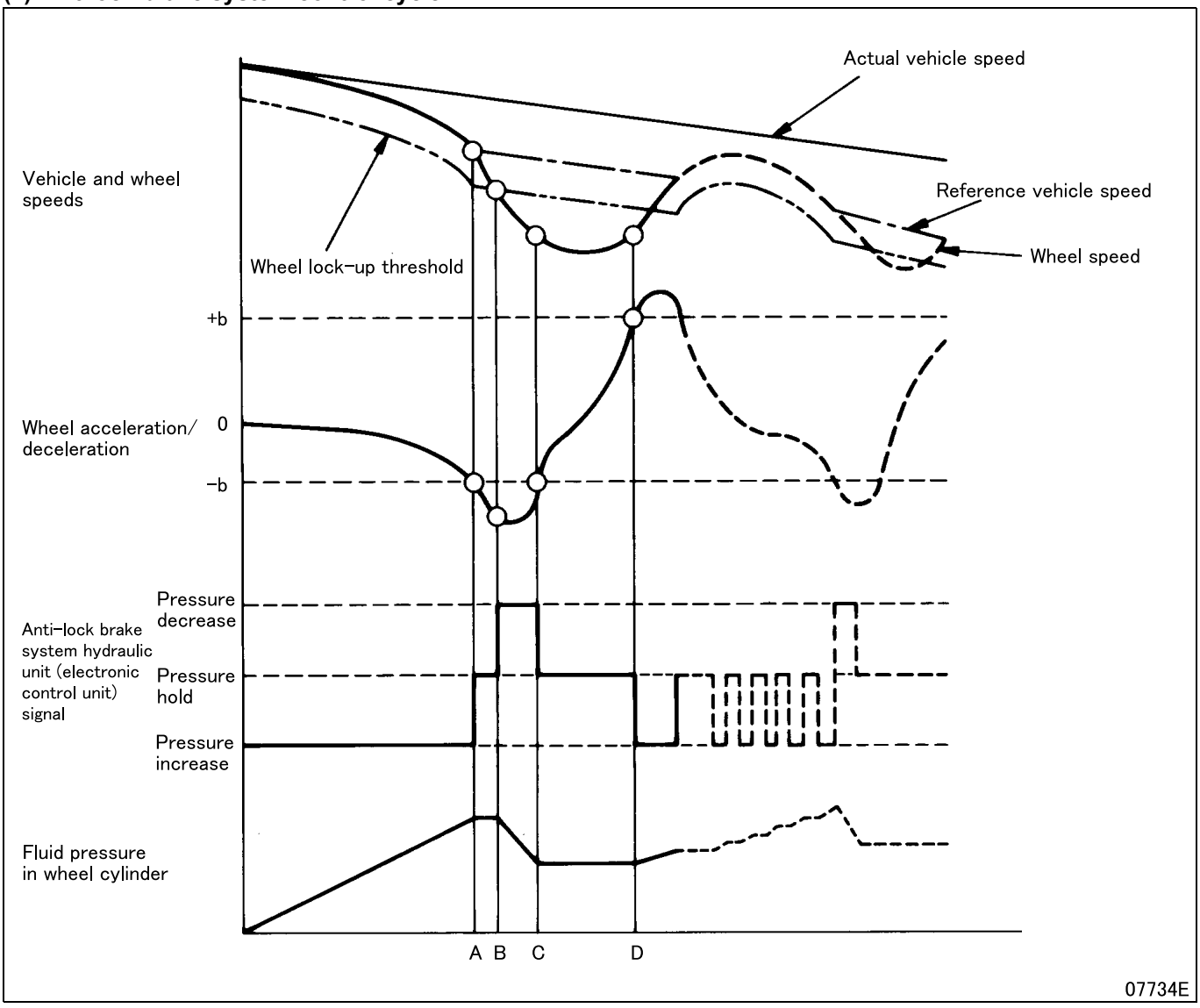
$$\text{Slip rate (\%)} = \frac{\text{Vehicle speed} - \text{Wheel speed}}{\text{Vehicle speed}} \times 100$$

- A slip ratio of 0% means that there is no slip between the wheel and the road surface. A slip rate of 100% means that the wheel is locked up.



- The graph shows the variation in the tire's coefficient of friction from free rolling to lock-up. As the brake pedal is slowly pressed, the tires continue to rotate but start slipping.
- As the stepping force on the brake pedal increases, the tires will stop rotating and the vehicle will just skid. This is wheel lock-up.
- As the graph shows, the coefficient of friction peaks within the hatched area.
- In other words, the maximum coefficient of friction can be achieved, not by stepping on the brake pedal with full force, but by doing so moderately to try to place the slip rate within the hatched area.
- On vehicles equipped with antilock brake system, the hydraulic control unit (electronic control unit) controls the braking force so that it falls within the hatched area. This will ensure that the tires do not lock up but have the maximum coefficient of friction, thus achieving efficient braking performance.

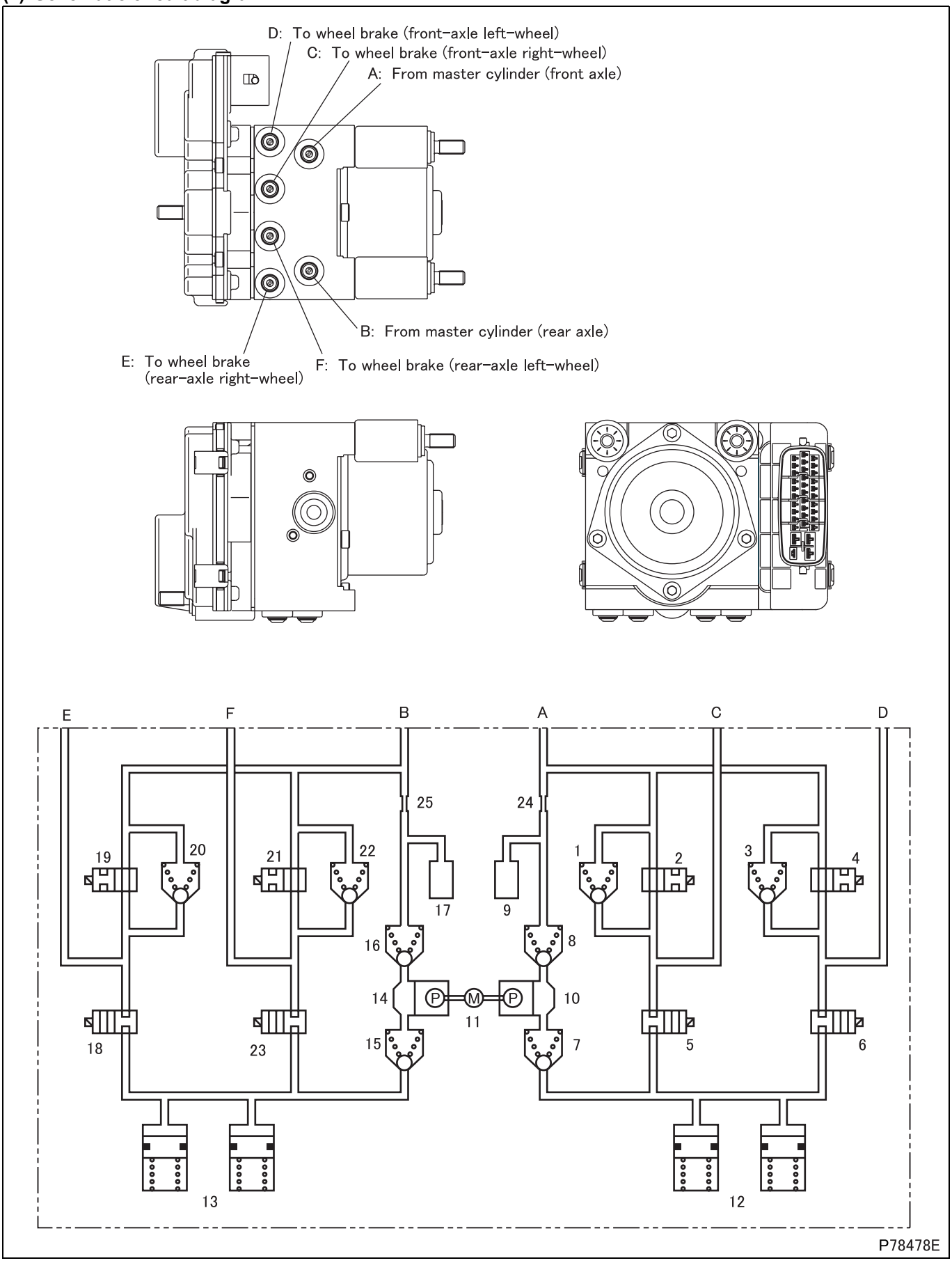
(1) Antilock brake system control cycle



- The above chart shows the typical control cycle of antilock brake system following the application of brakes, detailing in time series the variation in wheel speed, wheel speed acceleration/deceleration and fluid pressure in the wheel cylinder.
- When the wheel speed acceleration/deceleration drops to the “–b” threshold at A, the hydraulic unit (electronic control unit) sends “pressure hold” signal to maintain the fluid pressure in the wheel cylinder.
  At the same time, the hydraulic unit (electronic control unit) calculates the reference vehicle speed.
- When the vehicle decelerates to the wheel lock-up threshold at B, the hydraulic unit (electronic control unit) interprets this as imminent wheel lock-up and sends “pressure decrease” signal to reduce the fluid pressure in the wheel cylinder.
- When the wheel speed picks up and exceeds the “–b” threshold at C, the hydraulic unit (electronic control unit) sends “pressure hold” signal to maintain the fluid pressure in the wheel cylinder at the current level.
- When the wheel speed exceeds the “+b” threshold at D, the hydraulic unit (electronic control unit) determines that the imminent wheel lock-up has gone and sends “pressure increase” signal to increase the fluid pressure in the wheel cylinder.
- The pressure hold-decrease-increase cycle is repeated to keep the slip rate at optimum levels to prevent wheel lock-up.

1.3 Hydraulic unit (electronic control unit)

(1) Schematic circuit diagram



1 Check valve (front-axle right-wheel)
2 Solenoid valve (front-axle right-wheel HOLD)
3 Check valve (front-axle left-wheel)
4 Solenoid valve (front-axle left-wheel HOLD)
5 Solenoid valve (front-axle right-wheel DECREASE)
6 Solenoid valve (front-axle left-wheel DECREASE)
7 Inlet valve (front axle)
8 Outlet valve (front axle)
9 Damper (front axle)
10 Plunger pump (front axle)
11 Motor
12 Reservoir (front axle)
13 Reservoir (rear axle)
14 Plunger pump (rear axle)
15 Inlet valve (rear axle)
16 Outlet valve (rear axle)
17 Damper (rear axle)
18 Solenoid valve (rear-axle right-wheel DECREASE)
19 Solenoid valve (rear-axle left-wheel HOLD)
20 Check valve (rear-axle right-wheel)
21 Solenoid valve (rear-axle left-wheel HOLD)
22 Check valve (rear-axle left-wheel)
23 Solenoid valve (rear-axle left-wheel DECREASE)
24 Orifice (front axle)
25 Orifice (rear axle)

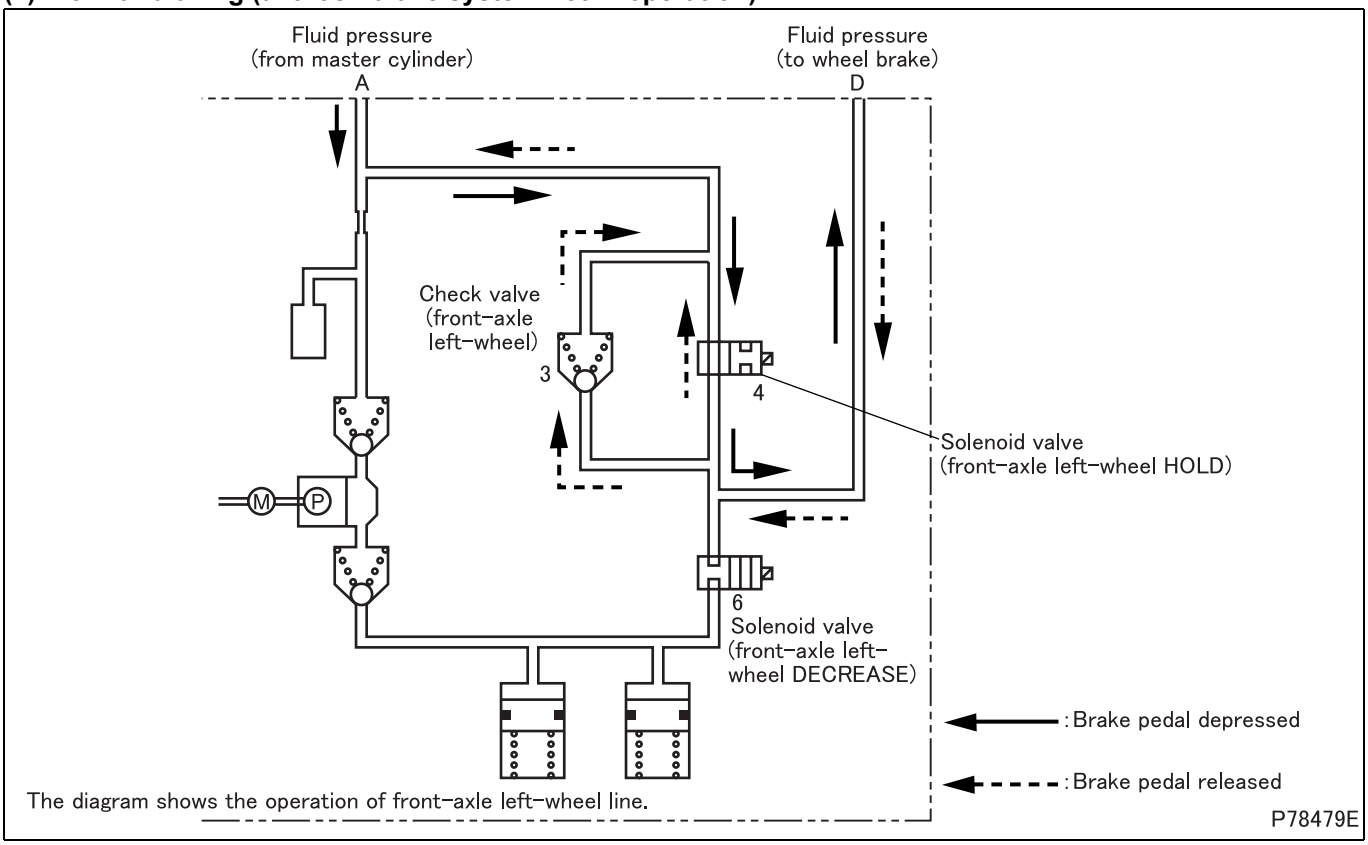
A: From master cylinder (front axle)
B: From master cylinder (rear axle)
C: To wheel brake (front-axle right-wheel)
D: To wheel brake (front-axle left-wheel)
E: To wheel brake (rear-axle right-wheel)
F: To wheel brake (rear-axle left-wheel)

- The hydraulic unit (electronic control unit) is the heart of antilock brake system control, energizing/de-energizing the solenoid valves and turning ON/OFF the motor. The table below shows how each solenoid valve and the motor are controlled in each phase.

		Antilock brake system control											
		Front-axle right-wheel			Front-axle left-wheel			Rear-axle right-wheel			Rear-axle left-wheel		
		DECREASE	HOLD	INCREASE	DECREASE	HOLD	INCREASE	DECREASE	HOLD	INCREASE	DECREASE	HOLD	INCREASE
Solenoid valve	Front-axle right-wheel DECREASE	O	×	×	–	–	–	–	–	–	–	–	–
	Front-axle right-wheel HOLD	O	O	×	–	–	–	–	–	–	–	–	–
	Front-axle left-wheel DECREASE	–	–	–	O	×	×	–	–	–	–	–	–
	Front-axle left-wheel HOLD	–	–	–	O	O	×	–	–	–	–	–	–
	Rear-axle right-wheel DECREASE	–	–	–	–	–	–	O	×	×	–	–	–
	Rear-axle right-wheel HOLD	–	–	–	–	–	–	O	O	×	–	–	–
	Rear-axle left-wheel DECREASE	–	–	–	–	–	–	–	–	–	O	×	×
	Rear-axle left-wheel HOLD	–	–	–	–	–	–	–	–	–	O	O	×
Motor		O											

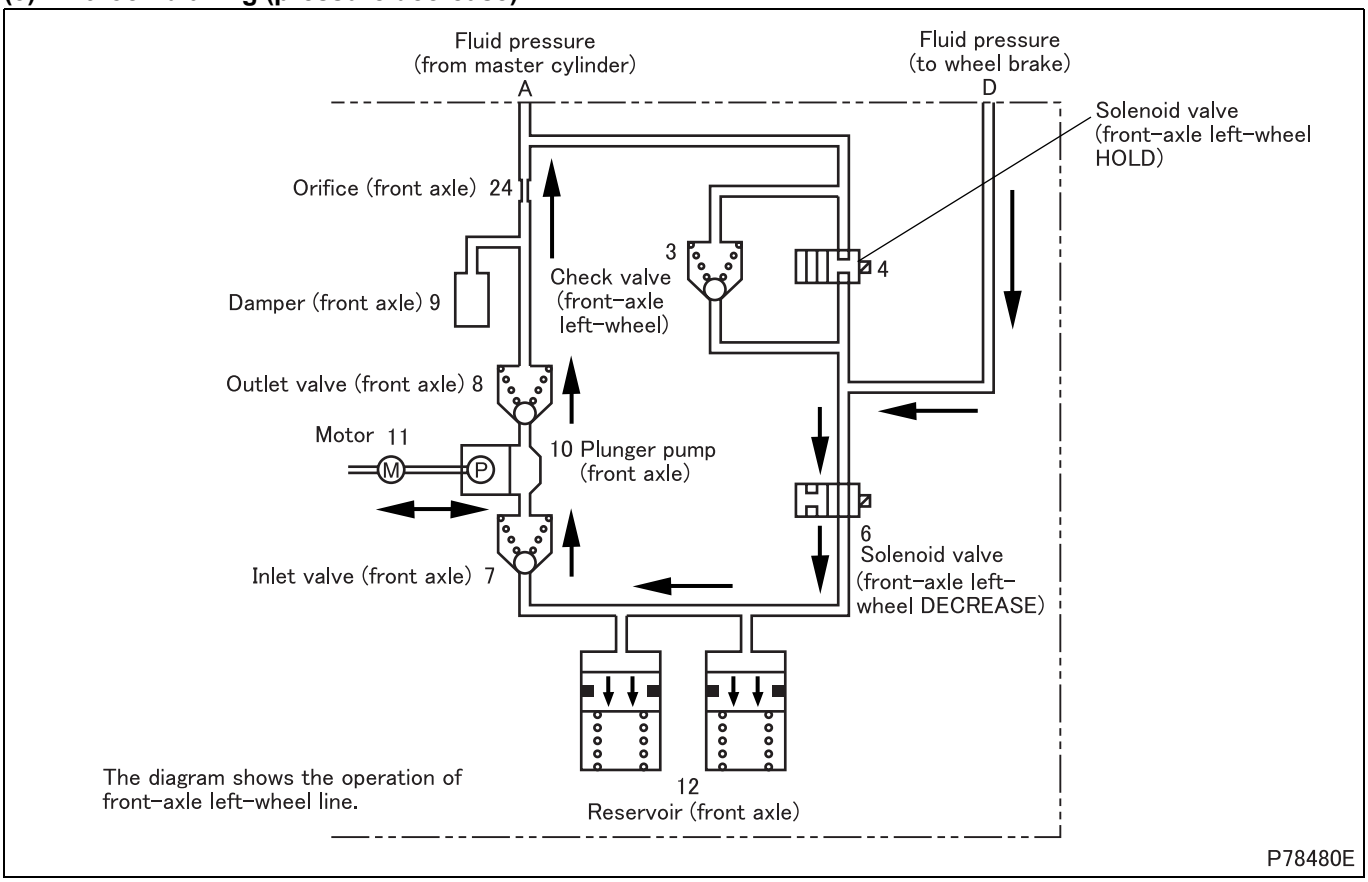
O: On
×: OFF

(2) Normal braking (antilock brake system not in operation)



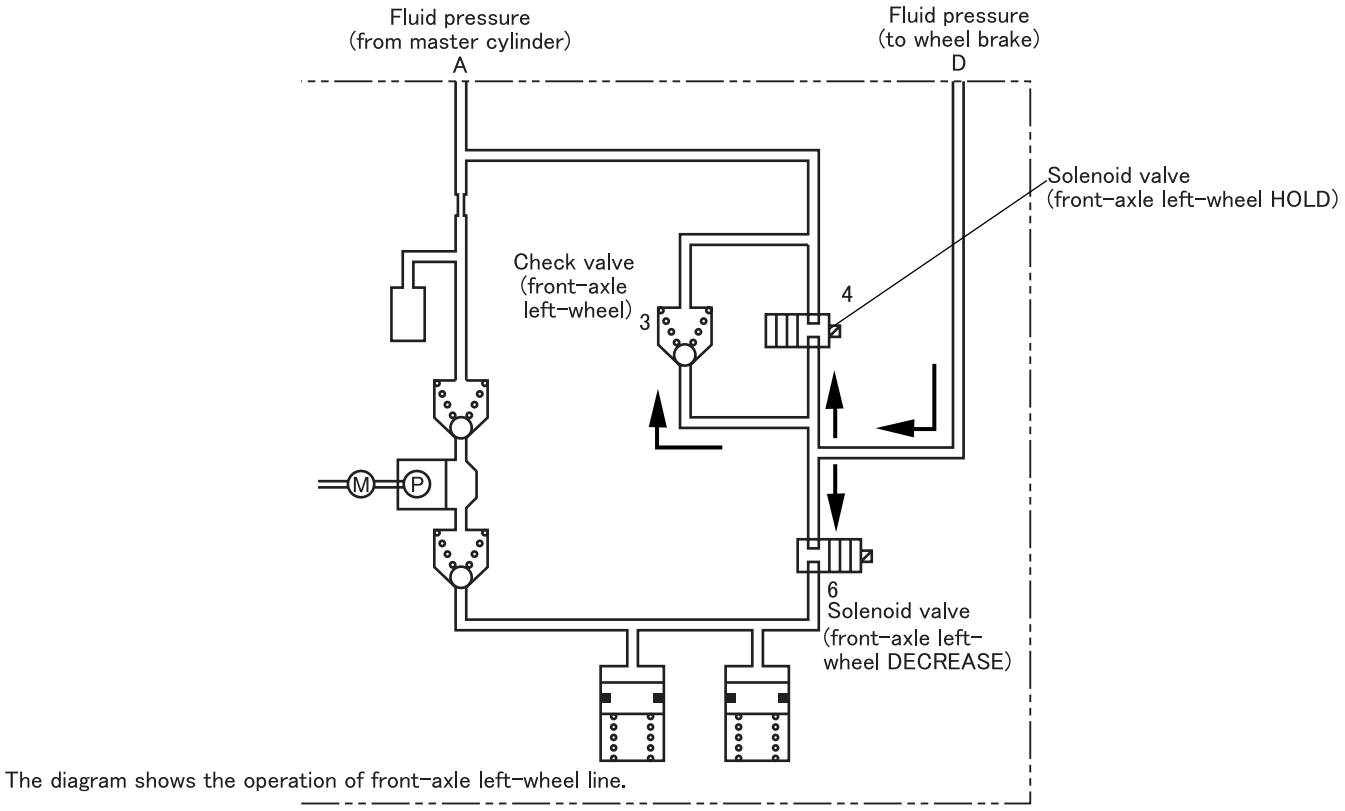
- When the brake pedal is pressed and there is no imminent wheel lock-up, the hydraulic unit (electronic control unit) will not send any control signal to the solenoid valve (front-axle left-wheel DECREASE) or to the solenoid valve (front-axle left-wheel HOLD). The former valve remains closed while the latter valve stays open.
- Pressure fluid **A** from the brake master cylinder flows past the solenoid valve (front-axle left-wheel HOLD) and to the wheel brake **D**.
- When the brake pedal is released, pressure fluid **A** from the brake master cylinder drops. Pressure fluid from the wheel brake **D** now flows past the solenoid valve (front-axle left-wheel HOLD) and the check valve (front-axle left-wheel) and returns to the brake master cylinder.

(3) Antilock braking (pressure decrease)



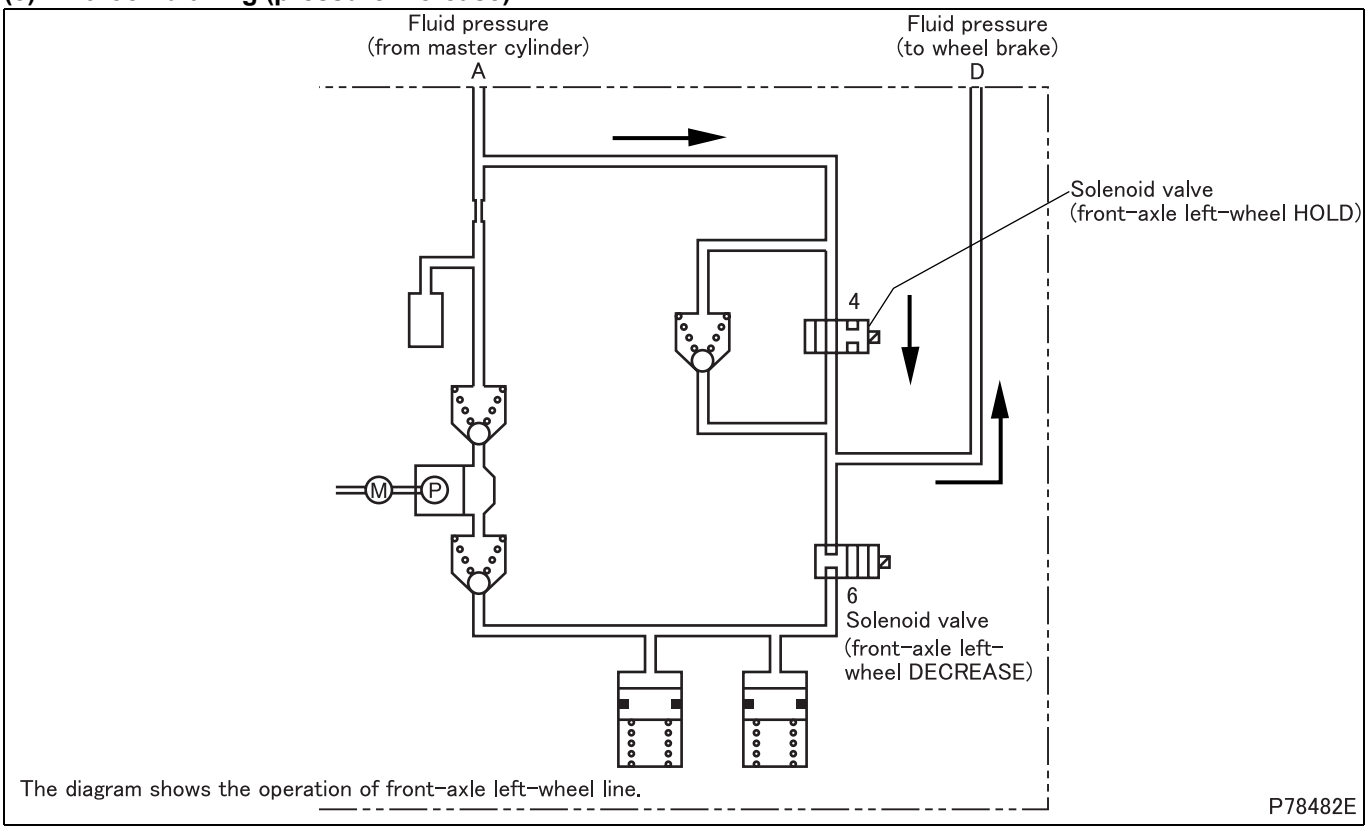
- When the brake pedal is pressed and there is imminent wheel lock-up, the hydraulic unit (electronic control unit) sends control signal to the solenoid valve (front-axle left-wheel DECREASE) and the solenoid valve (front-axle left-wheel HOLD). The former valve will open while the latter valve will close.
- Pressure fluid form the wheel brake **D** now flows past the solenoid valve (front-axle left-wheel DECREASE) and to the reservoirs. The line pressure will drop.
- When the hydraulic unit (electronic control unit) sends control signal to the solenoid valve (front-axle left-wheel DECREASE) and the solenoid valve (front-axle left-wheel HOLD), it also sends control signal to the motor at the same time, causing the plunger pump (front axle) to start pumping. Pressure fluid in the reservoirs now flows past the inlet valve (front axle), the outlet valve (front axle), the damper (front axle) and the orifice (front axle) and returns to the master cylinder.
- During this process, the check valve (front-axle left-wheel) remains closed by the fluid pressure **A** from the brake master cylinder. As a result, no pressure fluid from the master cylinder flows to the wheel brake.

(4) Antilock braking (pressure hold)



- When it becomes necessary to hold the fluid pressure **D** in the wheel brake at the same level as part of antilock brake system control, the hydraulic unit (electronic control unit) sends “HOLD” signal to the solenoid valve (front-axle left-wheel HOLD). As a result, both of the solenoid valve (front-axle left-wheel HOLD) and the solenoid valve (front-axle left-wheel DECREASE) will be closed, which holds the fluid pressure in the wheel brake at the current level.
- The check valve (front-axle left-wheel) remains closed by the fluid pressure **A** from the brake master cylinder.

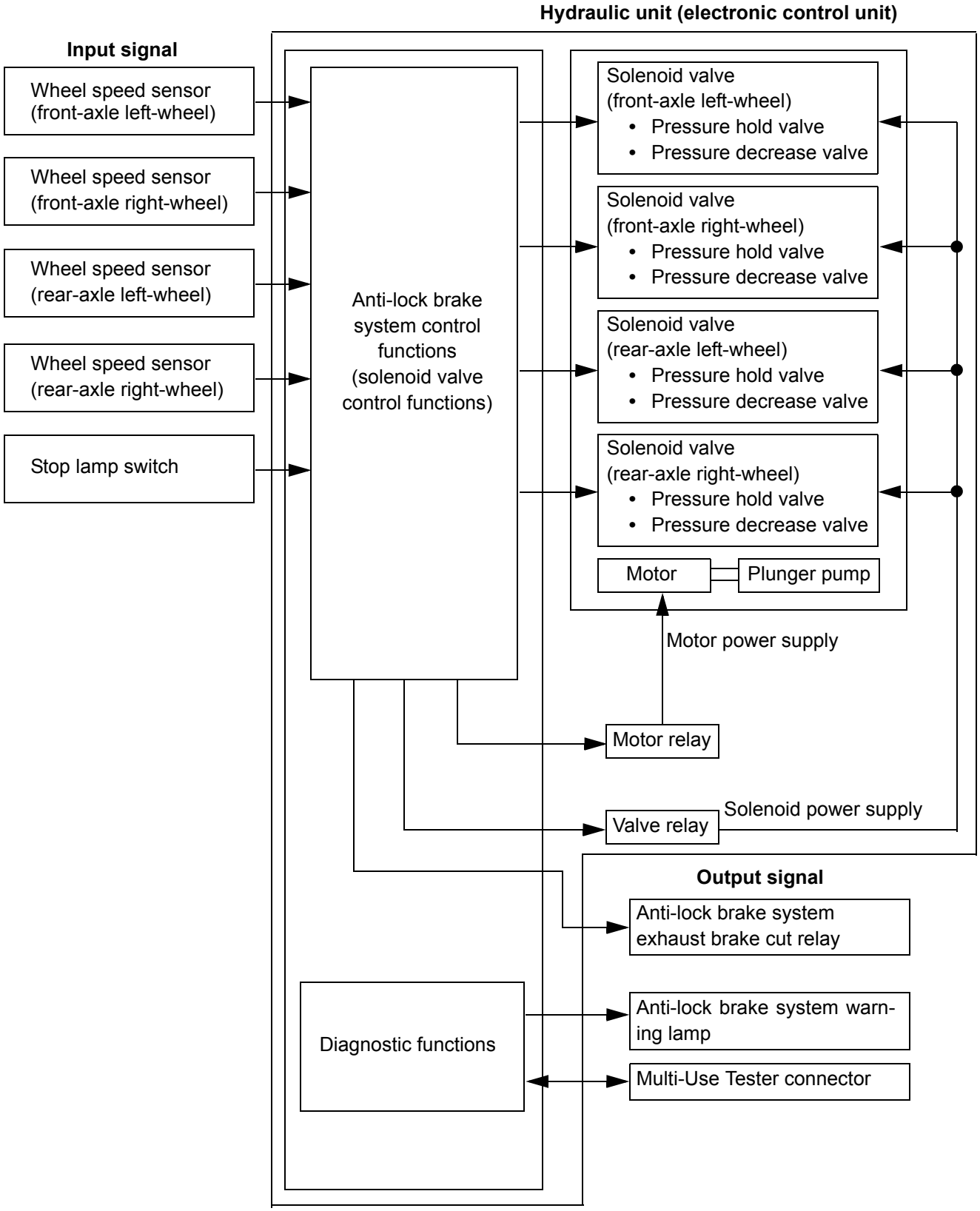
(5) Antilock braking (pressure increase)



- When it becomes necessary to increase the fluid pressure **D** in the wheel brake, control signal from the hydraulic unit (electronic control unit) to the solenoid valve (front-axle left-wheel HOLD) and to the solenoid valve (front-axle left-wheel DECREASE) will be cut off.
- As a result, the solenoid valve (front-axle left-wheel HOLD) will open while the solenoid valve (front-axle left-wheel DECREASE) will close. Both valves are now in their normal-braking positions. Fluid pressure **A** being generated by the depression of the brake pedal is now applied to the wheel brake to increase the braking force.

2. Electronic Control System

2.1 Block diagram



Part	Primary function or operation
Wheel speed sensor	Senses wheel speed
Brake light switch	Senses the depression of brake pedal
Antilock brake system exhaust brake cut relay	Cuts off exhaust brake in antilock braking mode
ABS warning (diagnostic light)	Displays antilock brake system faults; Performs system check
Multi-Use Tester connector	Communicates with Multi-Use Tester; Displays/Clears diagnosis codes

2.2 Antilock brake system control functions

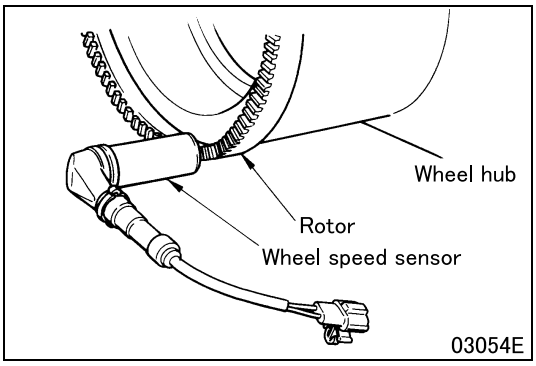
- The hydraulic unit (electronic control unit) continuously monitors signals from the wheel speed sensors. The unit sends signal to solenoid valves.

(1) Antilock brake system fail-safe

- If any fault occurs in the antilock brake system, the warning light comes on to warn the driver of the fault and the normal braking will resume in place of the antilock braking which will be disabled.

(2) Antilock brake system and exhaust brake

- On slippery roads, wheel lock-up can result even from application of the exhaust brake. In the antilock braking mode, activation of the exhaust brake makes it difficult for antilock brake system to perform controlled braking.
  To avoid this, the exhaust brake will be disabled upon activation of antilock brake system even when the exhaust brake switch is in the “ON” position.
  The exhaust brake will automatically be enabled upon deactivation of antilock brake system.



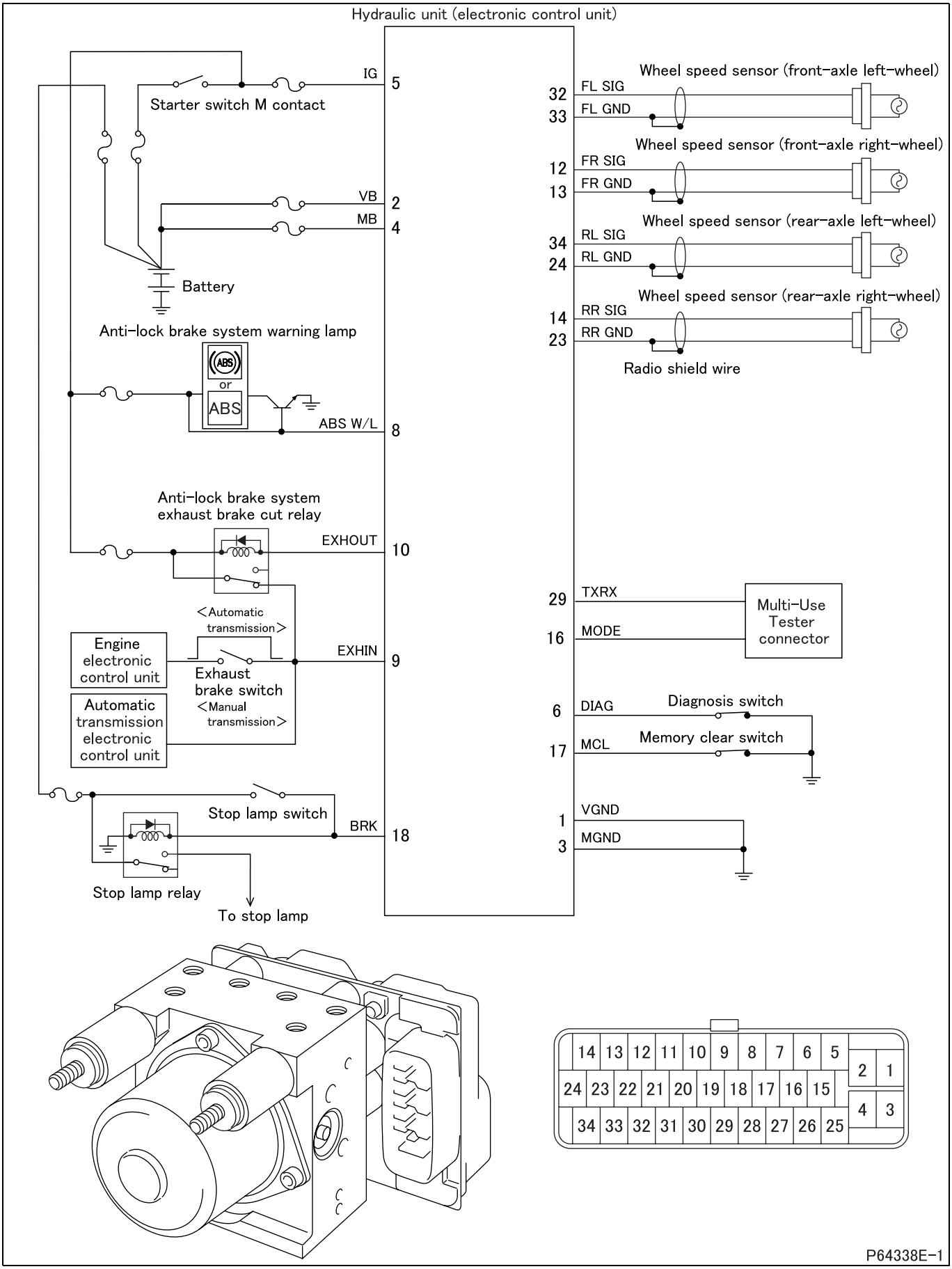
(3) Wheel speed sensor

- Each wheel speed sensor detects wheel speed and sends this as a signal to the hydraulic unit (electronic control unit). The sensor is essentially a magnetic pickup unit, consisting of a permanent magnet core and a coil of wire wound around the core.
- A rotor is fitted onto the wheel hub. This rotor, like a ring gear, has a set of evenly-spaced teeth directly facing the sensor. As the wheel rotates, these teeth pass through the magnetic flux of the sensor, inducing potential difference in the coil which is then sent as a signal (alternating voltage proportional to the wheel speed) to the hydraulic unit (electronic control unit).

2.3 Diagnostic functions

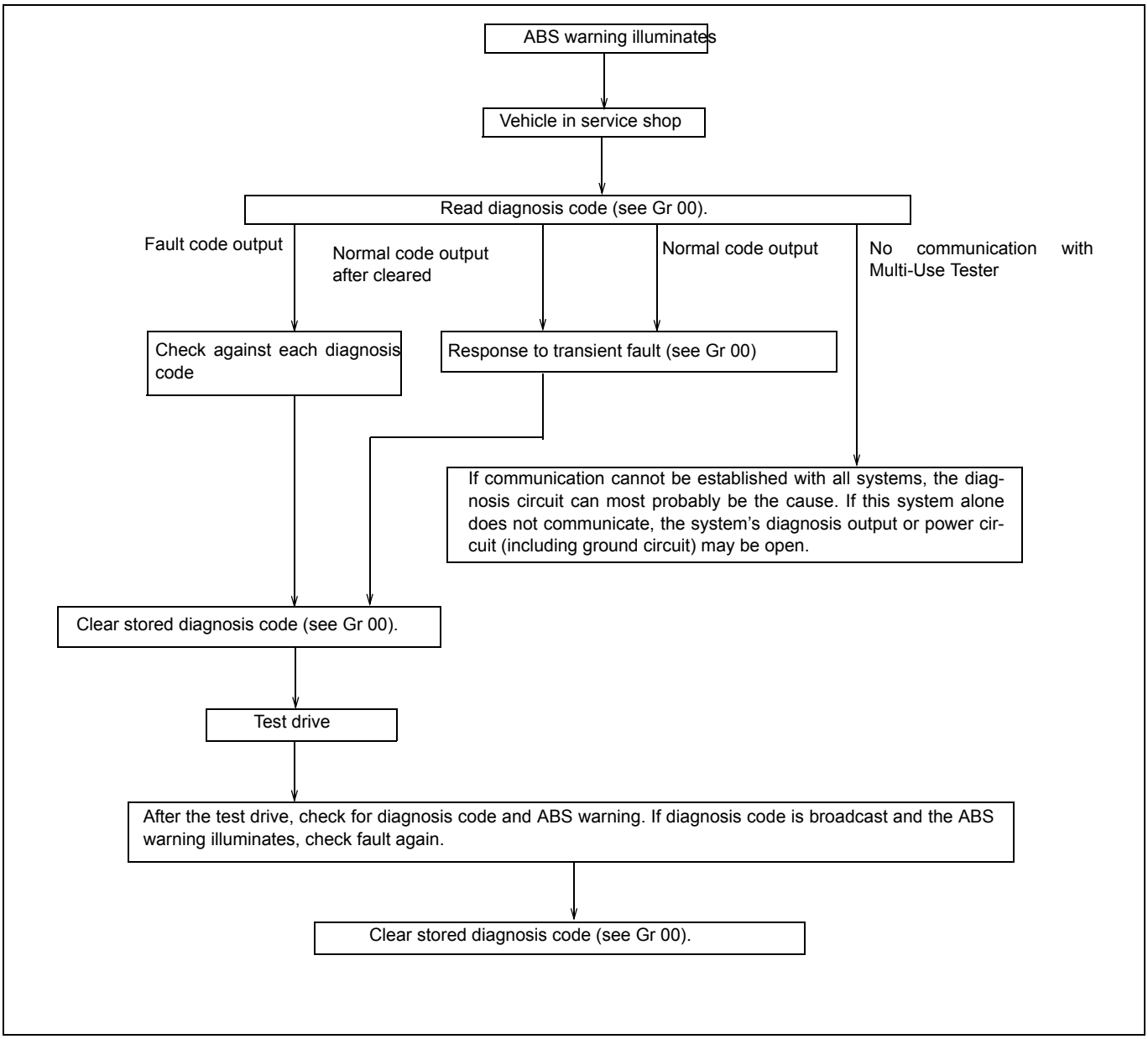
- When the ignition switch is in the ON position, the system continuously monitors the sensors and other system components. If any fault is detected, the system warns the driver of this by displaying the relevant fault information on the meter cluster. At the same time, the system also stores a relevant diagnosis code in the memory and starts operation in the fault mode.
- In the fault-mode operation, the system functions are limited to ensure safety for the driver and the vehicle. Stored diagnosis codes can be accessed using Multi-Use Tester or can be read by observing the flashing of the diagnostic light.

3. Electronic Control Unit Schematic Diagram



1. Diagnosis Procedure

- The system can be efficiently inspected for faults using a Multi-Use Tester.
  System inspection can be accomplished basically in two ways according to trouble symptom and diagnosis code as shown below.
  - Check against each diagnosis code stored in memory by the electronic control unit
  - Response to transient fault



2. Diagnostic Precautions

- Before measuring voltage, check the battery for charged condition and specific gravity. If system inspection is performed with the battery uncharged or reduced in specific gravity, accurate measurements cannot be achieved.
- To avoid having electrical parts damaged, set the ignition switch and headlight switch to LOCK or OFF before disconnecting and reconnecting battery cables.
- Before disconnecting connectors, set the ignition switch to LOCK or OFF, then allow at least 20 seconds. Voltage may remain in electric parts or connected circuit.
- When performing measurement with the tester, handle the test bar carefully so that it does not damage internal circuit and other electrical parts of the electronic control unit to result in a short-circuit failure between terminals in connector or between connector and car body.
- Resistance is affected by temperature. Determine the necessity of resistance measurement following given temperature specification as a guide. Otherwise, use normal temperature (10 to 35°C {50 to 95°F}) as the measuring condition.

3. Diagnosis Based on Diagnosis Codes

3.1 List of diagnosis codes

Code	Message	Warning lamp indication
11	FR SENSOR	O
12	FL SENSOR	O
13	RR SENSOR	O
14	RL SENSOR	O
21	FR SENSOR SIG	O
22	FL SENSOR SIG	O
23	RR SENSOR SIG	O
24	RL SENSOR SIG	O
31	BATT VOLT ERR	O
35	EXB CUT RLY	O
41	FR VALVE	O
42	FL VALVE	O
43	RR VALVE	O
44	RL VALVE	O
51	VALVE RLY	O
52	MOTOR RLY	O
53	MOTOR ERR	O
61	ECU ID ERR	O
63	ECU ERR	O
64	ILLEGAL WHEEL	O
65	LONG ABS	O

3.2 Code generation criteria and inspection items

11: FR SENSOR

Code generation criteria		Wheel speed sensor resistance out of range
Resettability		System resets when normal resistance is detected after ignition switch OFF → ON.
Electronic control unit control		Antilock brake system disabled
Inspection item	Service data	11: FR SPEED
	Electronic control unit connector	01: Wheel speed sensor
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit

12: FL SENSOR

Code generation criteria		Wheel speed sensor resistance out of range
Resettability		System resets when normal resistance is detected after ignition switch OFF → ON.
Electronic control unit control		Antilock brake system disabled
Inspection item	Service data	12: FL SPEED
	Electronic control unit connector	01: Wheel speed sensor
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit

13: RR SENSOR

Code generation criteria		Wheel speed sensor resistance out of range
Resettability		System resets when normal resistance is detected after ignition switch OFF → ON.
Electronic control unit control		Antilock brake system disabled
Inspection item	Service data	13: RR SPEED
	Electronic control unit connector	01: Wheel speed sensor
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit

14: RL SENSOR

Code generation criteria		Wheel speed sensor resistance out of range
Resettability		System resets when normal resistance is detected after ignition switch OFF → ON.
Electronic control unit control		Antilock brake system disabled
Inspection item	Service data	14: RL SPEED
	Electronic control unit connector	01: Wheel speed sensor
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit

21: FR SENSOR SIG

Code generation criteria		When driving off, no wheel speed sensor output or abrupt change in wheel speed sensor output
Resettability		System resets upon normal signal input after ignition switch OFF → ON
Electronic control unit control		Antilock brake system disabled
Inspection item	Service data	11: FR SPEED
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit
	Other	• Inspect rotor (See Gr26.) • Incorrectly installed wheel speed sensor

22: FL SENSOR SIG

Code generation criteria		When driving off, no wheel speed sensor output or abrupt change in wheel speed sensor output
Resettability		System resets upon normal signal input after ignition switch OFF → ON
Electronic control unit control		Antilock brake system disabled
Inspection item	Service data	12: FL SPEED
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit
	Other	• Inspect rotor (See Gr26.) • Incorrectly installed wheel speed sensor

23: RR SENSOR SIG

Code generation criteria		When driving off, no wheel speed sensor output or abrupt change in wheel speed sensor output
Resettability		System resets upon normal signal input after ignition switch OFF → ON
Electronic control unit control		Antilock brake system disabled
Inspection item	Service data	13: RR SPEED
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit
	Other	• Inspect rotor (See Gr27.) • Incorrectly installed wheel speed sensor

24: RL SENSOR SIG

Code generation criteria		When driving off, no wheel speed sensor output or abrupt change in wheel speed sensor output
Resettability		System resets upon normal signal input after ignition switch OFF → ON
Electronic control unit control		Antilock brake system disabled
Inspection item	Service data	14: RL SPEED
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit
	Other	• Inspect rotor (See Gr27.) • Incorrectly installed wheel speed sensor

31: BATT VOLT ERR

Code generation criteria		Electronic control unit power-supply terminal voltage out of range
Resettability		Normal signal with ignition switch in the ON position
Electronic control unit control		Antilock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02: Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power supply circuit

35: EXB CUT RLY

Code generation criteria		Antilock brake system exhaust brake cut relay monitor terminal voltage out of range
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Exhaust brake control disabled (no exhaust brake cut while antilock brake system is operating)
Inspection item	Service data	22: EXB CUT RLY, 23: EXB MONITOR
	Actuator test	22: EXB RLY ON
	Electronic control unit connector	03: Antilock brake system exhaust brake cut relay
	Electrical part	#201: Antilock brake system exhaust brake cut relay
	Wiring diagram	Antilock brake system exhaust brake cut relay circuit

41: FR VALVE

Code generation criteria		Solenoid valve terminal voltage out of range
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Antilock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02: Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

42: FL VALVE

Code generation criteria		Solenoid valve terminal voltage out of range
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Antilock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02: Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

43: RR VALVE

Code generation criteria		Solenoid valve terminal voltage out of range
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Antilock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02: Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

44: RL VALVE

Code generation criteria		Solenoid valve terminal voltage out of range
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Antilock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02: Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

51: VALVE RLY

Code generation criteria		Terminal voltage of valve relay in electronic control unit out of range
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Antilock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02: Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

52: MOTOR RLY

Code generation criteria		Terminal voltage of motor relay in electronic control unit out of range
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Antilock brake system enabled
Inspection item	Service data	32: MOTOR RLY
	Actuator test	21: ABS MOTOR ON
	Electronic control unit connector	02: Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit

53: MOTOR ERR

Code generation criteria		Motor terminal voltage out of range
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Antilock brake system enabled
Inspection item	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

61: ECU ID ERR

Code generation criteria		Wiring incorrect for vehicle system
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Antilock brake system enabled
Inspection item	Electronic control unit connector	04: Configuration check
	Wiring diagram	Antilock brake system EXB cut relay circuit

63: ECU ERR

Code generation criteria	Electronic control unit internal fault
Resettability	Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control	Antilock brake system enabled
Other	Clear memory and re-energize. If system still does not reset, replace hydraulic unit (electronic control unit).

64: ILLEGAL WHEEL

Code generation criteria		At 30 km/h {18.6 mph} or above, difference in output signal between wheel speed sensors exceeds the limit. (The difference should be less than 20% between front and rear wheel speed sensors and less than 10% between left and right wheel speed sensors.)
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Antilock brake system disabled
Inspection item	Service data	11: FR SPEED, 12: FL SPEED, 13: RR SPEED, 14: RL SPEED * Min. speed displayed = 2 km/h {1.2 mph}
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit

65: LONG ABS

Code generation criteria		Antilock brake system operates longer than the specified time duration.
Resettability		Normal signal after ignition switch OFF → ON (re-energize electronic control unit)
Electronic control unit control		Antilock brake system disabled
Inspection item	Service data	11: FR SPEED, 12: FL SPEED, 13: RR SPEED, 14: RL SPEED
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit
	Other	• Inspect rotor (See Gr26, Gr27.) • Incorrectly installed wheel speed sensor

4. Multi-Use Tester Service Data

NOTE

- **Service data can be accessed while actuator test is being performed, and vice versa.**

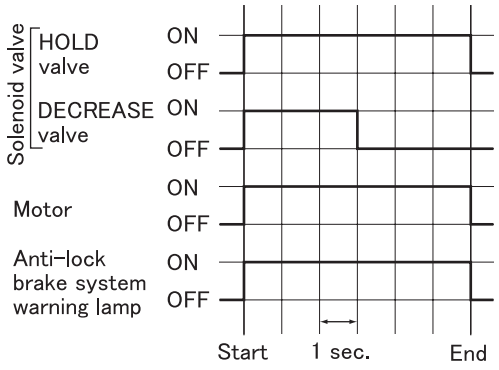
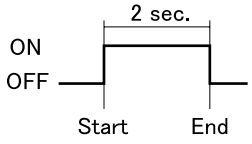
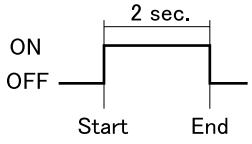
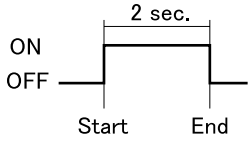
No.	Item	Data	Diagnosis condition	Pass criteria
11	FR SPEED	■■■. ■km/h	Drive at a constant speed	Synchronized with speedometer
12	FL SPEED	■■■. ■km/h		
13	RR SPEED	■■■. ■km/h		
14	RL SPEED	■■■. ■km/h		
15	BATT VOLTAGE	■■. ■■V	Ignition switch ON	Correspond with battery voltage
21	BRAKE SW	ON/OFF	Brake pedal depressed	ON
			Brake pedal released	OFF
22	EXB CUT RLY	ON/OFF	When antilock brake system exhaust brake cut relay activated	ON
			When antilock brake system exhaust brake cut relay not activated	OFF
			[Actuator test] 22: EXB RLY ON	
23	EXB MONITOR	ON/OFF	When antilock brake system exhaust brake cut relay activated	ON
			When antilock brake system exhaust brake cut relay not activated	OFF
			[Actuator test] 22: EXB RLY ON	
24	ABS LAMP	ON/OFF	ABS warning ON	ON
			ABS warning OFF	OFF
			[Actuator test] 23: ABS LAMP ON	
25	DIAGNOSIS SW	OPEN/CLOSE	Diagnosis switch fuse removed	OPEN
			Diagnosis switch fuse plugged in	CLOSE
26	DIAG.RESET SW	OPEN/CLOSE	Memory clear switch fuse removed	OPEN
			Memory clear switch fuse plugged in	CLOSE
31	VALVE RLY	ON/OFF	When valve relay activated	ON
			When valve relay not activated	OFF
32	MOTOR RLY	ON/OFF	Motor in operation	ON
			Motor stationary	OFF
			[Actuator test] 11: FR ABS MV ON 12: FL ABS MV ON 13: RR ABS MV ON 14: RL ABS MV ON 21: ABS MOTOR ON	
41	FR-DV	ON/OFF	Solenoid valve energized (front-axle right-wheel DECREASE)	ON
			Solenoid valve de-energized (front-axle right-wheel DECREASE)	OFF
			[Actuator test] 11: FR ABS MV ON	

No.	Item	Data	Diagnosis condition	Pass criteria
42	FR-HV	ON/OFF	Solenoid valve energized (front-axle right-wheel HOLD)	ON
			Solenoid valve de-energized (front-axle right-wheel HOLD)	OFF
			[Actuator test] 11: FR ABS MV ON	
43	FL-DV	ON/OFF	Solenoid valve energized (front-axle left-wheel DECREASE)	ON
			Solenoid valve de-energized (front-axle left-wheel DECREASE)	OFF
			[Actuator test] 12: FL ABS MV ON	
44	FL-HV	ON/OFF	Solenoid valve energized (front-axle left-wheel HOLD)	ON
			Solenoid valve de-energized (front-axle left-wheel HOLD)	OFF
			[Actuator test] 12: FL ABS MV ON	
45	RR-DV	ON/OFF	Solenoid valve energized (rear-axle right-wheel DECREASE)	ON
			Solenoid valve de-energized (rear-axle right-wheel DE-CREASE)	OFF
			[Actuator test] 13: RR ABS MV ON	
46	RR-HV	ON/OFF	Solenoid valve energized (rear-axle right-wheel HOLD)	ON
			Solenoid valve de-energized (rear-axle right-wheel HOLD)	OFF
			[Actuator test] 13: RR ABS MV ON	
47	RL-DV	ON/OFF	Solenoid valve energized (rear-axle left-wheel DECREASE)	ON
			Solenoid valve de-energized (rear-axle left-wheel DECREASE)	OFF
			[Actuator test] 14: RL ABS MV ON	
48	RL-HV	ON/OFF	Solenoid valve energized (rear-axle left-wheel HOLD)	ON
			Solenoid valve de-energized (rear-axle left-wheel HOLD)	OFF
			[Actuator test] 14: RL ABS MV ON	

5. Actuator Test Using Multi-Use Tester

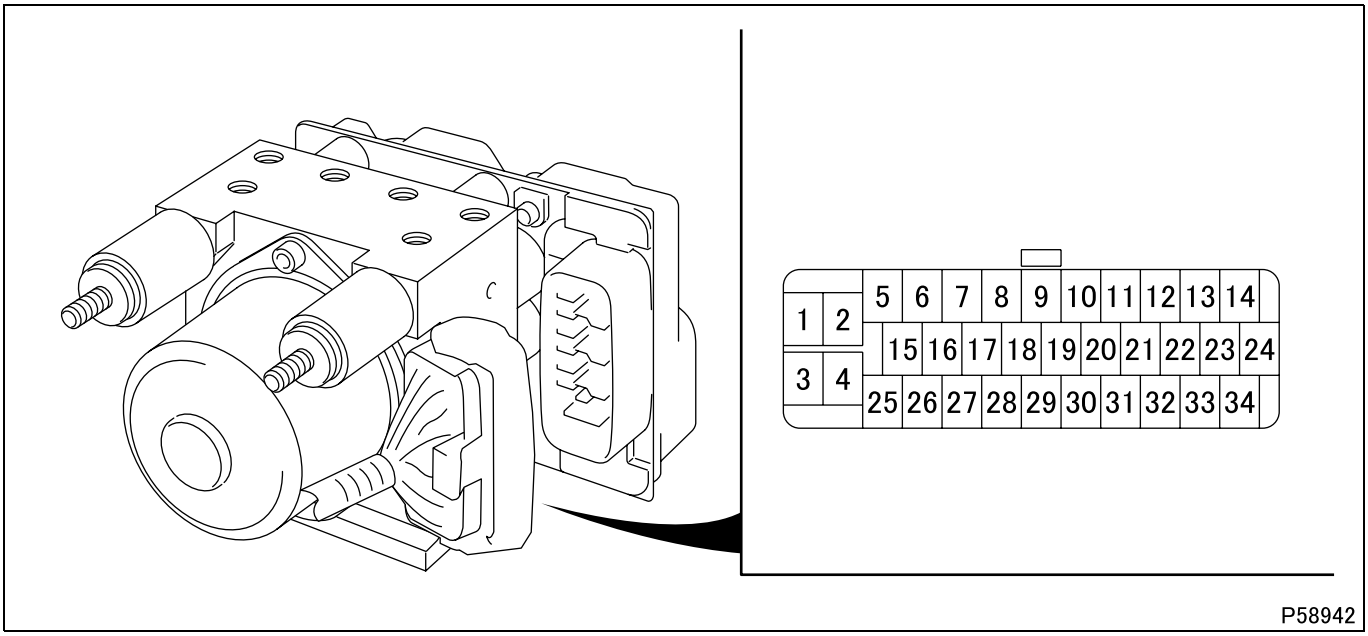
NOTE

- **Service data can be accessed while actuator test is being performed, and vice versa.**

No.	Item	Description	Verification method
11	FR ABS MV ON	 P49621E	Hydraulic unit (electronic control unit) functional check [Service data] 32: MOTOR RLY 41: FR-DV 42: FR-HV 43: FL-DV 44: FL-HV 45: RR-DV 46: RR-HV 47: RL-DV 48: RL-HV Use the data when bleeding the system (See Gr 35A.)
12	FL ABS MV ON		
13	RR ABS MV ON		
14	RL ABS MV ON		
21	ABS MOTOR ON	Motor  P49620E	Motor noise [Service data] 32: MOTOR RLY
22	EXB RLY ON	Exhaust brake cut relay  P49620E	Relay noise [Service data] 22: EXB CUT RLY 23: EXB MONITOR
23	ABS LAMP ON	ABS warning  P49620E	ABS warning ON [Service data] 24: ABS LAMP

6. Inspection at Hydraulic Unit (Electronic Control Unit) Connector

- This inspection is intended to aid troubleshooting by verifying whether or not hydraulic unit (electronic control unit) signals are correctly transmitted via the vehicle harness and connector.
  The **01**, **02** ··· in the table below is a cross reference to the electronic control unit connector inspection items listed in the table in "**3. Diagnosis Based on Diagnosis Codes**" of this manual.



- The inspection requires the connector with a locking feature to be uncoupled. Before carrying out the inspection, read the "Hydraulic Unit Connector Uncoupling and Coupling" in this manual.

CAUTION ⚠

- **Do not touch terminals that are not part of the inspection being performed. When using a tester, be careful not to cause a short circuit across the terminals being measured.**

Check item	Measurement
01 Wheel speed sensor resistance	[Condition] • Ignition switch OFF • With the connector uncoupled, inspect at vehicle harness connector half [Pass criteria] Between terminals: 12 and 13 (FR) Between terminals: 32 and 33 (FL) Between terminals: 14 and 23 (RR) Between terminals: 34 and 24 (RL) • The resistance measured should be 1 to 2 kΩ
02 Electronic control unit power-supply voltage	[Condition] • Ignition switch ON • With the connector uncoupled, inspect at vehicle harness connector half [Pass criteria] Between terminals (+) - (–): 2 - 1 (VB) 4 - 3 (MB) 5 - 1 (IG) • 10 to 18 V

Check item	Measurement
03 Antilock brake system exhaust brake cut relay voltage	[Condition] • Ignition switch ON • With the connector uncoupled, inspect at vehicle harness connector half [Pass criteria] Between terminals (+) - (–): 10 - 1 (EXHOUT) 9 - 1 (EXHIN) • 10 to 18 V
04 Configuration check	[Pass criteria] Terminals 11, 22 and 30 should be free (no wiring connected). **NOTE** • **If wires are connected to these terminals, disconnect the wires and insulate the exposed portions.**

M E M O

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Functional Check

1.1 Inspection with vehicle stationary

- While pressing the brake pedal, check the hydraulic unit (electronic control unit) and the brake lines and connections for fluid leakage.
- If fluid is leaking from the hydraulic unit (electronic control unit), replace the unit. If fluid is leaking from the brake lines or connections, retighten the hardware.

1.2 Inspection using brake tester

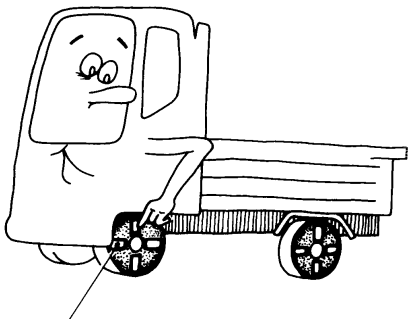
- Using the brake tester, check each wheel for braking force following the normal procedures.
- If faulty, check the wheel brake in question, the service brake system and the hydraulic unit (electronic control unit).

1.3 Inspection of antilock brake system operation while driving the vehicle

WARNING ⚠

- **To prevent personal injury, do not allow any other vehicle or any persons onto the test course during this inspection.**

- The vehicle being tested should be unloaded.
- Apply white tape to the sidewalls of both front and rear tires to aid observation of wheel rotation.
- Turn the ignition switch from LOCK to ON. The ABS warning should illuminate and, in several seconds, go out.
- Drive the vehicle at 20 to 30 km/h {12 to 19 mph} and apply the brakes hard. The wheels should not lock up.



23971E

2. Inspection of Hydraulic Unit (Electronic Control Unit) Operation

2.1 Inspection using Multi-Use Tester

- Raise the vehicle with a jack and support it on safety stands, or place the vehicle on the rollers of a brake tester.

WARNING ⚠

- **Apply the parking brake when testing the front brakes. Chock the front wheels when testing the rear brakes.**

NOTE

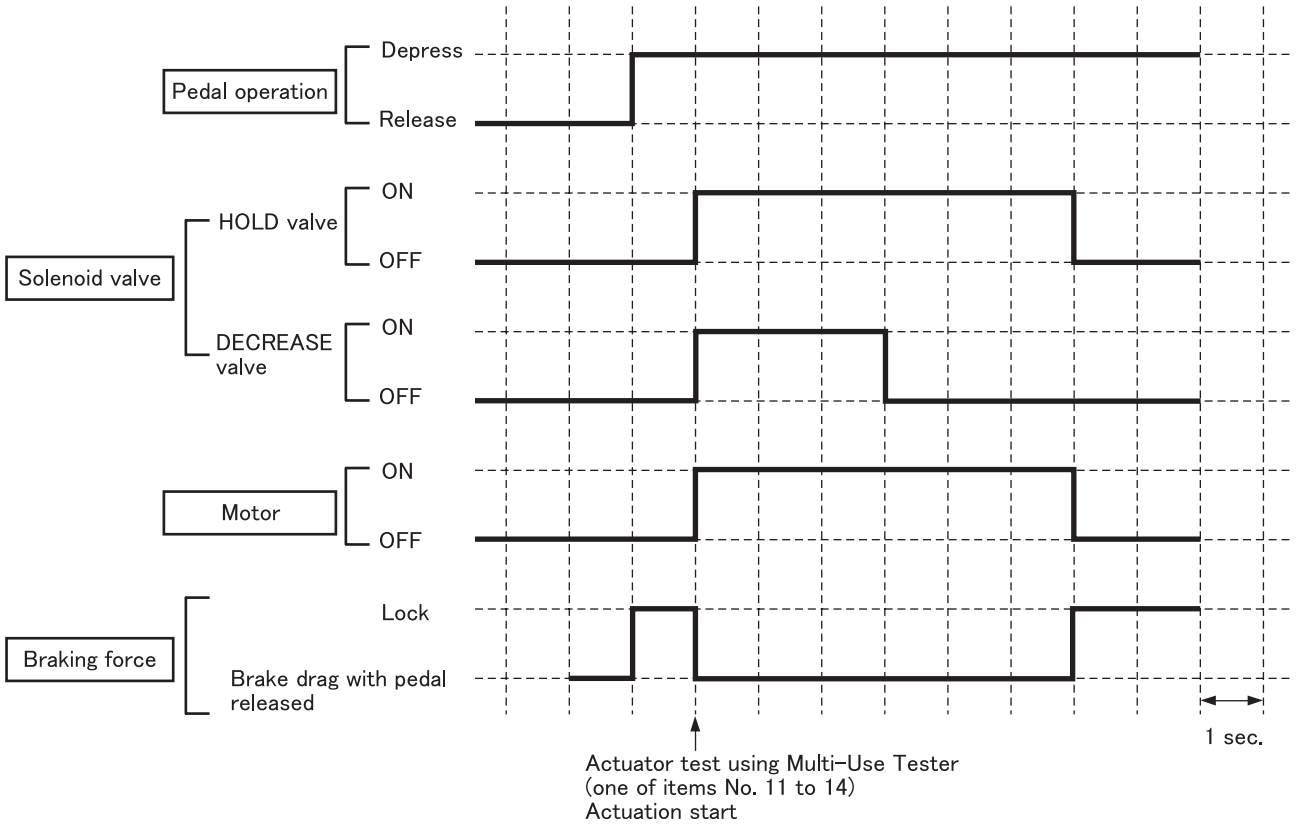
- **During the inspection, keep the brake tester rollers and the tires dry.**

- With the parking brake released, feel the brake drag of each wheel. When using a brake tester, note the brake drag reading.
- Connect the Multi-Use Tester (see Gr00).
- With the transmission in neutral, start the engine.
- Using the Multi-Use Tester, move the actuator.

NOTE

- **It is not possible to test the actuator using the Multi-Use Tester when the hydraulic unit (electronic control unit) is inoperative in fail-safe mode.**

- While rotating the wheel by hand, feel the variation in brake drag/force as the brake pedal is pressed and released. This can be expressed as follows.



- Determine whether the system is faulty or not by referring to the diagnosis table on the next page. If faulty, take the actions indicated.

Diagnosis table (actuator test using Multi-Use Tester)

No.	Multi-Use Tester display	Operation	Diagnosis		Cause	Remedial action
			Normal	Faulty		
11	FR ABS MV ON	(1) Press the brake pedal to lock up the wheel. (2) Using Multi-Use Tester, select the wheel being tested and move the corresponding actuator. (3) Rotate the wheel being tested using the brake tester or by hand, and check the variation in braking force.	Braking force drops for 6 seconds following wheel lock-up.	Wheel will not lock up when brake pedal is pressed.	Clogged brake line outside hydraulic unit (electronic control unit)	Inspect and clean brake line
12	FL ABS MV ON				Clogged line inside hydraulic unit (electronic control unit)	Replace hydraulic unit (electronic control unit)
13	FR ABS MV ON			Braking force will not drop.	Incorrectly connected hydraulic unit (electronic control unit) brake piping	Connect piping correctly
14	RL ABS MV ON				Faulty hydraulic unit (electronic control unit) magnetic valve	Replace hydraulic unit (electronic control unit)

- With the inspection completed, turn the ignition switch to LOCK before removing the Multi-Use Tester.

3. Inspection after Replacing or Removing/Installing Hydraulic Unit (Electronic Control Unit)

- Check the hydraulic unit (electronic control unit) for normal operation.
- After replacing or removing/installing the hydraulic unit (electronic control unit), always check the system for normal operation. Controlled braking will not be available if the piping is incorrect.
- After replacement or reinstallation of the hydraulic unit (electronic control unit), be sure to bleed the brake system. (See Gr35A.)
- The vehicle harness connector is equipped with a locking device. For correct use of the device, see "**HYDRAULIC UNIT CONNECTOR COUPLING AND UNCOUPLING**" in this manual.

4. Oscilloscopic Inspection through Wheel Speed Sensor Signal Waveform

- The tester is inappropriate to inspection for dented rotor or missing rotor tooth. Instead, use the oscilloscope function of the Multi-Use Tester or an oscilloscope capable of waveform recording.
- In many cases, dented rotor or missing rotor tooth results from the contact of the rotor press-fitted in the hub tip with the axle or elsewhere that can occur in the process of the hub and brake drum being assembled to the axle. Therefore, care should be taken so that the rotor does not touch other parts when the hub and brake drum are assembled to the axle.

4.1 Inspection

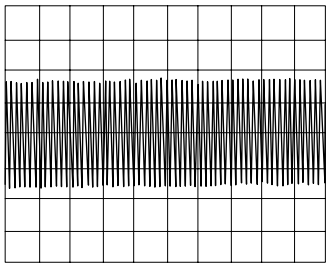
- Jack up the wheel under inspection. Disconnect the wheel speed sensor connector.
- Connect the oscilloscope terminals to the disconnected connector. Rotate the wheel at a certain speed and check oscilloscopic waveform for dented rotor or missing rotor tooth.
- If any wave is evidently smaller in width than others, there should be a dented rotor or missing rotor tooth. The standard wave width is as calculated below.

$$\frac{\text{Vmean} - \text{Vmin}}{\text{Vmean}} \times 100 \leq 20\%$$

where
Vmin: Minimum wave width
Vmean: Average of maximum wave widths

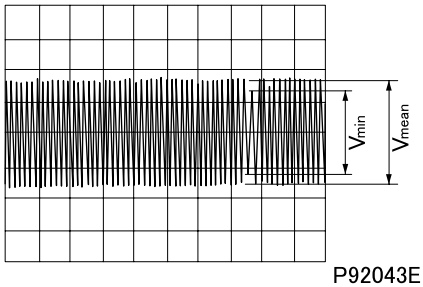
- If there is a wave more than 20% smaller in width than others, visually examine the rotor for the defect and replace if necessary. (See Gr26, 27).

Normal waveform
(no dent or chipped tooth on the rotor)



P03122E

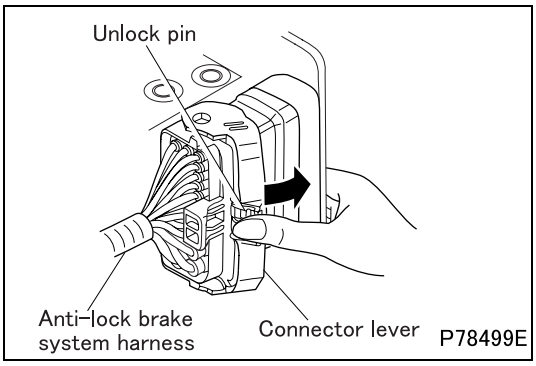
Abnormal waveform
(with dented rotor or missing rotor tooth)



P92043E

HYDRAULIC UNIT CONNECTOR COUPLING AND UNCOUPLING

1. Uncoupling the Connector



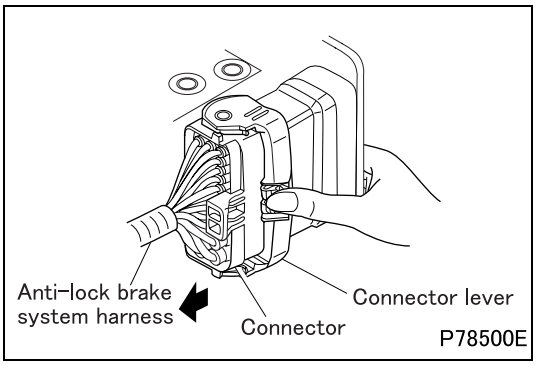
- While holding the connector, push the unlock pin on the connector lever.
- With the connector unlocked, push the connector lever in the direction of the arrow.

CAUTION ⚠

- **Do not force the connector lever. It may break.**

NOTE

- **If the connector lever will not move, return the connector lever to the locked position and try again.**

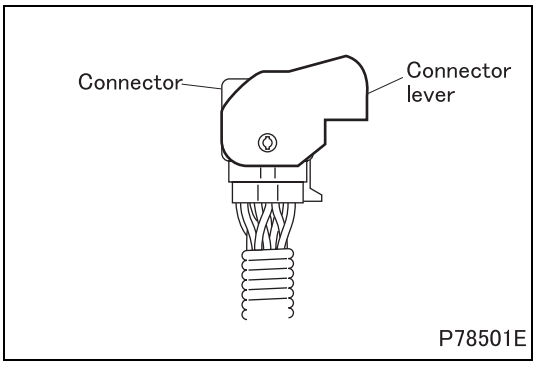


- With the connector lever fully pushed back, remove it, together with the antilock brake system harness, while continuing to hold the connector.

CAUTION ⚠

- **If the locking device is not completely unlocked, do not attempt to remove the connector by force. This may damage the connector. Push the connector lever all the way back and try again.**

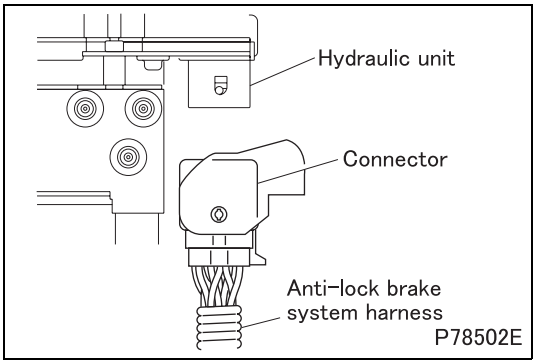
2. Coupling the Connector



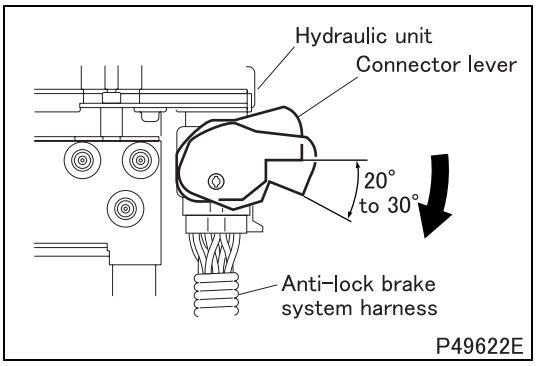
- Ensure that the connector terminals are clean and free from dirt or debris.
- Set the connector lever to the position shown in the illustration.

CAUTION ⚠

- **If the connector lever is not properly positioned, trying to plug in the connector may damage the connector lever.**



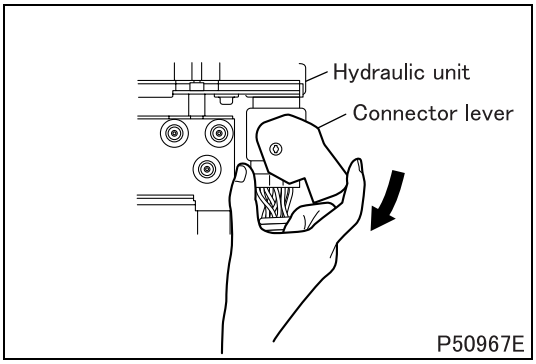
- Insert the antilock brake system harness connector straight into the other connector half on the hydraulic unit.



- Gently turn the connector lever to the specified angle in the direction of the arrow.

CAUTION ⚠

- **If the connector lever fails to turn to the specified angle, start the connector installation procedure again from the beginning. If this is not done, the connector lever could be broken when it is turned in the next step.**

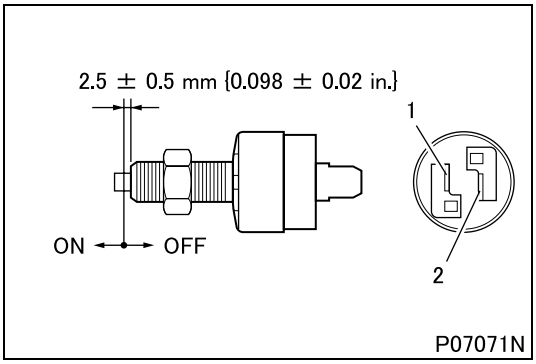


- In order to lock the connector lever, turn the lever in the direction of the arrow until it clicks. Apply force to the central part of the lever while holding the connector body.

NOTE

- **If the connector is not completely connected, the antilock brake system (ABS) warning may be illuminated. If the light is illuminated, start the connector installation procedure again.**

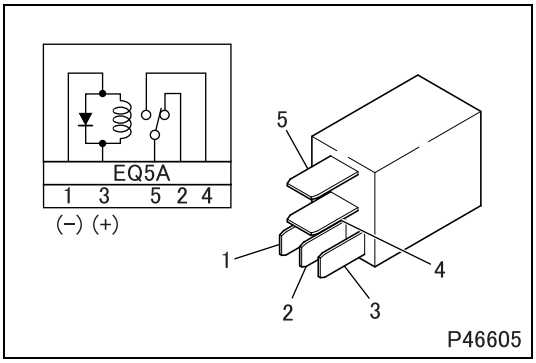
INSPECTION OF ELECTRICAL COMPONENTS



#042 Inspection of brake light switch

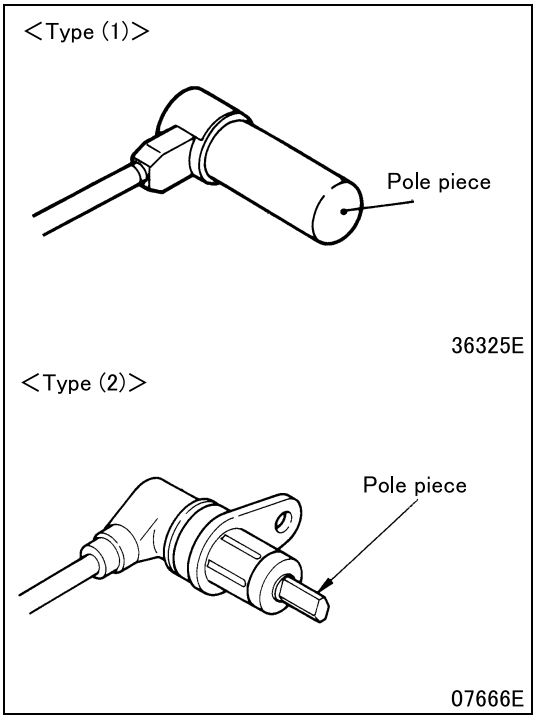
Switch position	Continuity between the terminals
OFF	–
ON	1 – 2

- If faulty, replace the brake light switch.



#201 Inspection of relay (normally open 5-pin relay)

- Check the relay for continuity and normal operation. If faulty, replace the relay.



#329 Inspection of wheel speed sensor

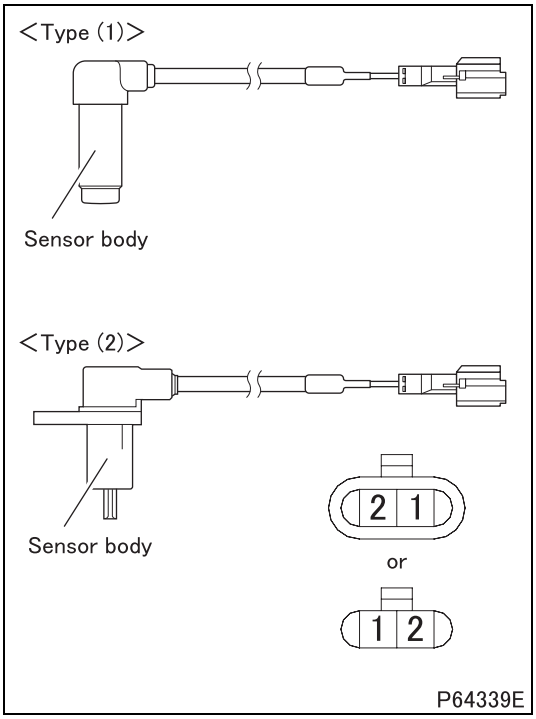
- Manufacturer of wheel speed sensor.

Type	Manufacturer
(1)	Sumitomo Electric
(2)	Bosch

- Carry out the following checks. If faulty, replace the wheel speed sensor.

CAUTION ⚠

- **The pole piece is magnetized by the magnet housed in the wheel speed sensor. Be careful not to allow metal parts to stick onto the pole piece.**



(1) Resistance between terminals

Standard value	Type (1)	1.4 ± 0.2 kΩ
	Type (2)	1.6 ± 0.16 kΩ

(2) Insulation resistance (between the sensor body and each terminal)

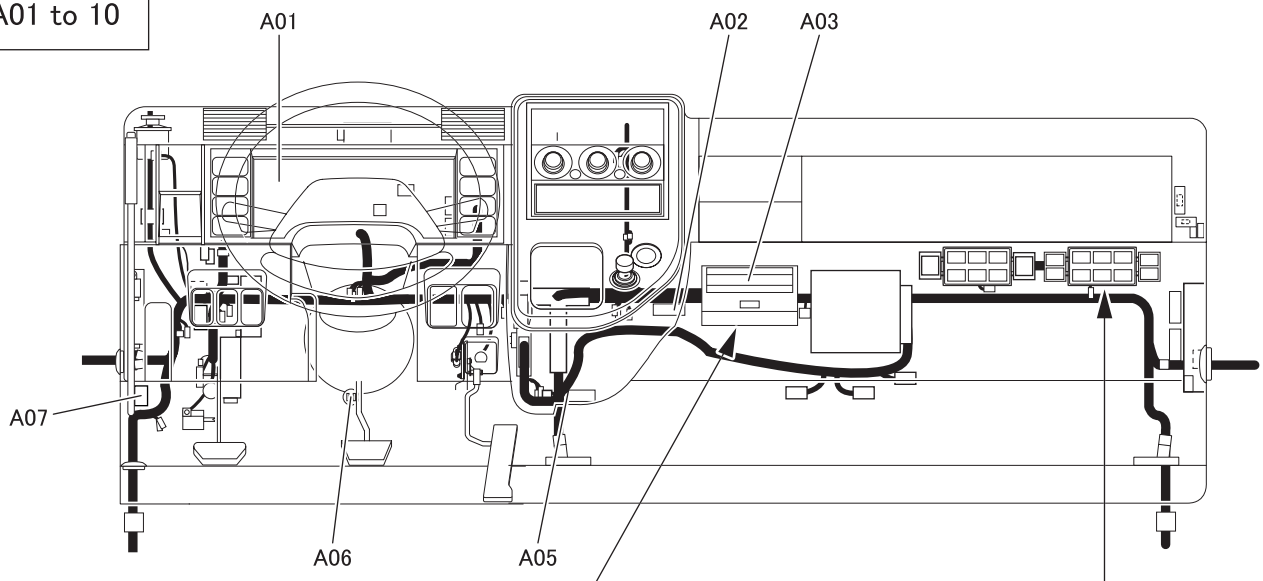
Standard value	Type (1)	1000 kΩ or above
	Type (2)	100 kΩ or above

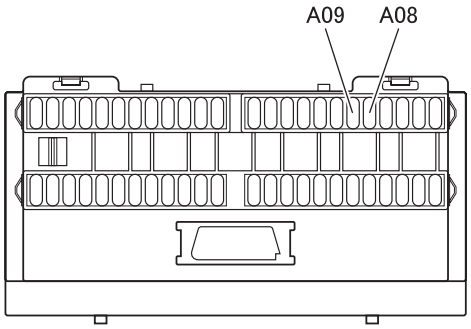
(3) Open circuit

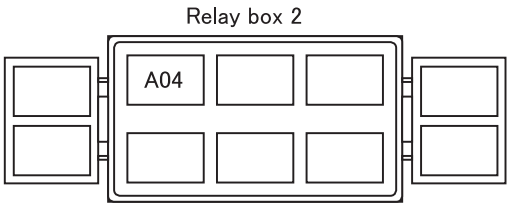
- If open circuit is suspected, remove the harness clamps and wiggle the harness to determine whether it is an intermittent fault or not. Check also the connector terminals for proper connection.

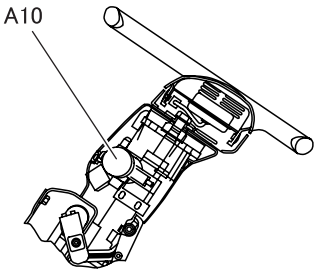
COMPONENT LOCATIONS

A01 to 10





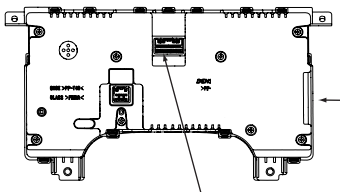




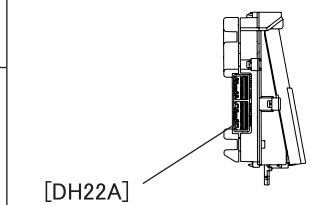
A01 Meter cluster
A02 Joint connector (J/C-1)
A03 Fuse box
A04 ABS exhaust brake cut relay
A05 Joint connector (J/C-M1)
A06 Stop lamp switch
A07 Multi-use tester connector
A08 Memory clear switch
A09 Diagnosis switch
A10 Starter switch

ABS : Anti-lock brake system
J/C : Joint connector

(Meter cluster backward view)



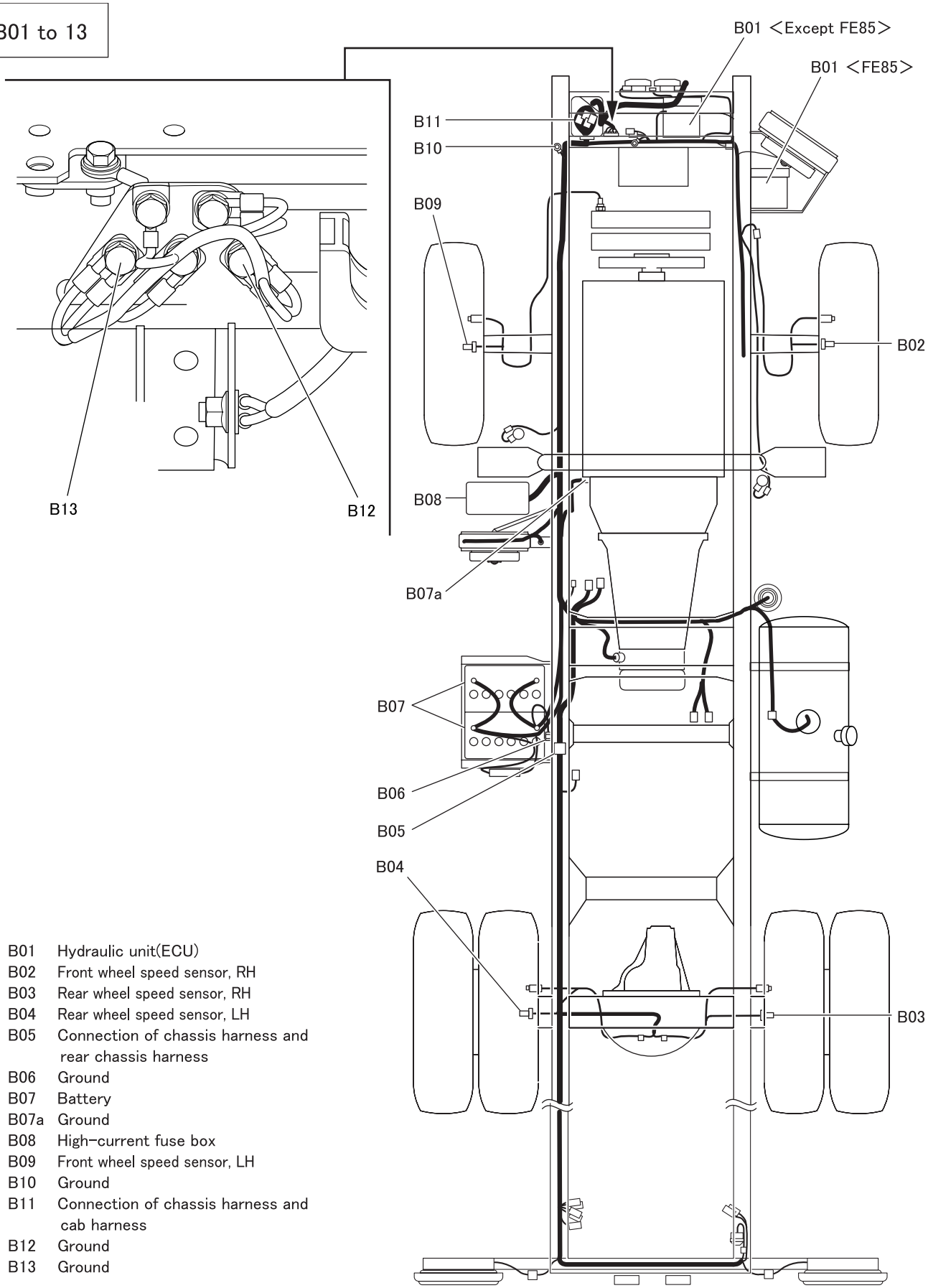
[DH20A]



[DH22A]

L02389

B01 to 13

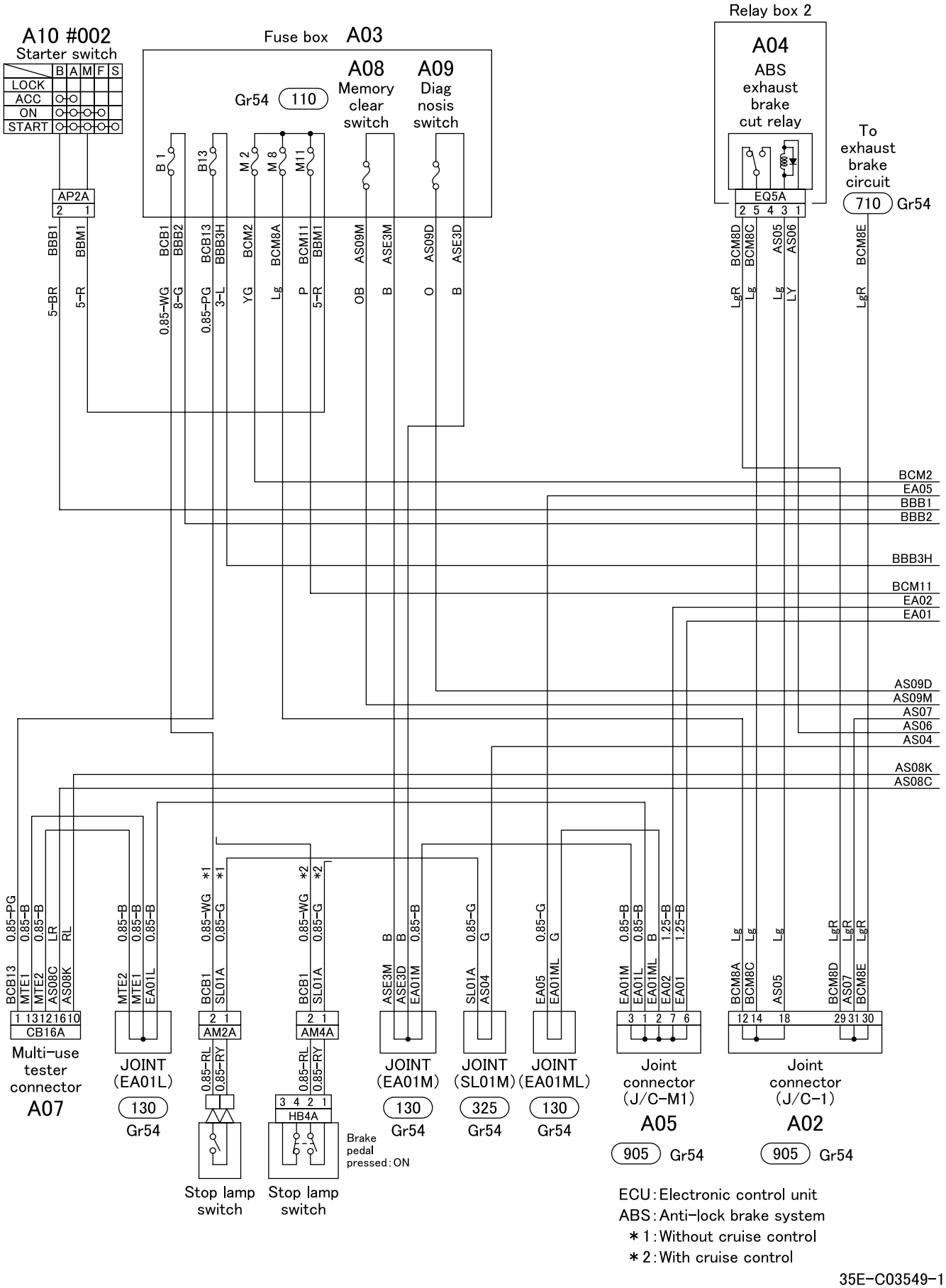


B01 Hydraulic unit(ECU)
B02 Front wheel speed sensor, RH
B03 Rear wheel speed sensor, RH
B04 Rear wheel speed sensor, LH
B05 Connection of chassis harness and rear chassis harness
B06 Ground
B07 Battery
B07a Ground
B08 High-current fuse box
B09 Front wheel speed sensor, LH
B10 Ground
B11 Connection of chassis harness and cab harness
B12 Ground
B13 Ground

ABS : Anti-lock brake system
ECU : Electronic control unit

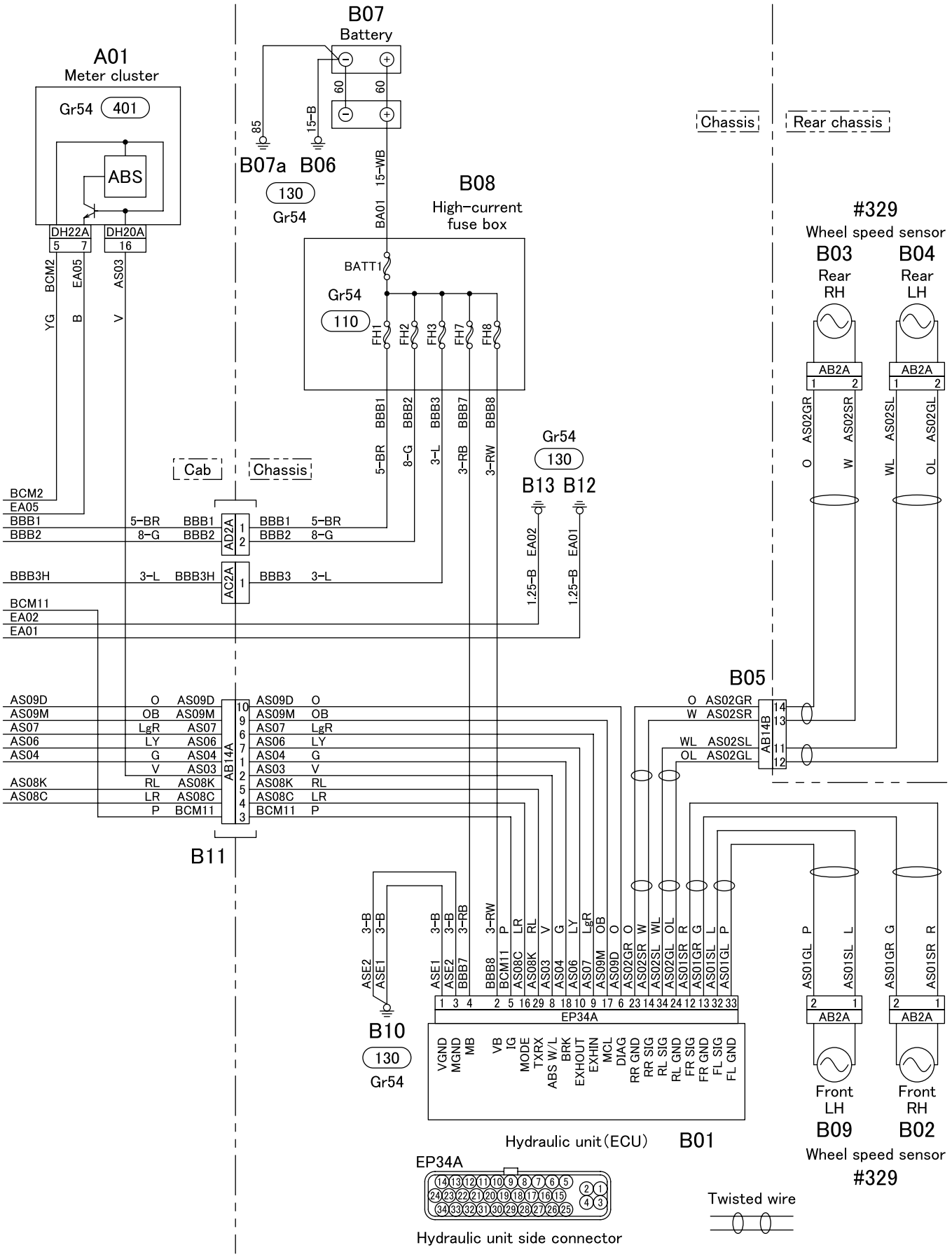
L02390

ELECTRICAL WIRING DIAGRAM



ECU : Electronic control unit
ABS : Anti-lock brake system
＊1 : Without cruise control
＊2 : With cruise control

35E-C03549-1


B07
Battery
A01
Meter cluster
Gr54 401
ABS
DH22A
5 7
DH20A
16
BCM2
EA05
AS03
YG
B
V
85
15-B
60
60
B07a B06
130
Gr54
15-WB
BA01
B08
High-current fuse box
BATT1
Gr54
110
FH1
FH2
FH3
FH7
FH8
BBB1
BBB2
BBB3
BBB7
BBB8
5-BR
8-G
3-L
3-RB
3-RW
Chassis
Rear chassis
Cab
Chassis
Gr54
130
B13 B12
EA02
EA01
1.25-B
1.25-B
#329
Wheel speed sensor
B03
Rear RH
B04
Rear LH
AB2A
AS02GR
AS02SR
AS02SL
AS02GL
O
W
WL
OL
BCM2
EA05
BBB1
BBB2
BBB3H
AD2A
AC2A
BCM11
EA02
EA01
B05
AB14B
AS09D
AS09M
AS07
AS06
AS04
AS08K
AS08C
AB14A
B11
ASE2
ASE1
ASE1
ASE2
BBB7
BBB8
BCM11
AS08C
AS08K
AS03
AS04
AS06
AS07
AS09M
AS09D
AS02GR
AS02SR
AS02SL
AS02GL
AS01SR
AS01GR
AS01SL
AS01GL
EP34A
B10
130
Gr54
VGND
MGND
MB
VB
IG
MODE
TXRX
ABS W/L
BRK
EXHOUT
EXHIN
MCL
DIAG
RR GND
RR SIG
RL SIG
RL GND
FR SIG
FR GND
FL SIG
FL GND
Hydraulic unit(ECU)
B01
Front LH
B09
Front RH
B02
Wheel speed sensor
#329
EP34A
Hydraulic unit side connector
Twisted wire

GROUP 36 INDEX

SPECIFICATIONS 36-2

STRUCTURE AND OPERATION
- **1. Components and Parts 36-3**
- **2. Parking Brake Lever 36-3**
- **3. Parking Brake 36-4**

TROUBLESHOOTING 36-5

ON-VEHICLE INSPECTION AND ADJUSTMENT
- **1. Adjustment of Parking Brake Shoe Clearance 36-6**
- **2. Inspection and Adjustment of Parking Brake Lever 36-7**

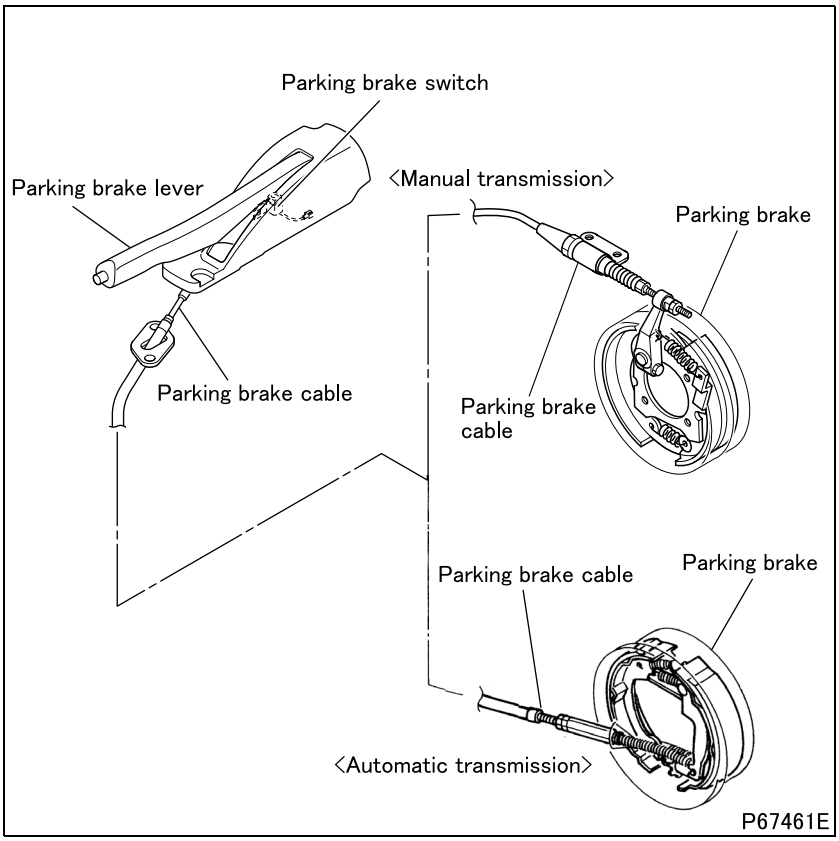
PARKING BRAKE CONTROL 36-8

PARKING BRAKE 36-12

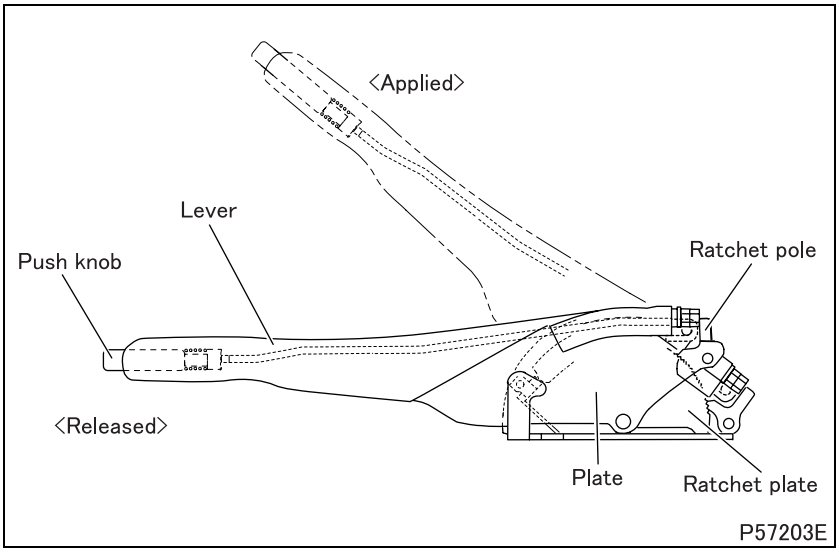
SPECIFICATIONS

Item			Specifications	
Brake	Type		Internal expanding, acting on propeller shaft (driveline parking brake)	
	Operation type		Mechanical cable	
Parking brake	Type		Duo servo type	
	Brake drum I.D.	mm {in}	ϕ190 {7.48}	ϕ203.2 {8.00}
	Lining width × thickness	mm {in}	45 × 4.0 {1.77 × 0.16}	50 × 4.0 {1.97 × 0.16}

1. Components and Parts



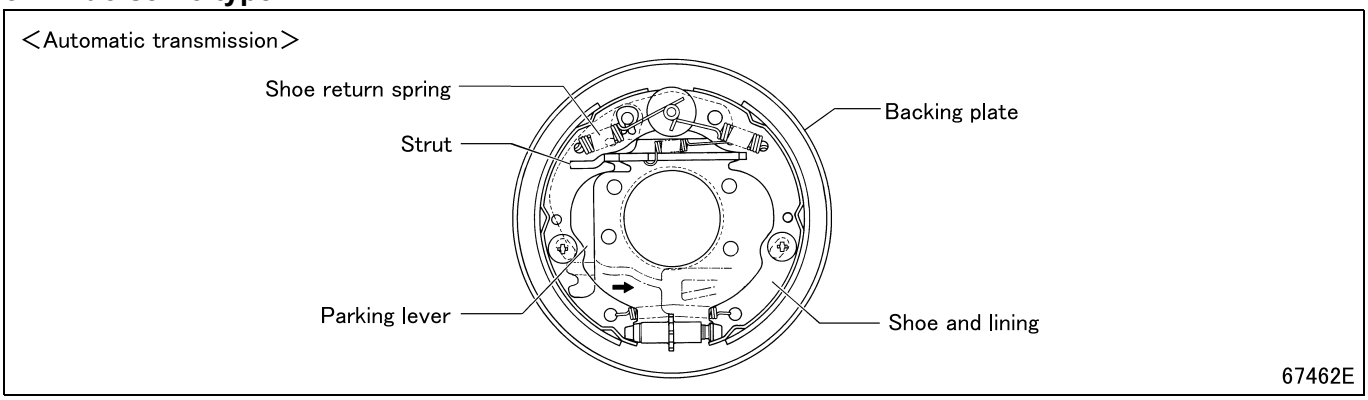
2. Parking Brake Lever



- Pulling the parking brake lever makes the parking brake work, at which point the ratchet pole engages with the ratchet plate and the lever is locked.
- To release the parking brake lever, slightly pull it up while pushing the release knob. This disengages the ratchet pole from the ratchet plate, allowing the parking brake lever to return to the released position.

3. Parking Brake

3.1 Duo servo type



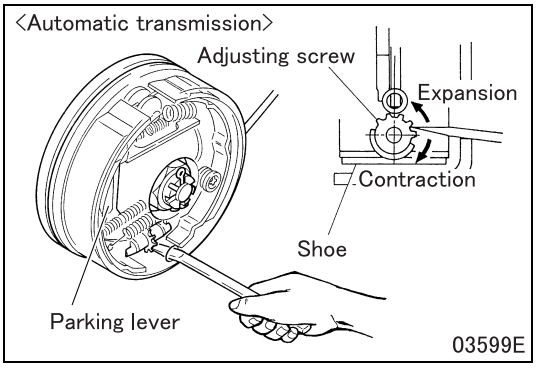
- The parking lever that actuates the shoe and lining is a built-in component of the parking brake body. Pulling the parking brake lever pulls the parking brake cable, which in turn pulls the parking lever.
- When the parking lever is pulled, one shoe and lining is forced to expand with the medium of strut. At the same time, the parking lever directly expands the other shoe and lining. Thus, each shoe and lining assembly works as a leading shoe.
- When the parking brake lever (parking lever) is returned to the released position, the repercussive force of the shoe return spring releases the brake.

Possible causes / Symptoms		Parking brake does not work	Parking brake release not smooth (dragging)	Parking brake lever operating physical force insufficient	Parking brake lever operating physical force excessive	Reference Gr
Parking brake cable	Inner cable stretched or damaged	O	O	O	O	
	Inner cable improperly adjusted	O	O	O	O	
	Front parking cable and rear parking cable improperly connected	O	O	O	O	
	Front parking cable and rear parking cable joints in poor contact	O	O	O	O	
Parking brake lever	Ratchet pole and ratchet plate pawl engaged improperly	O				
	Pulling stroke insufficient		O		O	
	Pulling stroke excessive	O		O		
Parking brake	Shoe clearance insufficient		O		O	
	Shoe clearance excessive	O		O		
	Parking brake drum inner surface deformed or warped	O		O		
	Lining worn unevenly	O		O		
	Brake drum inner surface greasy or oily	O				
	Lining surface greasy or oily	O				
	Shoe return spring fatigued or fractured		O			

1. Adjustment of Parking Brake Shoe Clearance

Service standards: mm {in}

Location	Maintenance item		Standard value	Limit	Remedy
–	Brake shoe clearance	Automatic transmission	0.2 to 0.25 {0.0079 to 0.0098}	–	Adjust



- Chock the front wheels and raise the rear wheels with a jack before adjusting the shoe clearance.
- Operate the parking brake lever to release the parking brake. (The parking lever or camshaft lever is released from locking.)
- Using a standard screwdriver inserted through the shoe adjusting hole in the parking brake drum, turn the adjusting screw in the C direction (expansion) shown to bring the shoe into close contact with the brake drum.
- Turn the adjusting screw 8 notches in the B direction (contraction) shown from the position where the shoe is in close contact with the drum. The shoe clearance should be adjusted to the standard value.

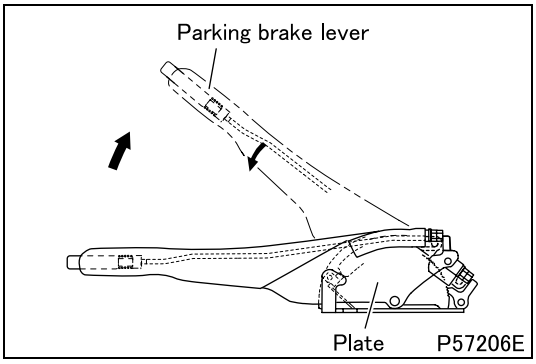
2. Inspection and Adjustment of Parking Brake Lever

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Parking brake lever pulling stroke (with operating physical operating of 300N {67 lbf})	7 to 9 notches	–	Adjust or inspect

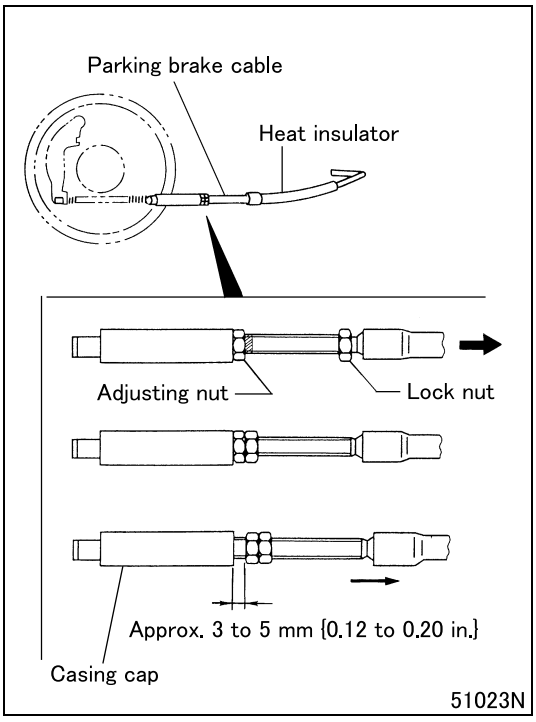
Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
–	Lock nut <Automatic transmission>	18.7 to 27.5 {14 to 20}	–



[Inspection]

- Pull the parking brake lever from the released position with an operating physical force of 300N {67 lbf} and count the number of cleared notches.
- If the count of notches deviates from the specified range of standard values, adjust the length of the parking brake cable.
- If the count of notches (pulling stroke) is still out of the specified range after cable length adjustment, check the parking brake shoe clearance.



<Automatic transmission>

- Pull the outer cable of the parking brake cable with a force of 60 to 100 N {13 to 22 lbf} to zero the parking brake shoe clearance.

CAUTION ⚠

- **When pulling the outer cable, take care not to move heat insulator on the parking brake cable out of place.**

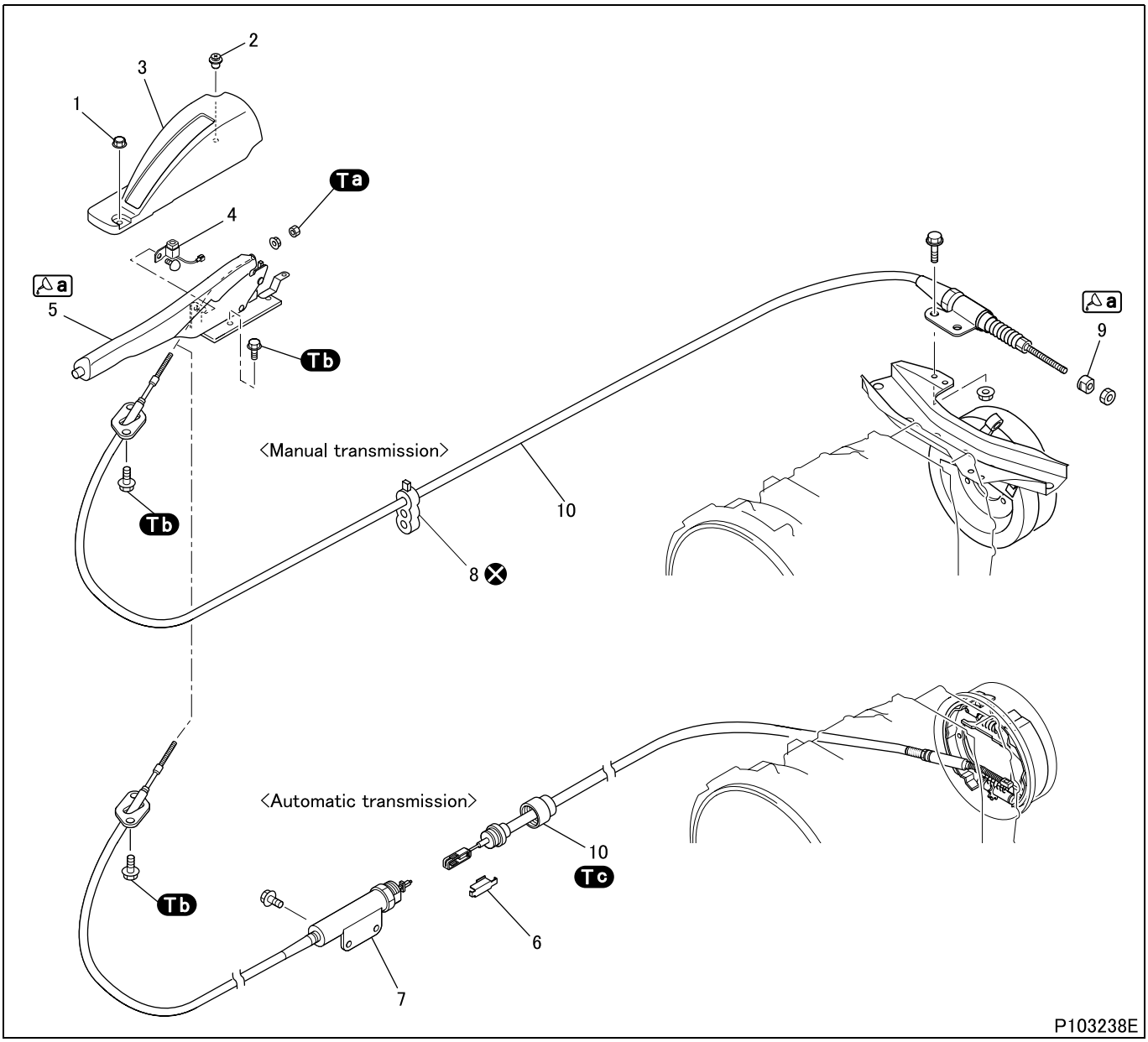
- While pulling the parking brake cable, tighten the adjusting nut until it seats the cable support end.
- Lock the adjusting nut with the lock nut.
- Operate the parking brake lever several times with the force of 500 N {110 lbf}.
- Pull the outer cable of the rear parking brake cable again with the force of 60 to 100 N {13 to 22 lbf}.

CAUTION ⚠

- **When pulling the outer cable, take care not to move heat insulator on the parking brake cable out of place.**

- Holding the parking brake cable in the pulled state, turn the adjusting nut until its distance from the casing cap becomes 3 to 5 mm {0.12 to 0.20 in} as shown in the illustration.
- Return the parking brake cable to the original position.
- Tighten the lock nut to the specified torque.

PARKING BRAKE CONTROL



●Removal sequence

1 Push nut
2 Push turn rivet
3 Cover
4 Parking brake switch
5 Parking brake lever
6 Cap <Automatic transmission>
7 Front parking brake cable <Automatic transmission>
8 Ball bushing <Manual transmission>
9 Parking brake cable <Manual transmission>
Rear parking brake cable <Automatic transmission>

●Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- **Perform the adjustment of the parking brake lever after installation (see ON-VEHICLE INSPECTION and ADJUSTMENT).**

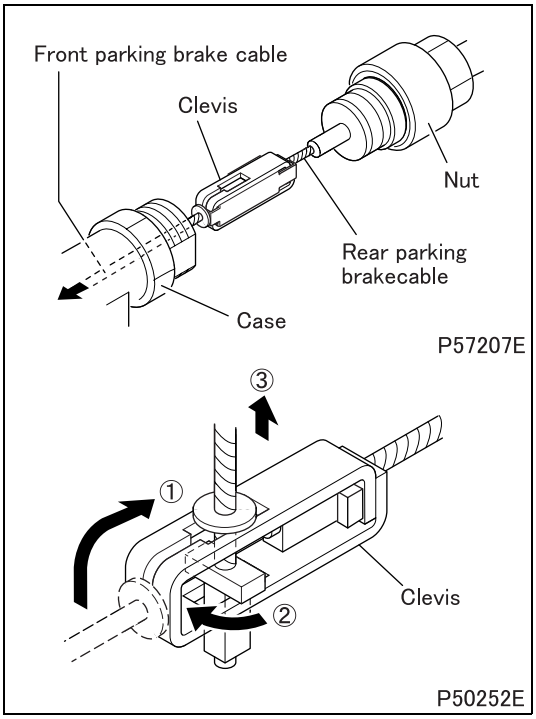
Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
Ta	Nut (parking brake cable attaching)	4 to 6 {3.0 to 4.4}	–
Tb	Bolt (parking brake lever mounting)	12 to 15 {8.9 to 11}	–
	Bolt (parking brake cable attaching)		
Tc	Rear parking brake cable to front parking brake cable connection <Automatic transmission>	62.5 ± 7.5 {46 ± 5.5}	–

Lubricant and/or sealant

Mark	Point of application	Specified lubricant and/or sealant	Quantity
a	Contact surfaces of parking brake lever	Chassis grease [NLGI No. 1 (Li soap)]	As required
	Spherical face of ball bushing <Manual transmission>		

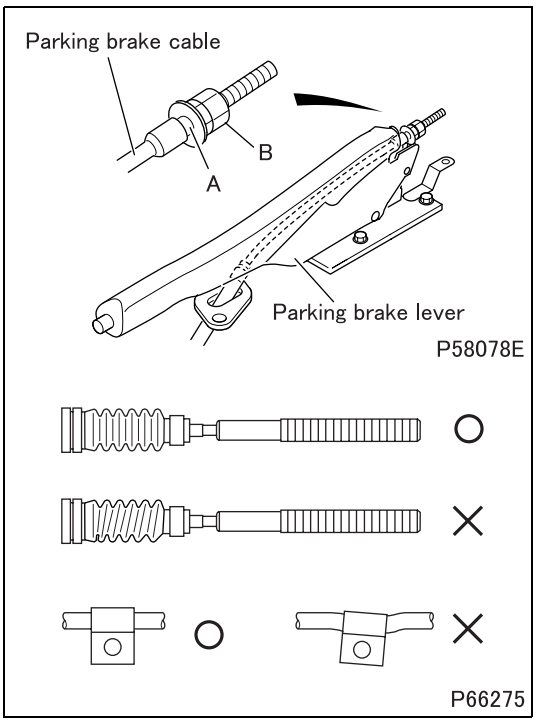
◆Removal procedure◆



■Removal: Front parking brake cable <Automatic transmission>

- Loosen the nut connecting the front and rear parking brake cables, then separate the front parking brake cable case from the rear parking brake cable.
- Remove the cap and pull out the clevis from the front parking brake cable case and remove it at the steps of 1, 2 and 3 in that order as shown.

◆Installation procedure◆

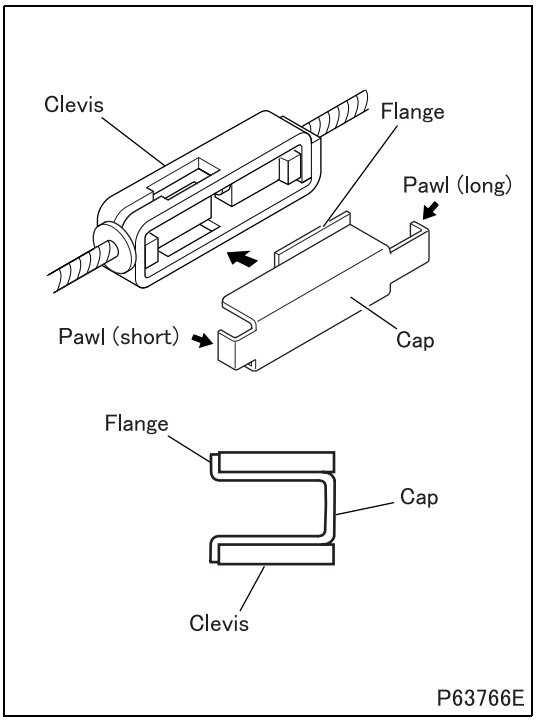


■ **Installation: Front parking brake cable or parking brake cable**

- Connect the front parking brake cable to the rear parking brake cable by following the removal procedure in reverse. <Automatic transmission>
- Attach the parking brake cable to the parking brake lever by fully tightening nut **A**, then tightening nut **B** to the specified torque.

CAUTION ⚠

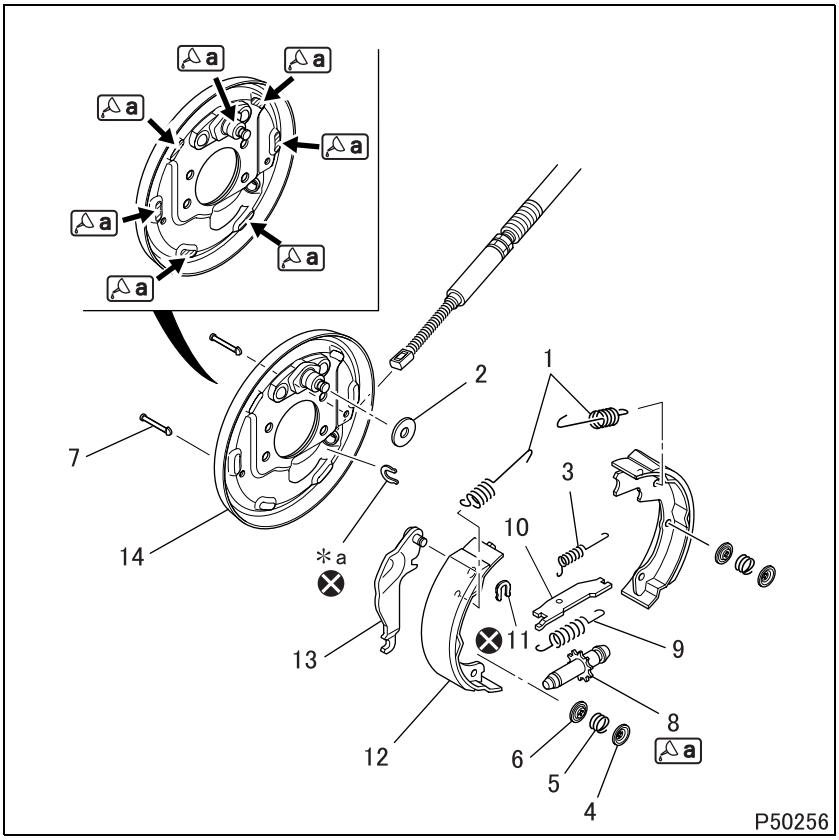
- **Cable bending radius must be at least 100 mm.**
- **The cable must not be bent at clamped portions.**
- **There must not be torsion in the boot.**
- **Avoid any interference with other components when routing the cable.**



■ **Installation: Cap <Automatic transmission>**

- Attach the cap to the clevis of the rear parking brake cable from the direction shown in the illustration.
- Fit the cap into the clevis all the way so that the flange of the cap comes out at the other side of the clevis.

M E M O



●**Disassembly sequence**

1 Shoe return spring
2 Washer
3 Strut spring
4 Shoe holddown cup
5 Shoe holddown spring
6 Shoe holddown cup
7 Shoe holddown pin
8 Adjuster
9 Adjuster spring
10 Strut
11 Retainer
12 Shoe and lining
13 Parking lever
14 Backing plate

***a**: Retainer
⊗: Non-reusable parts

●**Assembly sequence**

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **To prevent poor working of the brake, do not smear the surface of shoe and lining with grease or oil.**
- **When the shoe and lining has been replaced with a new one, always check it for contact with the parking brake drum.**

NOTE

- **Refer to Gr23 for parking brake removal and installation procedures.**

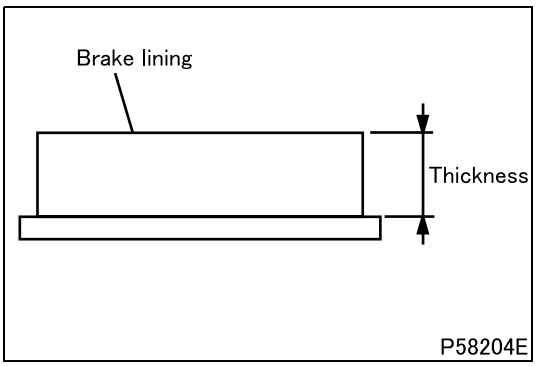
Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
1	Installed load of shoe return spring (installed length: 67.1 {2.64})	58.8 ± 5.9 N {13 ± 1.3 lbf}	49 N {11 lbf}	Replace
3	Installed load of strut spring (installed length: 49 {1.93})	29.4 ± 2.9 N {6.6 ± 0.7 lbf}	26 N {5.8 lbf}	Replace
5	Installed load of shoe holddown spring (installed length: 15.5 {0.61})	78.5 ± 7.9 N {18 ± 1.8 lbf}	71 N {16 lbf}	Replace
9	Installed load of adjuster spring (installed length: 78.2 {3.08})	58.8 ± 5.9 N {13 ± 1.3 lbf}	49 N {11 lbf}	Replace
12	Brake lining thickness of shoe and lining	4.0 {0.16}	1.4 {0.053}	Replace

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Adjuster ends in contact with shoe and lining	Brake grease (AKB100)	As required
	Backing plate anchor pin and surface in contact with shoe and lining		

◆Inspection procedure◆



■ **Inspection: Brake lining thickness of shoe and lining**

- If the measured value is lower than the limit, replace the shoe and lining.

INDEX

SPECIFICATIONS 37-2

STRUCTURE AND OPERATION
1. Steering System 37-4
2. Oil Flow 37-4
3. Power Steering Gear (Backlash Compensation Mechanism) 37-5
4. Power Steering Oil Pump <Kayaba Industry Product> 37-6
5. Power Steering Oil Pump <Unisia JKC Product> 37-8

TROUBLESHOOTING 37-10

ON-VEHICLE INSPECTION AND ADJUSTMENT
1. Change of Power Steering Fluid 37-12
2. Bleeding of Power Steering System 37-13
3. Performance Verification Test of Power Steering System 37-14
4. Steering Wheel Play 37-15
5. Steering Column Looseness 37-15
6. Inspection of Drag Link Ball Joint 37-15

STEERING COLUMN 37-16

POWER STEERING GEAR AND DRAG LINK 37-24

POWER STEERING OIL PUMP
<KYB Product> 37-42
<UNISIA JKC Product> 37-46

POWER STEERING OIL TANK 37-50

SPECIFICATIONS

Steering wheel, steering shaft and power steering gear

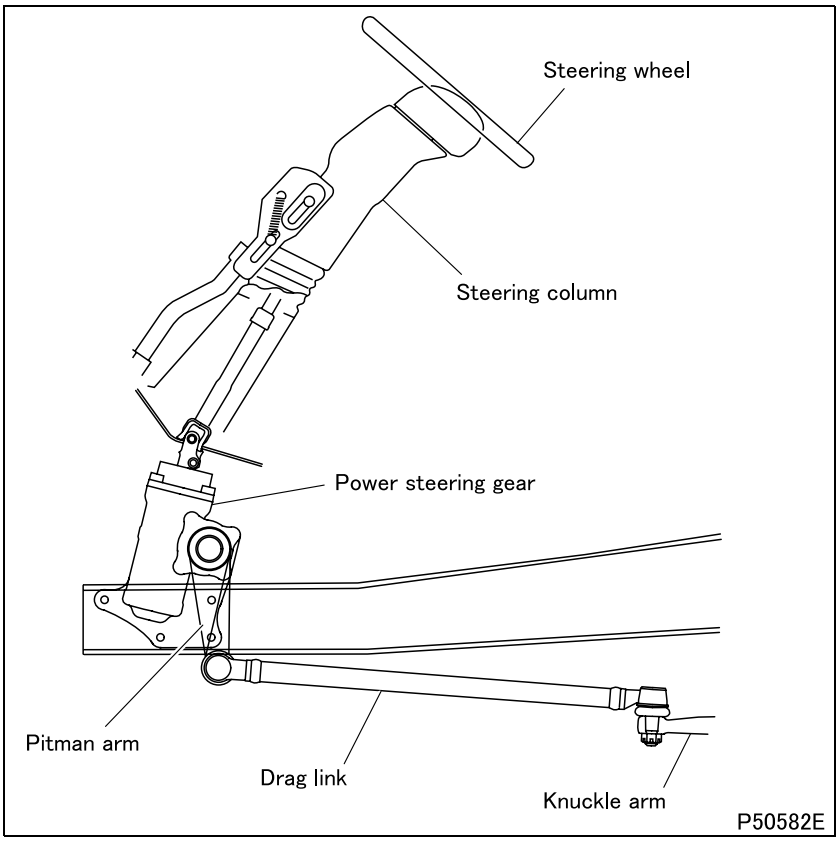
Item		Specifications
Steering wheel	Type	2-spoke type
	Outer diameter mm {in.}	400 {15.7}
Steering shaft	Type	Universal joint type (tilt and telescopic type)
Power steering gear assembly	Manufacturer	Unisia JKC Steering Systems
	Type	Ball nut type
	Form	Integral form
	Item number	448-00203
	Gear ratio	22.7
	Cylinder diameter mm {in.}	85 {3.35}

Power steering oil pump

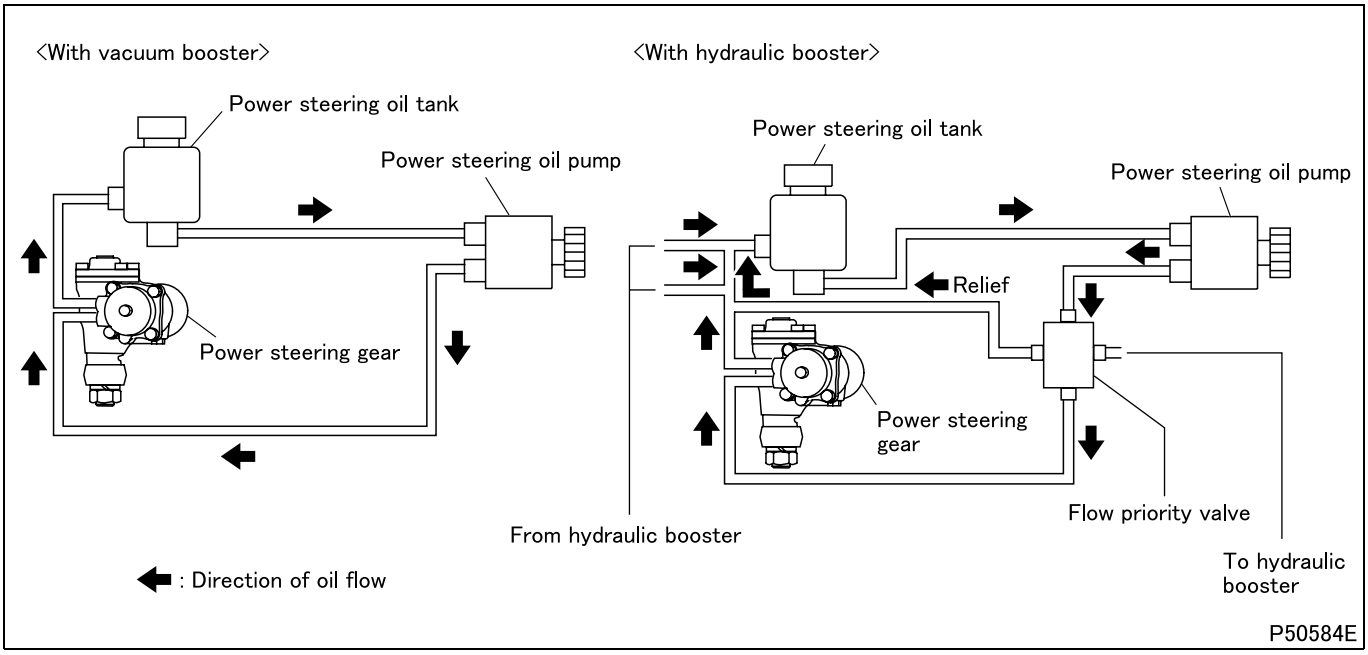
Item	Specifications	
	FE84	FE85
Manufacturer	Unisia JKC steering systems	KYB
Type	Vane type	
Manufacturer's item number	478-04302	B4220-13002
Delivery rate cm^3 {cu.in.}/rev.	9.6 {0.59}	13.6 {0.82}
Adjusted flow volume L {qts.}/min.	6 to 8 {6.3 to 8.5}	11 to 13 {12 to 14}
Adjusted pressure (relief valve) MPa {psi, kgf/cm^2}	$10.8\,^{+0.20}_{-0.49}$ {$1560\,^{+29}_{-71}$, $110\,^{+2}_{-5}$}	$12.3\,^{0}_{-0.49}$ {$1780\,^{0}_{-71}$, $125\,^{0}_{5.0}$}
Permissible revolutions rpm	600 to 6500	

M E M O

1. Steering System

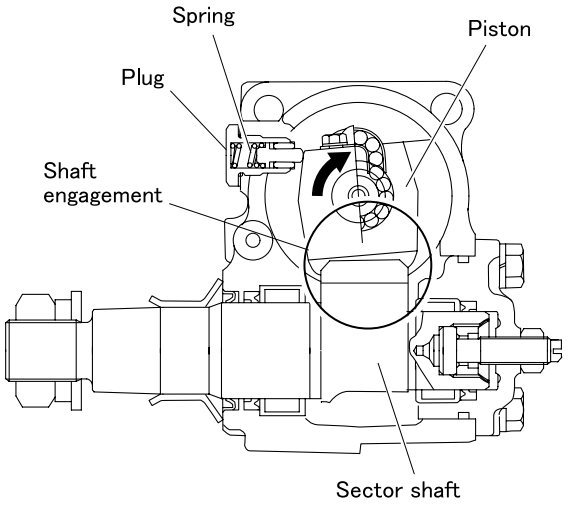


2. Oil Flow



- The power steering system with hydraulic booster is provided with a flow priority valve to reduce steering shock that occurs when the brakes are suddenly applied during steering wheel manipulation.

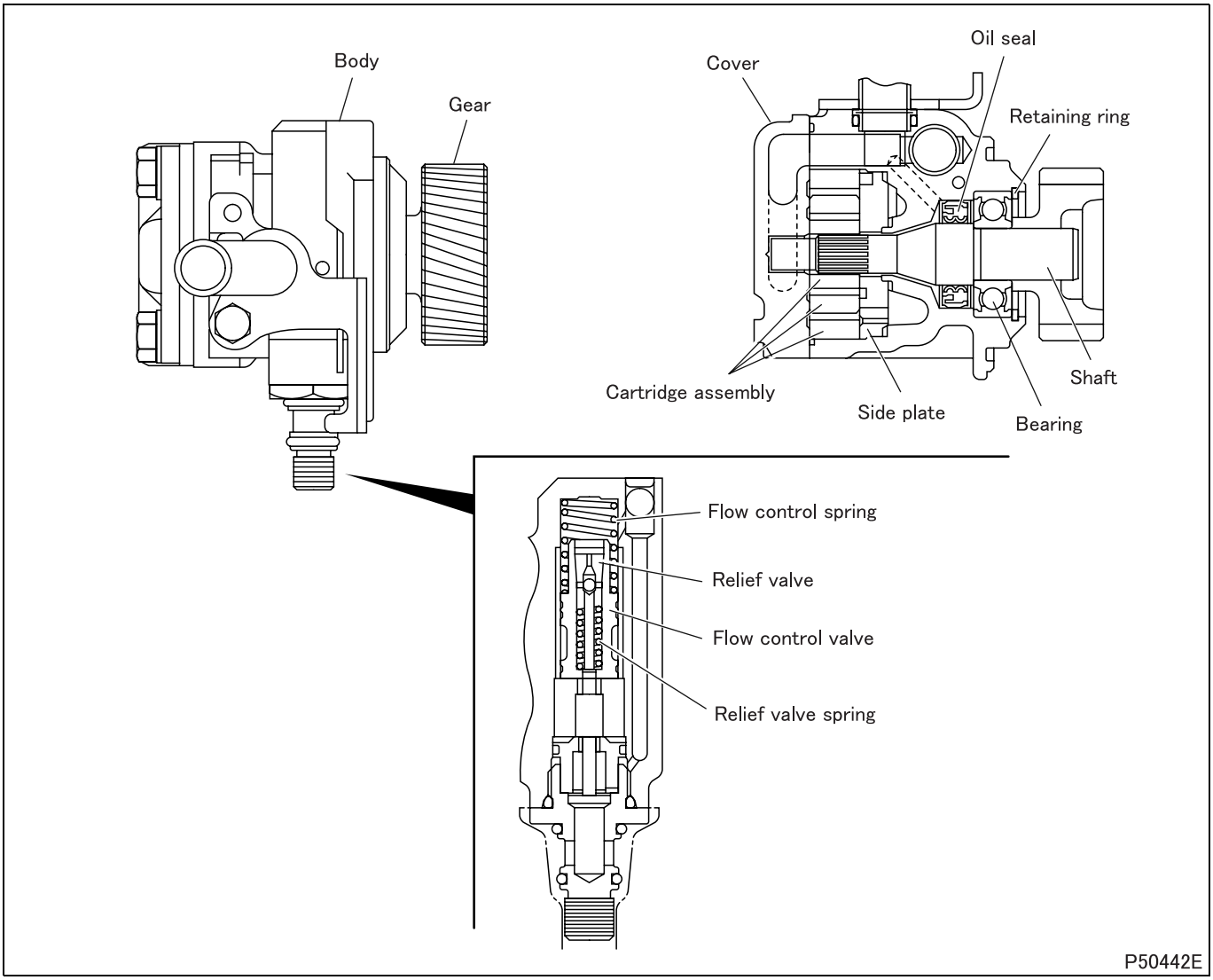
3. Power Steering Gear (Backlash Compensation Mechanism)



P67496E

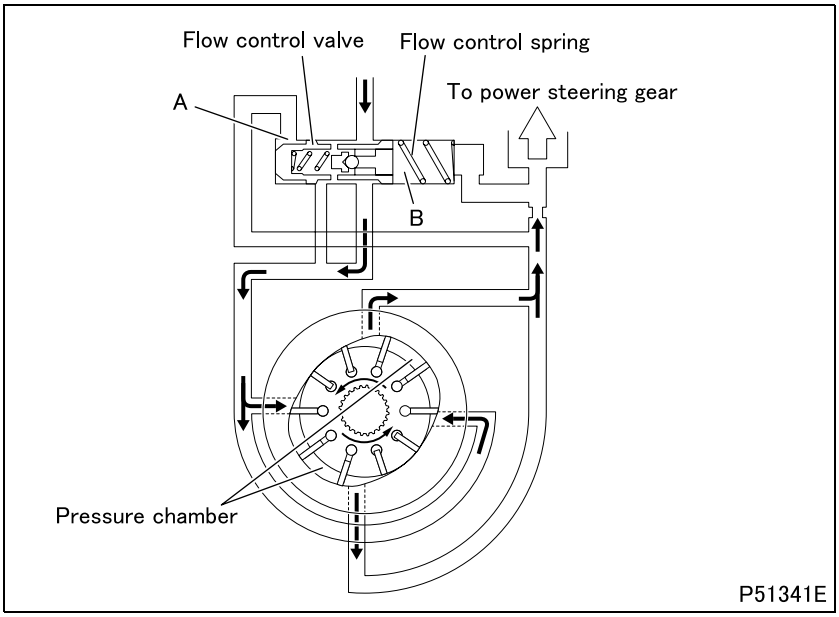
- The plug constantly presses the ball screw set shaft (piston in the case of Unisia JKC product) in the illustrated turning direction with the force of internal spring.
- This eliminates play between the ball screw set shaft and sector shaft where they are engaged to suppress backlash during straight travel, thus improving steerability.

4. Power Steering Oil Pump <KYB Product>



- The power steering oil pump is a hydraulic source pump with the vane in the rotor groove and is geared to the engine.
- The power steering oil pump consists of a cartridge assembly that discharges oil, a flow control valve that controls the oil flow rate and a relief valve that prevents free oil pressure rise.
- The flow control valve maintains constant the quantity of oil to the power steering gear during steering wheel manipulation.
  The relief valve is provided in the flow control valve to prevent oil pump pressure from rising beyond necessary level during stationary swing operation.

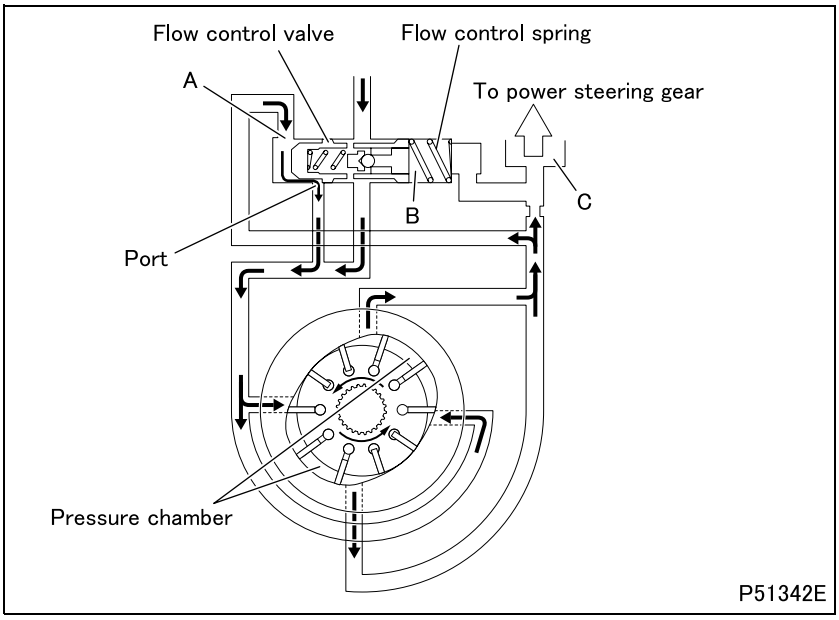
4.1 Flow control valve



(1) Operation of flow control valve

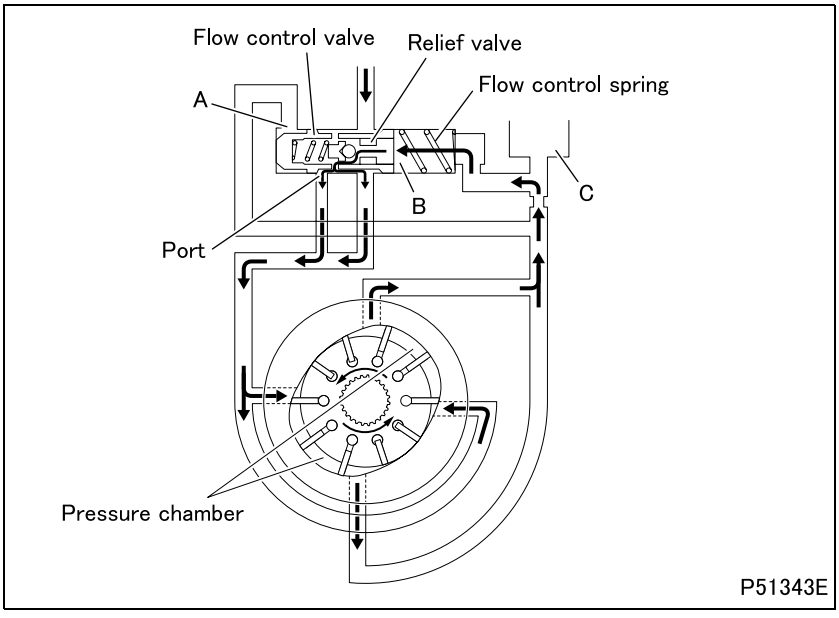
(1.1) When not functioning (oil pump in operation at low speed)

- Oil pressure in the chamber **A** is weaker than the combined force of oil pressure in the chamber **B** and tension of the flow control spring, and the flow control valve remains stationary.



(1.2) When functioning (oil pump in operation at middle to high speeds)

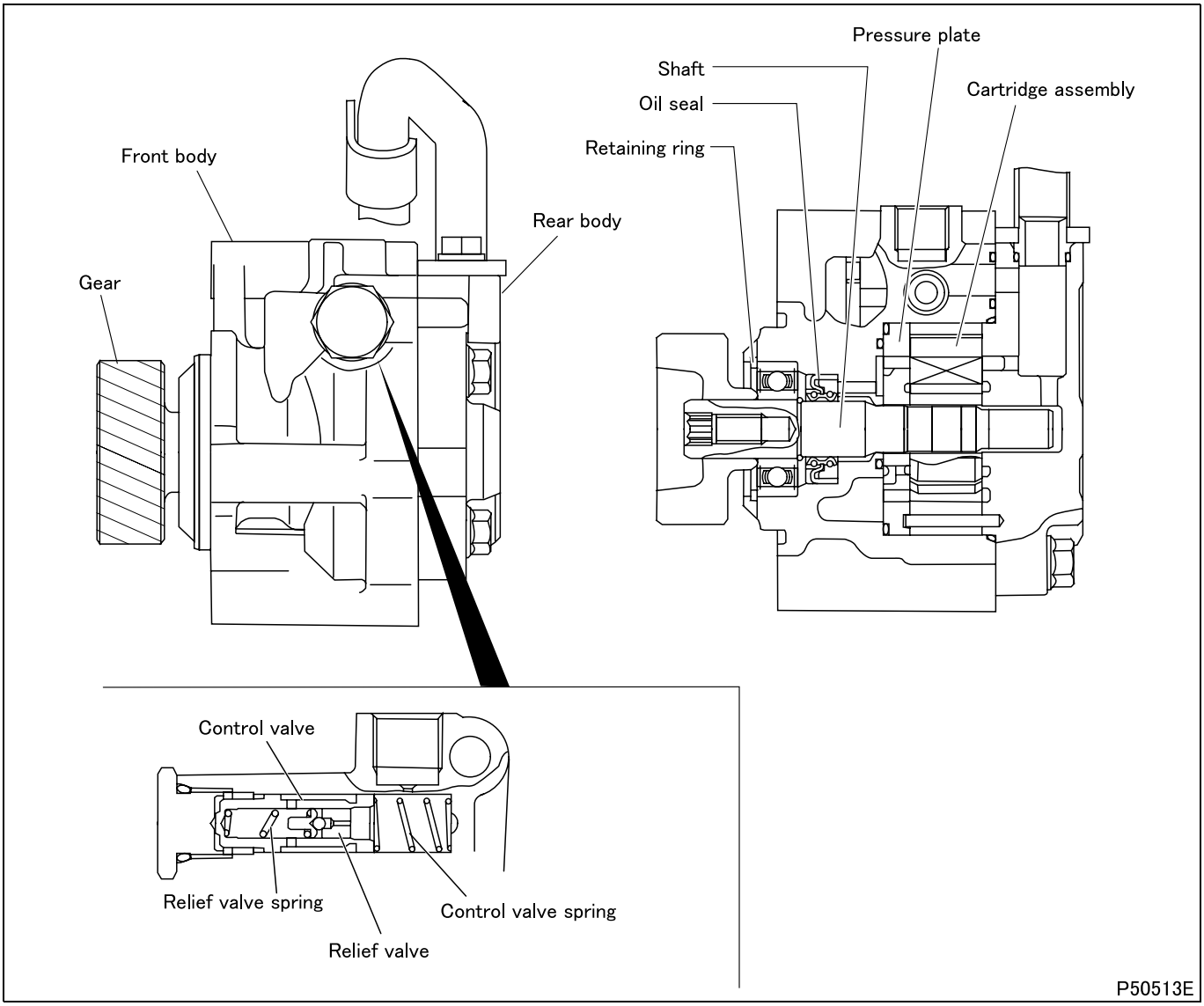
- Oil pressure in the chamber **A** overcomes the combined force of oil pressure in the chamber **B** and tension of the flow control spring, and the flow control valve is shifted.
- Port is made open to release oil pressure, and the flow rate from the chamber **C** is maintained constant.



(2) Operation of relief valve

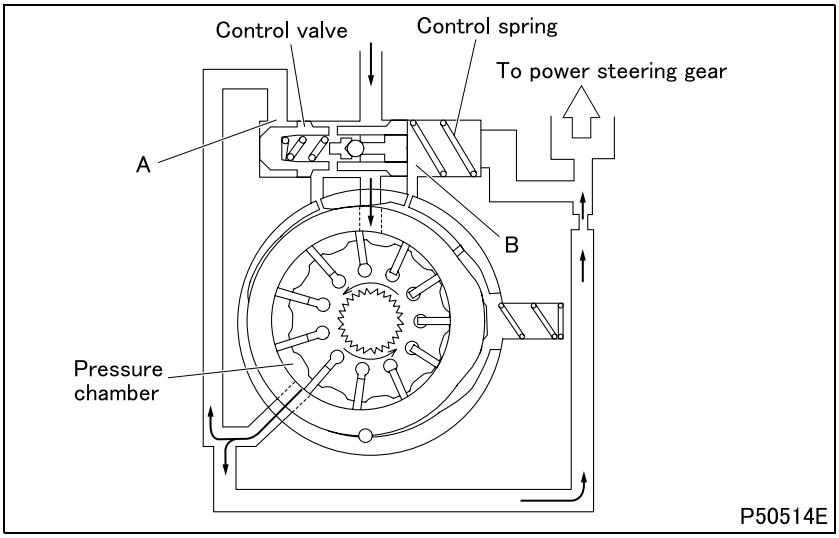
- When the combined force of oil pressure in the chamber **B** and tension of the flow control spring overcomes oil pressure in the chamber **A**, the flow control valve is shifted. Further increased oil pressure in the chamber **B** pushes the relief valve to open port, thus preventing excessive oil pressure from going to the chamber **C**.

5. Power Steering Oil Pump <Unisia JKC Product>



- The power steering oil pump is a hydraulic source pump with the vane in the rotor groove and is geared to the engine.
- The power steering oil pump consists of a cartridge assembly that discharges oil, a control valve that control the oil flow rate and a relief valve that prevents free oil pressure rise.
- The control valve maintains constant the quantity of oil to the power steering gear during steering wheel manipulation. The relief valve is provided in the control valve to prevent oil pump pressure from rising beyond necessary level during stationary swing operation.

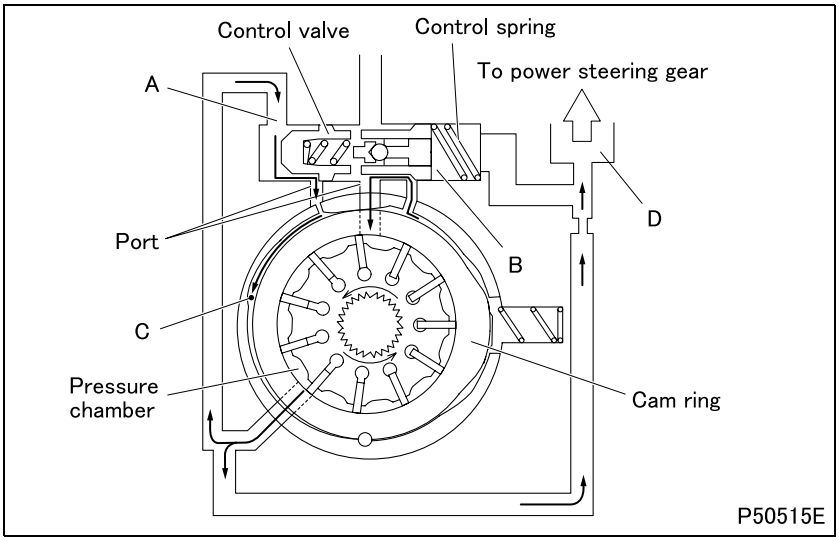
5.1 Control valve



(1) Operation of control valve

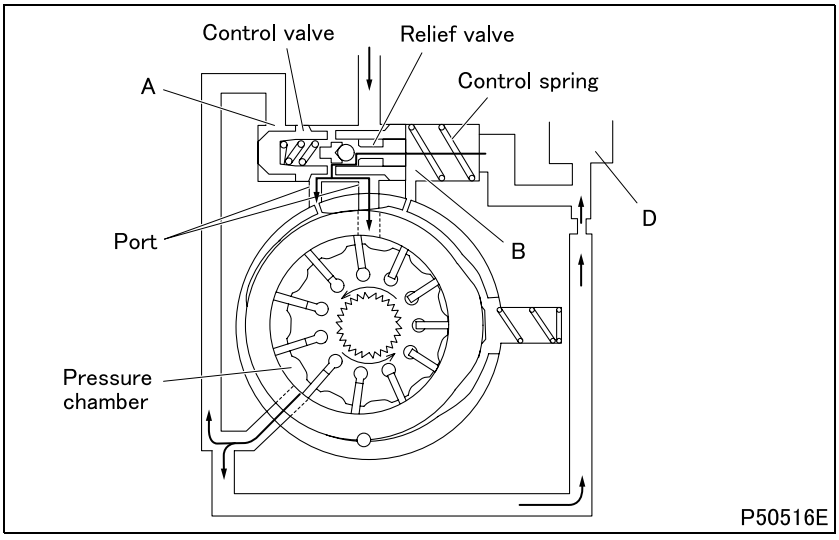
(1.1) When not functioning (oil pump in operation at low speed)

- Oil pressure in the chamber **A** is weaker than the combined force of oil pressure in the chamber **B** and tension of the control spring, and the control valve remains stationary.



(1.2) When functioning (oil pump in operation at medium to high speeds)

- Oil pressure in the chamber **A** overcomes the combined force of oil pressure in the chamber **B** and tension of the control spring, and shifts the control valve.
- Port is made open to release oil pressure in the chamber **A** into the chamber **C**, and the cam ring is shifted to right.
- This reduces the pressure chamber in capacity to decrease oil pump output per revolution, thus maintaining constant the flow rate from the chamber **D**.



(2) Operation of relief valve

- The combined force of oil pressure in the chamber **B** and tension of the control spring overcomes oil pressure in the chamber **A**, and the control valve is shifted.
  Increased oil pressure in the chamber **B** pushes the relief valve to open port, thus preventing excessive oil pressure from going to the chamber **D**.

Possible causes \ Symptoms		Steering wheel heavy to operate	Steering wheel play excessive and unstable	Steering wheel pulled to one side	Steering wheel vibration	Steering wheel return not smooth	Steering wheel does not turn	Steering angle insufficient or different between right and left	Oil leakage	Oil pump oil pressure abnormal	Noise from oil pump (grinding)	Noise from oil pump (squeaking)	Noise from oil pump (low whirring)	Reference Gr
Faulty power steering mechanism	Oil quantity insufficient	O	O											
	Oil quantity excessive								O					
	Air bleeding insufficient	O	O											
	Oil viscosity unsuitable	O												
	Hydraulic circuit clogged	O												
	Power steering gear assembly faulty	O	O	O	O	O	O							
	Power steering gear assembly improperly installed	O	O			O								
	Gear engagement rotating torque incorrectly adjusted	O				O								
	Pitman mounting position incorrect							O						
Faulty steering column and link mechanism	Steering shaft universal joint abnormally worn, or damaged	O	O											
	Link deformed	O						O						
	Drag link ball joint abnormally worn or damaged	O	O											
	Tie rod ball joint abnormally worn or damaged	O	O											
	Steering angle off center between left and right			O										
	Tie rod bent						O							
Faulty front axle, etc.	King pin poorly greased	O				O								
	Front wheel alignment (toe-in, camber and caster) incorrect	O		O	O	O								
	Thrust bearing damaged	O												
	Wheel hub bearing worn out or damaged		O	O	O									Gr26
	King pin or bushing worn out or damaged		O	O	O									
	Front axle deformed			O										
	Knuckle arm, tie rod arm, knuckle, etc. improperly tightened				O									
	Front spring U bolt, nut, etc. loose				O									Gr33A
	Front tire radial and lateral runout; static and dynamic balance incorrect				O									Gr31
	Front axle parts overtightened					O								Gr26
	Steering angle incorrectly adjusted						O	O						
	Mounted parts, connections loose		O											
	Knuckle stopper bolt improperly adjusted							O						

Possible causes \ Symptoms		Steering wheel heavy to operate	Steering wheel play excessive and unstable	Steering wheel pulled to one side	Steering wheel vibration	Steering wheel return not smooth	Steering wheel does not turn	Steering angle insufficient or different between right and left	Oil leakage	Oil pump oil pressure abnormal	Noise from oil pump (grinding)	Noise from oil pump (squeaking)	Noise from oil pump (low whirring)	Reference Gr
Faulty oil pump	Oil pump housing faulty								O					
	O-ring, oil seal faulty								O					
	Bolt improperly tightened								O					
	Maximum generated oil pressure insufficient									O				
	Oil line crushed or clogged									O				
	Air caught in oil pump										O			
	Oil pump interior seized									O	O	O		
	Mounting bolt and nut loose												O	
	Pump body faulty												O	
	Valve malfunctioning									O				
Faulty oil tank	Oil leakage from oil tank due to filling beyond capacity								O					
	Oil leakage from oil tank due to air caught inside								O					
Other abnormalities	Load excessive forward of load-carrying platform	O												
	Load excessive rearward of load-carrying platform		O											
	Load excessive on one side of loading bed			O										
	Difference excessive in wheelbase between left and right			O										
	Propeller shaft runout excessive				O									Gr25
	Rear axle housing bent			O										Gr27
	Final drive gear and final drive pinion damaged or improperly engaged				O									Gr27
	Tire pressure insufficient	O												Gr31
	Tire pressure excessive		O											
	Difference excessive in degree of wear between left and right tires			O										
	Left and right tires different in outer diameter			O										
	Front tire radial and lateral runout, static and dynamic balance incorrect				O									
	Braking force unbalanced			O										Gr35A, E

ON-VEHICLE INSPECTION AND ADJUSTMENT

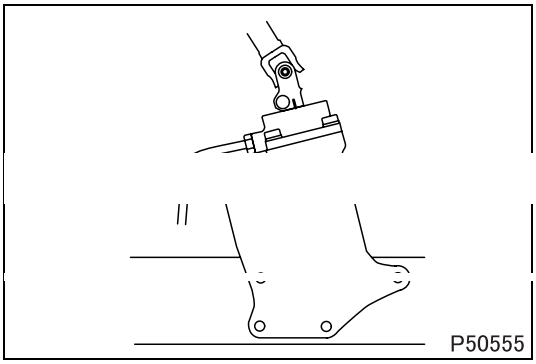
1. Change of Power Steering Fluid

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Feed pipe and return pipe	11.8 to 17.6 {8.7 to 13, 1.2 to 1.8}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Power steering oil tank	Automatic transmission fluid (DEXRON, DEXRON II or DEXRON III type)	Between MIN and MAX of power steering oil tank



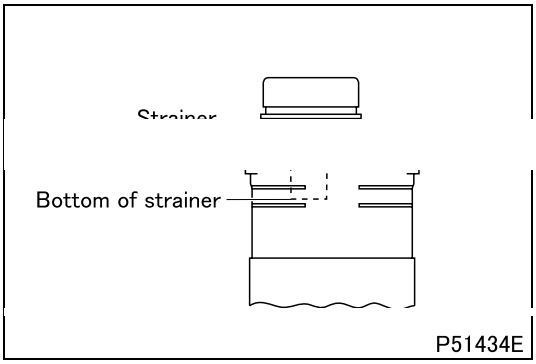
(1) Draining

- Jack up the front wheels.
- Loosen feed and return pipes connected to the power steering gear.

CAUTION ⚠

- **Clean the port area to prevent ingress of dirt, dust, and other foreign matters inside the power steering gear.**

- Repeatedly turn the steering wheel fully left and right to drain the fluid from the power steering gear.
- After draining the fluid, tighten the feed and return pipes to specified torque.



(2) Filling

- Pour fluid into the power steering oil tank up to the bottom of the strainer.

CAUTION ⚠

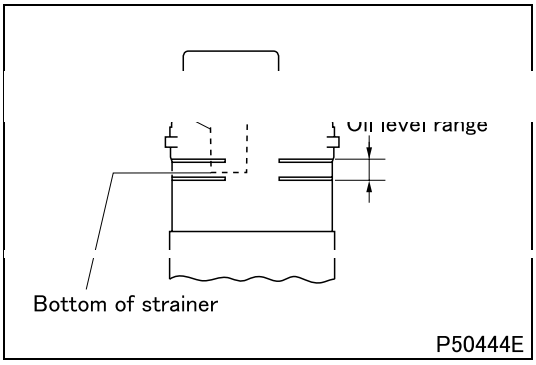
- **Power steering fluid is used for brake booster (hydraulic booster). Therefore, do not supply any other oil than power steering fluid such as brake fluid to the oil tank. <Hydraulic booster>**

- Bleed the power steering system of air.

2. Bleeding of Power Steering System

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Power steering oil tank	Automatic transmission fluid (DEXRON, DEXRON II or DEXRON III type)	Between MIN and MAX of power steering oil tank



- Pour fluid to the power steering oil tank up to the bottom of the strainer.

CAUTION ⚠

- **Power steering fluid is used for brake booster (hydraulic booster). Therefore, do not supply any other oil than power steering fluid such as brake fluid to the oil tank. <Hydraulic booster>**

- With the engine stopped, jack up the front wheels.
- Repeatedly turn the steering wheel fully left and right. When the fluid level has dropped, add fluid enough to maintain the fluid level within the specified range.
- Start the engine to idle.
- When the fluid level has dropped, stop the engine and add fluid enough to maintain the fluid level within the specified range.
- Restart the engine. While checking for a drop in fluid level, turn the steering wheel fully left and right and add fluid as much as necessary. Repeat this practice until the fluid level is stabilized within the specified range.
- Fully press the brake pedal (with a foot force of approximately 250 N {55 lbs., 25 kgf or more}) a few times. Repeat this until the fluid level is stabilized within the specified range. (In this case, there is no need to operate the steering wheel.) <Hydraulic booster>
- Turn the steering wheel fully left and right repeatedly.

CAUTION ⚠

- **To avoid seizure of the power steering oil pump, do not keep the steering wheel turned fully to left or right for more than 10 seconds when the engine is running.**

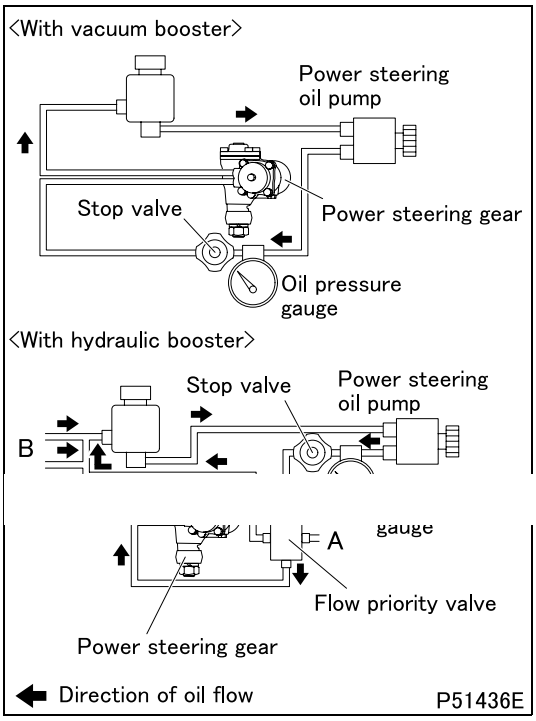
- If there is any abnormal noise or a fluid level fluctuation, air should be still trapped in the power steering system. Turn the steering wheel several times to raise the fluid temperature to approximately 60 to 80°C {140 to 175°F}.
- Stop the engine and wait for approximately five minutes.
- Lower the front wheels and turn the steering wheel several times. If there is no noise or fluid level fluctuation, the bleeding of the power steering system is completed.
- With the engine stopped, press the brake pedal several times and bleed the brake booster (hydraulic booster) by means of emergency pump. <Hydraulic booster)
- Repeat starting and stopping the engine several times to remove small air bubbles left in the power steering oil tank.
- If air bubbles are not removed completely, drive the vehicle for a while, then check for abnormal noise and oil level fluctuation.
- When bleeding is finished, check that fluid in the power steering oil tank is within the specified level range. Also check pipe and hose connections for fluid leaks.
- After bleeding is finished, check the brake booster (hydraulic booster) for performance (input and output characteristics). <Hydraulic booster>

3. Performance Verification Test of Power Steering System

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Power steering system fluid pressure (with hands off steering wheel)	With vacuum booster	490 kPa {71 psi, 5.0 kgf/cm^2}	–	Repair*
		With hydraulic booster	980 kPa {140 psi, 10.0 kgf/cm^2}	–	
–	Relief set pressure	With vacuum booster	$10.8\ ^{+0.20}_{-0.49}$ MPa {$1560\ ^{+29}_{-71}$ psi, $110\ ^{+2}_{-5}$ kgf/cm^2}	–	Replace
		With hydraulic booster	$12.3\ ^{0}_{-0.49}$ MPa {$1780\ ^{0.0}_{-71}$ psi, $125\ ^{0}_{-5}$ kgf/cm^2}	–	

*Check the power steering gear assembly and hydraulic circuit for clogging.



- Perform the following tests to verify normal operation of the power steering gear assembly and power steering oil pump.
  A: To hydraulic booster
  B: From hydraulic booster

- Install oil pressure gauge capable of measuring upward of 13.2 MPa {1910 psi, 135 kgf/cm^2} and stop valve between power steering oil pump and power steering gear <with vacuum booster> or flow priority valve <with hydraulic booster>, then bleed air.
- Start engine to idle.
- Turn steering wheel left and right several times to raise fluid temperature up to 50 to 60°C {122 to 140°F}.
- With the engine idling, fully open stop valve.

CAUTION ⚠

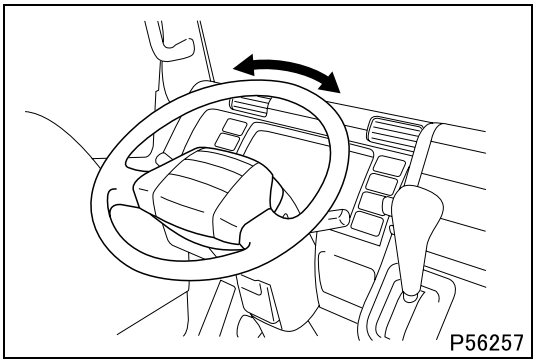
- **To avoid seizure of the power steering oil pump, never close the stop valve for more than 10 seconds.**

Test item	Test procedure	Assembly standard
Verification of smooth operation	• Jack up front wheels and turn steering wheel fully left and right.	Smooth operation throughout test
Measurement of fluid pressure in power steering system	• Measure fluid pressure with hands off steering wheel.	Specified standard value
Measurement of relief set pressure	• Gradually increase engine speed to 1000 to 1500 rpm, then close stop valve and measure maximum fluid pressure. • Do not close stop valve for longer than 10 seconds.	Specified standard value

4. Steering Wheel Play

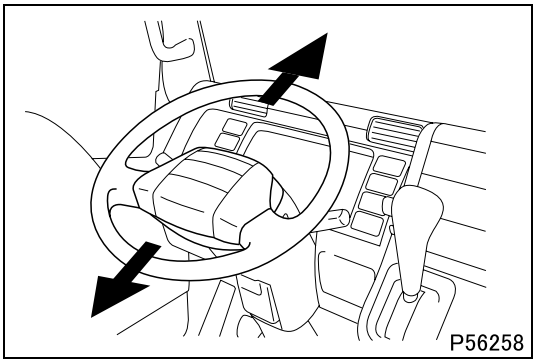
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Steering wheel play (measure at the periphery of steering wheel)	5 to 50 {0.2 to 2.0}	–	Adjust



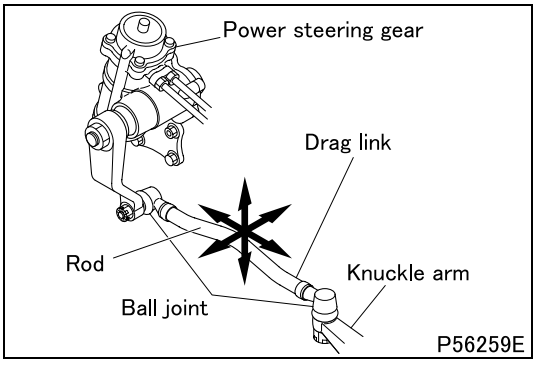
- With vehicle placed straight forward, start the engine and gently turn the steering wheel left and right to measure its peripheral play.
- If the play deviates from the standard value, check tightening points and the power steering gear.

5. Steering Column Looseness



- Push and pull the steering wheel by hand to check the steering column for looseness.
- With the steering column tilted all the way forward, pull the steering wheel backward and check the steering column for looseness.
- If the steering column is loose, adjust the tilting and telescoping lever.

6. Inspection of Drag Link Ball Joint

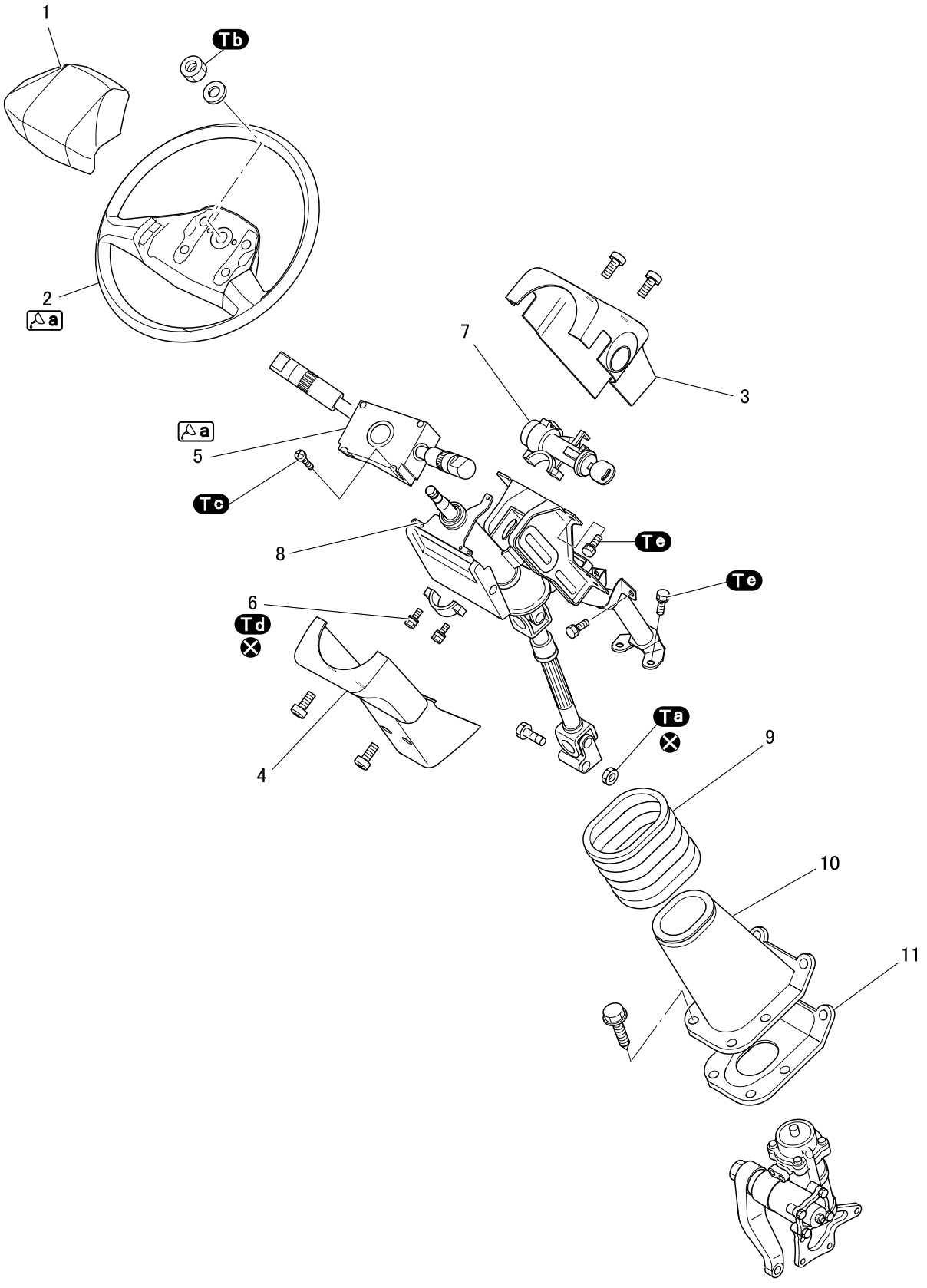


(1) Back lash

- With the vehicle in the stationary state, move the drag link by the rod in the forward, backward, vertical and lateral directions of the vehicle and check for play at the ball joints with the gear power steering gear and knuckle arm.
- If play is excessive, replace the drag link.

(2) Dust cover

- Check the dust cover for wear, cracks and other damage.
- If there is any abnormality, replace the dust cover.


1
Tb
2
a
7
3
a
5
Tc
8
Te
Te
6
Td
4
Ta
9
10
11
P67468

●Removal sequence

1 Horn pad
2 Steering wheel
3 Front column cover
4 Rear column cover
5 Combination switch
6 Twist-off bolt
7 Starter switch
8 Steering column
(For details, see later pages.)
9 Dust cover
10 Dust cover
11 Dust cover

⊗: Non-reusable parts

●Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- **After installation, check the steering column for looseness. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

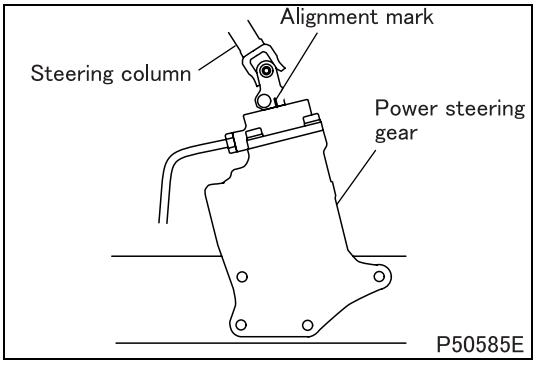
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (steering column and power steering gear mounting)	22 to 31 {16 to 23, 2.2 to 3.2}	–
Tb	Nut (steering wheel mounting)	39 to 49 {29 to 36, 4.0 to 5.0}	–
Tc	Screw (combination switch mounting)	2.5 ± 0.5 {1.8 ± 0.4, 0.3 ± 0.1}	–
Td	Twist-off bolt (starter switch mounting)	14.2 ± 1.5 {10 ± 1.1, 1.4 ± 0.2}	–
Te	Bolt (steering column assembly mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	–
Tf	Bolthorn (horn pad mounting)	7 to 11 {5.2 to 8.1, 0.7to 1.1}	

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Contact ring under steering wheel	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Horn contact piece on combination switch side		

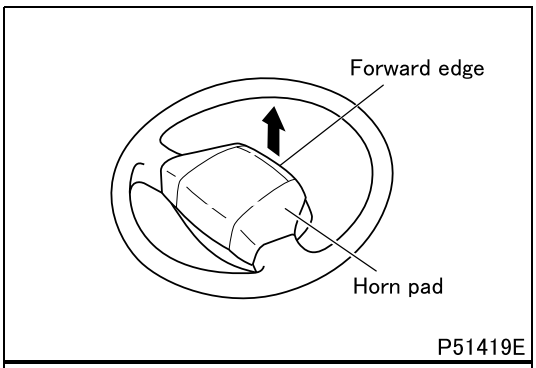
◆Work before removal◆



■ **Alignment mark: Steering column and power steering gear**

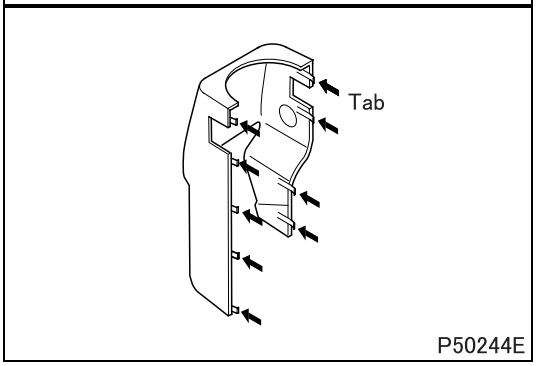
- Provide alignment marks on the steering column and power steering gear.

◆Removal procedure◆

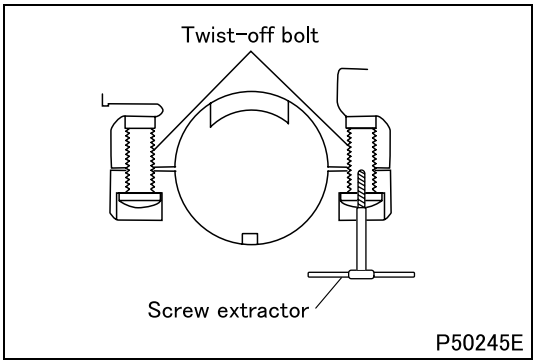


■ **Removal: Horn pad**

- Lift up the horn pad by the forward edge to remove from the steering wheel.

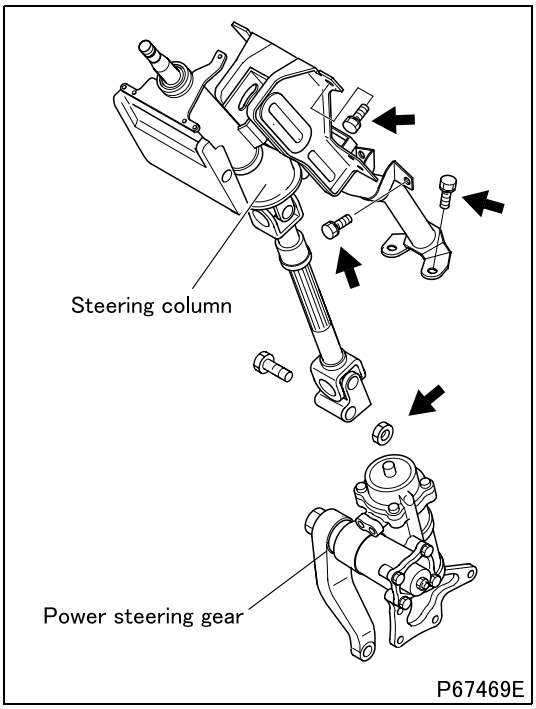


■ **Removal: Front column cover**



■ **Removal: Starter switch**

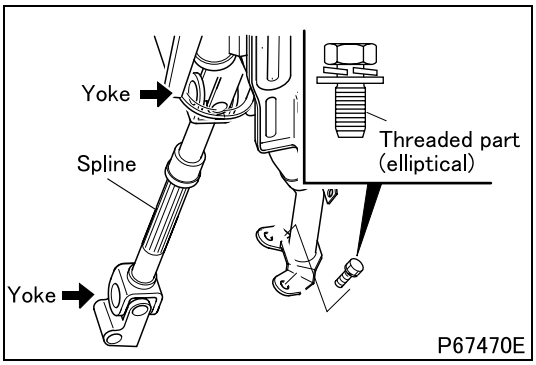
- Drill a hole of 5.5 to 6 mm {0.22 to 0.24 in.} in diameter to a depth of 10 to 15 mm {0.39 to 0.59 in.} in the twist-off bolt.
- Using the drilled hole, screw the screw extractor counterclockwise into the twist-off bolt and remove it.



■ **Removal: Steering column**

- To remove the steering column, remove the nut connecting it to the power steering gear, in addition to mounting bolts in the cab.

◆Installation procedure◆

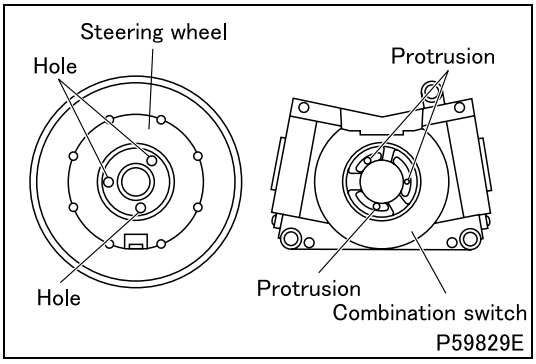


■ Installation: Steering column

- If the spline is off the steering column, assemble them with the yokes facing in the same direction.
- Install the steering column using the illustrated bolts. The threaded portion of these bolts is elliptical for grounding the horn circuit properly.

■ Installation: Starter switch

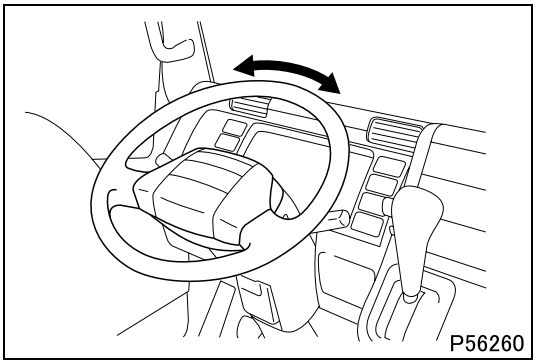
- Install the starter switch using new twist-off bolts. Tighten the bolts to specified torque to snap off their heads.



■ Installation: Steering wheel

- Align the three holes of the steering wheel with three protrusions of the cancel cam on the combination switch to attach the steering wheel.

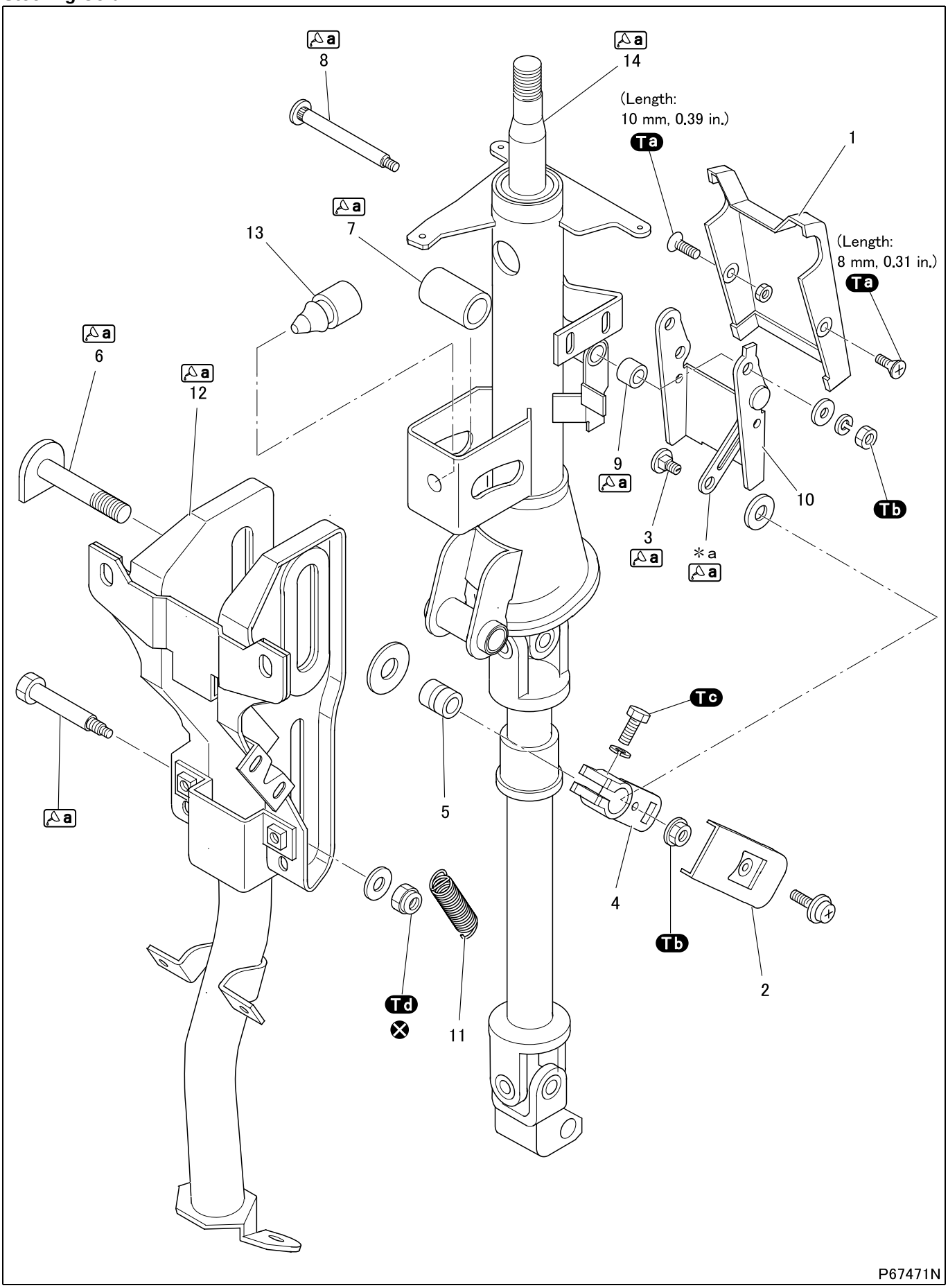
◆Inspection after installation◆



■ Inspection: Noise from steering wheel

- Lightly turn the steering wheel left and right and check for noise and other abnormalities.
- If any abnormality is found, disassemble the steering wheel, remove the cause and reinstall.

Steering Column



● Disassembly sequence

1 Lever cover
2 Lever protector
3 Pin
4 Lock lever
5 Nut
6 Bolt
7 Spacer
8 Pin
9 Collar
10 Tilting and telescoping lever
11 Spring
12 Steering column support
13 Shock absorbing rubber
14 Steering column

***a**: Link plate
⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

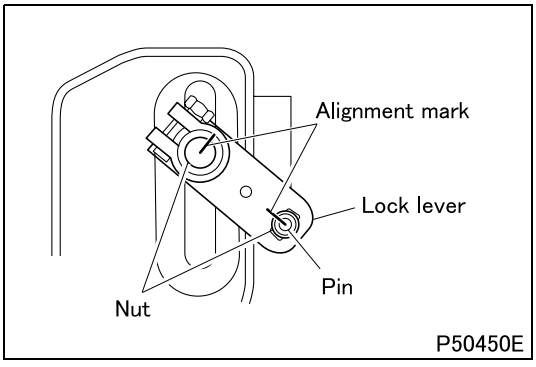
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (lever cover mounting)	1.0 to 1.5 {0.7 to 1.1, 0.1 to 0.2}	–
Tb	Nut (lock lever mounting)	3.9 to 5.9 {2.9 to 4.4, 0.4 to 0.6}	–
	Nut (tilting and telescoping lever mounting)		–
Tc	Bolt (lock lever mounting)	16 to 20 {12 to 15, 1.6 to 2.0}	–
Td	Nut (steering column support mounting)	9 to 14 {6.6 to 10, 0.9 to 1.4}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Friction surface of pin	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Friction surface of collar		
	Staked area of link plate		
	Friction surface and thread of bolt		
	Friction surface of spacer		
	Friction surfaces of steering column support and steering column		
	Friction surface of bolt		

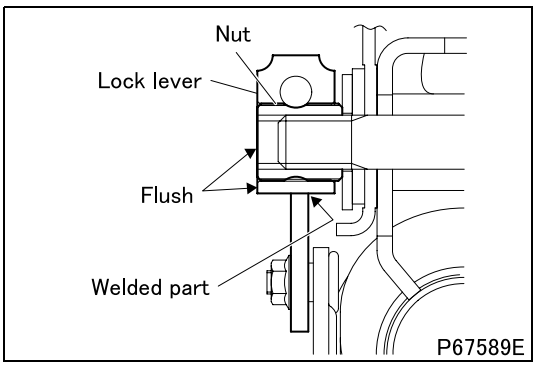
◆Work before removal◆



■ Alignment mark: Nut and lock lever

- Be sure to provide alignment marks on the lock lever and nuts before removal.

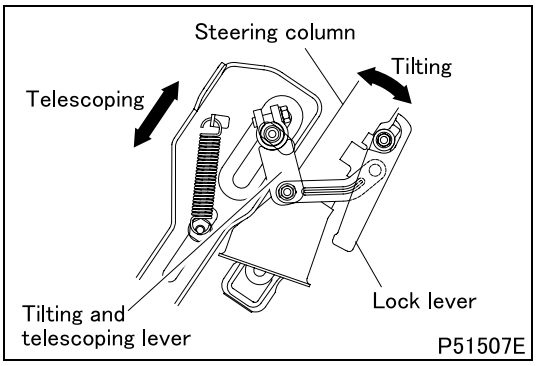
◆Installation procedure◆



■ **Installation: Lock lever**

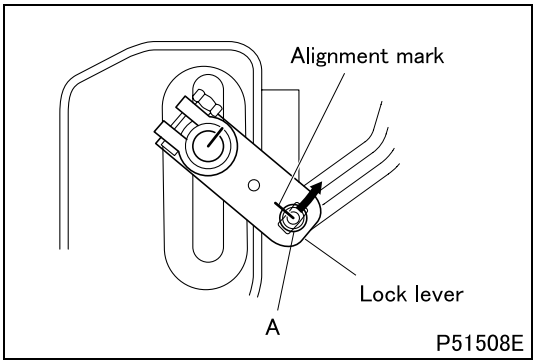
- Install the lock lever flush with the nut, with the welded part facing in the illustrated direction.

◆Inspection after installation◆



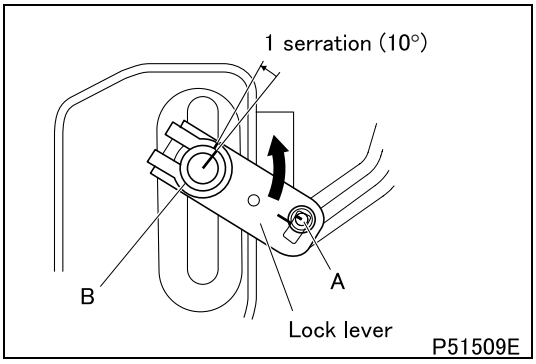
■ **Inspection: Tilting and telescoping lever operating force**

- Tilt the steering column all the way forward and telescope it to the mid-point of the movable range.
- Push the tilting and telescoping lever in and lock the steering column. In this state, check that the force required to operate the tilting and telescoping lever is 140 N {31 lbs, 14 kgf} or more.
- Push the steering column forward by hand to check that it is securely held.
- Adjust the installed position of the lock lever if necessary.



■ **Adjustment: Lock lever**

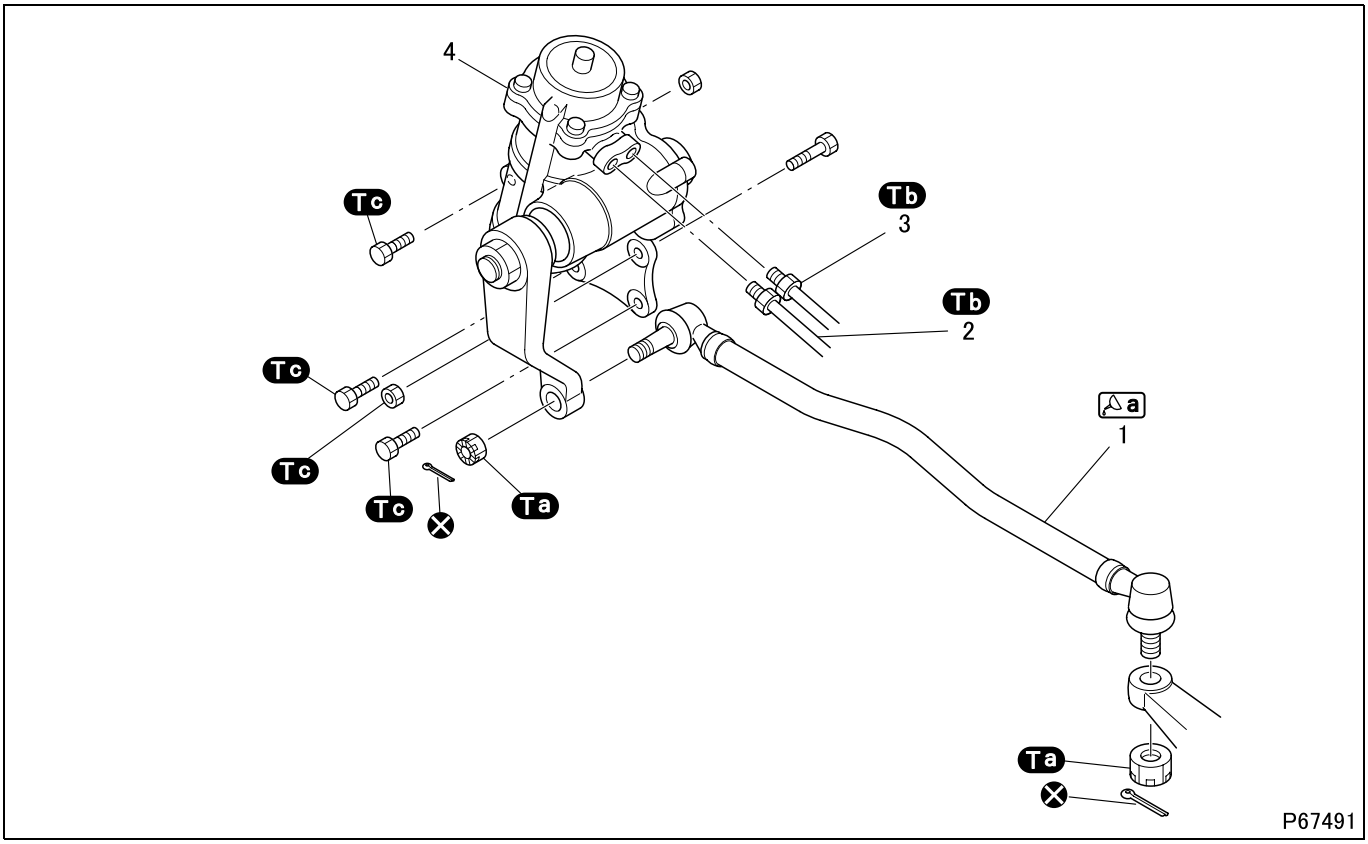
- Loosen nut **A**.
- Move the lock lever to relocate the nut **A** in the slot from the alignment mark in the arrow direction, then tighten the nut **A** in that position.



- If the nut **A** is already at the end of the slot in the lock lever and cannot be relocated, remove the lock lever and turn the nut **B** one serration (10°) from the alignment mark in the arrow direction, then reinstall the lock lever.
- Adjust the tightening position of the nut **A** so that the tilting and telescoping lever operating force becomes 140 N {31 lbs, 14 kgf} or more.

M E M O

POWER STEERING GEAR AND DRAG LINK



● **Removal sequence**

1 Drag link
2 Feed pipe
3 Return pipe
4 Power steering gear
⊗: Non-reusable parts

CAUTION ⚠

- **When removing the drag link, take care not to deform or damage the dust cover.**
- **Do not attempt to disassemble the drag link because it is of a unit construction.**

● **Installation sequence**

Follow the removal sequence in reverse.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
1	Drag link ball joint	Play (± 980 N {220 lbs ± 100 kgf} loaded)	0.1 to 5.9 N·m {0.1 to 4.4 ft.lbs, 0.01 to 0.6 kgf·m}	–	Replace
		Rotational Torque	1.0 to 5.9 N·m {0.1 to 4.4 ft.lbs, 0.1 to 0.6 kgf·m}		

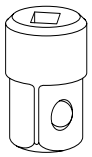
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (drag link mounting)	137 to 196 {100 to 145, 14 to 20}	–
Tb	Feed pipe and return pipe	11.8 to 17.6 {8.7 to 13, 1.2 to 1.8}	–
Tc	Bolt or nut (power steering gear mounting)	83.5 to 108 {61 to 80, 8.5 to 11}	–

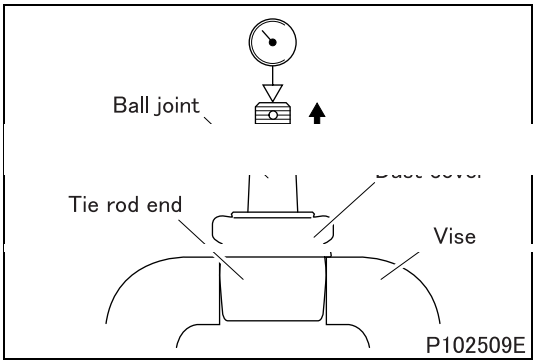
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Lip area of drag link ball joint dust cover	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools

Mark	Tool name and shape	Part No.	Application
a	Preload socket  P48876	MB990326	Measurement of drag link ball joint turning torque

◆Inspection procedure◆



■ **Inspection: Drag link**

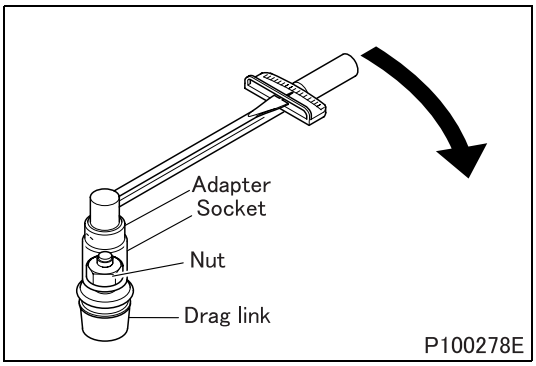
(1) Play

- Fix the tie drag link with a vise.

CAUTION ⚠

- **Take care not to deform or damage the dust cover when fixing it with a vise.**

- If measured value deviates from the standard value with applying the specified load (push and pull) to the ball joint, replace the tie drag link.



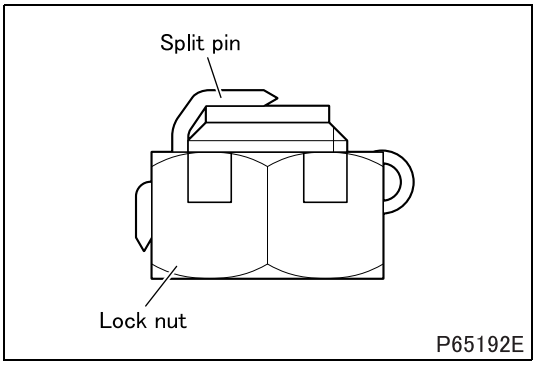
(2) Rotation torque

- Install the drag link mounting nut on the drag link.
- Install the socket, adapter and torque wrench to measure the rotation torque.
- If the measured value deviates from the standard value, replace the drag link.

(3) Dust cover

- Check the dust cover for wear, cracks and other damage. These abnormalities may cause water infiltration to the ball joint and wear out it at early stage.
- If any abnormality is found in the dust cover, replace the drag link.

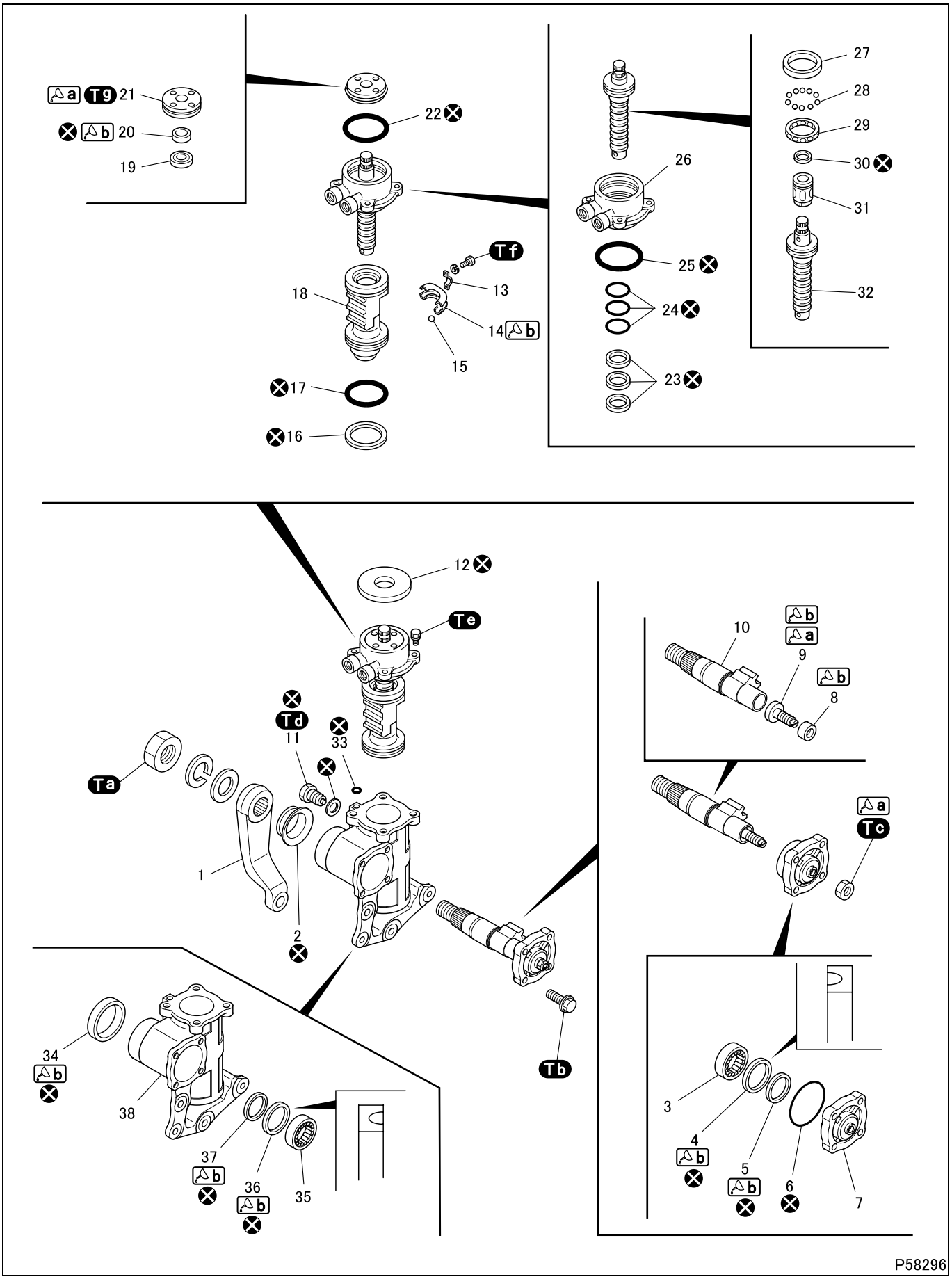
◆Installation procedure◆



■ **Installation: Drag link**

- Align a slot in the lock nut with the split pin hole in the ball joint by turning the lock nut in the tightening direction while checking the torque is within the specified range, then install the split pin as shown in the illustration.

Power Steering Gear



● Disassembly sequence

1 Pitman arm
2 Dust cover
★3 Needle bearing
4 Y-packing
5 Backup ring
6 O-ring
7 Side cover
★8 Retainer
★9 Adjusting screw
10 Sector shaft
11 Plug
12 Dust cover
13 Ball tube clip
14 Ball tube
15 Steel ball
16 Seal ring
17 O-ring
18 Piston
19 Ball bearing
20 Oil seal
21 Adjusting plug
22 O-ring
23 Seal ring
24 O-ring
25 O-ring
26 Valve housing
27 Side race
28 Steel ball
29 Bearing cage
30 Seal ring
31 Rotor
32 Worm and stub shaft
33 O-ring
34 Oil seal
★35 Needle bearing
36 Y-packing
37 Backup ring
38 Body

⊗: Non-reusable parts

NOTE

- **Do not remove parts marked ★ unless absolutely necessary.**

CAUTION ⚠

- **When holding the body with a vise, take care not to scratch the gasket seated surface of plug.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Repair kit

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Power steering gear	Starting torque	0.88 N·m {0.6 ft.lbs, 0.1 kgf·m} or less	–	Adjust
		Engaging torque	0 to 0.25 N·m {0 to 0.2 ft.lbs, 0 to 0.03 kgf·m}	–	
		Normal turning torque	0.15 to 0.78 N·m {0.1 to 0.6 ft.lbs, 0.02 to 0.1 kgf·m}	–	
9, 10	Play between adjusting screw and sector shaft		0.1 {0.0039} or less	–	Replace
10	Sector shaft outer diameter	Adjusting screw side	ϕ34.975 {1.38}	ϕ34.875 {1.37}	Replace
		Pitman side	ϕ44.975 {1.77}	ϕ44.875 {1.77}	
18, 32	Play in diametric direction between piston and worm and stub shaft		–	0.5 {0.020} or less	Replace
18, 38	Clearance between piston and body		0.11 {0.0043}	0.16 {0.0063}	Replace
31, 32	Clearance between rotor and worm and stub shaft		0.02 {0.00079}	0.03 {0.0012}	Replace

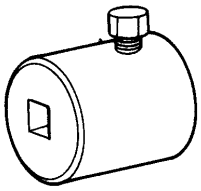
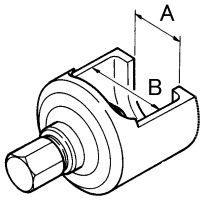
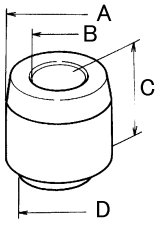
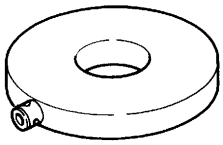
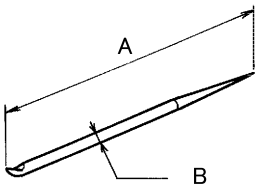
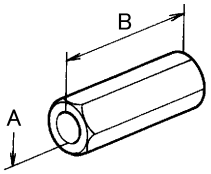
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (pitman arm fastening)	294 to 343 {215 to 255, 30 to 35}	–
Tb	Bolt (sector shaft mounting)	53.9 to 63.7 {40 to 47, 5.5 to 6.5}	–
Tc	Nut (adjusting screw tightening)	63.7 to 73.5 {47 to 54, 6.5 to 7.5}	–
Td	Plug	73.6 to 83.4 {54 to 62, 7.5 to 8.5}	–
Te	Bolt (valve housing attaching)	98.1 to 107.9 {72 to 80, 10 to 11}	–
Tf	Screw (ball tube clip fitting)	4.41 to 5.39 {3.3 to 4.0, 0.4 to 0.5}	–
Tg	Adjusting plug	147 to 166 {110 to 120, 15 to 17}	–

Lubricant and/or sealant

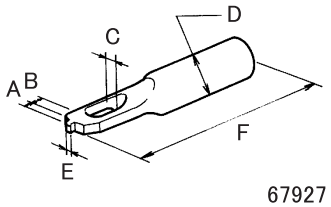
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Nut threads and contact surface of side cover	Hermetic seal 101Y or ThreeBond 1102	As required
	Adjusting screw threads		
	Periphery of adjusting plug		
b	Inner periphery of backup ring	Multi-purpose type grease [NLGI No. 2 (Li soap)]	As required
	Inner periphery of Y-packing		
	Inner periphery of retainer		
	Adjusting screw threads and contact surface of sector shaft		
	Inner surface of ball tube		
	Inner periphery of oil seal		

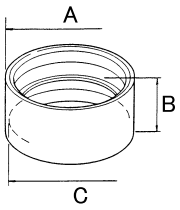
Special tools (Unit: mm {in.})

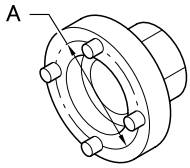
Mark	Tool name and shape	Part No.	Application
a	Preload socket  10028	MB991006	Measurement of power steering gear starting torque
b	Pitman arm puller A: 49 {1.93} B: 76 {2.99}  01355	MH062472	Removal of pitman arm
c	Insert tool assembly  01358 A: ϕ35 {1.38} B: ϕ25 {0.98} C: 53.5 {2.11} D: ϕ33 {1.30}	MH062881 *910-21719	Forming of backup ring
d	Insert tool assembly  01356	MC811971 *910-11001	Forming of backup ring and installation of oil seal
e	Needle A: 120 {4.72} B: ϕ3 {0.12}  02288	MC811948 *910-21200	Removal of O-ring and seal ring
f	Bar A: ϕ16.5 {0.65} B: 57 {2.24}  01360	MC811955 *910-22811	Turning of retainer

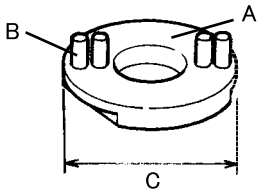
*: Unisia JKC part numbers

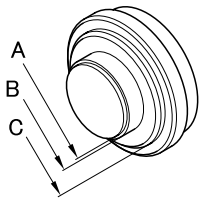
Special tools (Unit: mm {in.})

<table>
<tr><th>Mark</th><th>Tool name and shape</th><th>Part No.</th><th>Application</th></tr>
<tr><td>g</td><td>Squeeze tool
 

67927
<table><tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th></tr><tr><td>5
{0.20}</td><td>8
{0.31}</td><td>18
{0.71}</td><td>ϕ30
{1.18}</td><td>6
{0.24}</td><td>160
{6.30}</td></tr></table></td><td>MC811950
*910-21801</td><td>Crimping of retainer</td></tr>
<tr><td>h</td><td>Insert tool
<table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>ϕ98
{3.86}</td><td>50
{1.97}</td><td>ϕ85.05
{3.35}</td></tr></table> 

02289</td><td>MC8131516
*910-21718</td><td>Forming of piston seal ring</td></tr>
<tr><td>i</td><td>Wrench assembly
<table><tr><th>A</th></tr><tr><td>ϕ52
{2.05}</td></tr></table> 

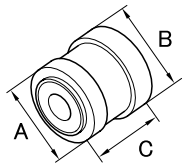
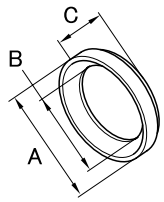
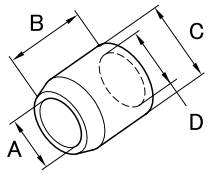
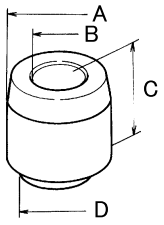
P51270</td><td>MH062883
*910-10745</td><td>Removal and installation of adjusting plug</td></tr>
<tr><td>j</td><td>Attachment assembly
(A: Adapter)
(B: Bolt (pin))
<table><tr><th>C</th></tr><tr><td>ϕ147
{5.79}</td></tr></table> 

02290</td><td>MC811969
*910-10671
(A:
*910-23581)
(B:
*910-23194)</td><td>Fixing of valve housing</td></tr>
<tr><td>k</td><td>Press-fit tool
<table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>ϕ29.7
{1.17}</td><td>ϕ31.8
{1.25}</td><td>ϕ45
{1.77}</td></tr></table> 

P51271</td><td>MH062884
*910-20405</td><td>Installation of oil seal</td></tr>
</table>

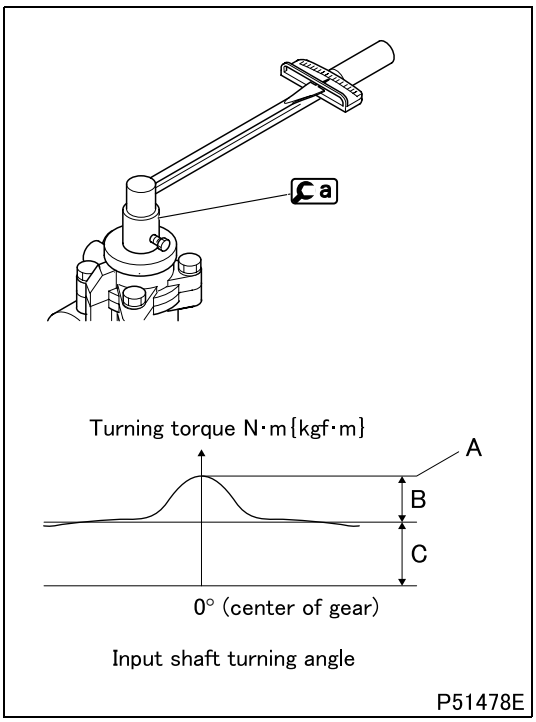
*: Unisia JKC part numbers

Special tools (Unit: mm {in.})

<table>
<tr><th>Mark</th><th>Tool name and shape</th><th>Part No.</th><th>Application</th></tr>
<tr><td>Cl</td><td>Adjusting tool
<table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>ϕ59.5
{2.34}</td><td>ϕ65.5
{2.58}</td><td>65
{2.56}</td></tr></table> 
P51272</td><td>MH062885
*910-22997</td><td rowspan="2">Assembly of thrust bearing</td></tr>
<tr><td>Cm</td><td>Guide assembly
<table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>ϕ76
{2.99}</td><td>ϕ56
{2.20}</td><td>13
{0.51}</td></tr></table> 
P51273</td><td>MH062886
*910-23051</td></tr>
<tr><td>Cn</td><td>Insert tool
 
P51274
<table><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr><tr><td>ϕ28.1
{1.11}</td><td>45
{1.77}</td><td>ϕ40
{1.57}</td><td>ϕ30.3
{1.19}</td></tr></table></td><td>MH062882
*910-22776</td><td>Forming of rotor seal ring and valve housing seal ring</td></tr>
<tr><td>Co</td><td>Insert tool
 
55473
<table><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr><tr><td>ϕ45
{1.77}</td><td>ϕ20
{0.79}</td><td>45
{1.77}</td><td>ϕ33
{1.30}</td></tr></table></td><td>MH062880
*910-21716</td><td>Forming of backup ring</td></tr>
</table>

*: Unisia JKC part numbers

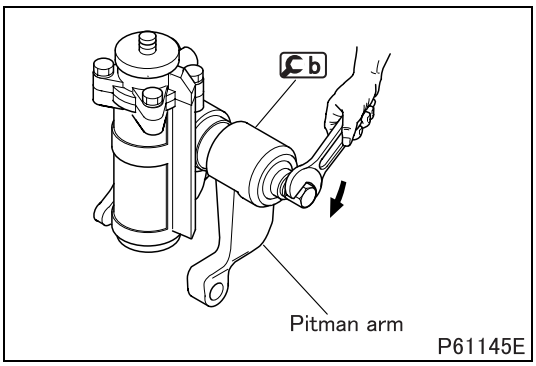
◆Inspection before removal◆



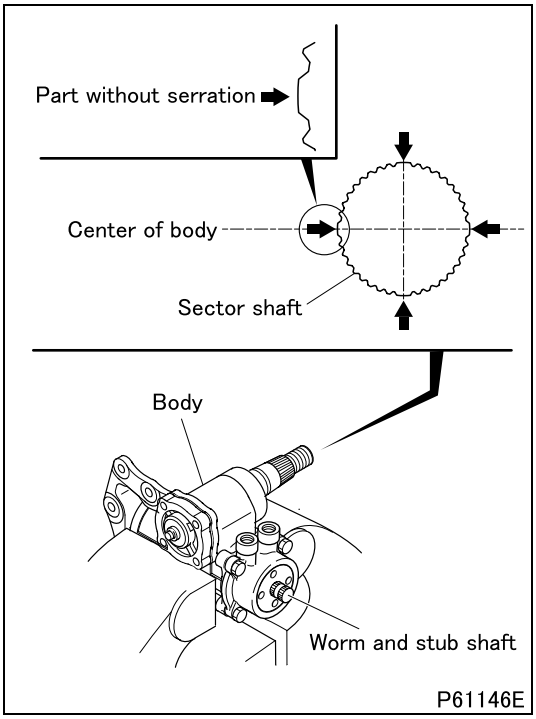
■ **Inspection: Starting torque**

- Using a, measure the starting torque of the power steering gear for reference at the time of reassembly before removal.
  - **A:** Starting torque (= engaging torque + normal turning torque)
  - **B:** Engaging torque
  - **C:** Normal turning torque

◆Removal procedure◆

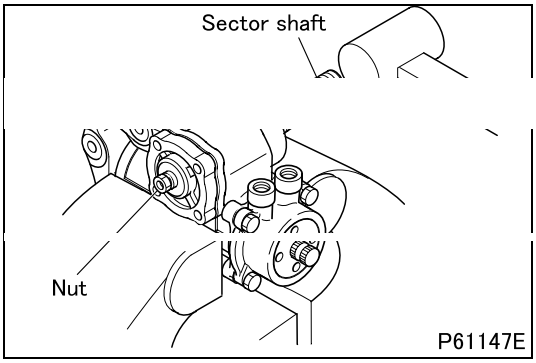


■ **Removal: Pitman arm**



■ **Removal: Sector shaft**

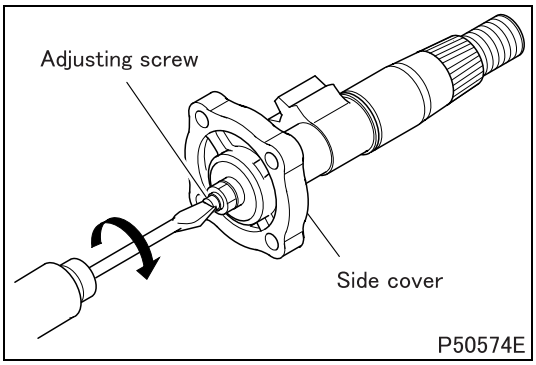
- Before removing, set the sector shaft in neutral position as follows.
- Turn the worm and stub shaft counterclockwise into the lock position, then back it up roughly 2.6 turns to bring the serration missing part of the serrated portion of the sector shaft into parallelism with the center of the body as shown.



- Loosen nut, and remove the sector shaft by tapping the shaft end with a plastic hammer.

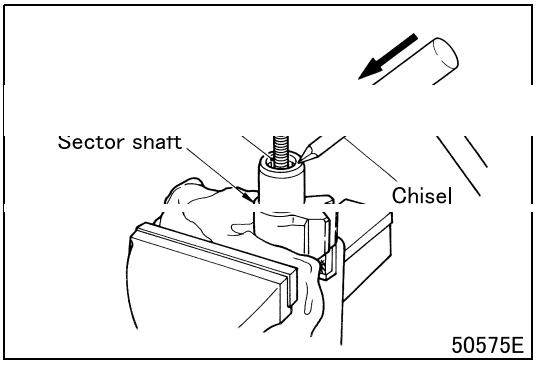
CAUTION ⚠

- **If the sector shaft is stuck, it should be out of neutral position. In such a case, do not attempt to force it out by hammering but redo the neutral positioning procedure.**



■ **Removal: Side cover**

- Remove the side cover by screwing in the adjusting screw.

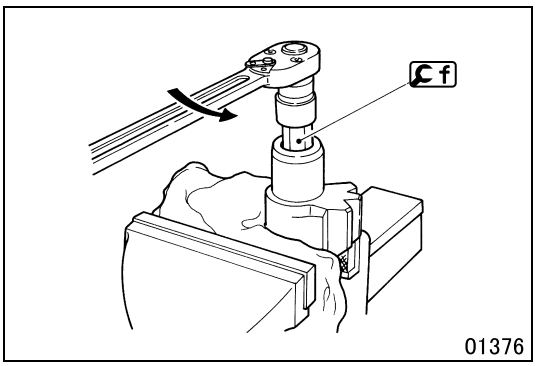


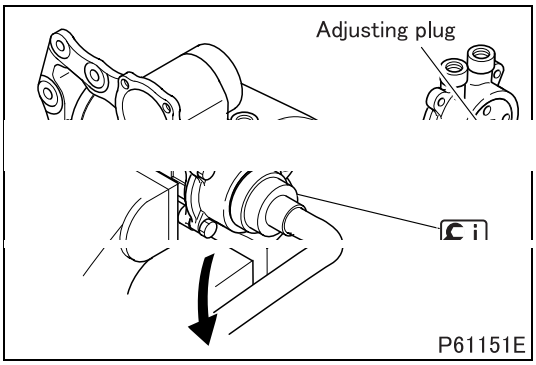
■ **Removal: Retainer**

- Undo the crimp of the retainer (at 2 points) using a chisel.

CAUTION ⚠

- **When holding the sector shaft with a vise, be sure to cover it with a cloth or the like for protection.**



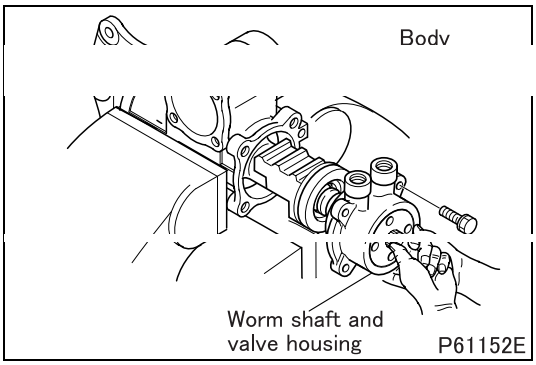


■ **Removal: Worm shaft and valve housing**

- Before removing the ball screw and valve housing, back up the adjusting plug by roughly 180° with i.

CAUTION ⚠

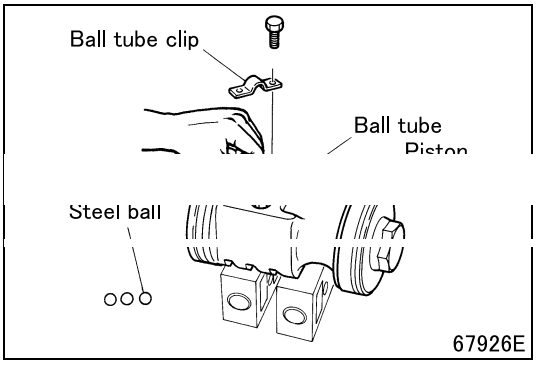
- **Do not remove the adjusting plug. If it is removed, bearing in the valve housing may pop out.**



- Remove the ball screw and valve housing from the body.

CAUTION ⚠

- **Take care so that balls in the ball screw and valve housing do not pop out.**
- **Take care not to scratch or otherwise damage the inner surface of the body and piston.**

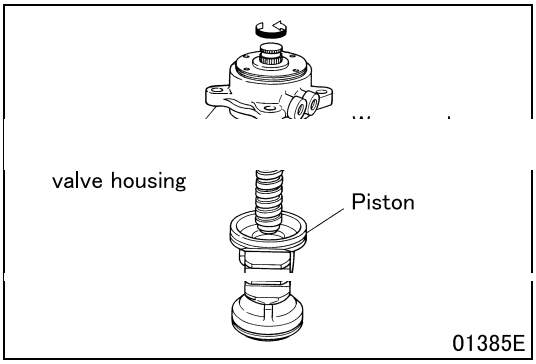


■ **Removal: Ball tube and steel ball**

- First remove steel balls from the piston, then remove ball tube clip. Hold the ball tube between fingers and remove it from the piston moving it lightly.

CAUTION ⚠

- **Be careful not to lose the steel balls (28 pieces in all).**

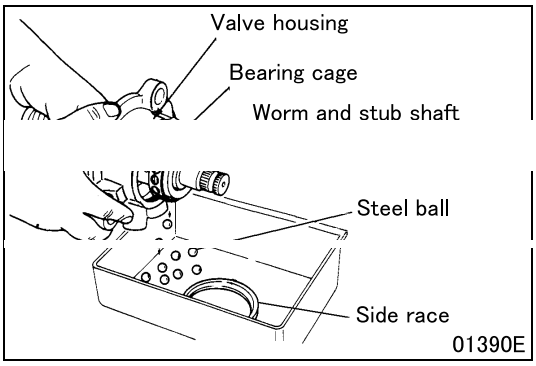


■ **Removal: Piston**

- Holding the worm shaft and valve housing with the piston downward, turn the worm and stub shaft, and remove the piston.

CAUTION ⚠

- **Be careful not to tilt the piston during removal. If it is tilted, steel balls will fall off the race of the piston and worm and stub shaft into the piston.**



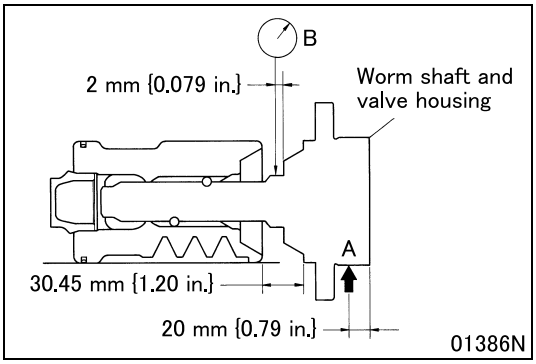
■ **Removal: Worm and stub shaft**

- Remove the worm and stub shaft by pushing its piston-side end out.

CAUTION ⚠

- **Use a suitable receptacle not to lose the side race, steel balls and bearing cage that fall off in separated pieces.**

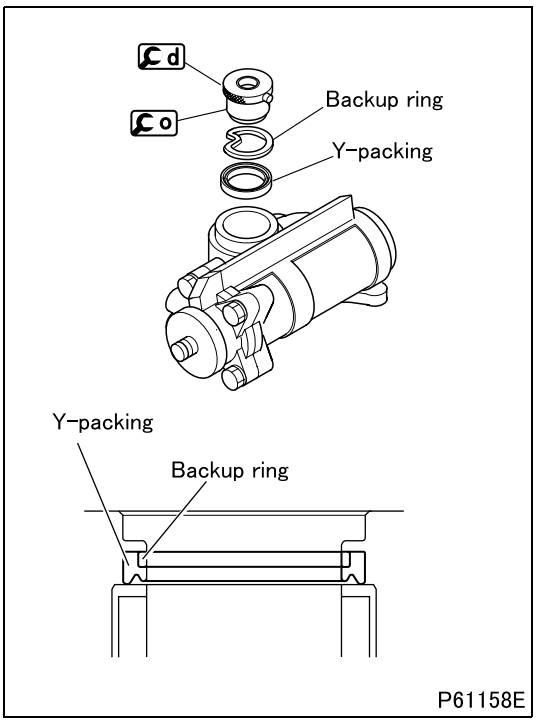
◆Inspection procedure◆



■ **Inspection: Side play of piston and worm and stub shaft**

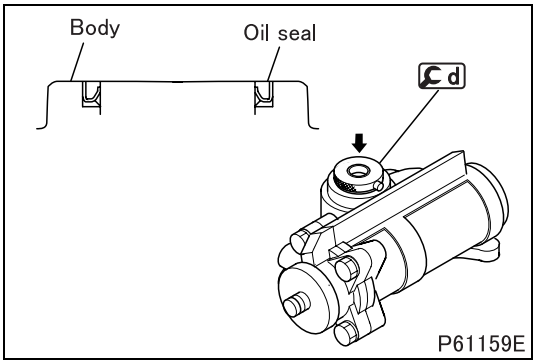
- Apply a force of 49 N {11 lbs, 5.0 kgf} to the illustrated point **A** and measure play **B** (play in the diametric direction) of the worm shaft and valve housing.
- If the measurement exceeds the limit, replace the faulty parts.

◆Installation procedure◆



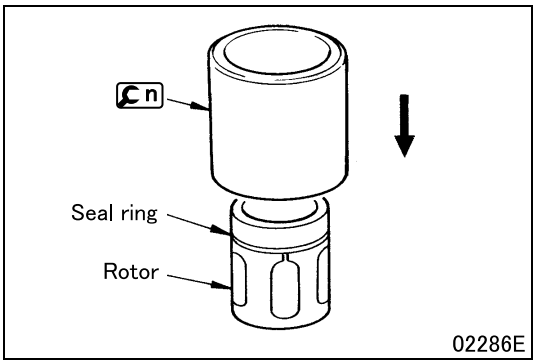
■ Installation: Backup ring and Y-packing

- Fill grease in the groove of Y-packing and install Y-packing in the illustrated direction.
- Install backup ring, formed as shown, using d and o.



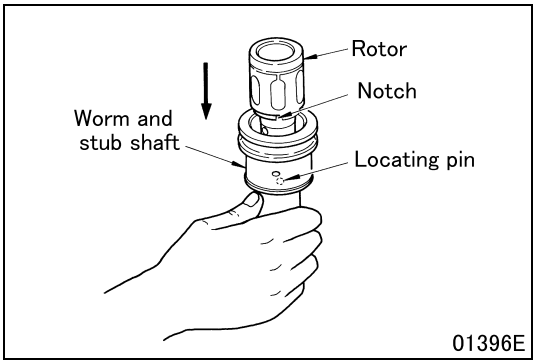
■ Installation: Oil seal

- Install the oil seal to the body in the illustrated direction.



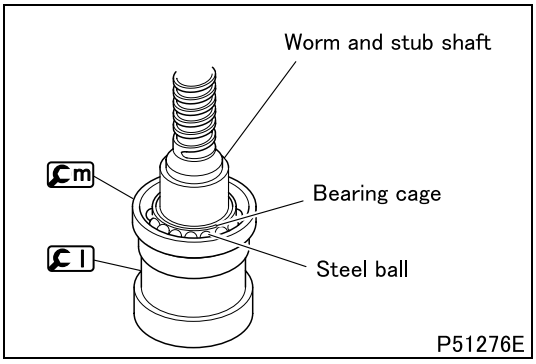
■ Installation: Seal ring

- Install the seal ring onto the rotor.
- Form the seal ring to fit the rotor using n.



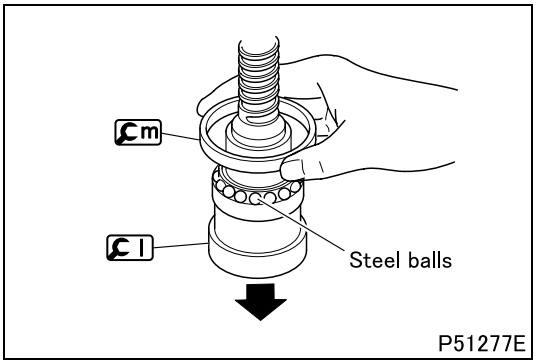
■ **Installation: Rotor**

- Install the rotor aligning its notch with the locating pin of the worm and stub shaft.

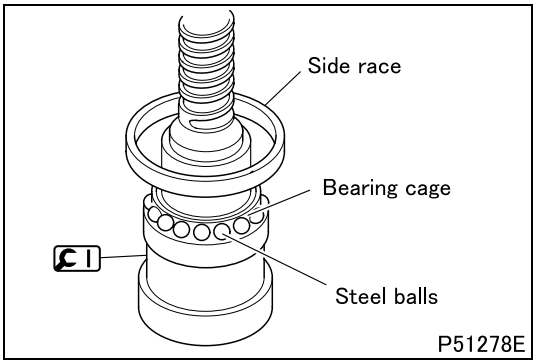


■ **Installation: Side race, steel balls and bearing cage**

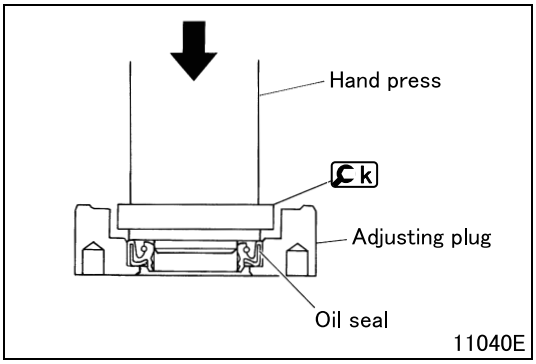
- Using [l] and [m] assembled, install the worm and stub shaft in the illustrated direction.
- Install the bearing cage and steel balls onto the worm and stub shaft.



- Holding [m] with hand, slide [l] downward to have steel balls set in place.

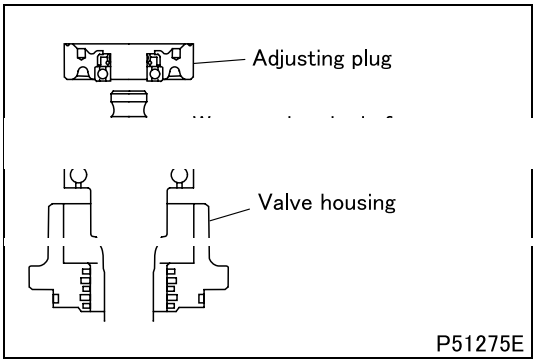


- Install the side race onto the steel balls and bearing cage.



■ **Installation: Oil seal**

- Using k, press oil seal in the illustrated direction into the adjusting plug.

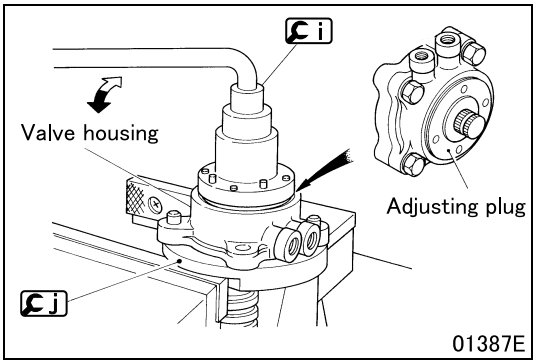


■ **Installation: Worm and stub shaft**

- Install the valve housing onto the worm and stub shaft and secure it in place with adjusting plug.

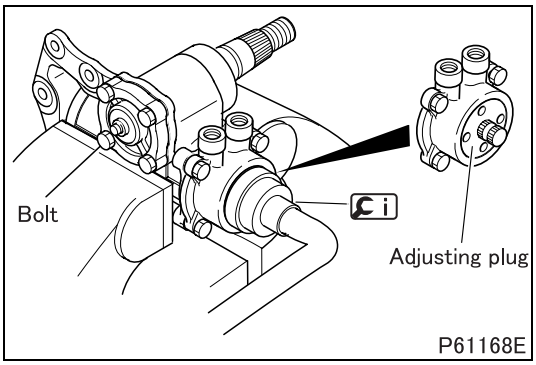
CAUTION ⚠

- **Take care not to damage the seal rings with the ball race of the worm and stub shaft.**

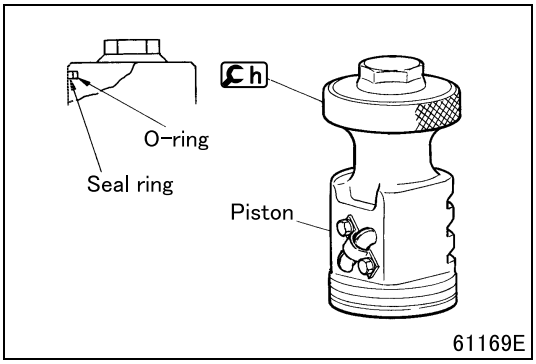


■ **Installation: Adjusting plug**

- Hold j with a vise and secure the valve housing to it.
- Tighten the adjusting plug to the specified torque using i, then back it up by approximately 180°.

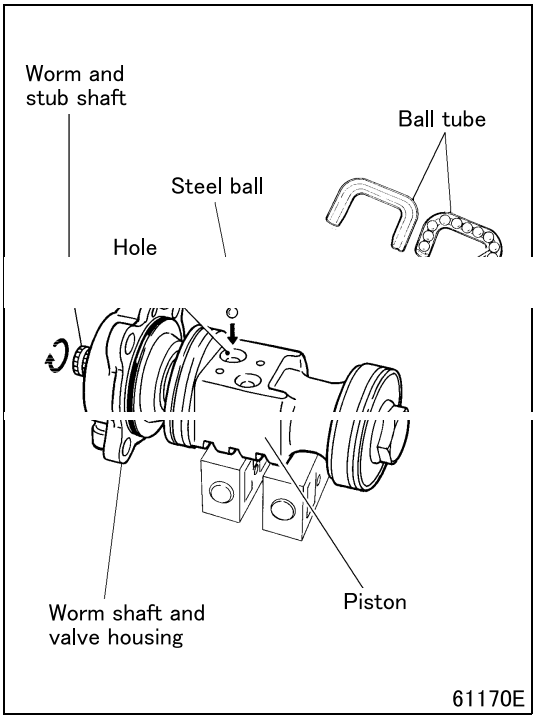


- Tighten bolt to the specified torque, then retighten the adjusting plug using i.



■ **Installation: Seal ring and O-ring**

- Install seal ring and O-ring in the outer surface grooves of the piston, and form the seal ring to fit in place using [h].

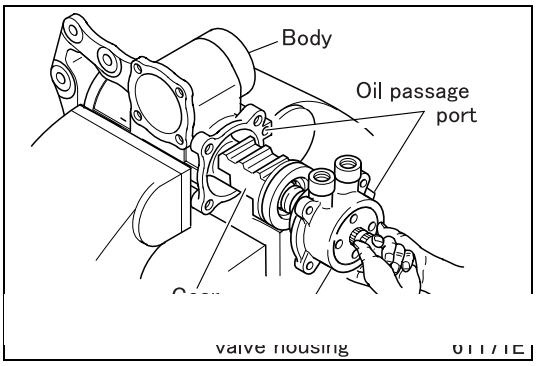


■ **Installation: Ball tube**

- Pack grease in one half of the ball tube, place 10 to 11 steel balls in it and put the other half upon it.
- Place the piston on a flat workbench, align the positions of the worm shaft and valve housing and piston ball race, then while turning the worn and stub shaft, let steel balls fall from the ball tube hole.

CAUTION ⚠

- **Do not draw out the warm shaft and valve housing until its end passes over the ball tube hole during installation. Otherwise the steel balls will come out of the ball race.**

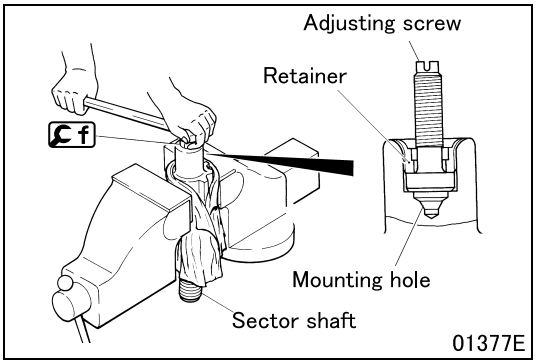


■ **Installation: Ball screw and valve housing**

- Position the gear toothed portion of the ball screw and valve housing in the illustrated direction so that it engages with the sector shaft.
- Install the ball screw and valve housing to the body, lightly holding it with hand so that its gear portion does not turn out of position. When installing, align the oil passage ports of the ball screw and valve housing and body.

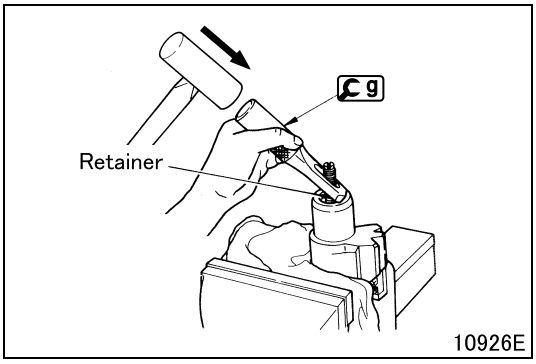
CAUTION ⚠

- **Be careful not to damage the seal ring on the piston and the inner surface of the body.**

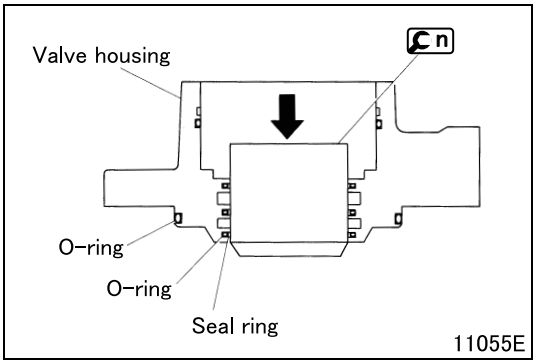


■ **Installation: Retainer**

- Pack grease in the adjusting screw mounting hole on the sector shaft.
- Install the adjusting screw into the sector shaft.
- Using f, tighten the retainer into place in the sector shaft.
- Back up the retainer by 180°, retighten it to a torque of 39 N·m {29 ft.lbs, 4 kgf·m}, then back it up again by 20°.
- Check that the adjusting screw turns smoothly.

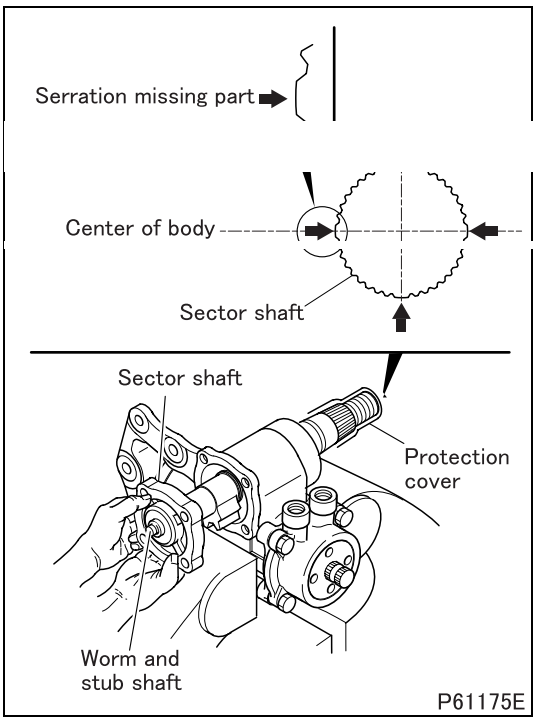


- Using g, crimp the retainer at two places.



■ **Installation: Seal ring and O-rings**

- Install seal ring and O-rings to the valve housing.
- Form seal ring to fit the valve housing using n.



■ **Installation of sensor shaft**

- Set the sector shaft in the neutral position and install it into the body.

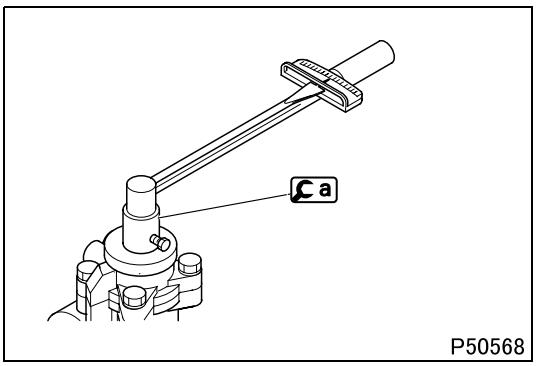
CAUTION ⚠

- **When installing the sector shaft, cover up its threaded end and serration portions for protection.**

NOTE

- **Turn the worm and stub shaft to check that it makes roughly five turns lock to lock.**
- **If the number of turns is less, check engagement of the worm and stub shaft with the sector shaft, and correct if necessary.**

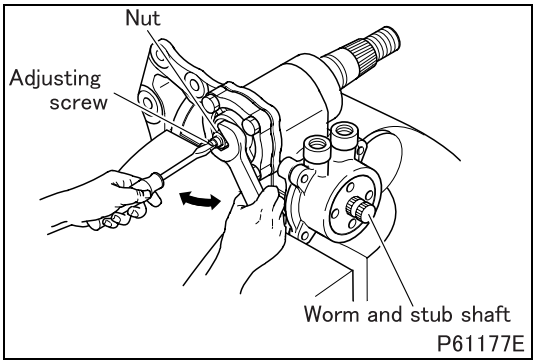
◆Adjustment after installation◆



■Inspection: Starting torque

[Inspection]

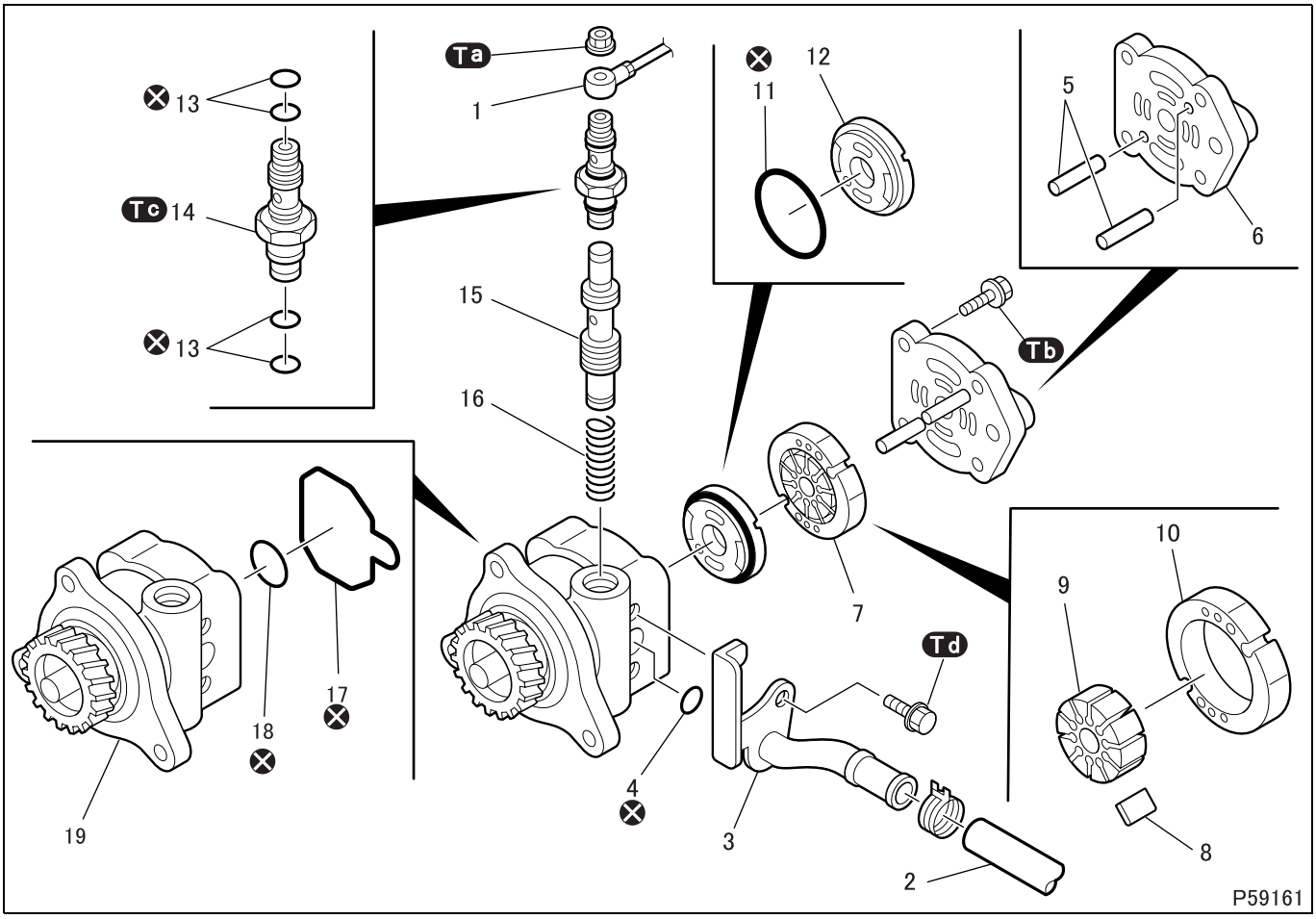
- Using a, measure the starting torque of the power steering gear in the same manner as the measurement before removal. If the measurement deviates from the standard value, adjust the power steering gear for proper starting torque or replace.



[Adjustment]

- Loosen nut.
- Rotating the worm and stub shaft approximately 1/4 turns left and right, make adjustment for proper starting torque with the adjusting screw.

POWER STEERING OIL PUMP <KYB Product>



● **Disassembly sequence**

1 Pipe
2 Hose
3 Suction connector
4 O-ring
5 Pin
6 Cover
7 Cartridge assembly
8 Vane
9 Rotor
10 Cam ring
11 O-ring
12 Side plate
13 O-ring
14 Connector
15 Flow control valve
16 Flow control spring
17 O-ring
18 O-ring
19 Body

⊗: Non-reusable parts

NOTE

- **See Gr11 for removal and installation of the power steering oil pump.**

CAUTION ⚠

- **Do not disassemble the flow control valve and body.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Seal repair kit

Service standards (Unit: mm {in.})

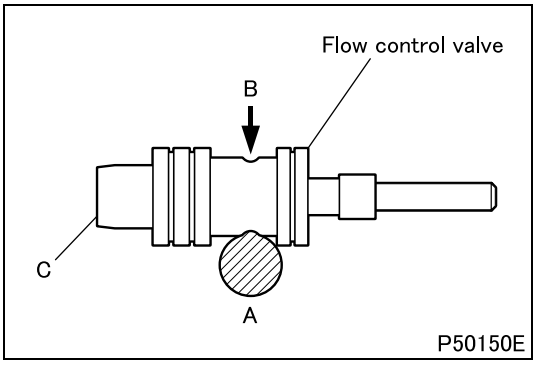
Location	Maintenance item	Standard value	Limit	Remedy
6	Stepped wear on rotor and vane contact surfaces of cover	–	0.05 {0.0020}	Replace*
8, 9	Clearance between vane and rotor	0.01 {0.00039}	0.06 {0.0024}	Replace
12	Stepped wear on rotor and vane contact surfaces of side plate	–	0.05 {0.0020}	Replace*
15, 19	Clearance between flow control valve and body	0.01 to 0.02 {0.00039 to 0.00079}	0.03 {0.0012}	Replace*
16	Free length of flow control spring	36.5 {1.44}	33.5 {1.32}	Replace

*: Replace the power steering oil pump.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (pipe mounting)	29.4 to 39.2 {22 to 29, 3 to 4}	–
Tb	Bolt (cover mounting)	18 to 22 {13 to 16, 1.8 to 2.2}	–
Tc	Connector	49 to 69 {36 to 51, 5.0 to 7.0}	–
Td	Bolt (suction connector mounting)	7.8 to 11.8 {5.8 to 8.7, 0.8 to 1.2}	–

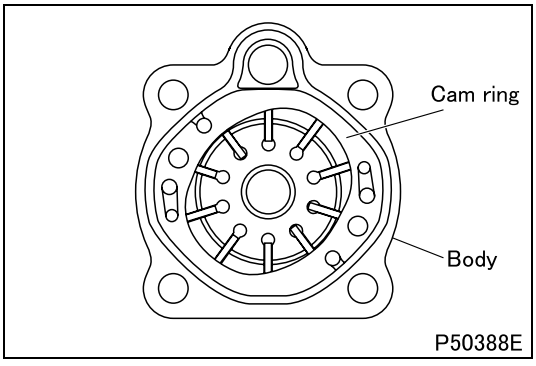
◆Inspection procedure◆



■ Inspection: Flow control valve

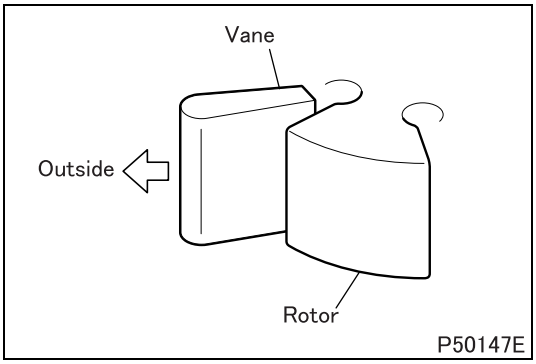
- Cover port **A** of the flow control valve with a finger.
- Apply air pressure (390 to 490 kPa {57 to 71 psi, 4.0 to 5.0 kgf/cm^2}) to port **B**.
- Check for a leak of air from port **C**.
- If there is an air leakage, replace the power steering oil pump.

◆Installation procedure◆



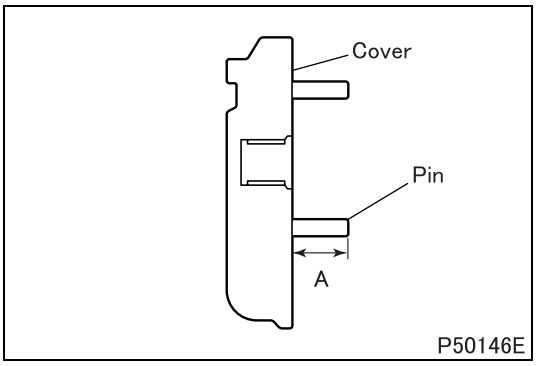
■ Installation: Cam ring

- Install the cam ring in the illustrated direction to the body.



■ **Installation: Vane**

- Fit the vane into the rotor, with its round edge facing toward outside.

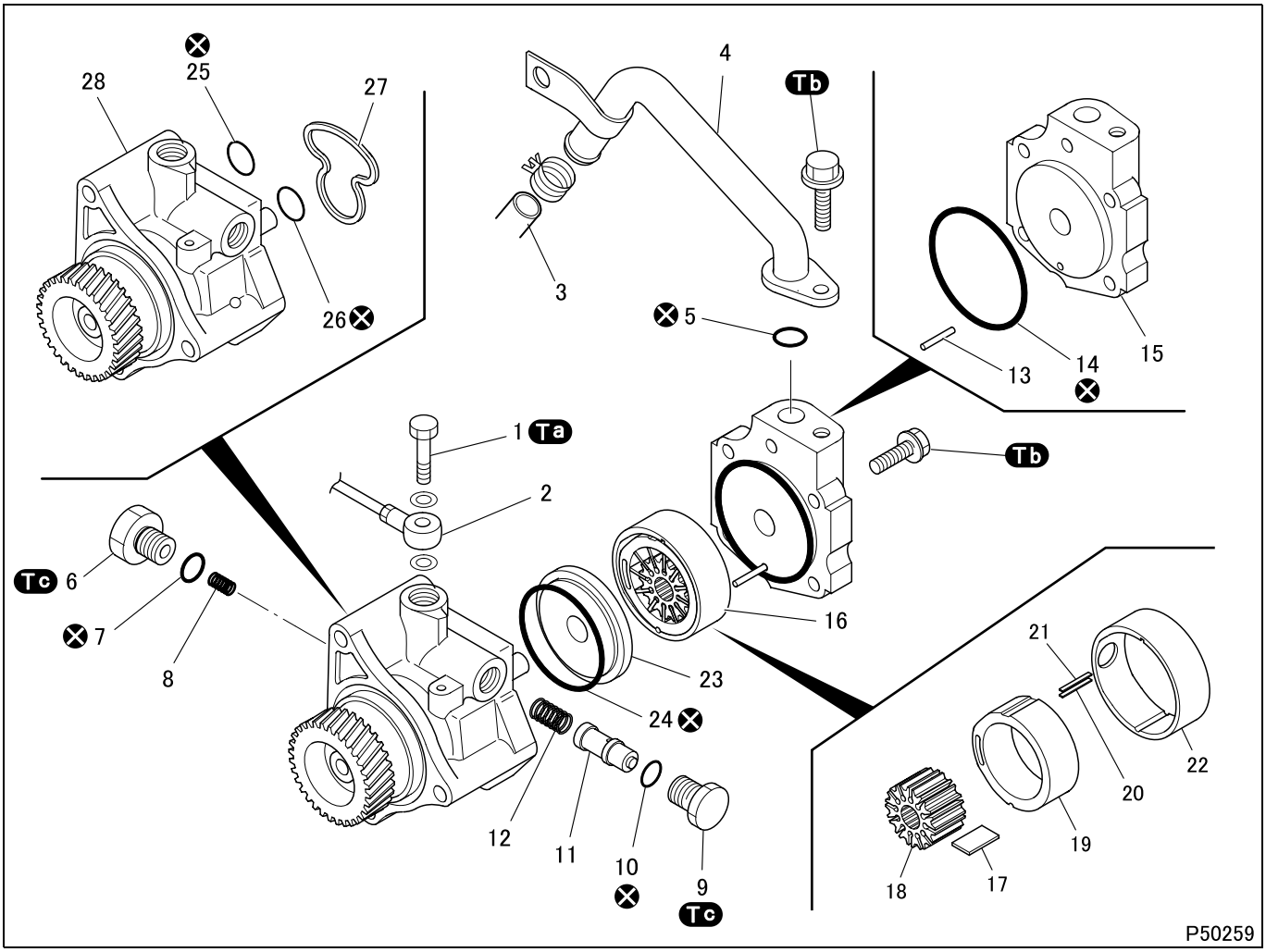


■ **Installation: Pin**

- Fit the pins into the cover so that they protrude to the illustrated length **A** from the cover.
  A: 18.1 mm {0.71 in.}

M E M O

POWER STEERING OIL PUMP <UNISIA JKC Product>



● **Disassembly sequence**

1	Eyebolt	**11**	Control valve	**21**	Rubber spring
2	Pipe	**12**	Control valve spring	**22**	Adapter
3	Hose	**13**	Straight pin	**23**	Pressure plate
4	Suction connector	**14**	O-ring	**24**	O-ring
5	O-ring	**15**	Rear body	**25**	O-ring
6	Plug	**16**	Cartridge assembly	**26**	O-ring
7	O-ring	**17**	Vane	**27**	Seal ring
8	Spring	**18**	Rotor	**28**	Front body
9	Plug	**19**	Cam ring		
10	O-ring	**20**	Seal	⊗:	Non-reusable parts

NOTE

- **See Gr11 for removal and installation of the power steering oil pump.**

CAUTION ⚠

- **Do not disassemble the control valve and front body.**
- **If the cartridge assembly is difficult to disassemble, not attempt to pry it out but heat the side surface of the front body with a dryer.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Repair kit

Service standards (Unit: mm {in.})

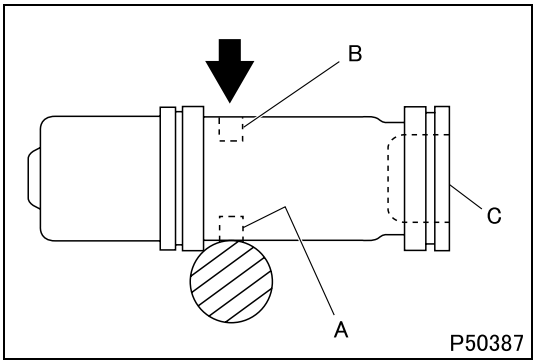
Location	Maintenance item	Standard value	Limit	Remedy
8	Free length of spring	24 {0.94}	23 {0.91}	Replace
11, 28	Clearance between control valve and front body	0.02 {0.00079}	0.03 {0.0012}	Replace*
12	Free length of control valve spring	26.2 {1.03}	23.6 {0.93}	Replace
15	Stepped wear on rotor and vane contact surfaces of rear body	–	0.01 {0.00039}	Replace*
17, 18	Clearance between vane and rotor	0.02 {0.00079}	0.03 {0.0012}	Replace
23	Stepped wear on rotor and vane contact surfaces of pressure plate	–	0.01 {0.00039}	Replace*

*: Replace the power steering oil pump.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eyebolt (pipe mounting)	49.0 to 63.7 {36 to 47, 5.0 to 6.5}	–
Tb	Bolt (suction connector mounting)	17.7 to 24.5 {13 to 18, 1.8 to 2.5}	–
	Bolt (rear body mounting)		
Tc	Plug	29.4 to 39.2 {22 to 29, 3.0 to 4.0}	–

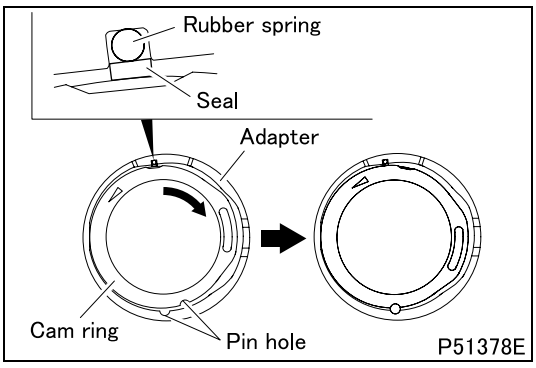
◆Inspection procedure◆



■ Inspection: Control valve

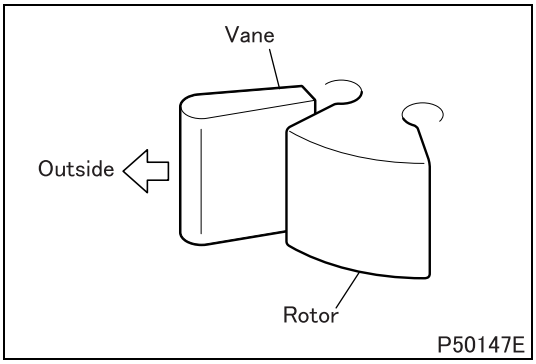
- Cover port **A** of the control valve with a finger.
- Apply air pressure (390 to 490 kPa {57 to 71 psi, 4.0 to 5.0 kgf/cm^2}) to port **B**.
- Check for a leak of air from port **C**.
- If there is an air leakage, replace the control valve.

◆Installation procedure◆



■ Installation: Seal and rubber spring

- Align the peripheral groove of the cam ring to the inner groove of the adapter, then fit the rubber spring (black) into the adapter and the seal (white) into the cam ring.
- Turn the cam ring clockwise to align pin holes.

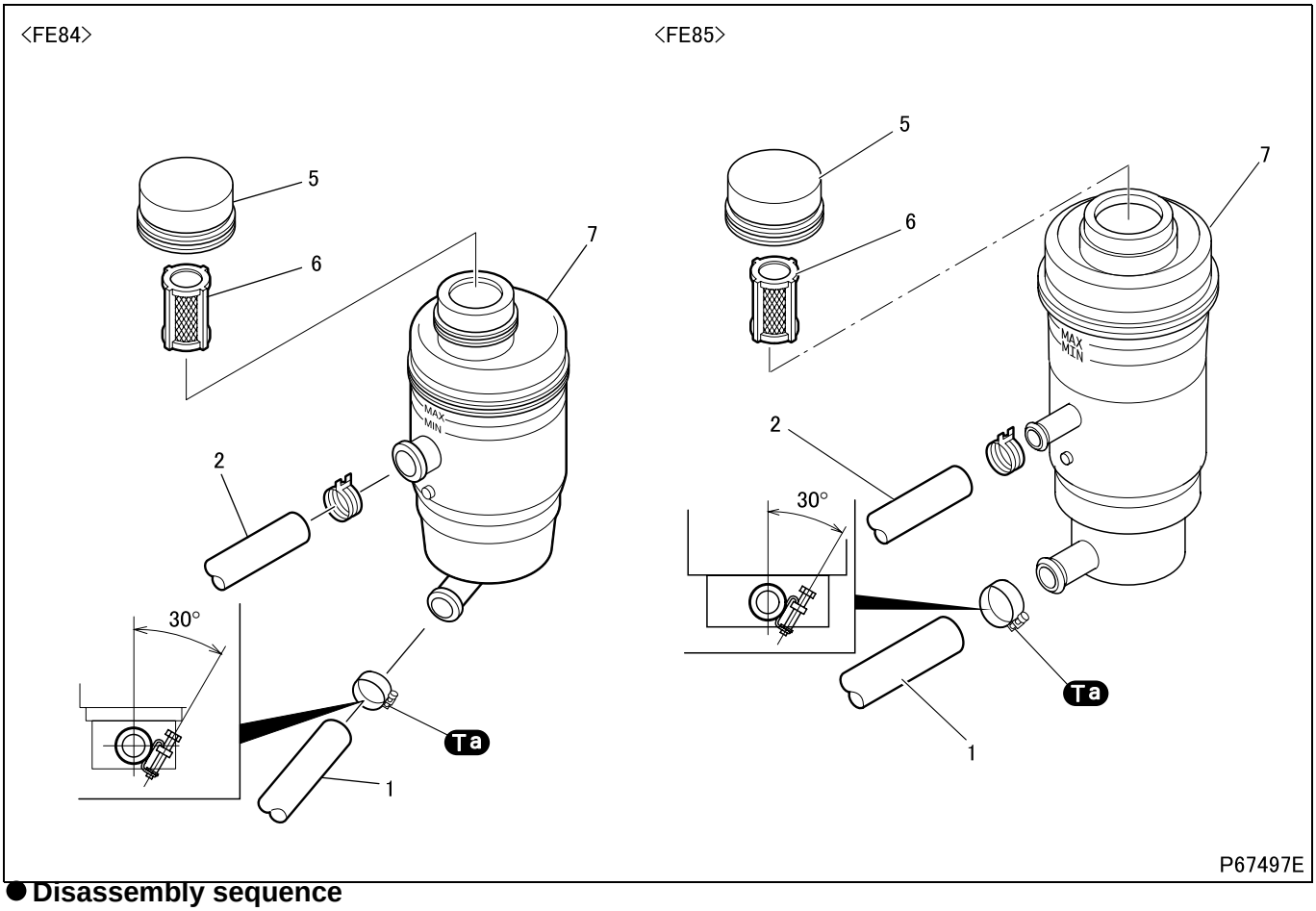


■ **Installation: Vane**

- Fit the vane into the rotor, with its round edge facing toward outside.

M E M O

POWER STEERING TANK



● **Disassembly sequence**

1 Hose
2 Hose
3 Cap
4 Strainer
5 Body

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	2.0 to 2.5 {1.5 to 1.8, 0.20 to 0.25}	–

INDEX

SPECIFICATIONS **41-2**

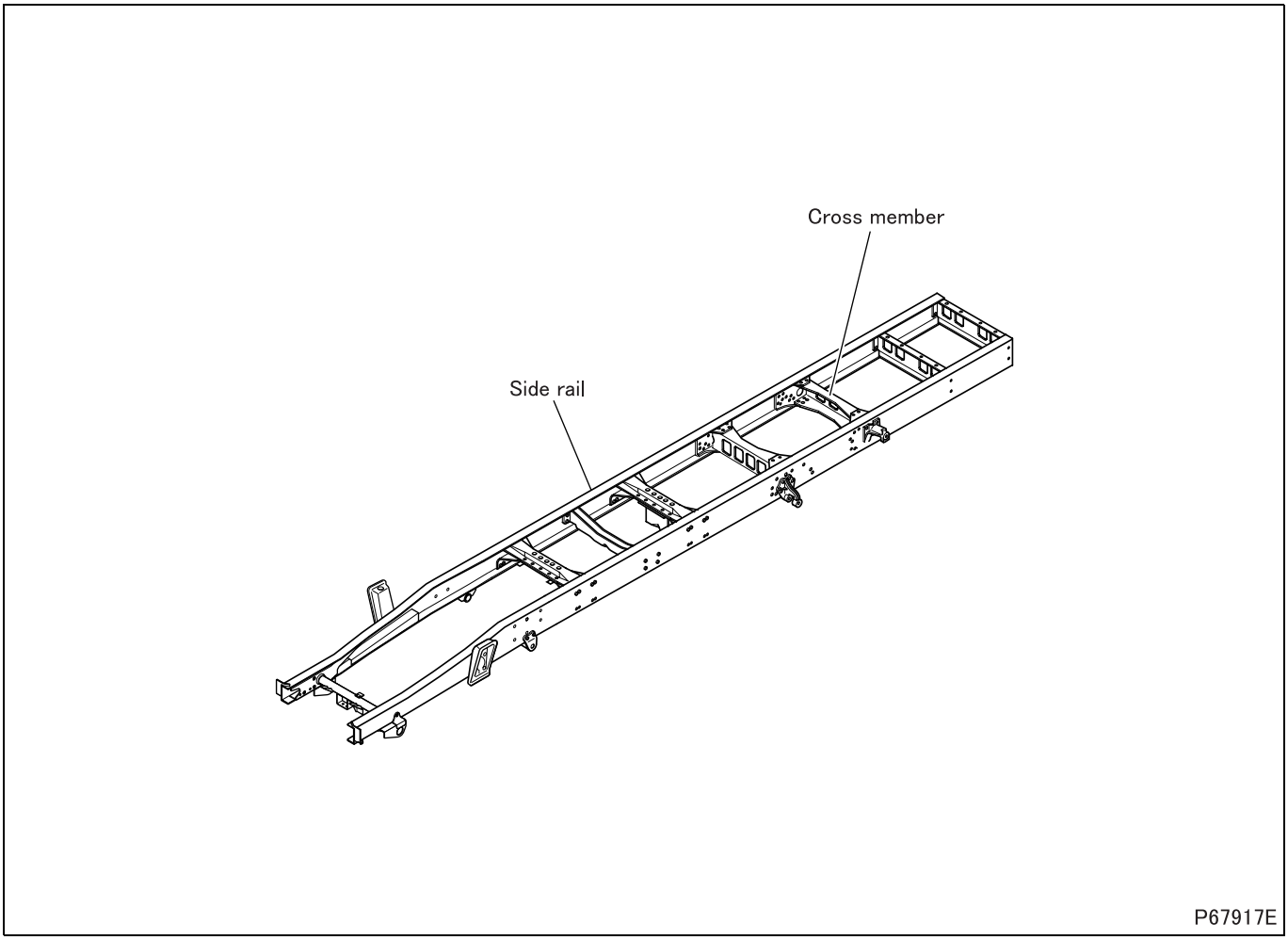
STRUCTURE AND OPERATION **41-3**

FRONT BUMPER **41-4**

FRAME **41-6**

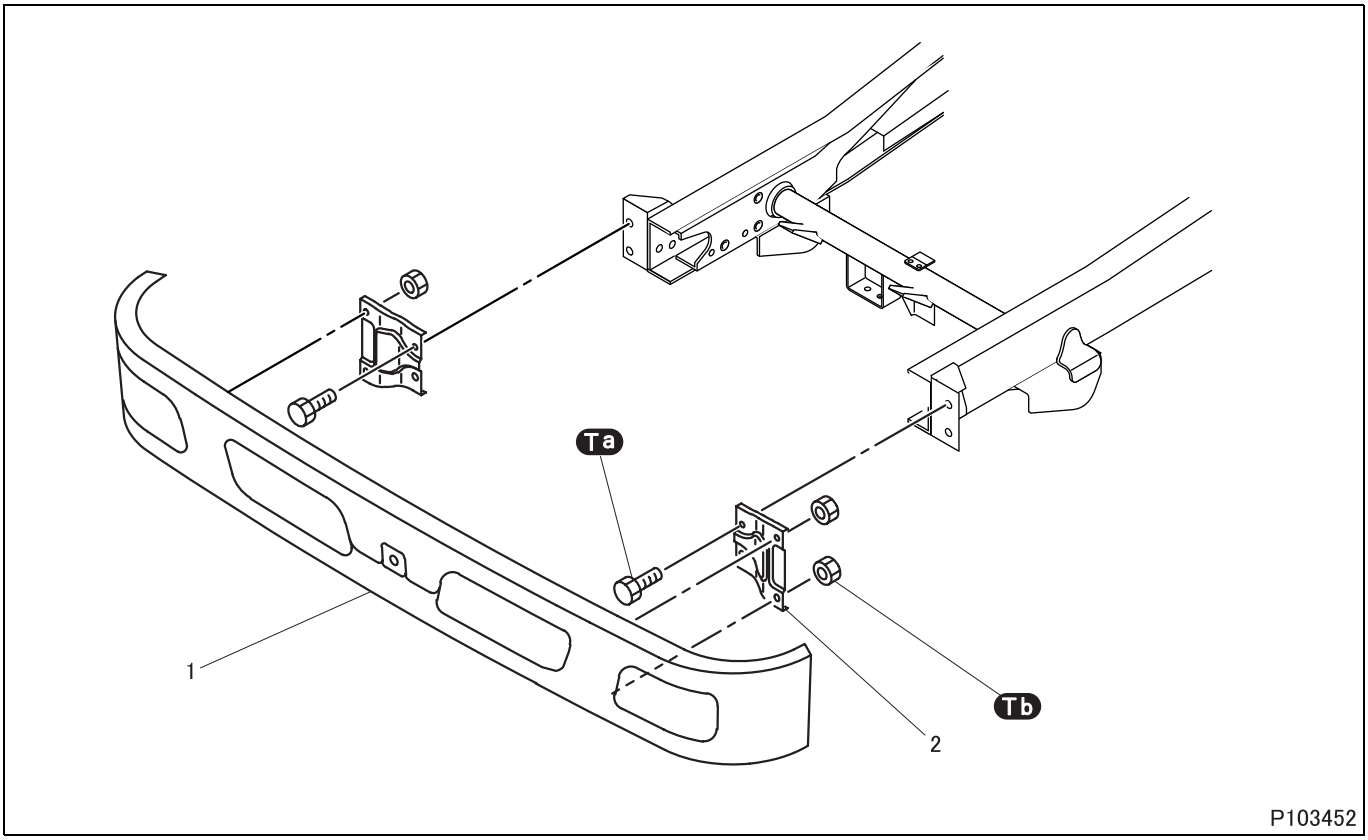
SPECIFICATIONS

Item	Specifications
Frame type	Ladder type
Cross section configuration of side rail	⊐ shaped (open) channel section



- The frame has cross members fastened to the web of side rails (lateral linkage) so that stress on the joints is very small. This allows joint rivets to maintain tightness and ensures long-lasting high torsional stiffness.
- Unlike vertical linkage where cross members are fastened to the flange of side rails, no rivets appear on top of the frame, making the body mounting greatly easier.

FRONT BUMPER



● **Removal sequence**

1 Front bumper
2 Bumper stay

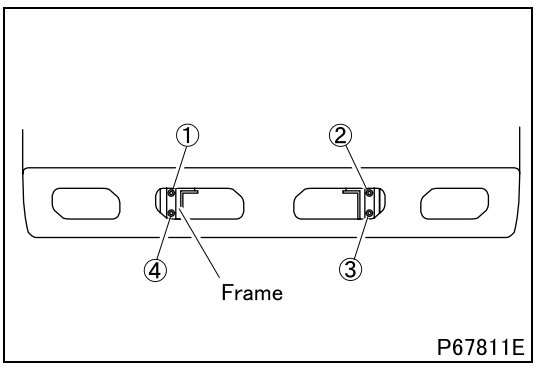
● **Installation sequence**

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (bumper stay mounting)	45 to 54 {33 to 40, 4.6 to 5.5}	–
Tb	Nut (front bumper mounting)	26 to 31 {19 to 23, 2.7 to 3.2}	–

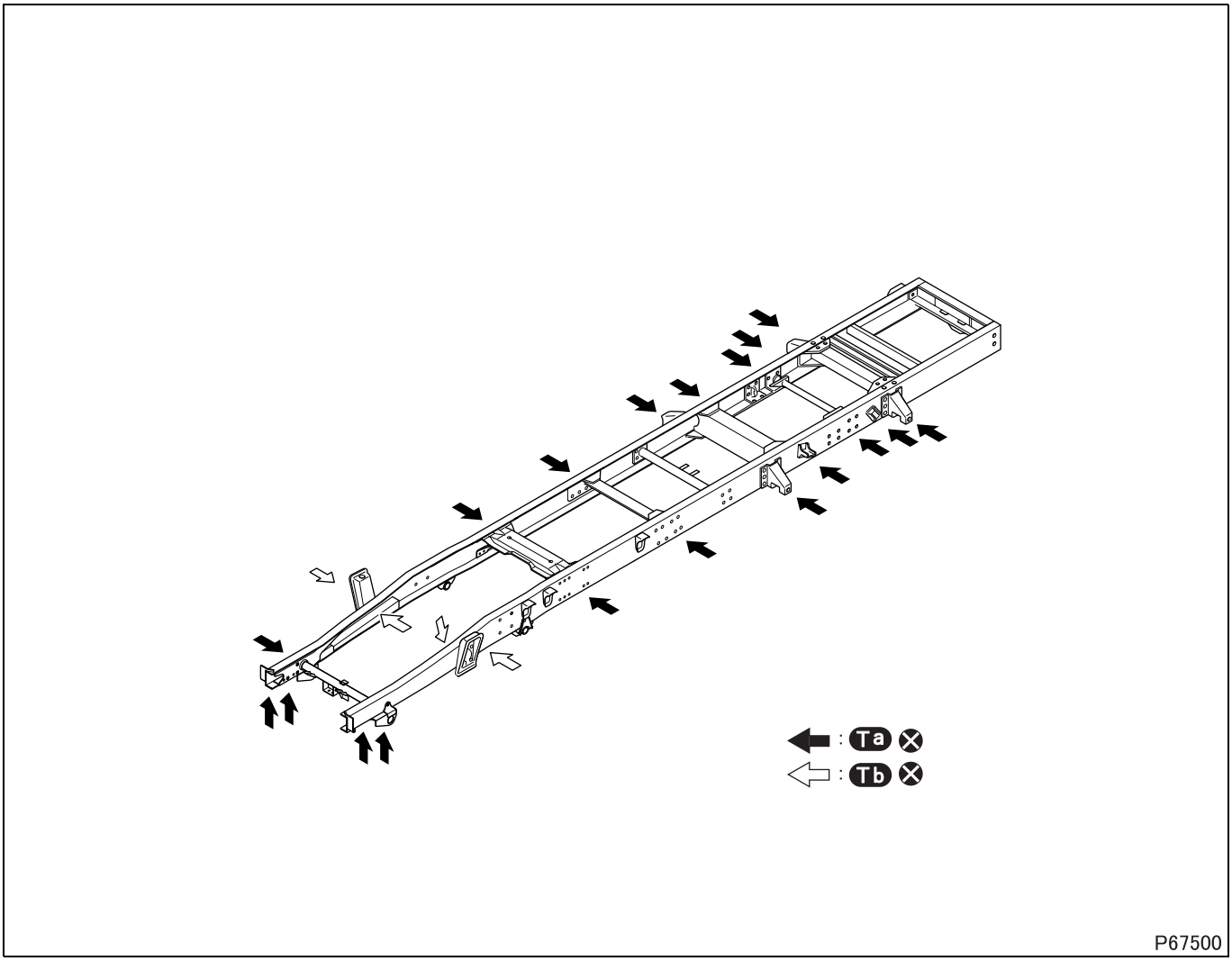
◆**Installation procedure**◆



■ **Installation: Bumper stay**

- Install the bumper stay on the frame by tightening the bolts (four places) to the specified torque in the order of the numbers (1 to 4) indicated in the illustration.

M E M O



⊗: Non-reusable parts

CAUTION ⚠

- **Since the mounting bolts and nuts are tightened by a torque-to-yield method, they must not be reused.**

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	M10 bolt or nut	60 to 80 {43 to 58, 6 to 8}	–
Tb	M12 bolt or nut	98 to 120 {72 to 87, 10 to 12}	–

◆Cleaning procedure◆

■ Cleaning: Frame

- Thoroughly remove mud, grease, rust etc. from the outer and inner surfaces of the frame.

◆Inspection procedure◆

WARNING ⚠

Improper welding technique may fatigue the frame and lead to structural failure and serious personal injury. The frame rails are made of heat treated steel. Only experienced, qualified persons using proper equipment should attempt welding the frame rails.

CAUTION ⚠

The vehicle is equipped with electronic control units. Serious damage to ECUs and components may result when welding unless the following precautions are taken.

- **Never allow an electronic component to be situated between the ground electrode and the weld site.**
- **Never lay welding cables on, near, or across any electronic component or wiring.**
- **Protect electronic components and wiring near the weld site from heat and splatter.**

1 Park the vehicle, shut down the engine, and set the parking brake. Chock the tires.
2 From the batteries, disconnect all negative cables first, then the positive cables, and prevent them from making connection with the frame or any other electrically conductive surface.
3 Disconnect all wiring from electronic control modules near the weld site, including any installed by the customer.
4 Attach the ground electrode as close as possible to the weld site (within 18").
5 Remove paint, rust, and grease to provide a clean, bare metal connection for the ground electrode. When welding work is completed, apply touch-up paint to protect the frame rail.

- **Avoid gas welding because heat embrittles the material of welded area. Be sure to use electric welding.**
- **Electric welding could allow the welding current to reverse through ground circuit and burn electrical components. To prevent this, be sure to disconnect negative cable from the battery and ground the welding machine at a point near the weld zone before work.**
- **For electric welding, follow other precautions given elsewhere.**
- **If there are any combustibles, such as pipeline, wiring harness, rubber part and fuel tank, near the weld zone, be sure to cover them for protection.**
- **Use low-hydrogen type coated CO_2 and arc welding electrodes for welding and check that there are not harmful defects such as undercut and blow hole after welding.**
- **Preheat the area around weld zone to approximately 50 to 350°C {120 to 660°F} before welding when the workshop temperature is below 0°C {32°F}.**
- **Be sure to protect mountings that may be affected by heat, such as main sills, using heat insulators or the like.**

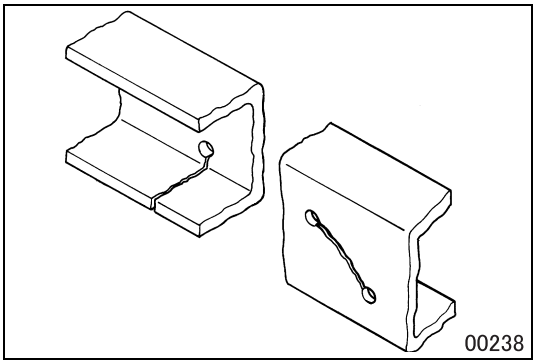
■Inspection: Frame

(1) Inspection for deformation

- If deformation or any other defect is found, repair the frame.

(2) Inspection for cracks

- Remove paint from suspected areas and carefully inspect exposed surfaces for cracks.
- If visual inspection is difficult, perform dye check or any other suitable examination. If a crack is found, repair as follows.

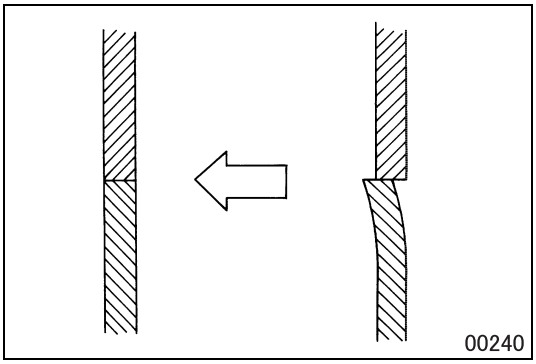


(3) Repair of crack in frame

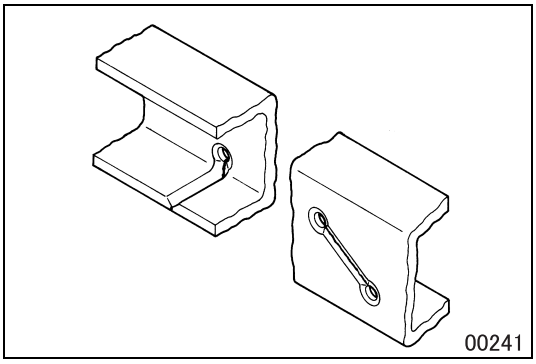
- With the vehicle unloaded, level the frame.
- Drill a hole, roughly twice the thickness of frame plate in diameter, 10 mm {0.39 in.} from the inside end of crack.

NOTE

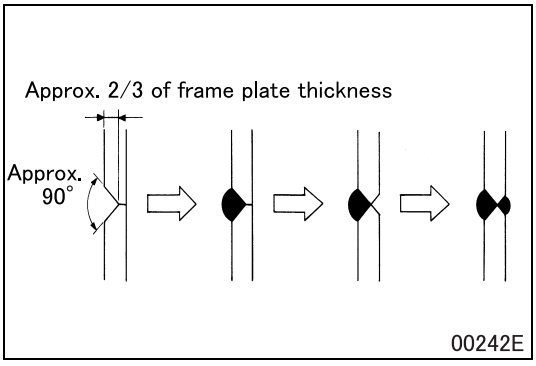
- **If crack is within the frame plate, drill holes at both ends of the crack.**



- If the edges of crack are uneven, make them even.



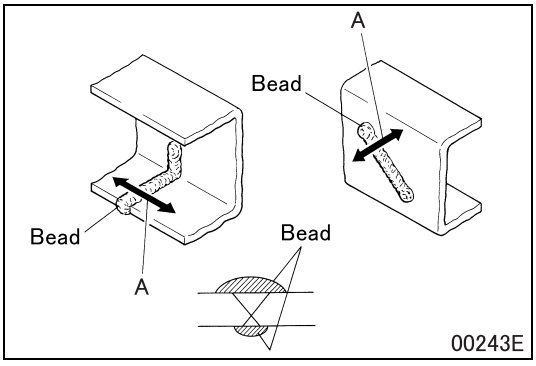
- Using a grinder, cut a 90° V-channel at the crack to a depth of approximately 2/3 of the frame plate thickness, then fill the channel with filler metal by welding.



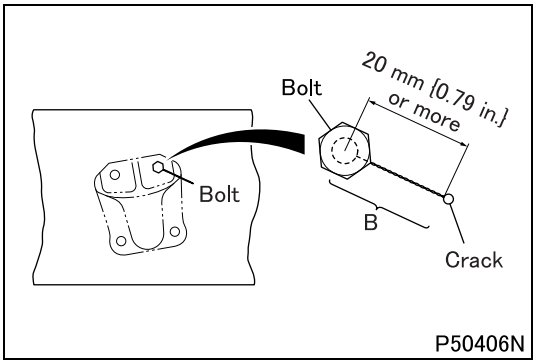
- Then, make a similar V-channel on the opposite side of the weld and fill it with filler metal by electric welding as well. At the same time, deposit metal to cover up the hole or holes at both ends of the crack by welding.

NOTE

- **In cold districts, heat the weld zone to approximately 200°C {390°F} after welding.**

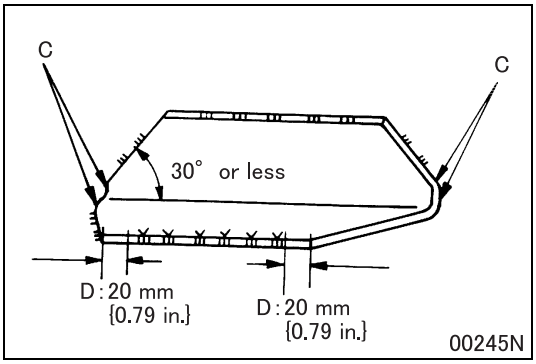


- After welding, run a grinder over the bead at right angles A to remove the hatched portion from the weld on each side of the plate.
- Finish the ground surfaces flat to a thickness equal to the original plate thickness.



[Repairing crack from rivet or bolt hole]

- To make the edges of cracked hole even, temporarily tighten bolt in the hole.
- First weld to close the crack at a point at least 20 mm {0.79 in.} apart from the center of the bolt.
  For this welding, see the aforementioned welding procedures for crack repair.
- Remove the temporary bolt. After making hole edges even, weld to close the rest B of the crack. Fill the hole with weld metal at the same time.
- Drill a hole at the location of original hole, and install a rivet or bolt in it.



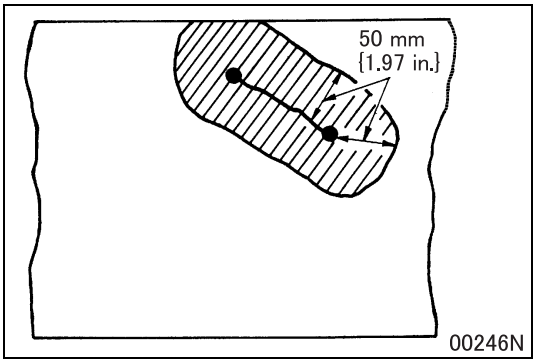
[Repairing using reinforcement plate]

- To prevent the concentration of welding stress at both ends C of the reinforcement plate, cut the ends at a bevel of 30° or less for welding. Do not weld at points D.
- The reinforcement plate must have enough to cover the cracked area.

NOTE

- **Reinforcement plate thickness: Equal to frame plate thickness**
- **Reinforcement plate material: As specified below or equivalent**

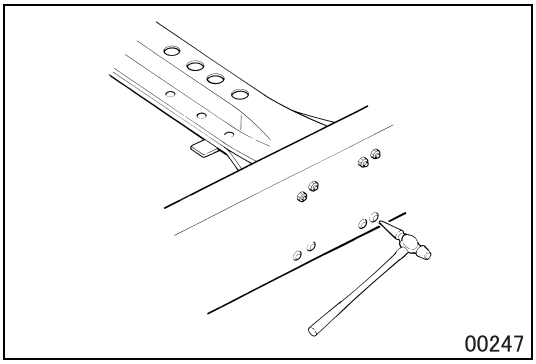
SAPH440 (Hot rolled steel for automobiles), or SS400 (Rolled steel for general structures)



- After welding, heat the hatched area to 600 to 700°C {1110 to 1292°F}.

CAUTION ⚠

- **Be sure to protect mountings that may be affected by heat, such as main sills, using heat insulators or the like.**

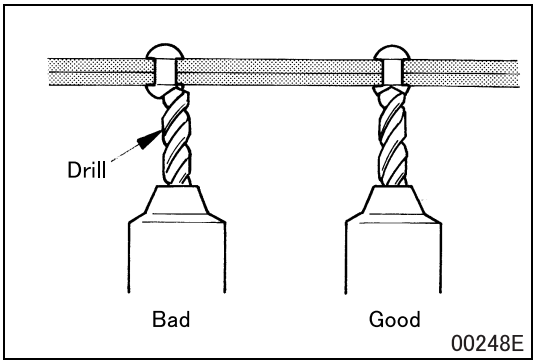


(4) Inspection of rivets for looseness

- Lightly tap the head of each rivet using an inspection hammer and feel or listen for the echo to determine if the rivet is loose.
- Rusting between rivet and frame plate is an indication of loosened rivet.

CAUTION ⚠

- **Be sure to replace loose rivets. They could break off or allow cracks to develop from the rivet holes, leading to an accident.**

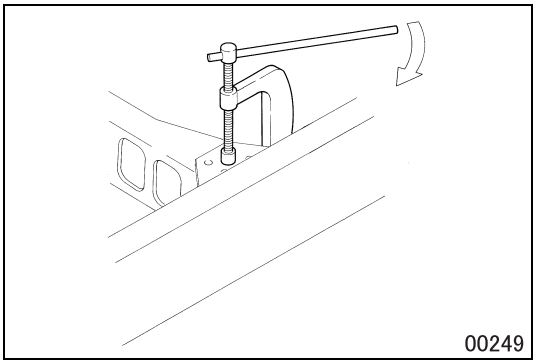


(5) Replacement of rivet

- To remove a loosened rivet, eliminate its head using a drill or grinder. When a drill is used, make a dent in the middle of the rivet's head and align the drill bit to the dent as shown.

NOTE

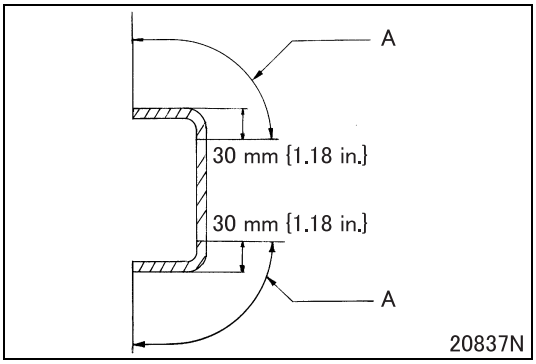
- **The rivet hole must be intact.**



- Before rivetting, clamp the two plates closely together near the rivet hole using a C vice.
- Using a rivetting machine, drive the rivet (cold rivet) into the rivet hole.
- If rivetting is impracticable, ream the rivet hole, drive a reamer bolt in the hole, fully tighten the nut, then weld it in place.
  As the reamer bolt and nut, use a flange bolt and a flange nut.

(6) Inspection of bolts and nuts for looseness

- Inspect the bolts attaching cross members to the side rails for looseness. If any loose bolt is found, retighten it to specified torque.



(7) Drilling hole in frame

NOTE

This manual does not cover the procedures and calculations necessary to do frame modifications. Before doing any modification to the frame rails, consult your regional service representative.

- When drilling holes in the frame becomes necessary, perform it using care in the following respects.

CAUTION ⚠

- **When drilling holes in the side rail, avoid the illustrated ranges A to prevent cracking.**
- **Grind the edge of drilled hole smooth.**
- **Avoid drilling a hole in the vicinity of a point where the rigidity of the side rail change sharply, such as an area near the joint to the cross member or an end of the stiffener.**
- **The diameter of drilled holes must be 11 mm {0.43 in} or smaller and the hole-to-hole distance must be 20 mm {0.79 in} or larger.**

INDEX

SPECIFICATIONS 42-2

STRUCTURE AND OPERATION
- **1. Front Cab Mounting 42-3**
- **2. Rear Cab Mounting 42-3**
- **3. Cab Tilt Link 42-4**

TROUBLESHOOTING 42-6

ON-VEHICLE INSPECTION AND ADJUSTMENT
- **1. Adjustment of Cab Tilt System 42-8**

REMOVAL AND INSTALLATION OF CAB 42-10

FRONT CAB MOUNTING 42-14

REAR CAB MOUNTING 42-16

CAB TILT LINK 42-18

CAB STAY 42-20

SPECIFICATIONS

Cab

Item	Specifications
Type	Cab-over type (forward control type)
Mass kg {lb}	410 {905}

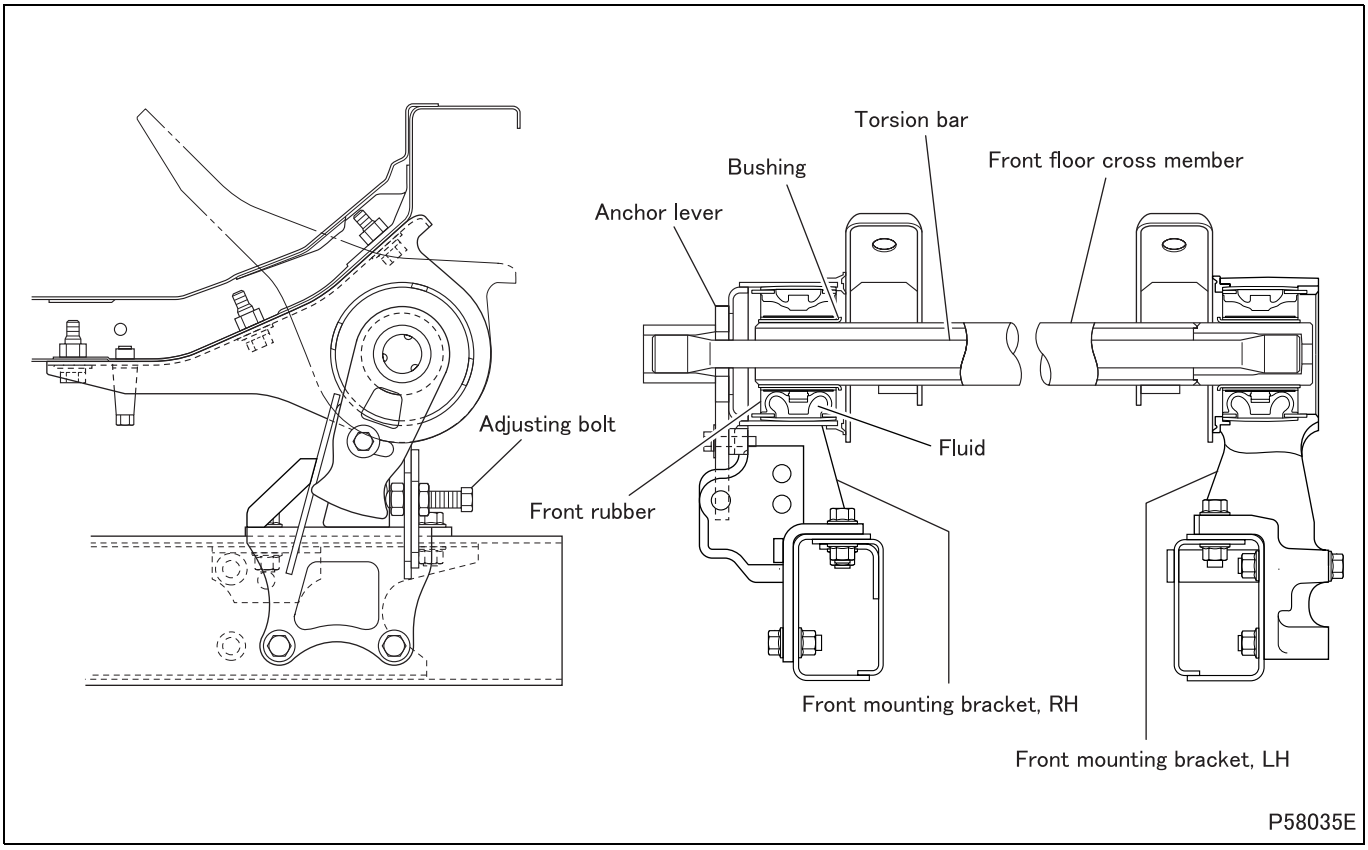
Cab Mounting

Item	Specifications
Type	Semi-floating type
Kind	Liquid-filled rubber cushioned mounting

Cab Tilt System

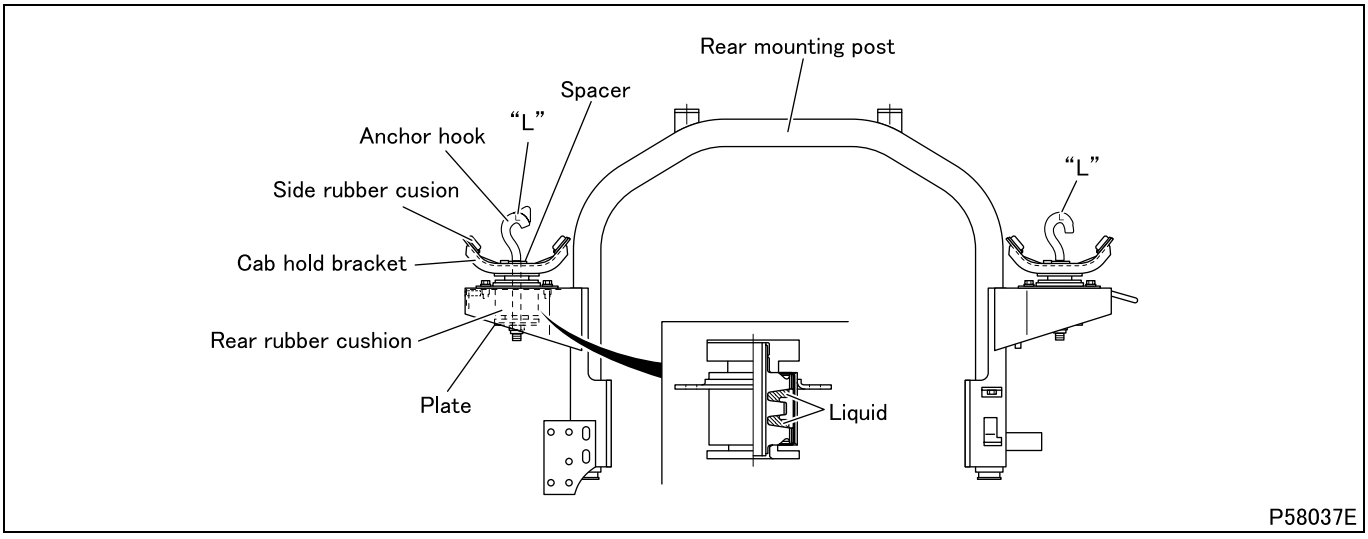
Item	Specifications
Type	Torsion bar type
Tilt angle	45°
Cab tilt lock	Manually operated hook type

1. Front Cab Mounting



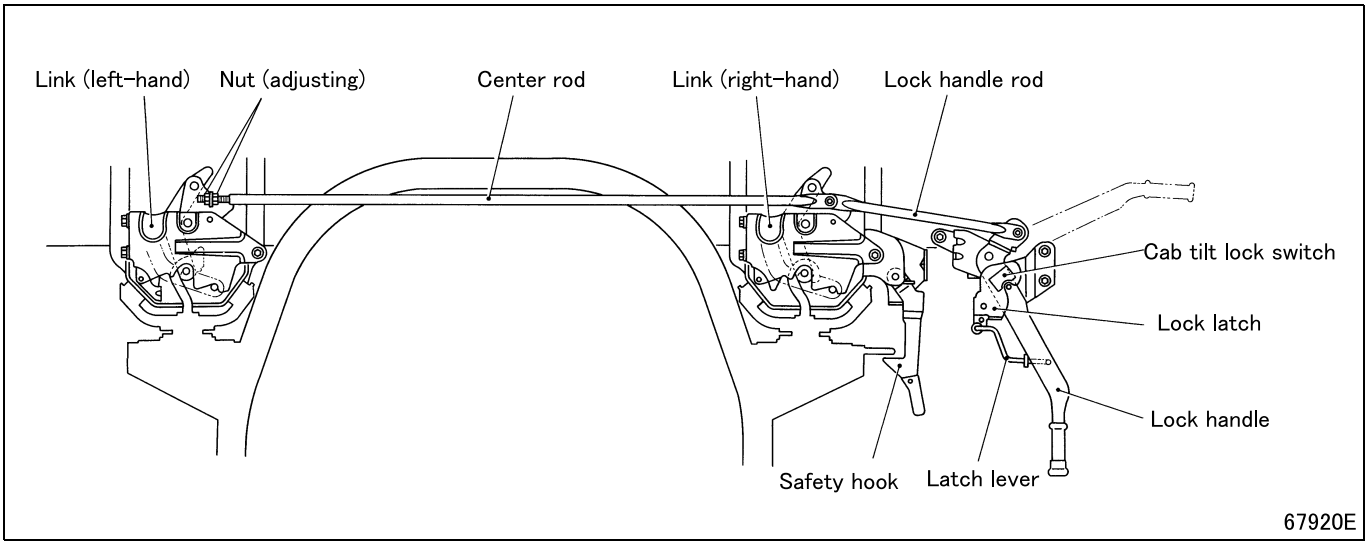
- The operating physical force for the cab tilt system can be adjusted using the adjusting bolt of the front mounting bracket. <Except crew cab>
- The front rubber cushion reduces the vibration and noise of the cab.

2. Rear Cab Mounting



- The operating physical force for the lock handle can be adjusted by increasing and decreasing the number of spacers provided between anchor hook and cab hold bracket.
- Rear mounting upper and lower rubber cushions reduce the vibration and noise of the cab.

3. Cab Tilt Link



- The length of center rod is adjustable with the adjusting nut.
- The cab tilt lock switch of the manual cab tilt system monitors the locking status of the lock handle.

M E M O

Cabs in general

Probable causes / Symptoms			Cab shimmy (vibration with pitching and rolling)	High-frequency vibration (above 20Hz) and noise in cab and steering wheel	Reference Gr
Cab-related problems	Front cab mounting	Front mounting bracket loose, play	O		
		Sagging of front rubber cushion		O	
	Center or rear cab mounting	Sagging of mounting rubber cushion		O	
	Cab improperly mounted			O	
Engine-related problems		Propeller shaft inclination angle excessive due to increased tilt angle caused by deteriorated engine mounting		O	Gr11
		Engine improperly mounted		O	
		Intake and exhaust system components improperly installed		O	Gr15
Transmission-related problem		Transmission improperly mounted		O	Gr22
Propeller shaft-related problems		Propeller shaft runout excessive		O	Gr25
		Universal joint excessively worn		O	
		Backlash excessive at slip yoke joint		O	
		Center bearing play excessive		O	
		Angle at propeller shaft joint excessive due to deteriorated center bearing rubber cushions or other causes		O	
		Angle at propeller shaft joint excessive due to increased tilt of drive axle caused by overloading		O	
Front axle-related problem		Sympathetic vibrations from axle seat	O		Gr26
Rear axle-related problems		Reduction gears in poor mesh		O	Gr27
		Differential gears in poor mesh		O	
Wheel and tire-related problems		Wheel and tire runout excessive	O		Gr31
		Wheels and tires out of balance	O		
		Use of tires different in size or type	O		
		Wheel mounting surface deformed	O		
Front suspension-related problem		Friction excessive between spring leaves	O		Gr33
Brake-related problems		Brake drum out of balance <Drum brake>	O		Gr35A
		Brake drum eccentric <Drum brake>	O		
		Disc brake rotor runout <Disc brake>	O		

Manual cab tilt system

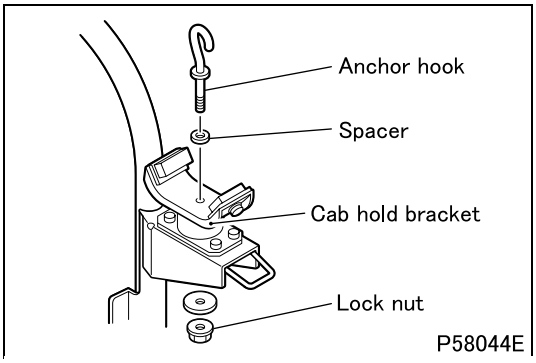
Symptoms / Probable causes	Cab fails to tilt up.	Cab cannot lock on rear mounting post.	Cab tilt warning lamp fails to come on.	Cab tilt warning lamp fails to go out.	Reference Gr
Main hook not released	O				
Safety hook not released	O				
Torsion bar damaged or fatigued	O				
Main hook does not engage with hook pin bracket		O			
Cab tilt lock switch poorly adjusted			O	O	
Cab tilt lock switch faulty			O	O	
Cab tilt warning lamp faulty			O		
Fuse or high current fuse blown			O		
Wiring open-circuited or improperly connected			O		

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Adjustment of Cab Tilt System

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Lock nut (anchor hook fitting)	83 to 98 {61 to 72, 8.5 to 10}	–



(1) Adjustment of lock handle operating physical force

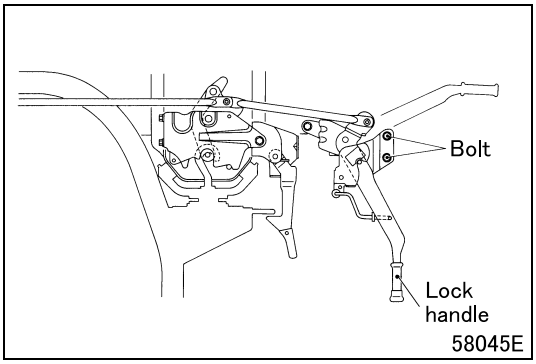
- Remove the lock nut, then remove the anchor hook.
- Adjust the operating physical force increasing or decreasing the number of spacers between anchor hook and cab hold bracket as follows.

	Number of spacers
If lock handle feels too heavy	Increase
If lock handle feels too light	Decrease

- After adjustment, tighten the lock nut to the specified torque.

CAUTION ⚠

- **If the lock handle feels too light, it is an indication that the handle could be easily unlocked by the vibration of the running vehicle. In such a case, there is a possibility that the cab tilt lock switch does not respond and the tilt warning lamp is lit.**

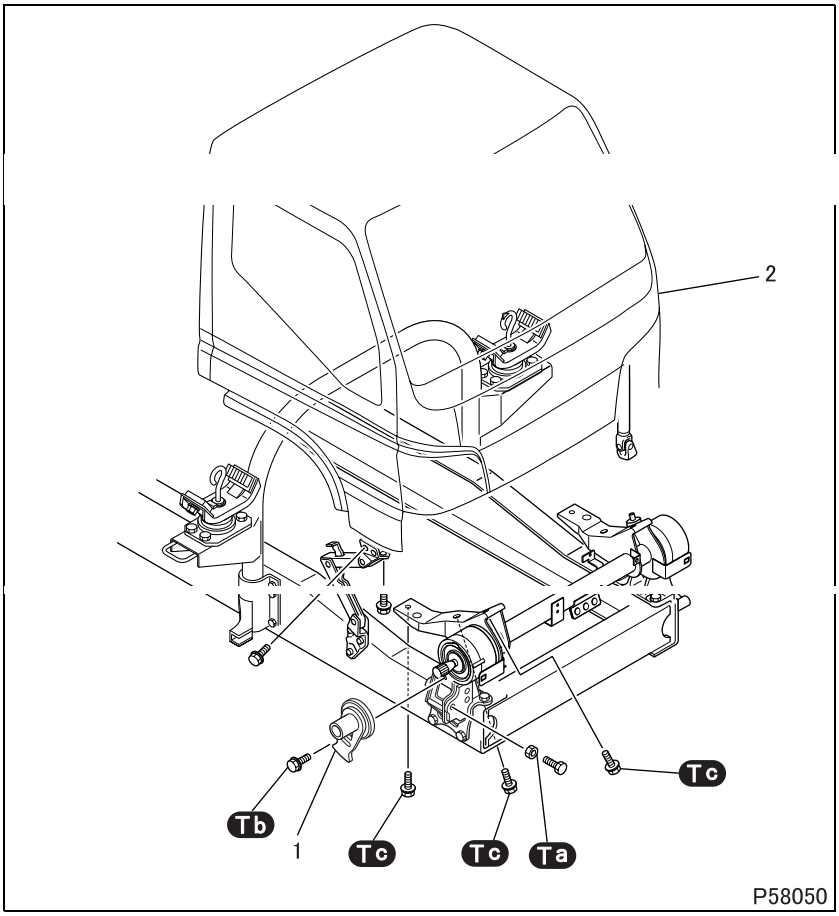


(2) Adjustment of latch

- If the latch resists, loosen bolts and adjust the installed position of the lock handle using bolt slot.
- After adjustment, retighten the bolts.

M E M O

REMOVAL AND INSTALLATION OF CAB



● Removal sequence

1 Anchor lever
2 Cab

CAUTION ⚠

- **During removal and installation of the cab, the parking brake is not available for holding the vehicle at a standstill. Therefore, be sure to apply chocks to the tires to ensure that the vehicle does not move.**
- **Never remove the chocks until all the operations are completed.**
- **Disconnect all cables, hoses and wires before removal and installation of the cab.**

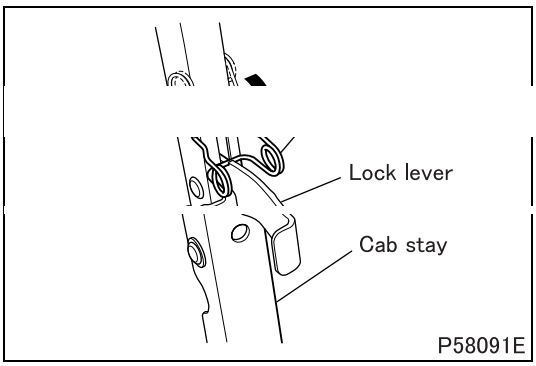
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (anchor lever adjusting bolt locking)	59 to 83 {43 to 61, 6 to 8.5}	–
Tb	Bolt (anchor lever attaching)	34 to 54 {25 to 40, 3.5 to 5.5}	–
Tc	Bolt (cab mounting)	70 to 95 {51 to 70, 7.1 to 9.7}	–

◆Removal procedure◆

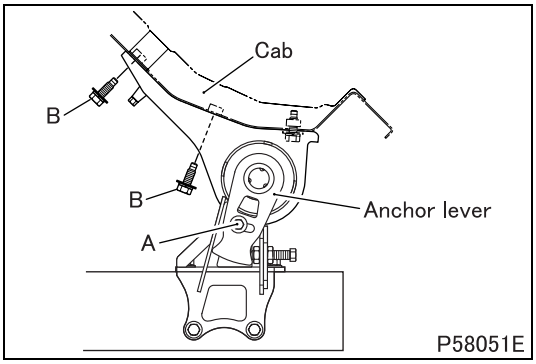


■ Removal: Cab

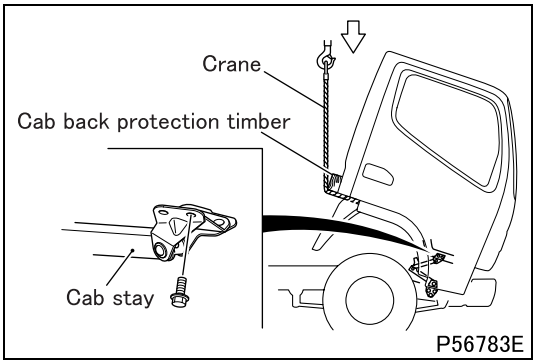
- Tilt the cab to securely lock the cab stay.

WARNING ⚠

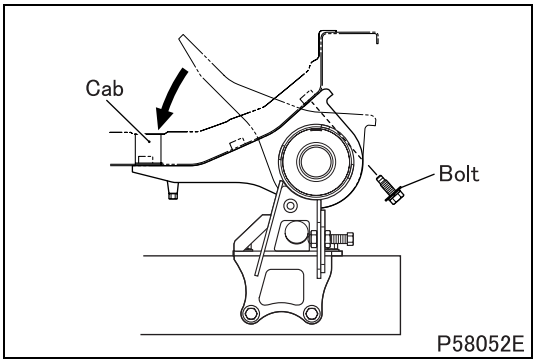
- **Be sure to fit the stopper onto the lock lever to lock the cab stay.**



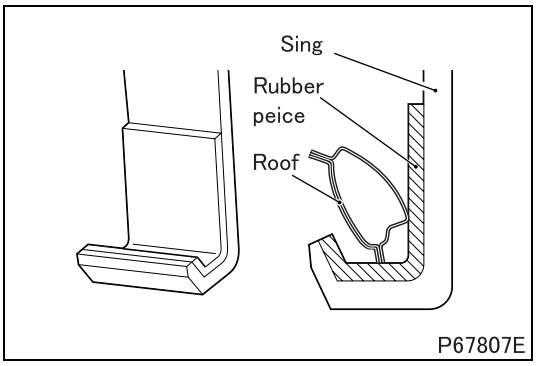
- Remove the bolt **A**, then detach the anchor lever.
- Remove the bolts **B** holding the cab in place.



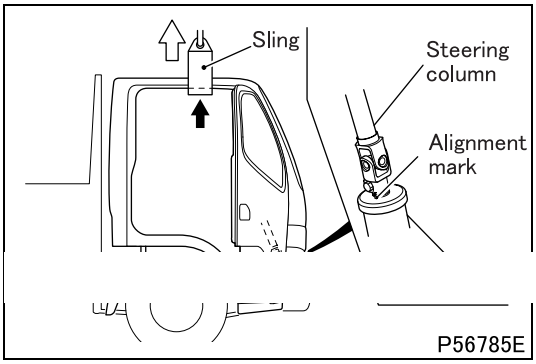
- Supporting the tilted cab with the crane, remove the cab stay.



- Lower the cab all the way, then remove bolt.



- Make available a sling rigid enough to carry the weight of the cab.
- The hook portion of the sling must be lined with a rubber piece as shown to prevent deformation of the roof of the cab.



- Hook the sling on the cab roof as shown, then hoist the cab a little to see if it maintains level (balanced at the center of gravity).
- Provide alignment marks on the power steering gear **C** and steering column, then separate the steering column.
- To prevent the steering column from falling off, tie it securely to the cab using a rigid cord.
- Lift off the cab straight.

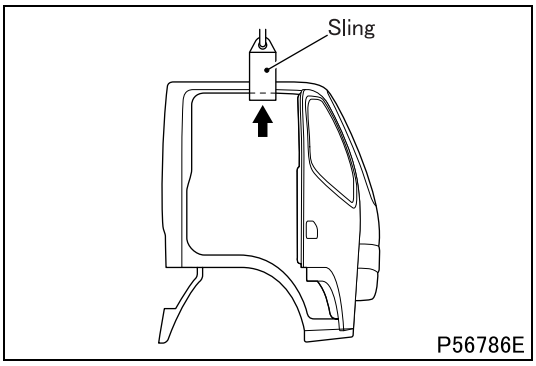
WARNING ⚠

- **While the cab is up in the air, be sure to stay out from under it.**

CAUTION ⚠

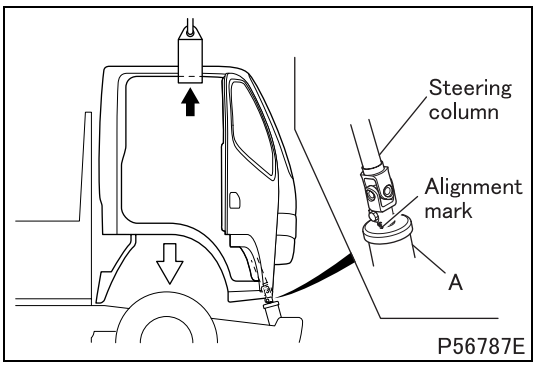
- **Before lifting the cab, check to ensure that cables, hoses, wires, etc. have been all disconnected.**

◆Installation procedure◆

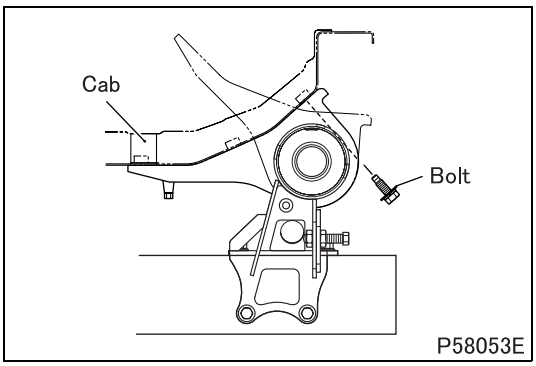


■ Installation: Cab

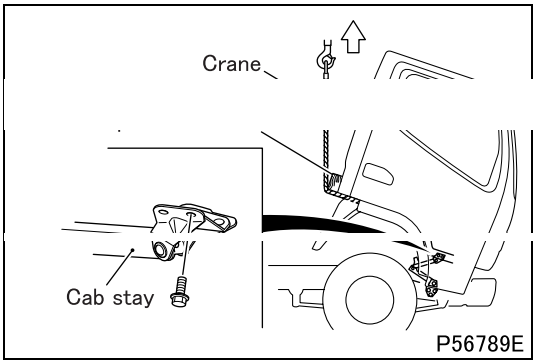
- Hook the sling at center-of-gravity points on both sides of the cab roof, and lift the cab.



- Slowly lower the cab halfway.
- Join the power steering gear **A** and steering column together in accordance with the alignment marks.



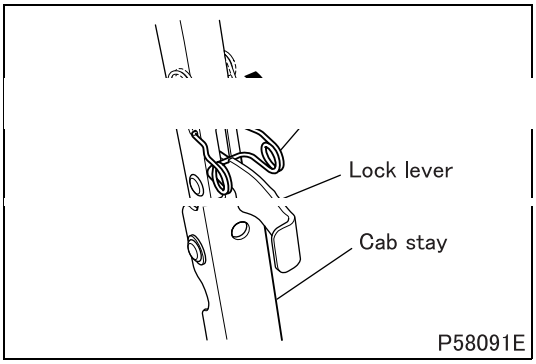
- Further lower the cab slowly to mount in position, then unhook the sling.
- Tighten mounting bolts to specified torque.



- Before tilting, support the cab using the crane.
- Tilt the cab with the crane, and install the cab stay.

WARNING ⚠

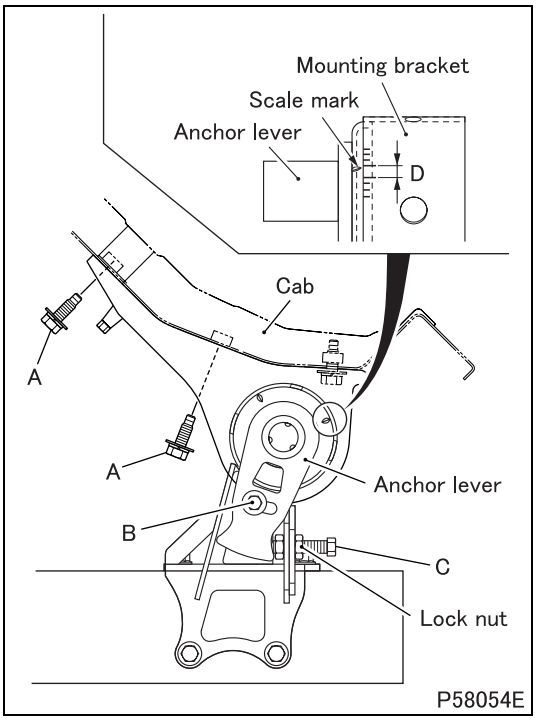
- **Be careful not to tilt the cab more than necessary. Doing so is extremely dangerous because it causes the cab to fall down forward.**



- After the cab stay is installed, tilt the cab to securely lock the cab stay. Then, remove the crane from the cab.

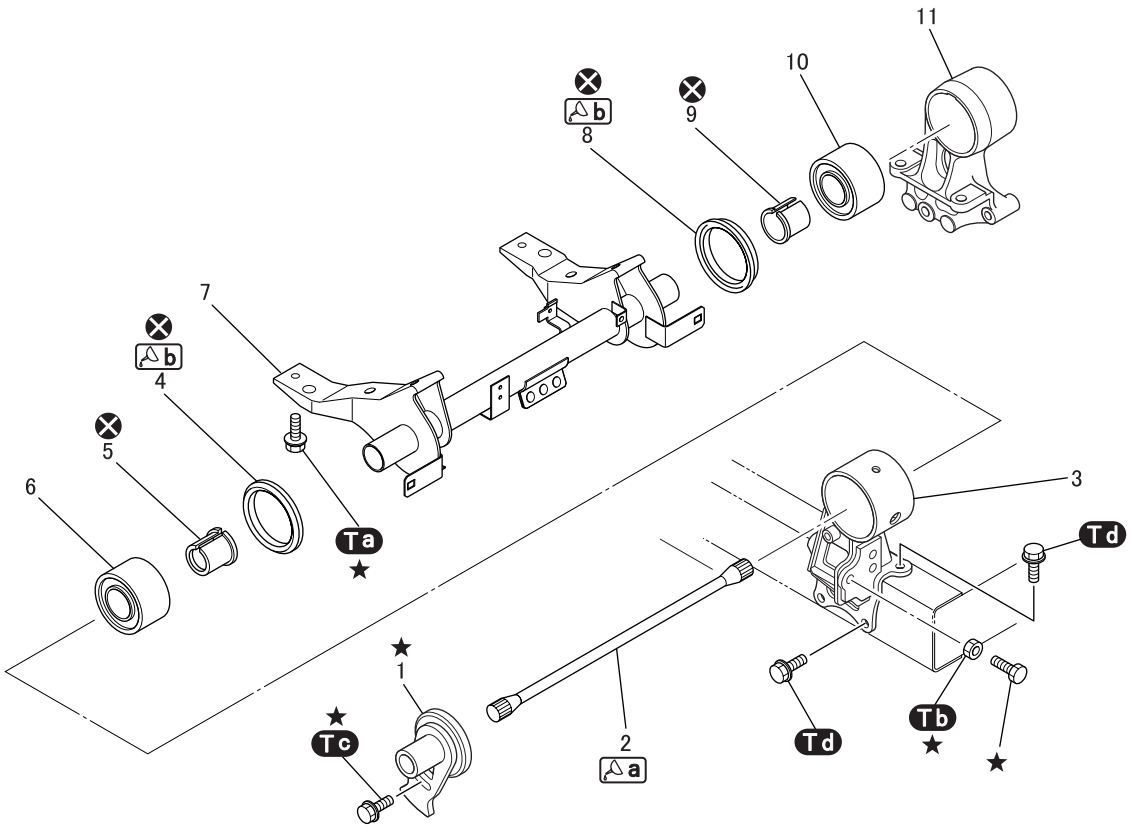
WARNING ⚠

- **Be sure to fit the stopper onto the lock lever to lock the cab stay.**



- Tighten the bolt **A** to specified torque.
- Align the graduated line of the anchor lever to the illustrated range of **D** (long division) of the scale graduated on the mounting bracket, then install the bolt **B** handtight.
- Tighten the bolt **C** to turn the anchor lever 5 degrees (one short division of the scale on the mounting bracket), then tighten the lock nut to specified torque.
- Tighten the handtight bolt **B** to specified torque.

FRONT CAB MOUNTING



Parts marked with ★ are to be installed while the cab assembly is mounted.
Assemble them by reference to the removal and installation procedures for cab assembly.

P103547E

● Disassembly sequence

1 Anchor lever
2 Torsion bar
3 Side cushion
4 Bushing
5 Front rubber cushion
6 Front mounting bracket, right-hand
7 Front mounting bracket, left-hand
8 Front floor cross member

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

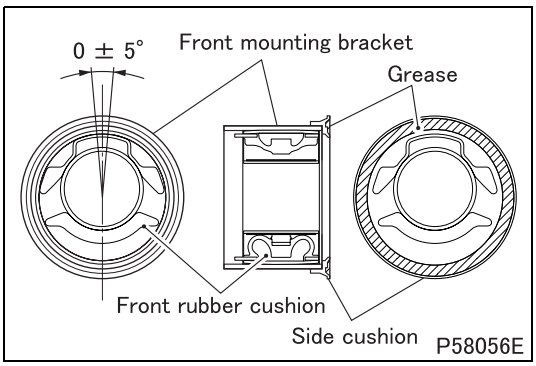
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (cab mounting)	70 to 95 {51 to 70, 7.1 to 9.7}	–
Tb	Nut (anchor lever adjusting bolt tightening)	59 to 83 {43 to 61, 6 to 8.5}	–
Tc	Bolt (anchor lever attaching)	34 to 54 {25 to 40, 3.5 to 5.5}	–
Td	Bolt (front mounting bracket attaching)	200 to 270 {145 to 200, 20 to 28}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Both serrated end portions of torsion bar	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
b	Front floor cross member contact surface of side cushion	Rubber Grease	As required

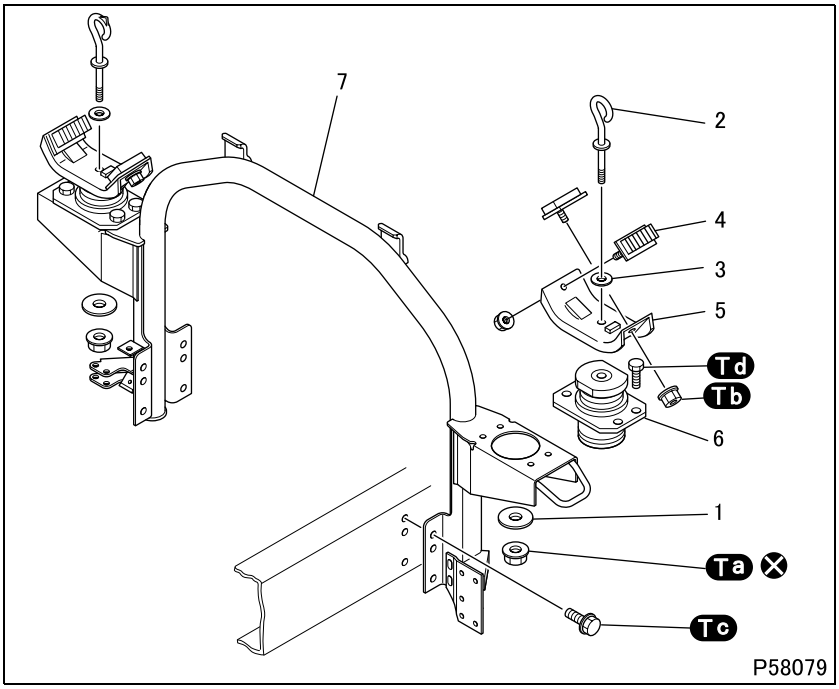
◆Installation procedure◆



■Installation: Side rubber cushion and front rubber cushion

- Fit the front rubber cushion to the front mounting bracket at an angle within the illustrated range.
- After installing the front rubber cushion, fit the side rubber cushion to it and fill grease in the side rubber cushion as shown.

REAR CAB MOUNTING



● Disassembly sequence

1 Plate
2 Anchor hook
3 Spacer
4 Side rubber cushion
5 Cab hold bracket
6 Rear lower rubber cushion
7 Rear mounting post

⊗: Non-reusable parts

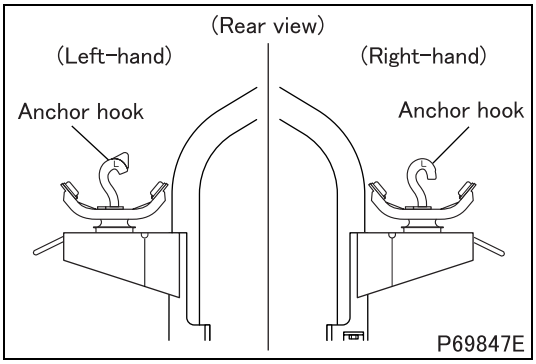
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (anchor hook attaching)	83 to 98 {61 to 72, 8.5 to 10}	–
Tb	Nut (side rubber cushion attaching)	10 to 15 {7.4 to 11, 1.0 to 1.5}	–
Tc	Bolt (rear mounting post attaching)	78 to 108 {5.8 to 80, 8 to 11}	–
Td	Bolt (rear rubber cushion attaching)	16 to 20 {12 to 14, 1.6 to 2}	–

◆Installation procedure◆

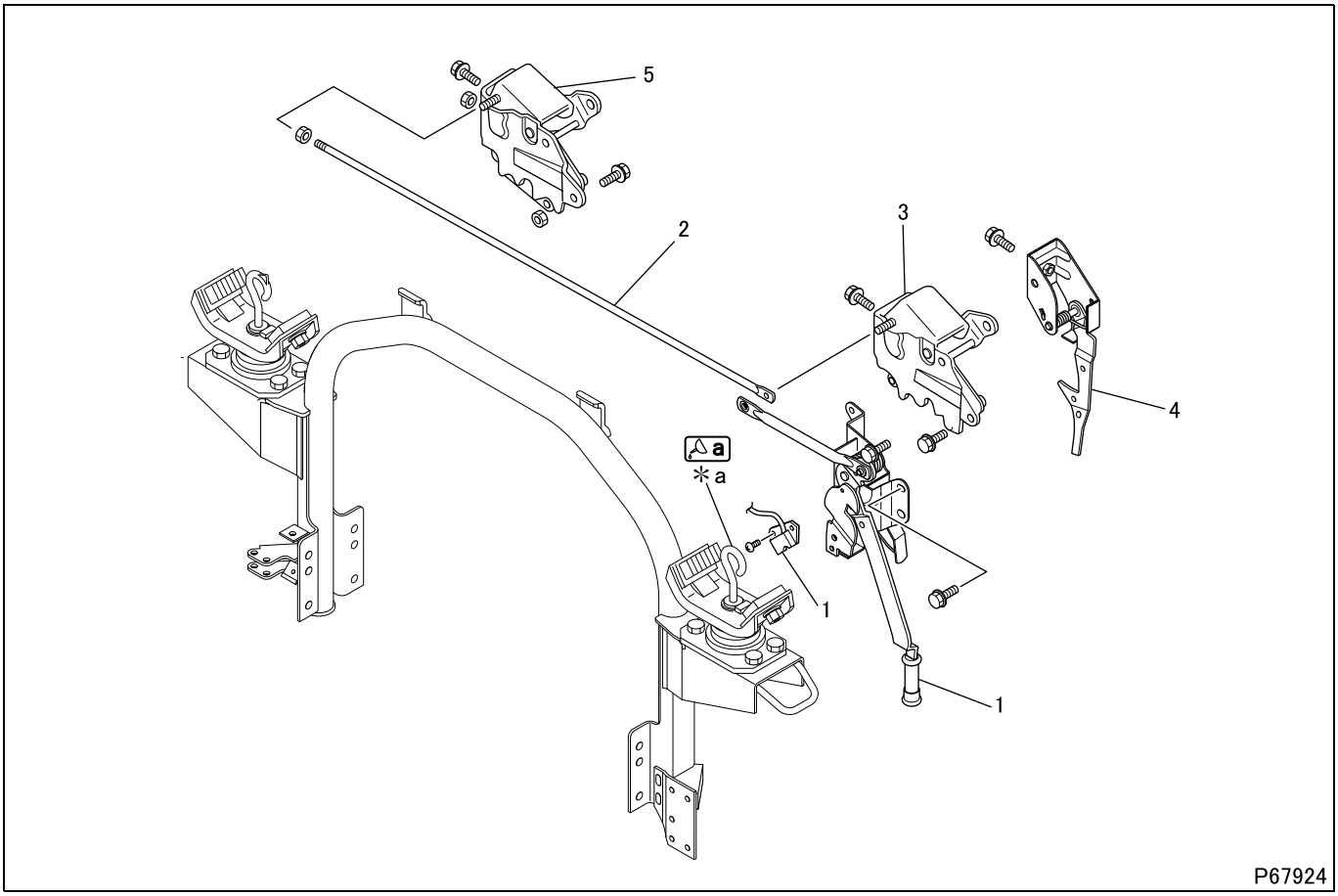


■ Installation: Anchor hook

- Fit the anchor hooks to the rear mounting post oriented as shown in the illustrations.

M E M O

CAB TILT LINK



● **Disassembly sequence**

1 Lock handle
2 Center rod
3 Link (right-hand)
4 Safety hook
5 Link (left-hand)

***a**: Anchor hook

● **Assembly sequence**

Follow the disassembly sequence in reverse.

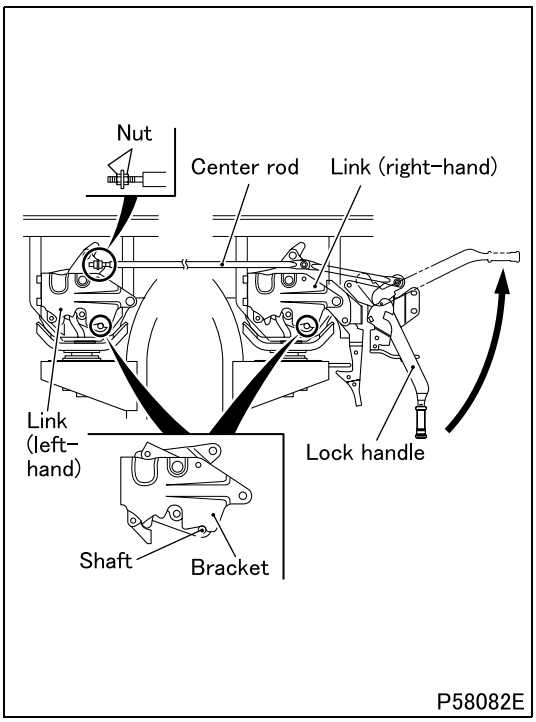
CAUTION ⚠

- **After assembly, adjust the lock handle operating physical force. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Contact of link (right-hand) of anchor hook	Chassis grease [NLGI No. 1 (Li soap)]	As required

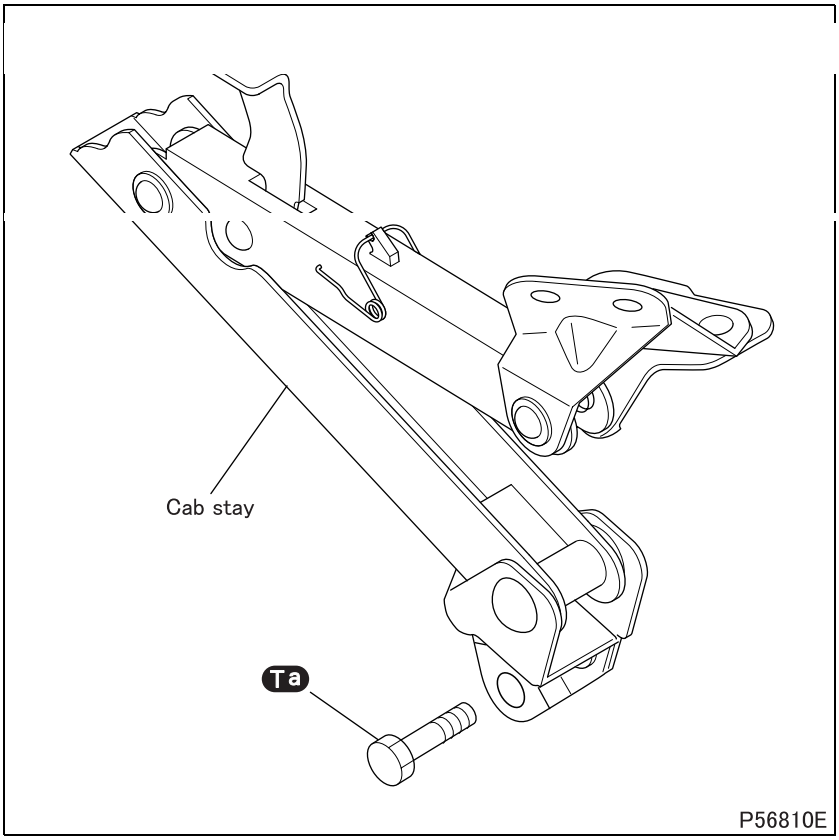
◆Installation procedure◆



■Installation: Center rod

- Operate the lock handle in the illustrated direction to unlock the left-hand and right-hand links.
- Adjust the center rod nut to bring the shafts of left-hand and right-hand links into contact with brackets.

CAB STAY



WARNING ⚠

- **Before removing the cab stay, be sure to support the cab with a crane or the like so that it does not fall during work.**

Tightening torque (Unit: N·m {ft. lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (cab stay mounting)	59 to 78 {43 to 58, 6 to 8}	–

INDEX

SPECIFICATIONS 43-2

STRUCTURE AND OPERATION
- **1. Door Lock System 43-3**
- **2. Window Opening and Closing Mechanism 43-4**

TROUBLESHOOTING 43-5

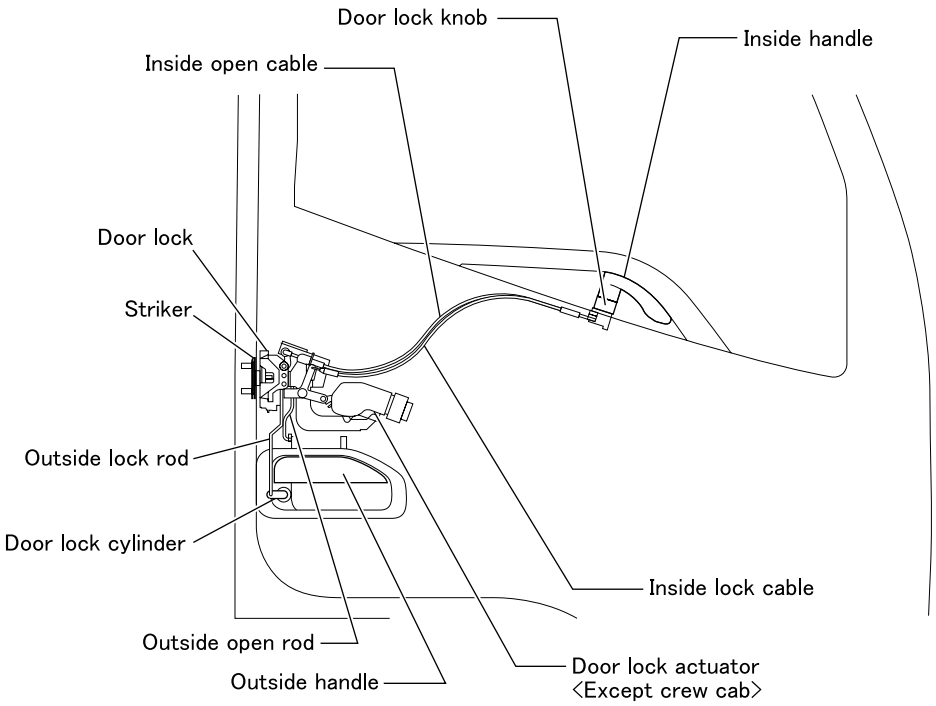
ON-VEHICLE INSPECTION AND ADJUSTMENT
- **1. Door Alignment 43-6**

DOOR 43-10

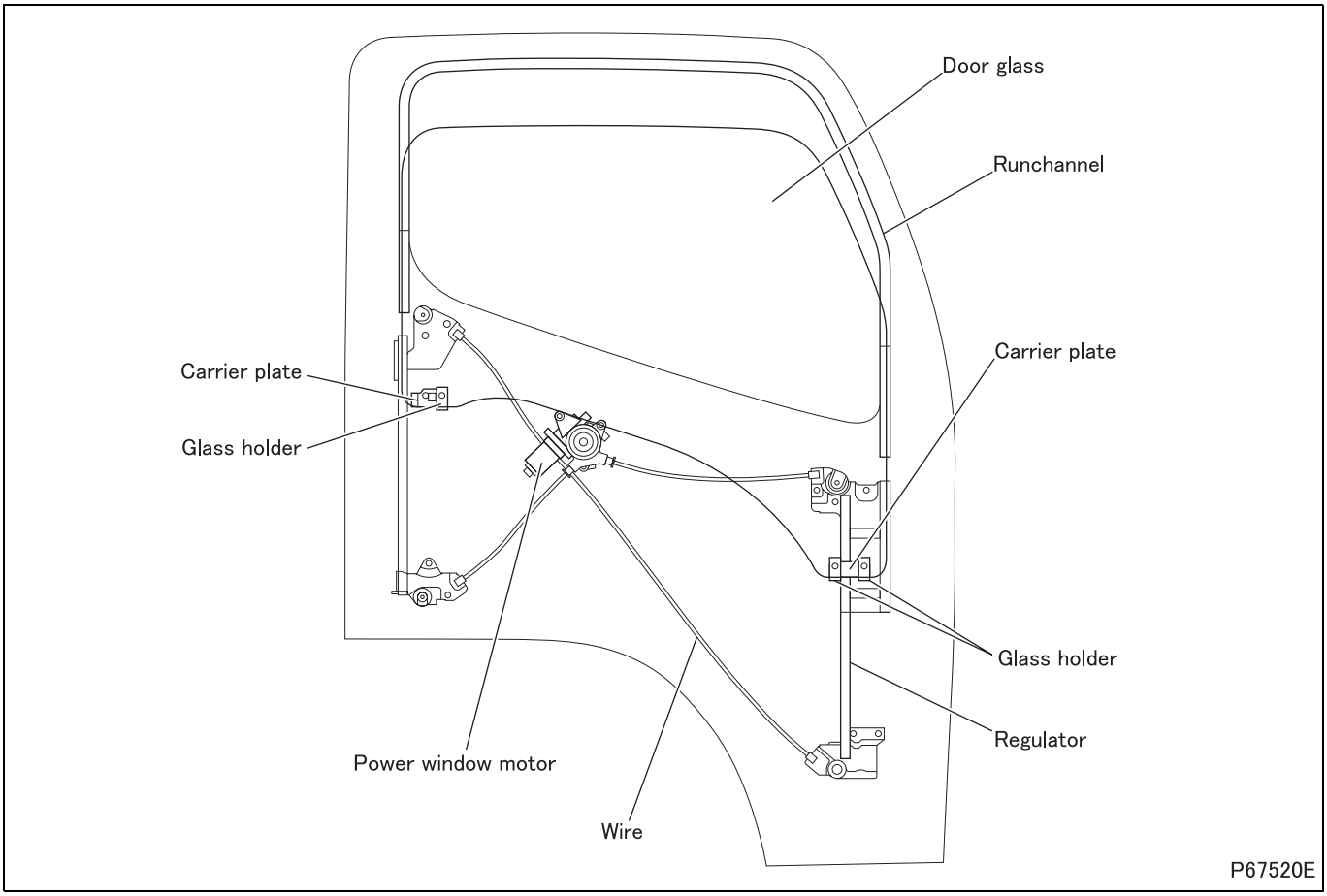
SPECIFICATIONS

Item		Specifications
		Except crew cab
Front door	Door lock system	Auto door lock system (centralized door lock)
	Door glass opening and closing mechanism	Electrical control type
Rear door	Door lock system	–
	Door glass opening and closing mechanism	–

1. Door Lock System



2. Window Opening and Closing Mechanism



- The door glass is secured to the carrier plate by the medium of glass holder.
- With the rotation of the power window motor <Electrical control type>, the carrier plate is moved up and down by means of the wire to open and close the door glass.

Door Glass Opening and Closing Mechanism

Symptoms / Possible causes	Door glass falls by gravity when vehicle is running	Regulator or motor emits noise when vehicle is running	Power window fails to operate	Power window fails to stop	Power window emits noise when in motion	Reference Gr
Power window switch faulty			O	O		Gr54
Regulator and motor assembly faulty	O		O	O	O	
Regulator and motor assembly improperly mounted					O	
Fuse or high current fuse blown			O			
Connector improperly connected, harness open-circuited or improperly grounded			O			
Door glass and door beltline molding unsteady		O				
Air temperature low						

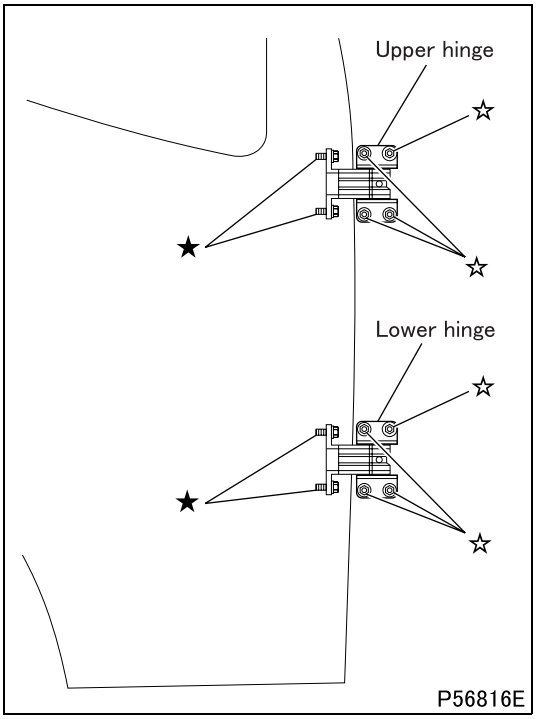
ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Door Alignment

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

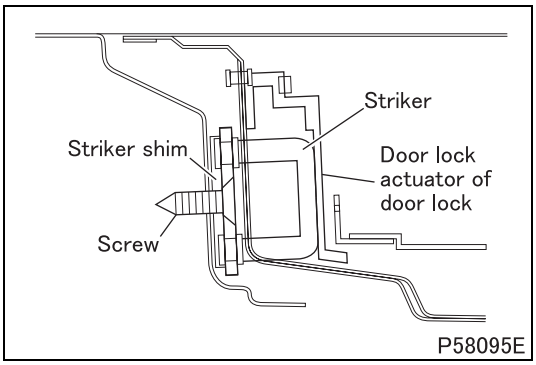
Mark	Parts to be tightened	Tightening torque	Remarks
–	Bolt (door mounting; ★ marked)	17 to 26 {12 to 19, 1.7 to 2.6}	–
	Bolt (upper and lower hinge mounting; ☆ marked)		
–	Screw (striker mounting)	9 to 14 {6.5 to 10, 0.9 to 1.4}	–

- Door alignment is adjusted by changing the positions of the upper and lower hinges and striker.
  Door alignment dimensions: See **1.3**.



1.1 Adjustment of hinge positions

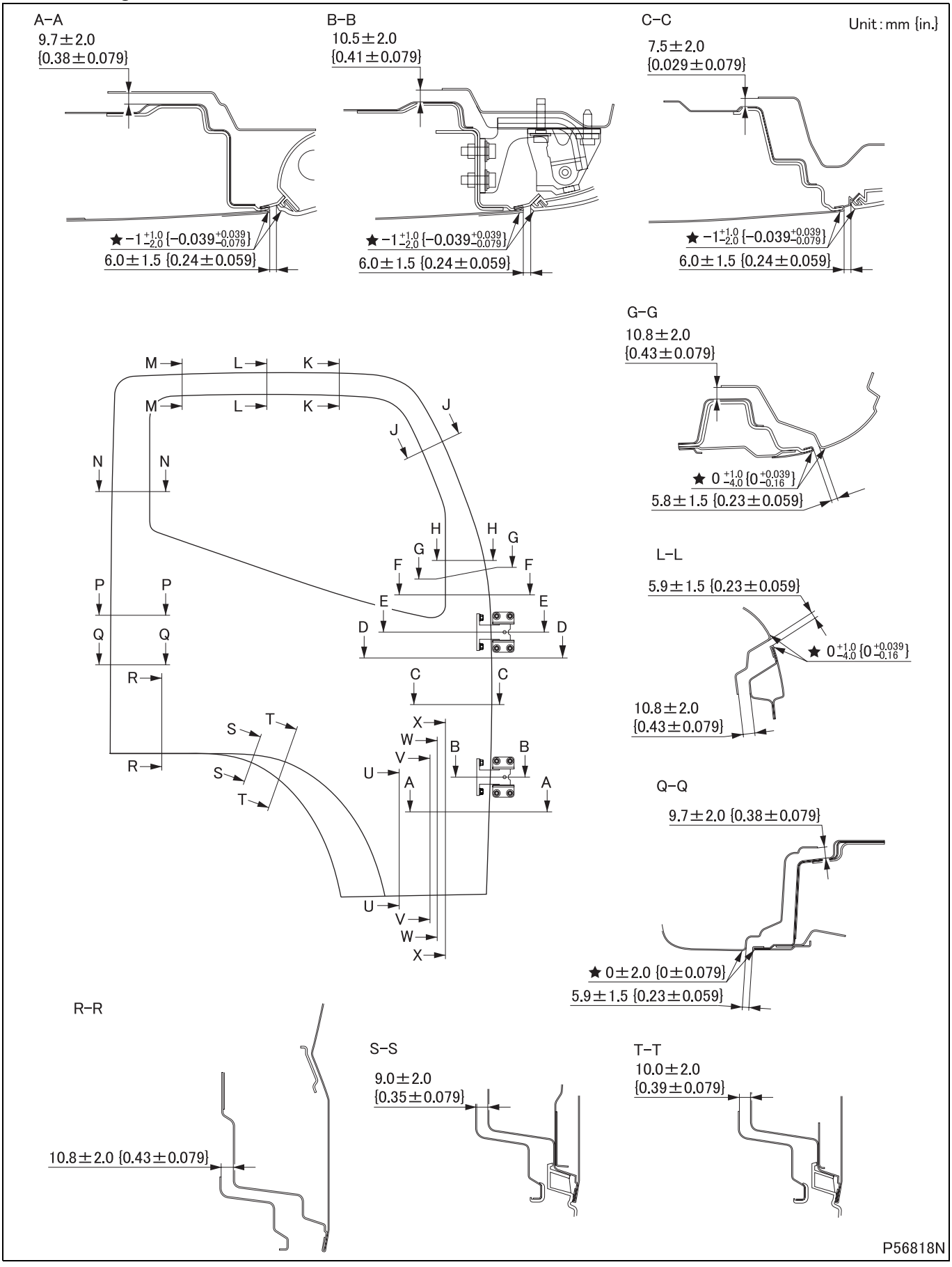
- Use ★ marked bolts to adjust gap.
- Use ☆ marked bolts to adjust flushness.



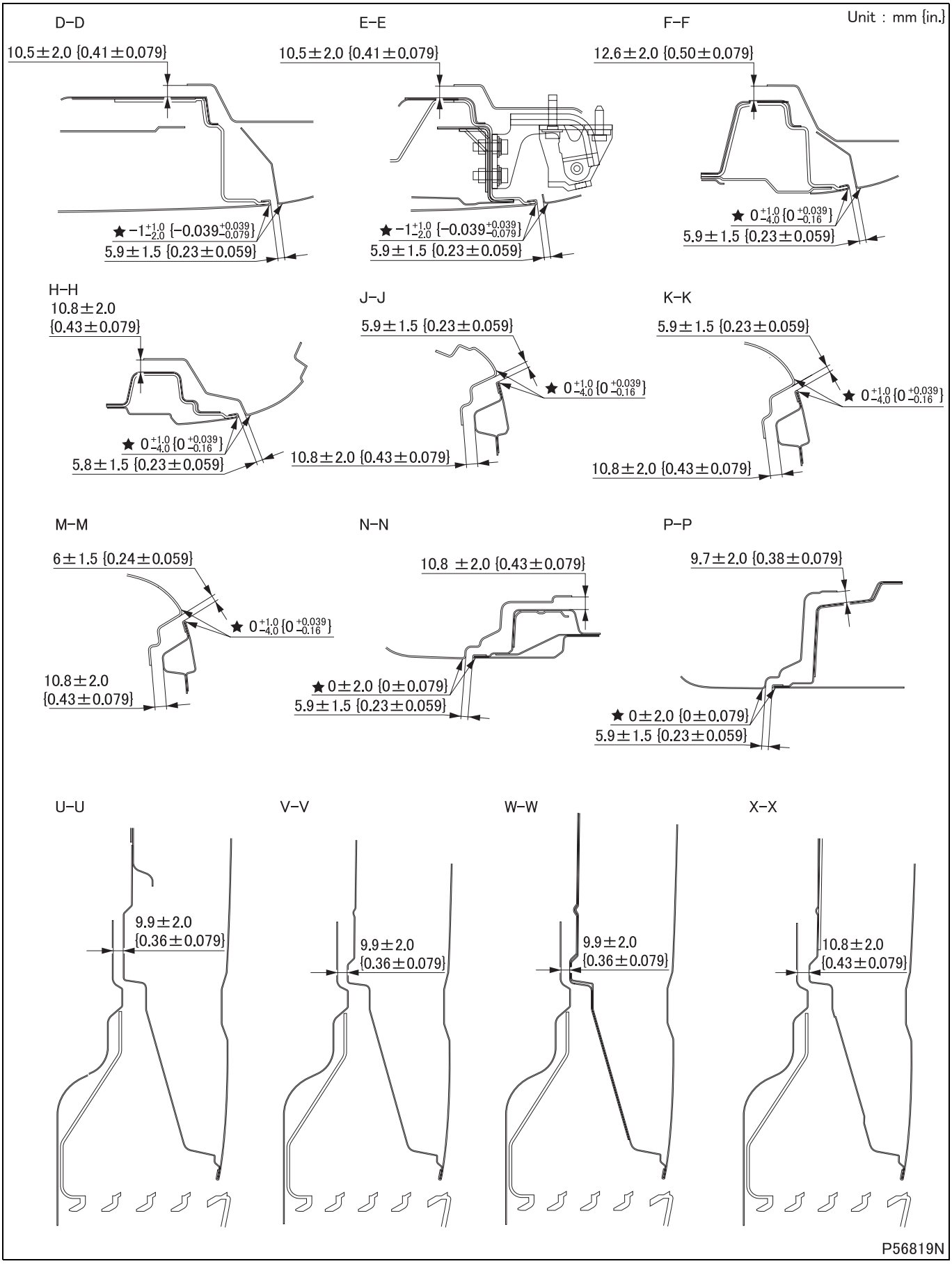
1.2 Adjustment of striker position

- Use mounting screw to make the adjustment.
- To adjust the engagement of the striker with the door lock actuator or door lock, change the number of striker shims as required.

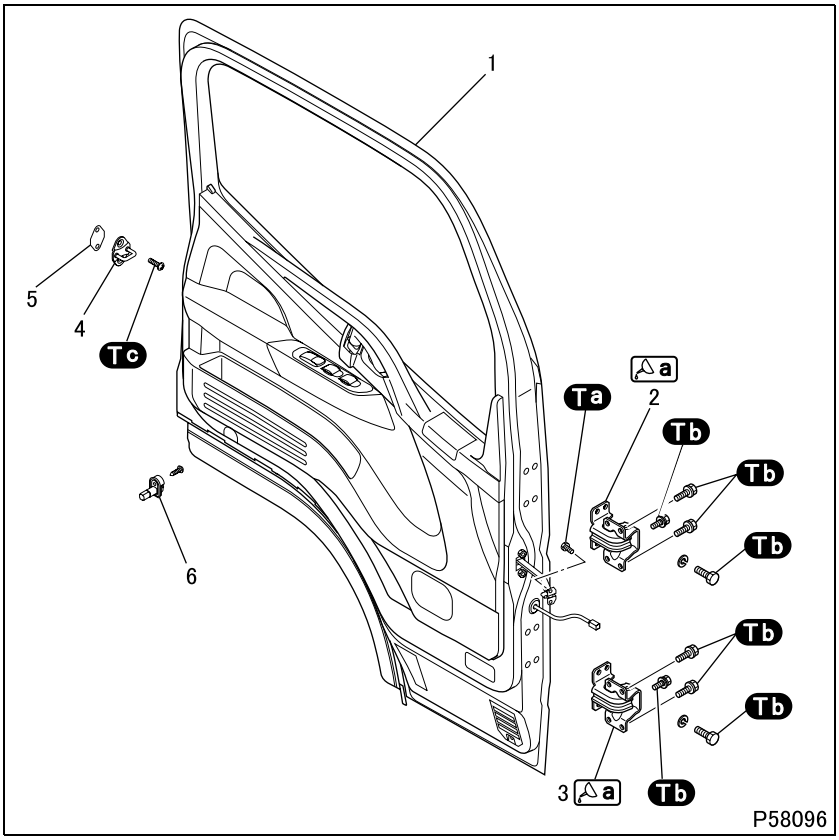
1.3 Door alignment dimensions



★: Flushness dimension (+ for outside of cab; – for inside of cab)


Unit : mm {in.}
D–D
10.5±2.0 {0.41±0.079}
★ −1 +1.0 −2.0 {−0.039 +0.039 −0.079}
5.9±1.5 {0.23±0.059}
E–E
10.5±2.0 {0.41±0.079}
★ −1 +1.0 −2.0 {−0.039 +0.039 −0.079}
5.9±1.5 {0.23±0.059}
F–F
12.6±2.0 {0.50±0.079}
★ 0 +1.0 −4.0 {0 +0.039 −0.16}
5.9±1.5 {0.23±0.059}
H–H
10.8±2.0
{0.43±0.079}
★ 0 +1.0 −4.0 {0 +0.039 −0.16}
5.8±1.5 {0.23±0.059}
J–J
5.9±1.5 {0.23±0.059}
★ 0 +1.0 −4.0 {0 +0.039 −0.16}
10.8±2.0 {0.43±0.079}
K–K
5.9±1.5 {0.23±0.059}
★ 0 +1.0 −4.0 {0 +0.039 −0.16}
10.8±2.0 {0.43±0.079}
M–M
6±1.5 {0.24±0.059}
★ 0 +1.0 −4.0 {0 +0.039 −0.16}
10.8±2.0
{0.43±0.079}
N–N
10.8 ±2.0 {0.43±0.079}
★ 0±2.0 {0±0.079}
5.9±1.5 {0.23±0.059}
P–P
9.7±2.0 {0.38±0.079}
★ 0±2.0 {0±0.079}
5.9±1.5 {0.23±0.059}
U–U
9.9±2.0
{0.36±0.079}
V–V
9.9±2.0
{0.36±0.079}
W–W
9.9±2.0
{0.36±0.079}
X–X
10.8±2.0
{0.43±0.079}
P56819N

M E M O



●Removal sequence

1 Door (See later section.)
2 Upper hinge
3 Lower hinge
4 Striker
5 Striker shim
6 Door switch

●Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- **Adjust front door alignment after installation. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

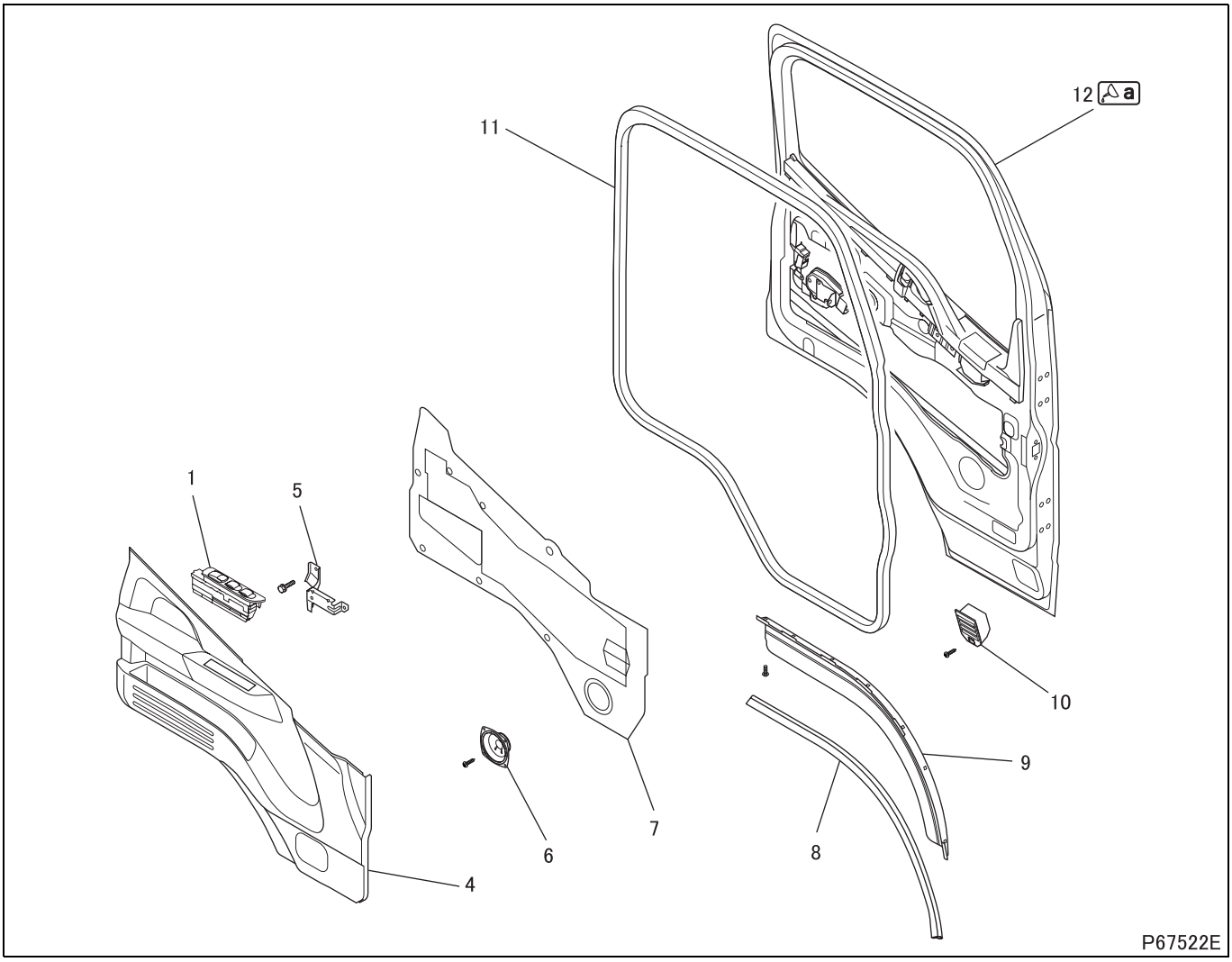
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (door mounting)	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	–
Tb	Bolt (door mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	–
	Bolt (upper and lower hinge mounting)		
Tc	Screw (striker mounting)	9 to 14 {6.5 to 10, 0.9 to 1.4}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Rotating contact parts of upper and lower hinges	Chassis grease [NLGI No. 1 (Li soap)]	As required

Door



●Disassembly sequence

1 Power window switch
2 Clip
3 Regulator handle
4 Lower door trim
5 Trim bracket
6 Speaker
7 Water-proof cover
8 Weatherstrip <FE>
9 Door fender <FE>
10 Air outlet garnish
11 Weatherstrip
12 Door panel (See later section.)

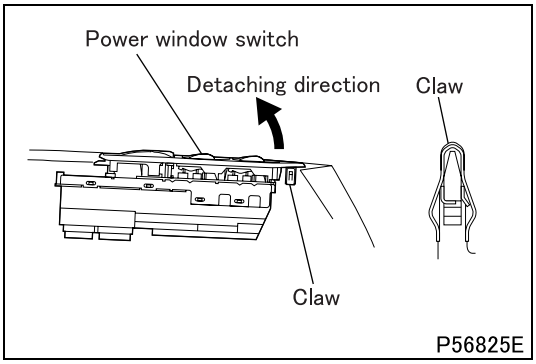
●Assembly sequence

Follow the disassembly sequence in reverse.

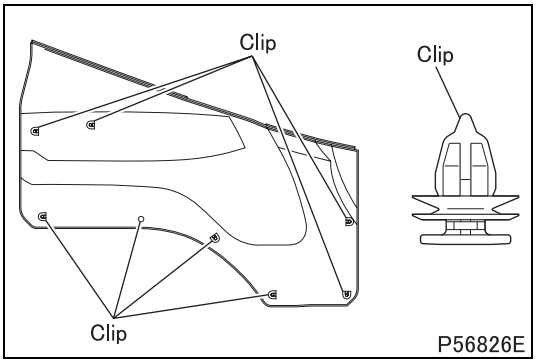
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Water-proof cover fitting surface of door panel	Butyl tape	As required

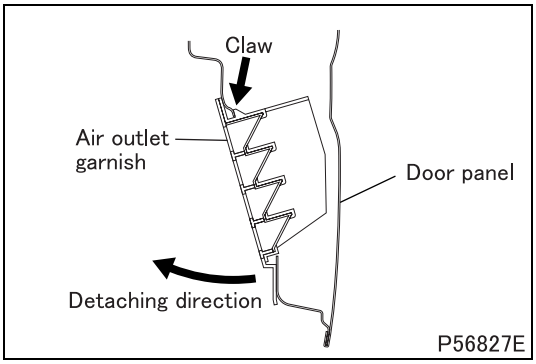
◆Removal procedure◆



■Removal: Power window switch

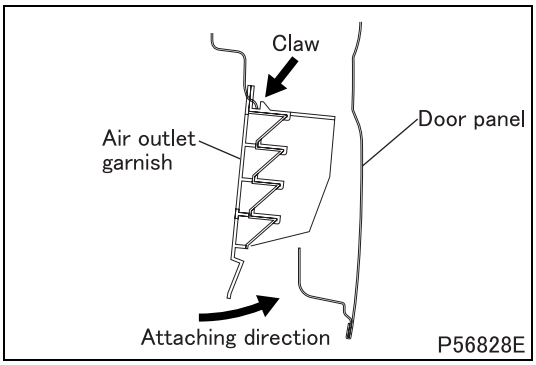


■Removal: Lower door trim



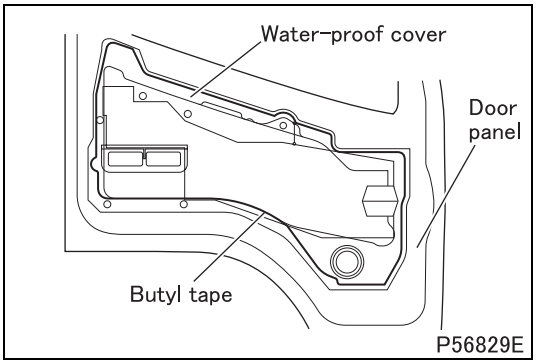
■Removal: Air outlet garnish

◆Installation procedure◆



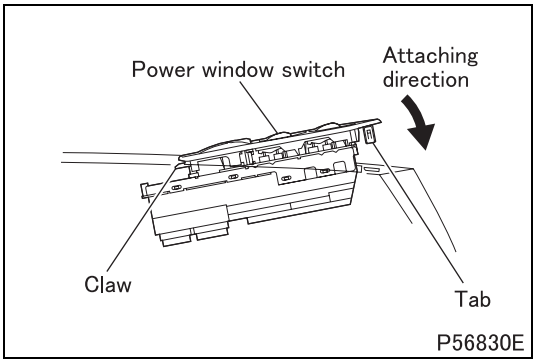
■Installation: Air outlet garnish

- Attach the air outlet garnish to the door panel in the illustrated direction, with its claw fitted in the door panel.



■**Installation: Water-proof cover**

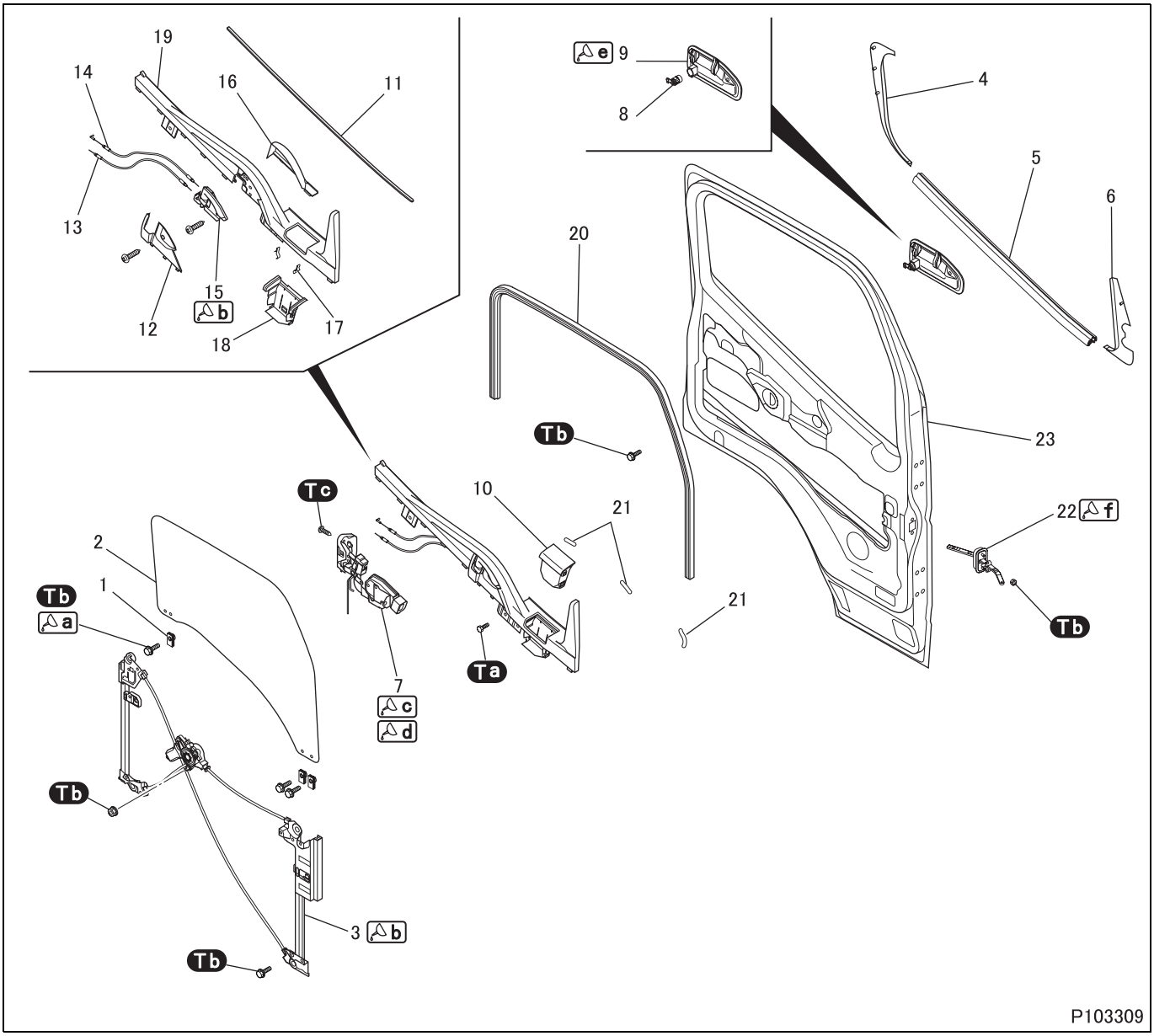
- Apply butyl tape to the door panel as shown, then attach the water-proof cover to the door panel.



■**Installation: Power window switch <Option>**

- To install the power window switch in position, fit claw first, then tab, in the lower door trim.

Door Panel Assembly



●Disassembly sequence

1 Glass holder
2 Door glass
3 Regulator and motor
Manual regulator
4 Sash garnish
5 Beltline molding
6 Delta garnish
7 Door lock actuator
<With auto door lock>
Door lock
<Without auto door lock>
8 Door lock cylinder
9 Outside handle
10 Ash tray
11 Weatherstrip
12 Inside handle inner cover
13 Inside lock cable
14 Inside open cable
15 Inside handle
16 Inside handle outer cover
17 Spring
18 Ash tray cover
19 Upper door trim
20 Runchannel
21 Protector
22 Door check
23 Door panel

●Assembly sequence

Follow the disassembly sequence in reverse.

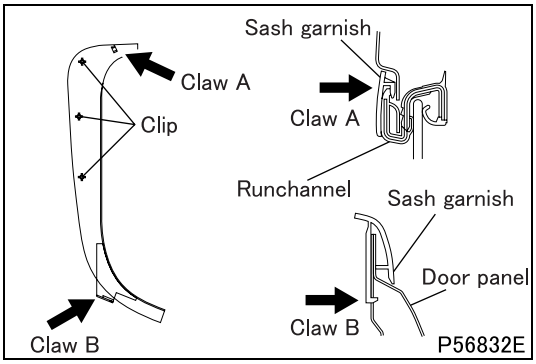
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (door glass attaching)	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	sealant
Tb	Nut (regulator and motor or manual regulator attaching)	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	–
	Bolt (regulator and motor or manual regulator attaching)		
	Bolt (outside handle attaching)		
	Nut (door check attaching)		
Tc	Screw (door lock attaching)	4.9 to 8.2 {3.7 to 6.1, 0.51 to 0.84}	–
Td	Bolt (upper door trim attaching)	10 to 15 {7.2 to 11, 1.0 to 1.5}	–

Lubricant and/or sealant

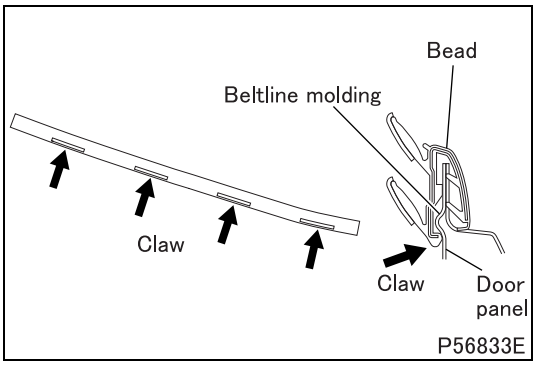
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads	LOCTITE Dri-Loc 202	As required
b	Sliding contact surface of regulator and motor assembly or regulator	Kyodo Yushi MULTEMP AC-D	As required As required
c	Rotating contact surface of door lock	Kyodo Yushi MULTEMP TAS-2	As required
d	Sliding contact surface of door lock	Kyodo Yushi MULTEMP SL-DII	As required
e	Rotating contact surface of outside handle	Showa Shell Sekiyu SUNLITE GREASE LA2	As required
	Rotating contact surface of inside handle		
f	Sliding contact surface of door check	Kyodo Yushi EMALUB M	1 g {0.035 oz}

◆ Removal sequence ◆



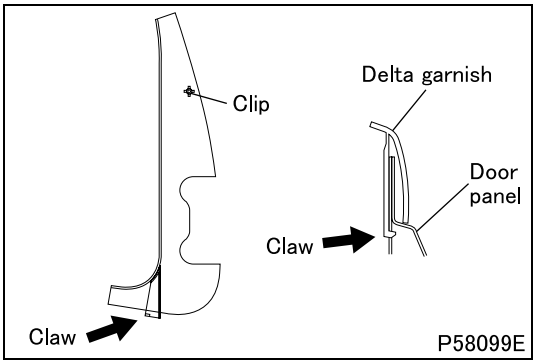
■Removal: Sash garnish

- Disengage claw A on upper part of the sash garnish from the runchannel, then remove clips (3 places).
- Disengage claw B on the lower part of the sash garnish from the door panel.



■Removal: Beltline molding

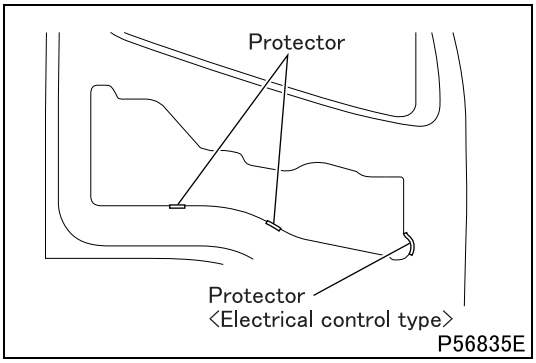
- Disengage claws (4 places) and remove the beltline molding from the door panel bead.



■**Removal: Delta garnish**

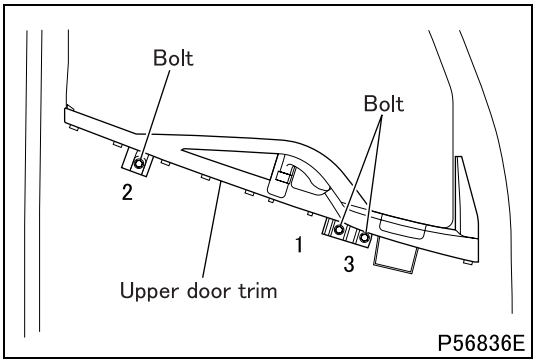
- Disengage clip (1 place) first and then claw to remove the delta garnish from the door panel.

◆Installation procedure◆



■**Installation: Protector**

- Fit the protectors (three on electrical control type; two on manual control type) to the door panel in the illustrated positions.

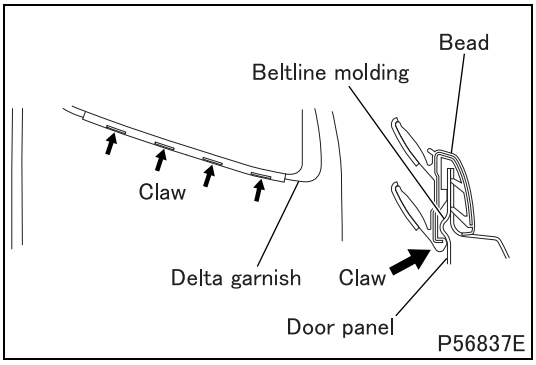


■**Installation: Upper door trim**

- Tighten bolts to specified torque in numerical order (1 to 3) as shown to secure the upper door trim.

■**Installation: Delta garnish**

- To install the delta garnish, follow the removal procedure in reverse.
  (See **"■Removal: Delta garnish"**.)

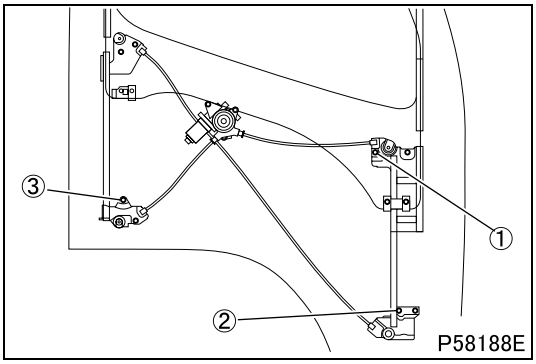


■**Installation: Beltline molding**

- Position the beltline molding with its front side applied to the delta garnish, then engage claws (4 places) with the door panel bead to secure the beltline molding in place.

■**Installation: Sash garnish**

- To install the sash garnish, follow the removal procedure in reverse.
  (See **"■Removal: Sash garnish"**.)



■**Installation: Regulator and motor or manual regulator**

- Tighten bolts (3 places) to specified torque in numerical order (1 to 3) as shown, then tighten the remaining bolts and nuts to specified torque.

INDEX

STRUCTURE AND OPERATION
1. Wiper and Washer System 51-2

TROUBLESHOOTING 51-3

MIRROR 51-4

WIPER AND WASHER 51-6

FRONT COVER 51-8

GRILLE 51-10

EXTERIOR LIGHTING AND FRONT CORNER PANEL 51-14

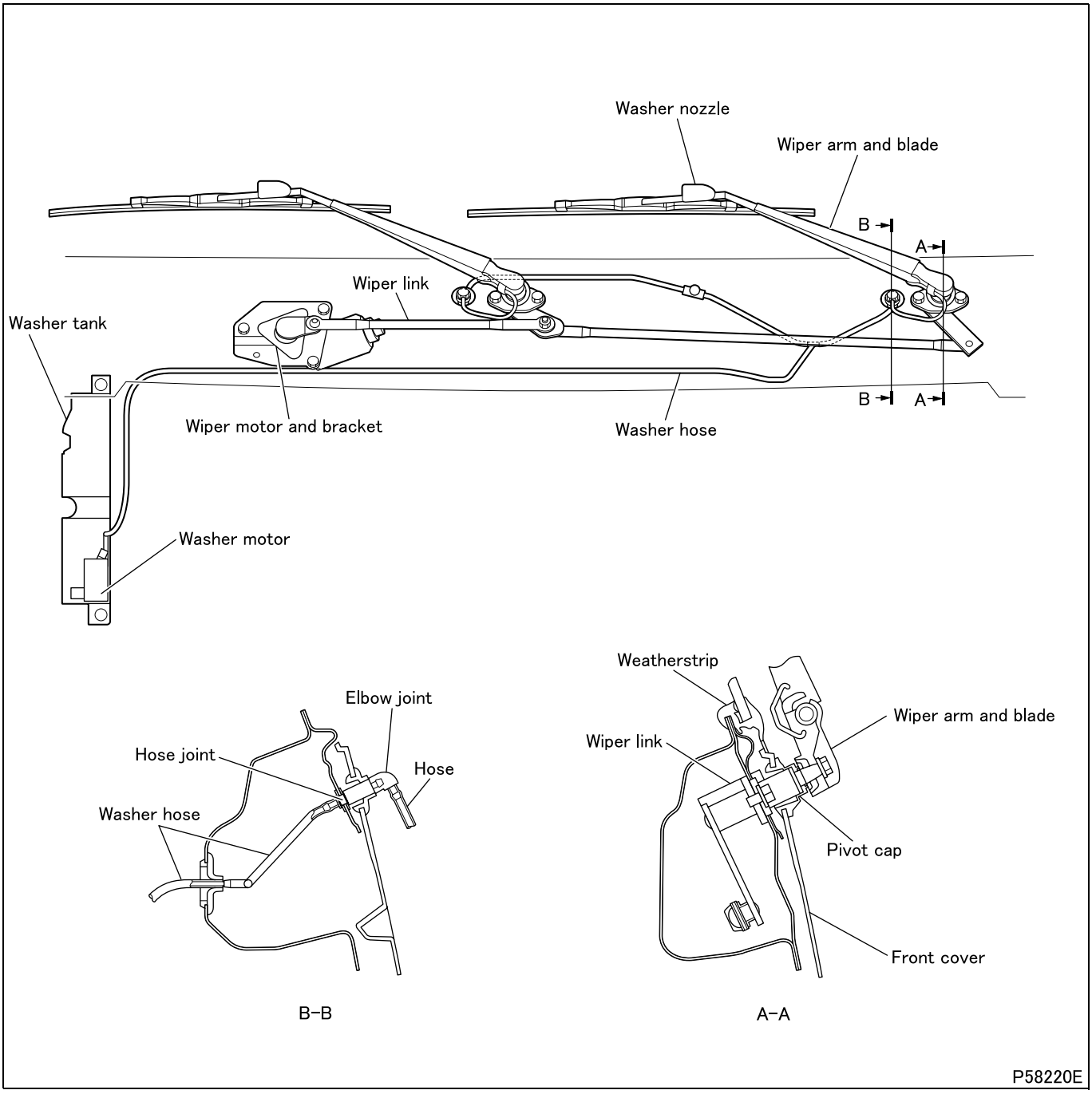
FENDER 51-19

STEP 51-20

WHEEL WELL 51-21

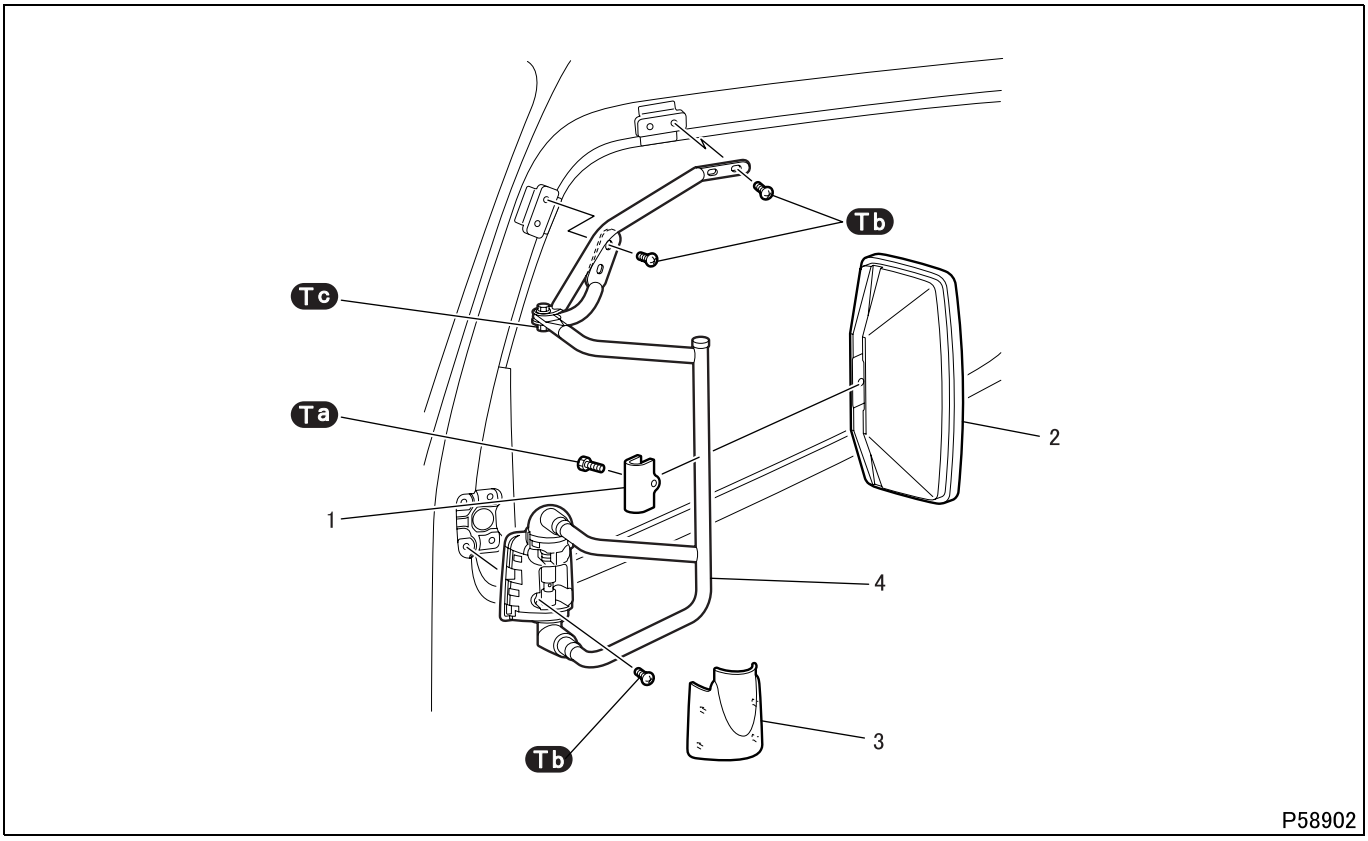
WINDSHIELD AND CAB REAR WINDOW 51-22

1. Wiper and Washer System



Wiper and washer

Symptoms / Possible causes	Wiper fails to operate	Wiper fails to stop	Wiper fails to operate intermittently	Wiper blade stops at improper position	Wiper does not wipe well	Wiper emits noise during operation	Washer motor fails to operate	Washer injects insufficient amount of fluid	Washer fails to inject washer fluid	Wiper fails to operate in unison with washer	Reference Gr
Wiper motor faulty	O	O		O		O					Gr54
Washer motor faulty							O	O	O		
Wiper and washer switch faulty	O	O	O				O			O	
MUTIC (control unit) faulty			O							O	
Wiper relay faulty	O						O				
Fuse/high current fuse blown	O						O				
Connector improperly connected, harness open-circuited, grounding improper	O		O				O		O	O	
Wiper motor crank arm out of position				O							
Wiper link and wiper arm improperly connected						O					
Wipe blade defective					O	O					
Wiper arm defective					O						
Washer hose twisted								O	O		
Washer hose improperly connected								O	O		
Washer nozzle clogged								O	O		
Washer fluid insufficient									O		



●Disassembly sequence

1 Clamp
2 Mirror
3 Cover
4 Mirror stay

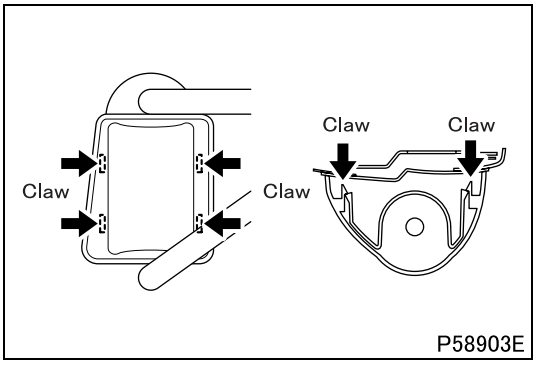
●Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

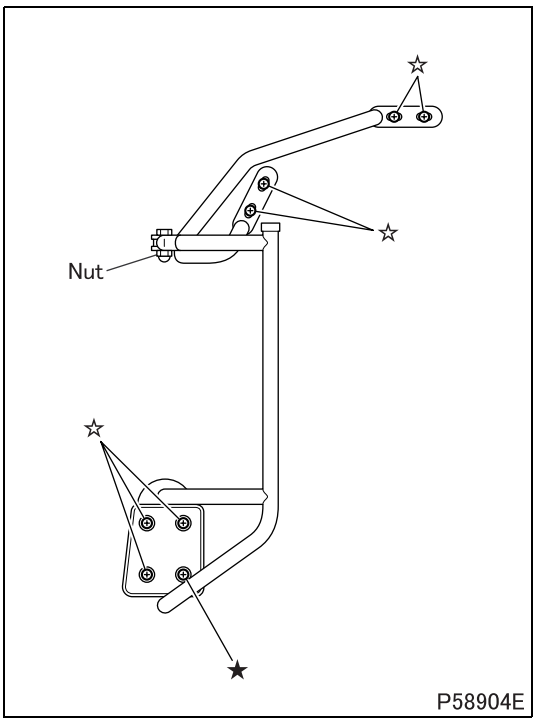
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (mirror mounting)	6.5 to 7.2 {4.8 to 5.3, 0.66 to 0.73}	–
Tb	Screw (mirror stay mounting)	9 to 14 {6.6 to 10, 0.9 to 14}	–
Tc	Nut (mirror stay fastening)	19 to 28 {14 to 21, 1.9 to 2.9}	–

◆Removal procedure◆



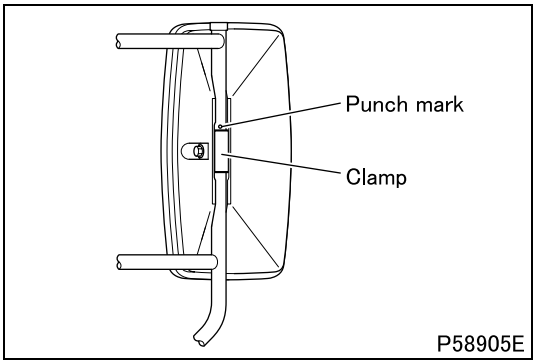
■Removal: Cover

◆Installation procedure◆



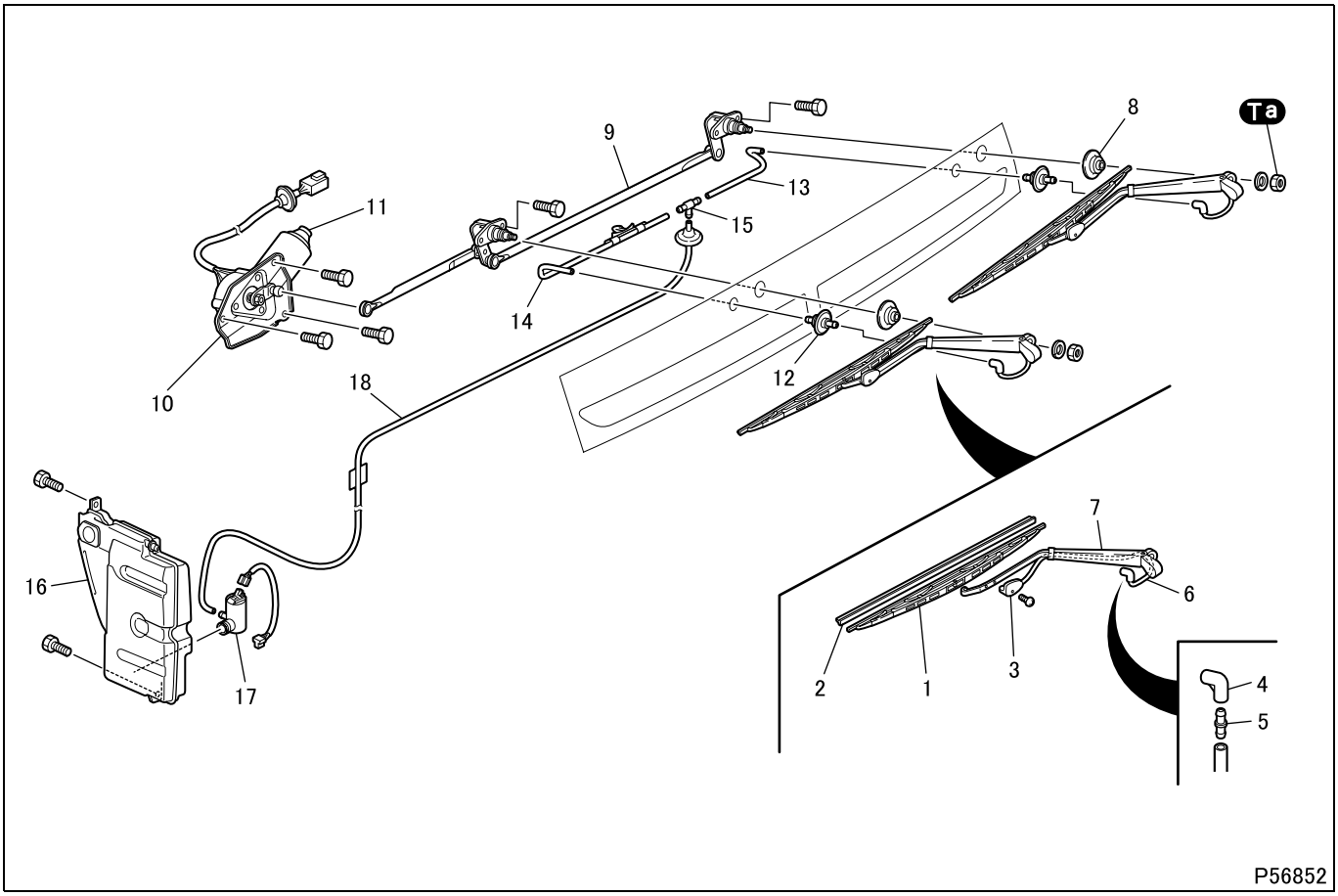
■Installation: Mirror stay

- Install the one screw marked ★ and adjust the position of the mirror stay.
- Install all the remaining seven screws marked ☆ to secure the mirror stay.
- Fasten the mirror stay nut to the specified torque.



■Installation: Mirror

- Adjust the height of the mirror by aligning the punch mark on the mirror stay with the clamp edge as shown in the illustration.



●Disassembly sequence

1 Wiper blade
2 Blade rubber
3 Washer nozzle
4 Elbow joint
5 Joint
6 Hose
7 Wiper arm
8 Pivot cap
9 Wiper link
10 Wiper motor bracket
11 Wiper motor
12 Joint
13 Washer hose
14 Washer hose
15 Joint
16 Washer tank
17 Washer motor
18 Washer hose

NOTE

- **Before disconnecting the connector to remove the wiper motor, pull out cab side harness enough, otherwise it will fall in the cab side and cannot be taken out without removing the instrument panel.**

●Assembly sequence

Follow the disassembly sequence in reverse.

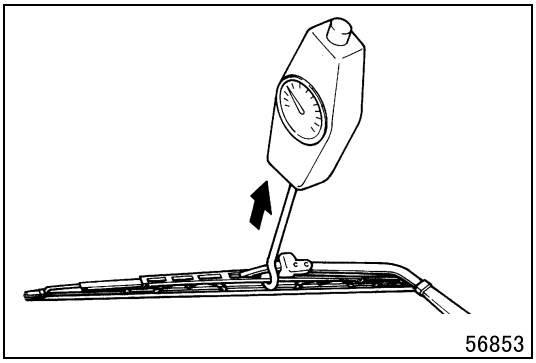
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
7	Wiper arm force to press blade against windshield	6.2 ± 0.5 N {1.4 ± 0.11 lbs, 0.63 ± 0.05 kgf}	–	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (wiper arm and blade attaching)	11 to 16 {8.1 to 12, 1.1 to 1.6}	–

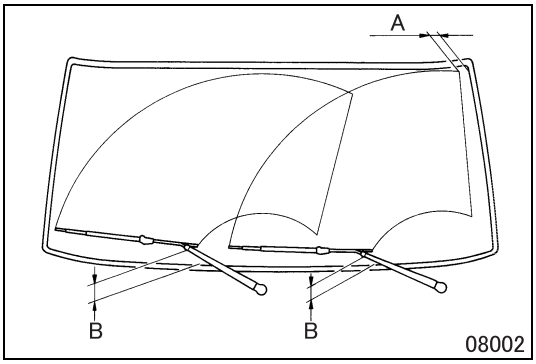
◆Inspection procedure◆



■Inspection: Wiper arm

- Measure the wiper arm force to press the blade against the windshield.
- If the measurement deviates from the standard value, replace the wiper arm.

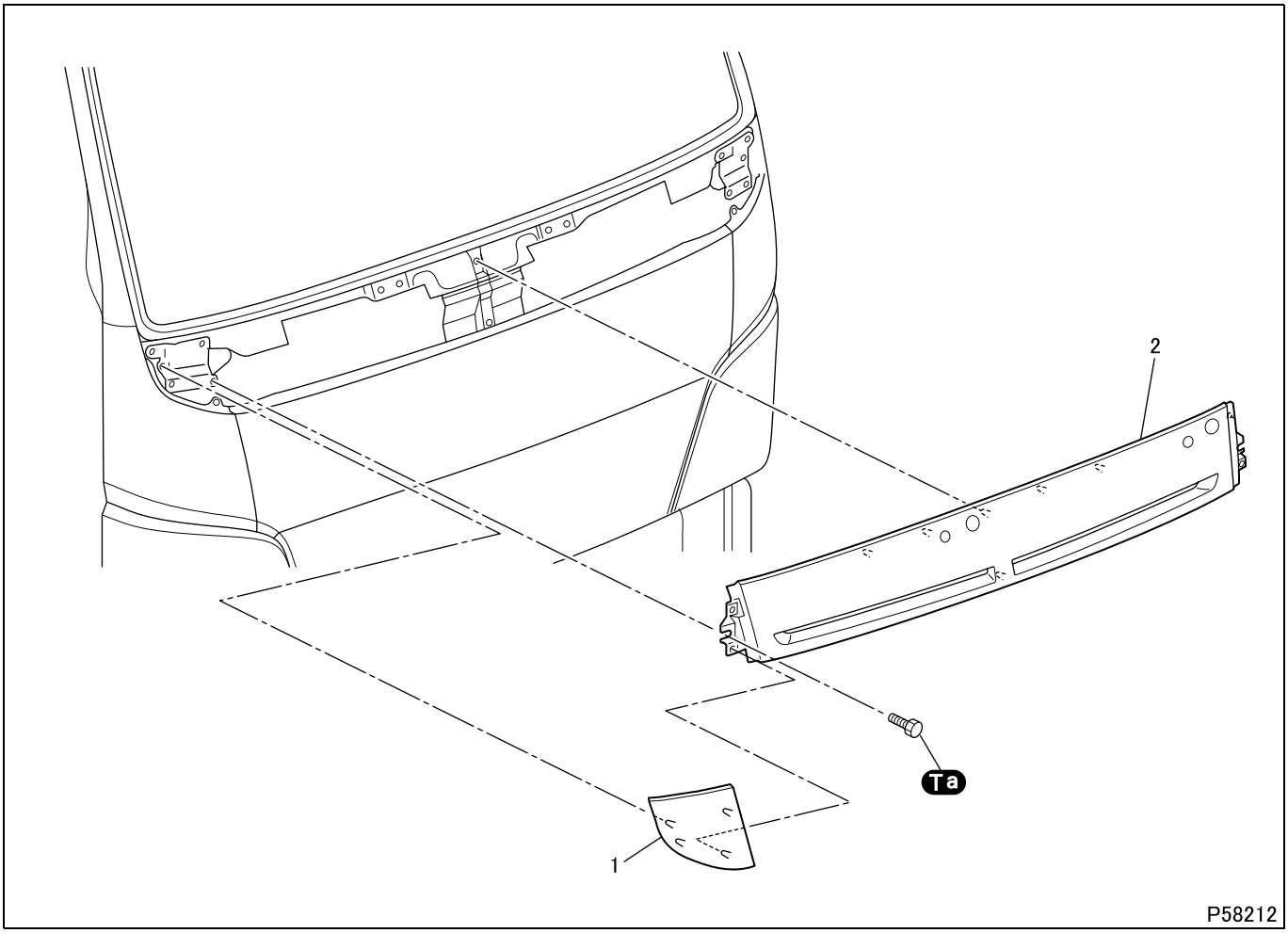
◆Installation procedure◆



■Installation: Wiper arm and blade

- Install the wiper arm and blade so that the blades come to the illustrated points as much as **A** and **B** apart from the edge of weatherstrip.
  A: 50 mm {1.97 in.}
  B: 59 ± 5 mm {2.3 ± 0.20 in.}

FRONT COVER



●Disassembly sequence

1 Front side cover
2 Front cover

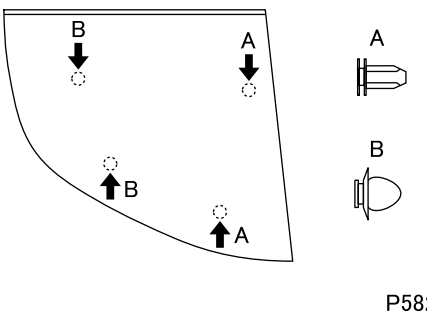
●Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (front cover attaching)	9 to 14 {6.6 to 10, 0.9 to 1.4}	–

◆Removal procedure◆

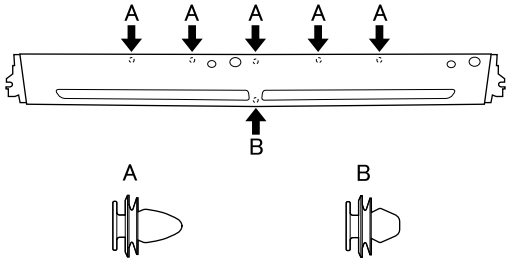


P58213

A. Body pane clip B. Trim clip

■Removal: Front side cover

1. Remove the two body panel clips on the inboard edge of the front side cover.
2. Remove the two trim clips on the outboard edge of the front side cover.



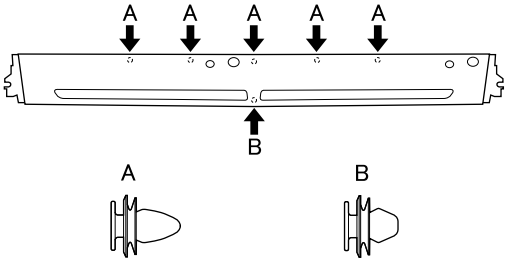
P58222

A. Long exterior trim clip
B. Short exterior trim clip

■Removal: Front cover

1. Remove the two front cover mounting capscrews, one on each end of the front cover.
2. Remove the five long exterior trim clips on the upper edge of the front cover.
3. Remove the short exterior trim clip on the lower edge of the front cover.

◆Removal procedure◆

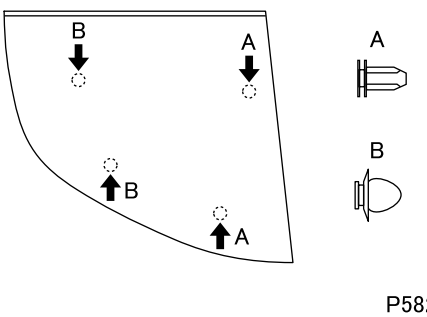


P58222

A. Long exterior trim clip
B. Short exterior trim clip

■Installation: Front cover

1. Install the five long exterior trim clips on the upper edge of the front cover.
2. Install the short exterior trim clip on the lower edge of the front cover.
3. Install the two front cover mounting capscrews and tighten them 9 to 14 N·m (7 to 10 lbf·ft).



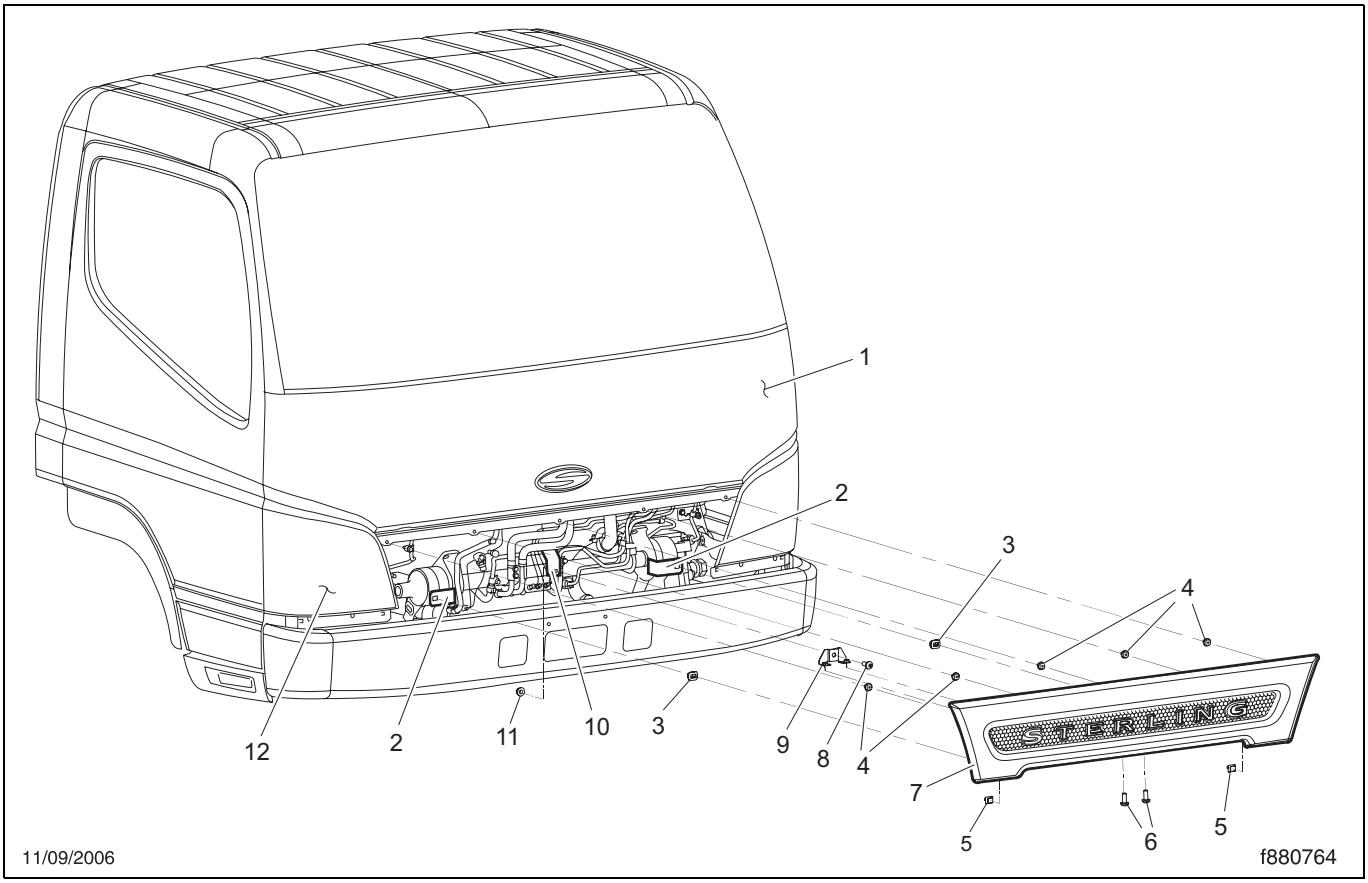
P58213

A. Body pane clip B. Trim clip

■Installation: Front side cover

1. Install the two body panel clips on the inboard edge of the front side cover.
2. Install the two trim clips on the outboard edge of the front side cover.

GRILLE



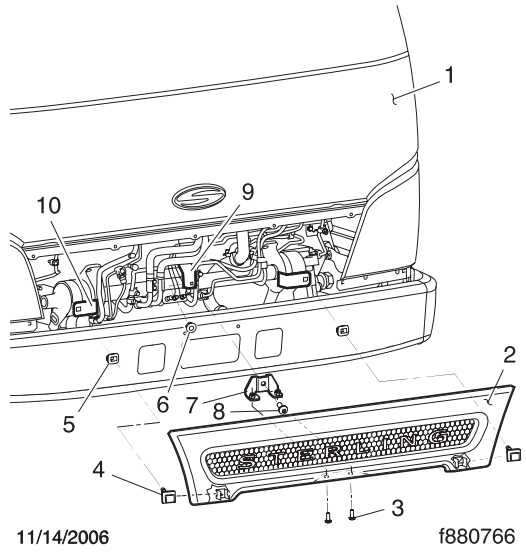
● **Grille and front corner panel components**

1 Cab
2 Grille side bracket
3 Pin clip retainer (grommet)
4 Bird-cage clip
5 Pin clip
6 Grille mounting screw (M8 pan-head)
7 Grille
8 Hanger bracket mounting screw (M8 pan-head)
9 Grille hanger bracket
10 Grille center bracket
11 Flange nut
12 Exterior lighting and front corner panel

Tightening torque (Unit: N·m {ft.lbs})

Mark	Parts to be tightened	Tightening torque	Remarks
6	Grille mounting screw	18 (13)	M8 Pan-head
9	Flange nut		–

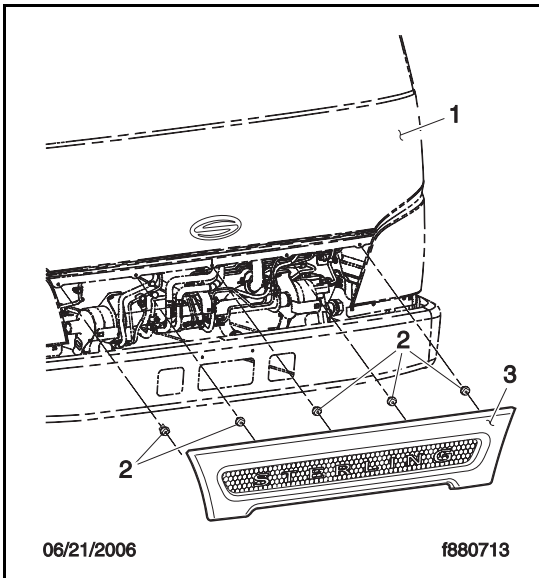
◆Removal procedure◆



1. Cab
2. Grille
3. Grille mounting screw
4. Pin clip
5. Pin clip retainer
6. Flange nut
7. Hanger bracket
8. Hanger bracket mounting screw
9. Center bracket
10. Side bracket

■Removal: Grille fasteners

1 Remove the two M8 grille mounting screws that attach the lower flange of the grille to the grolle hanger bracket.



1. Cab
2. Grille
3. Bird-cage clips

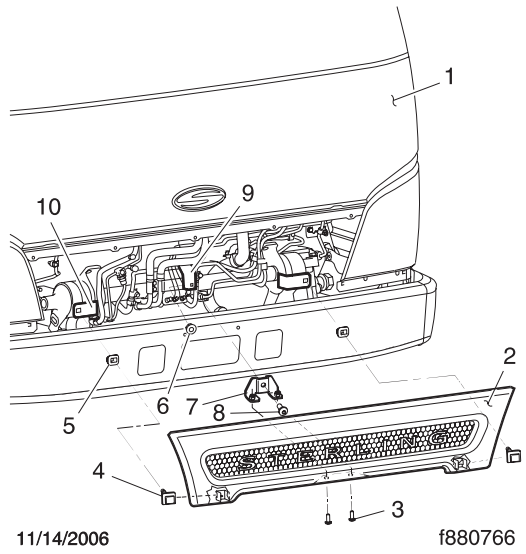
■Removal: Grille

1 Release the five bird-cage clips at the top of the grille and the two plastic pin clips from the pin clip receptacles at the bottom of the grille by gently pulling outward on the grille.

2 Remove the grille from the cab.

3 If it is also necessary to remove the grille hanger bracket, remove the M8 hanger bracket mounting screw and flange nut that attach the hanger bracket to the center bracket.

GRILLE

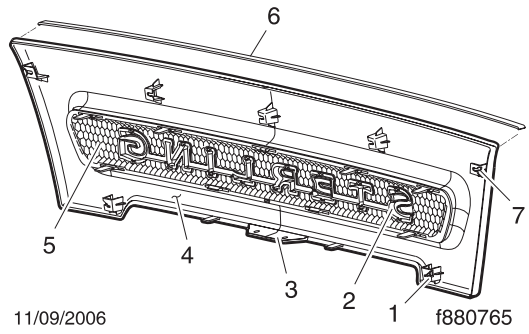


1. Cab
2. Grille
3. Grille mounting screw
4. Pin clip
5. Pin clip retainer
6. Flange nut
7. Hanger bracket
8. Hanger bracket mounting screw
9. Center bracket
10. Side bracket

■Installation: Grille fasteners

1 If the grille hanger bracket was removed, install the M8 hanger bracket mounting screw and flange nut that attach the hanger bracket to the center bracket. Tighten the nut 18 N·m (13 lbf·ft).

2 Position the lower flange of the grille on the grille hanger bracket.



1. Pin clip receptacle
2. Nameplate
3. Lower flange of grille
4. Grille
5. Nameplate support
6. Foam surround
7. Bird-cage clip receptacle

■Installation: Grille

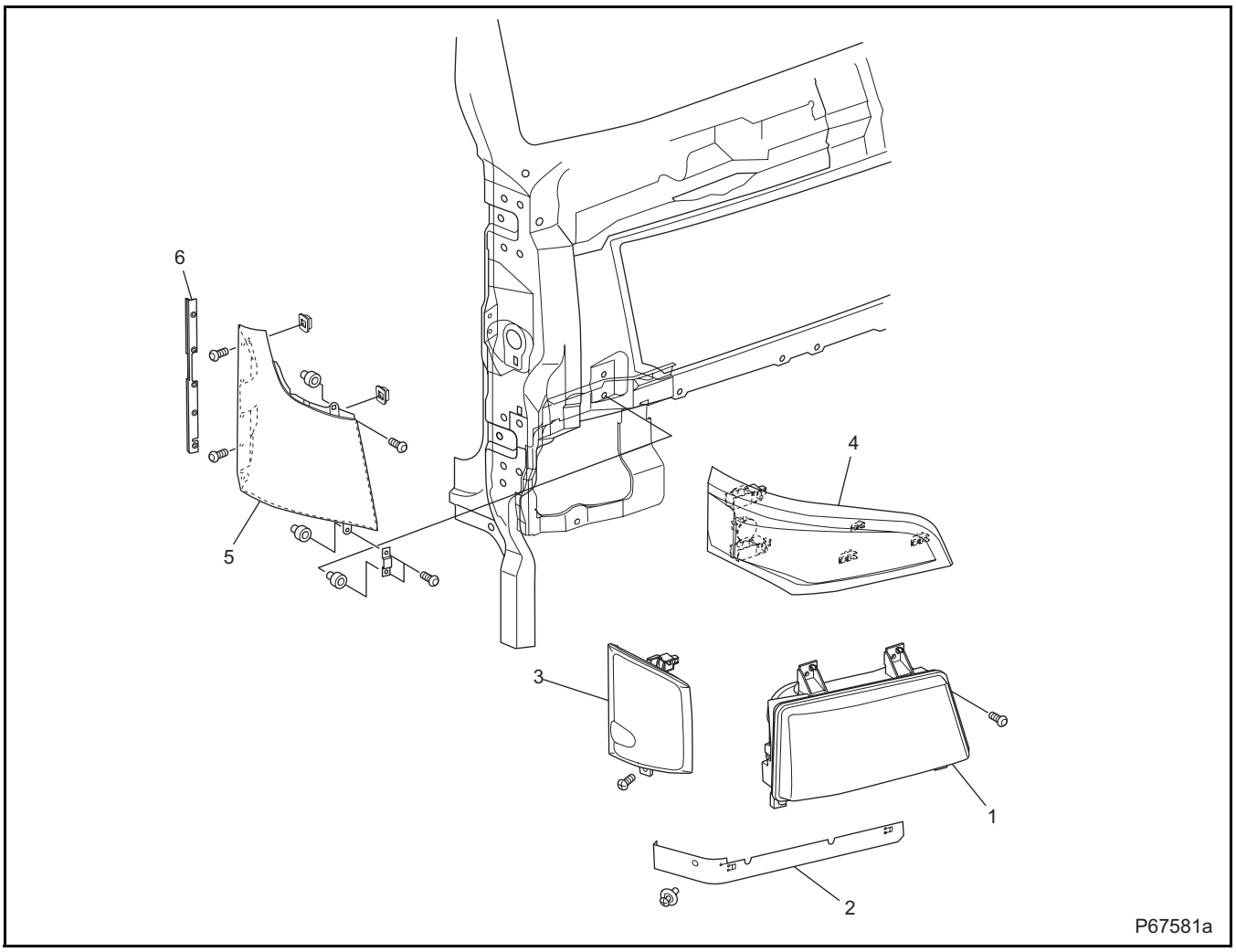
1 Check the foam surround at the top of the grille and remove any portions hanging down.

2 Install the five bird-cage clips at the top of the grille. Install the two plastic pin clips into the receptacles at the base of the grille.

3 Push in on the grille and make sure that it is flush with the front cab panel and all fasteners are snug.

4 Install the two M8 machine screws into the weld nuts on the grille hanger bracket and tighten them 18 N·m (13 lbf·ft).

M E M O



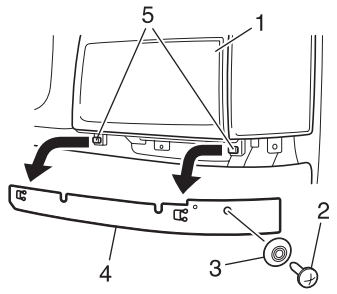
Headlight, turn signal lens, and reflector

1 Headlight
2 Headlight bezel
3 Reflector
4 Front and side turn signal lens
5 front corner panel
6 Door opening seal

CAUTION ⚠

- **Do not attempt to forcedly remove the reflector, fronta and side turn signal lens, and headlight. The mounting fasteners could be damaged.**

◆Removal procedure◆



Z11264a

1. Headlight
2. Screw
3. Rivet
4. Headlight bezel
5. Mounting tabs

■Removal: Headlight bezel

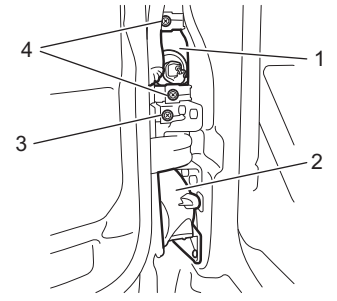
1. Remove the screw and rivet. Slide the headlight bezel sideways to release it.
2. Move the headlight bezel from underneath the headlight toward the centerline of the vehicle to release it from the mounting tabs.

CAUTION ⚠

- **When removing the headlight bezel, do not use excessive force. The mounting tabs could break.**

NOTE

The keeper screws are designed to remain in the vehicle. They are not supposed to be removed.



Z11265a

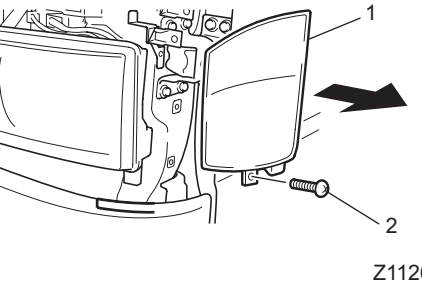
1. Front and side turn signal lens
2. Reflector
3. Keeper screw (reflector)
4. Keeper screws (turn signal lens)

■Removal: Front and side turn signal lens

1. Open the door. Loosen the two keeper screws behind the front and side turn signal lens until they spin freely.
2. Pull out the keeper screws until they are fully extended.
3. Close the door. Pull the turn signal lens away from the vehicle as shown in the illustration.
4. When the turn signal lens is free, remove the connector.

CAUTION ⚠

- **When removing the front and side turn signal lens, do not pull it forward (toward the front of the vehicle). This could break the mounting tabs.**
- **Do not open the door with the front and side turn signal lens moved outward (but not completely removed). The door could hit the lens and damage it.**

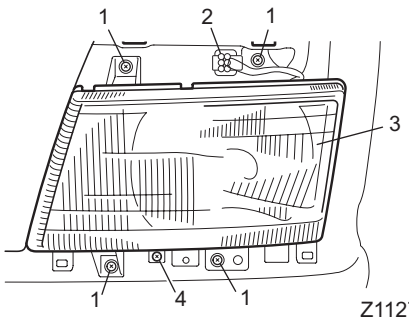


Z11268a

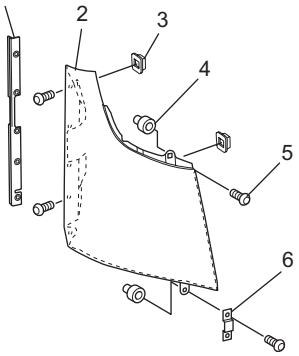
1. Reflector
2. Lower screw

■Removal: Reflector

1. Open the door. Loosen the keeper screw behind the reflector until it spins freely.
2. Pull out the keeper screw until it is fully extended.
3. Remove the lower screw (at the bottom of the reflector) and pull the reflector away from the vehicle, as shown in the illustration.



1. Headlight mounting screw
2. Connector
3. Headlight
4. Beam adjusting screw



1. Door opening seal
2. Front corner pane
l3. Pin clip retainer
4. Screw retainer
5. Panel screw
6. Bracket

■Removal: Headlight

CAUTION ⚠

- **Do not turn the beam adjusting screw. This would change the beam setting and could cause an injury accident.**

1 Remove the headlight mounting screws and connector.
2 Raise the headlight slightly to remove the tabs from the slots. Then pull it out towards you.

CAUTION ⚠

- **When setting down the removed headlight, place it on a soft cloth to avoid scratching the lens.**

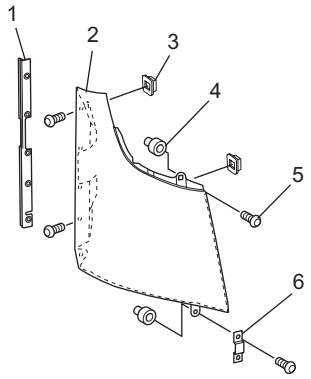
■Removal: Front corner panel

1 Open the door. Remove the two screws securing the front corner panel from behind.
2 Close the door. Remove the three screws securing the front corner panel from the front.
3 Remove the front corner panel.

NOTE

Do not remove the door opening seal unless absolutely nec-es-sary.

◆Installation procedure◆

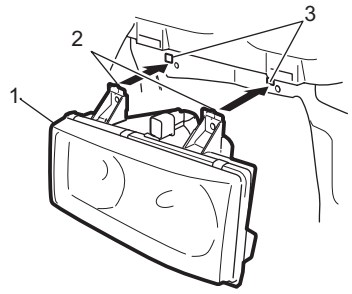


f602269

1. Door opening seal
2. Front corner pane
l3. Pin clip retainer
4. Screw retainer
5. Panel screw
6. Bracket

■Installation: Front corner panel

1 Position the front corner panel on the cab.
2 Install the screws, as removed.

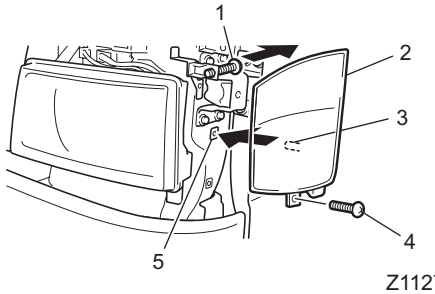


Z11272a

1. Headlight
2. Mounting tabs
3. Slots

■Installation: Headlamp

1 Insert the tabs on the headlight into the slots, and position the headlight properly.
2 Install the headlight bolts and connector, as removed.



Z11273a

1. Keeper screw
2. Reflector
3. Stud
4. Lower screw
5. Grommet

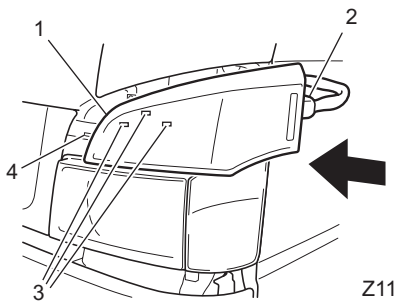
■Installation: Reflector

1 Pull out the reflector keeper screw until it is fully extended.
2 Insert the stud on the reflector into the grommet.

CAUTION ⚠

- **Do not overtighten the lower screw. This could damage the mounting.**

3 Open the door. Tighten the lower screw until firm.



1. Front and side turn signal lens
2. Connector
3. Mounting tabs
4. Slot

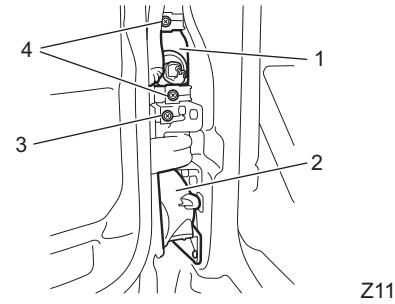
■Installation: Front and side turn signal lens

1. Install the connector on the front and side turn signal lens.
2. Pull out the two turn signal keeper screws until they are fully extended.
3. Align each mounting tab with its slot.
4. Press the turn signal lens inward, toward the centerline of the vehicle.

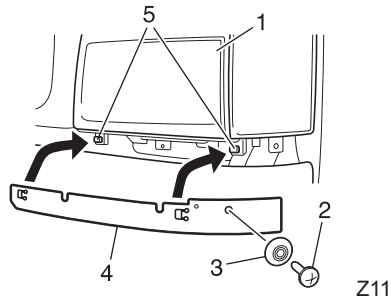
CAUTION ⚠

- **Press the front and side turn signal lens fully in toward the centerline of the vehicle. If the lens was not pressed fully into place and you opened the door, the door could hit the lens and damage it.**
- **Do not overtighten the keeper screws. This could damage the mounting.**

5. Open the door, and secure the turn signal lamp by tightening screws from behind.



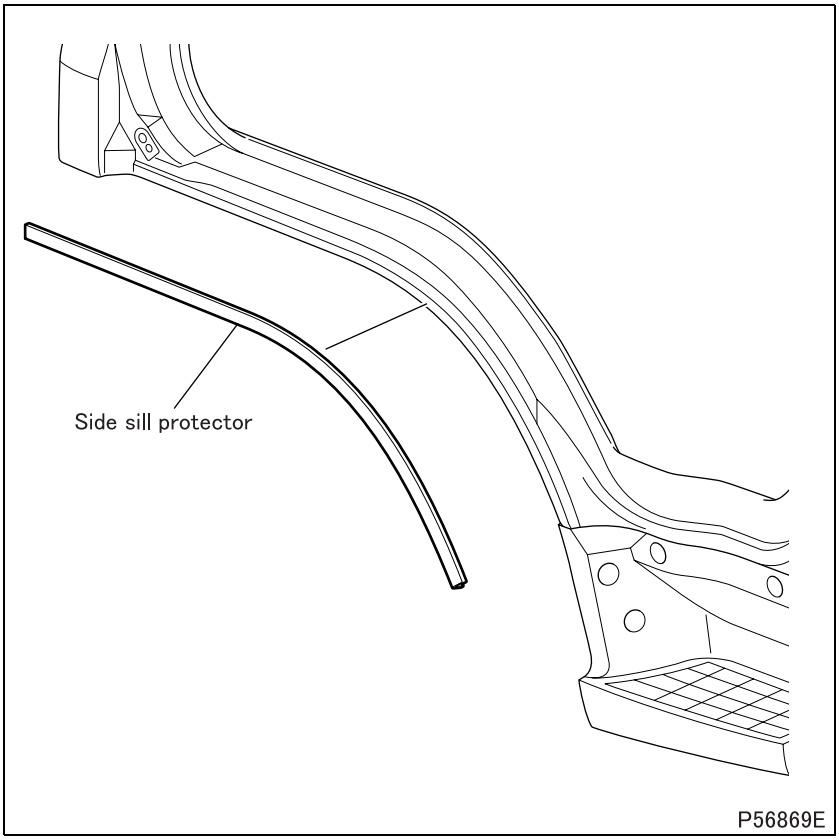
1. Front and side turn signal lens
2. Reflector
3. Keeper screw (reflector)
4. Keeper screws (turn signal lens)



1. Headlight
2. Screw
3. Rivet
4. Headlight bezel
5. Mounting tabs

■Installation: Headlight bezel

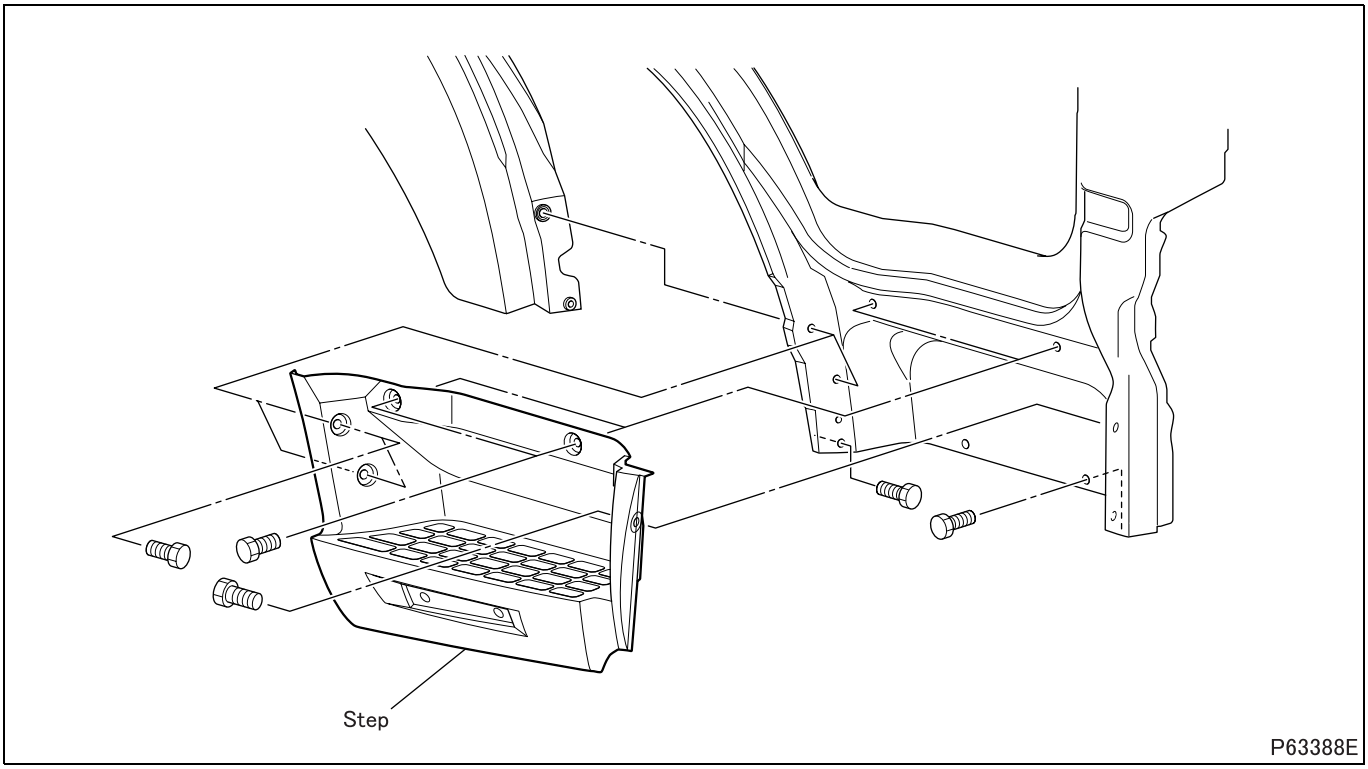
1. Fit the headlight bezel under the headlight and onto the tabs by moving it toward the outside of the vehicle.
2. Install the rivet and then press in the screw.

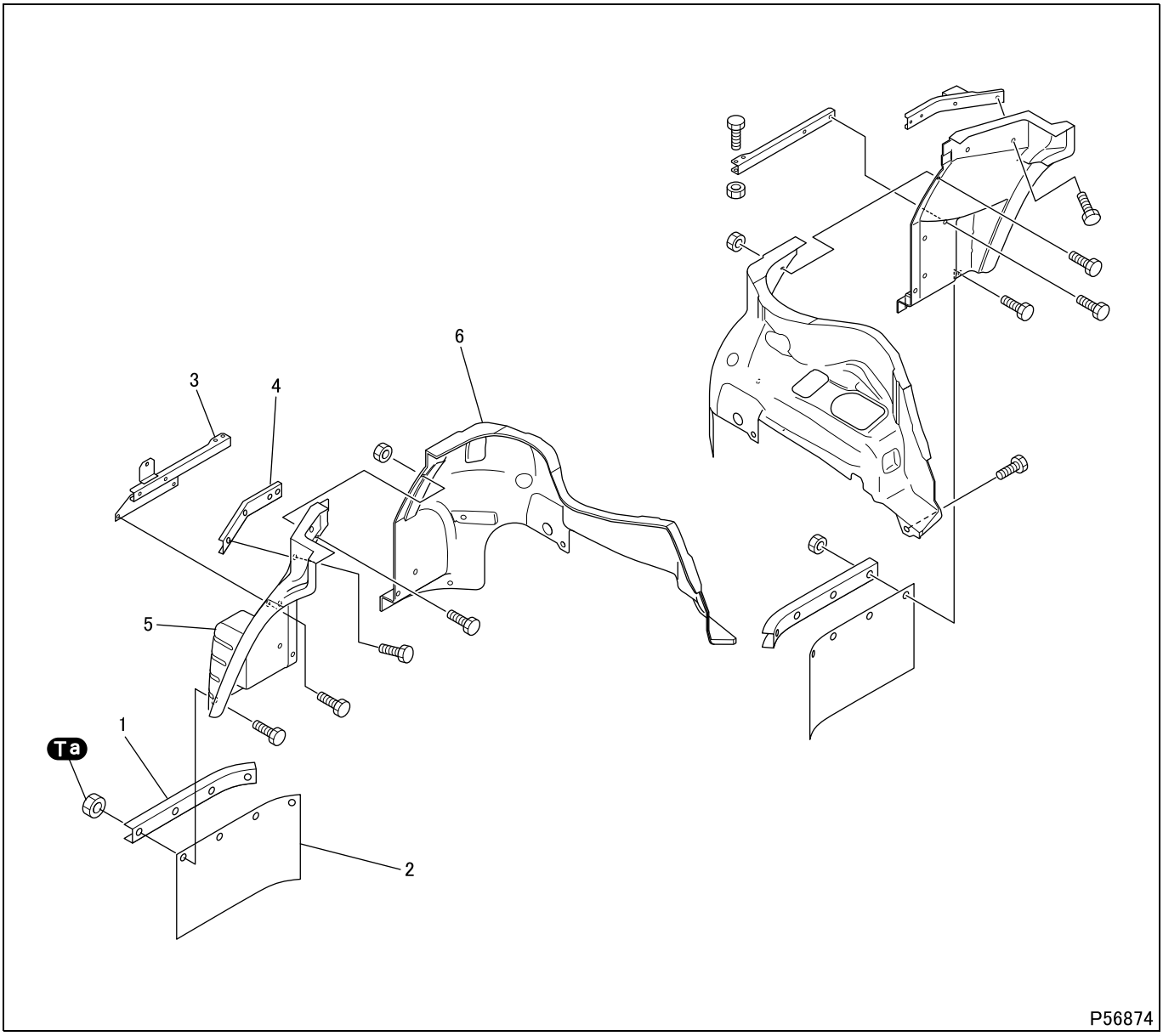


NOTE

- **For details on removal and installation of the fender, refer to Gr43.**
- **Attach the side sill protector using double-coated adhesive tape.**

STEP





●Removal sequence

1 Apron support
2 Mud guard apron
3 Mud guard lower suport
4 Mud guard upper support
5 Mud under guard
6 Lower shield panel

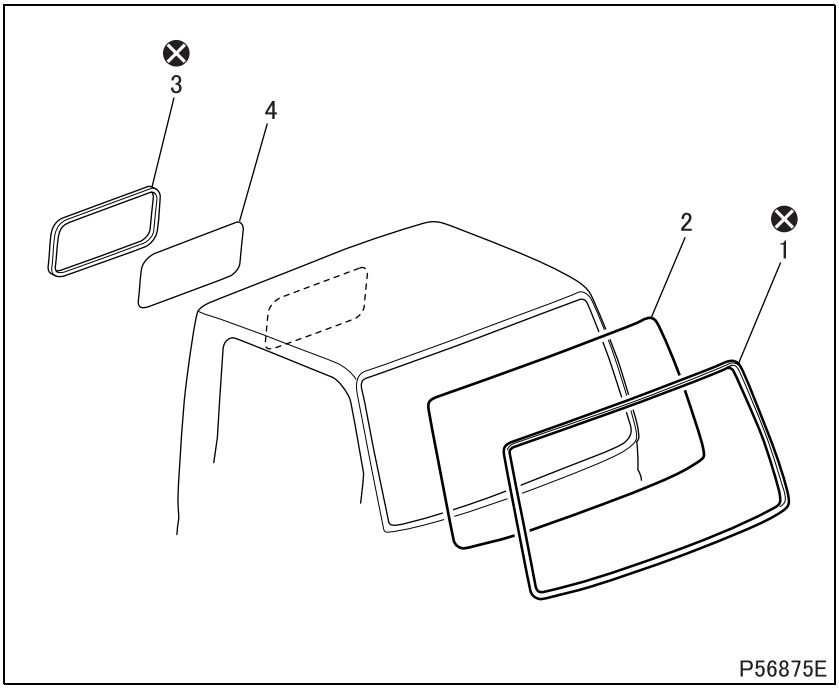
●Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (attaching apron support to mud guard apron)	3.9 to 5.9 {2.9 to 4.4, 0.4 to 0.6}	–

WINDSHIELD AND CAB REAR WINDOW



●Removal sequence

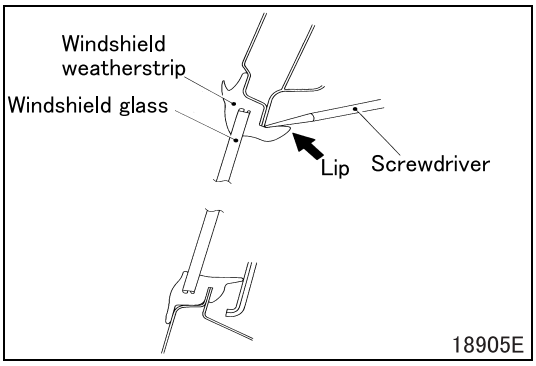
1 Windshield weatherstrip
2 Windshield glass
3 Rear window weatherstrip
4 Rear window glass

⊗: Non-reusable parts

●Installation sequence

Follow the removal sequence in reverse.

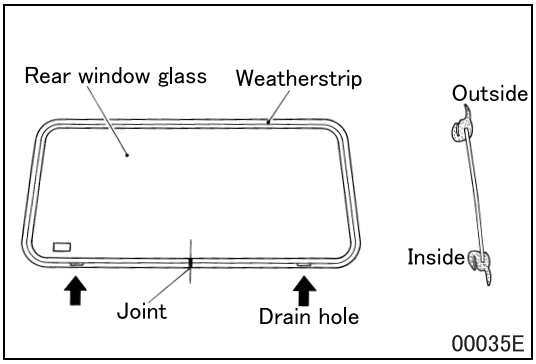
◆Removal procedure◆



■Removal: Windshield weatherstrip and windshield glass

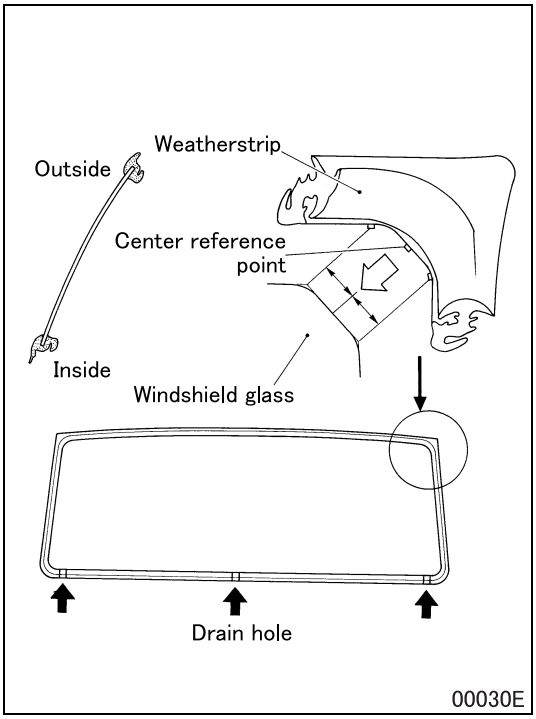
- While prying up the lip of the weatherstrip with the tip of a screwdriver, push the windshield glass out from inside the cab.

●Installation procedure



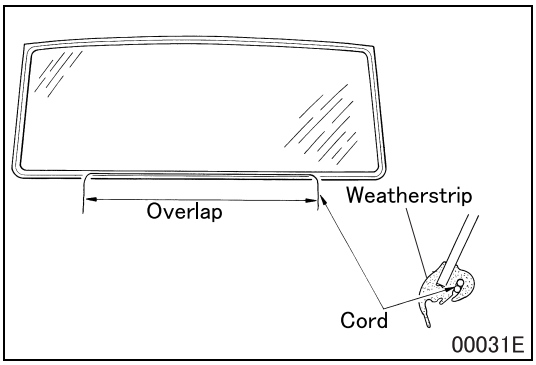
■Installation: Rear window weatherstrip and rear window glass

- Fit the rear window weatherstrip round the rear window glass so that the joint of weatherstrip comes at the bottom center of the glass.
- Except for the point mentioned above, install the rear window glass in the same manner as the windshield glass.

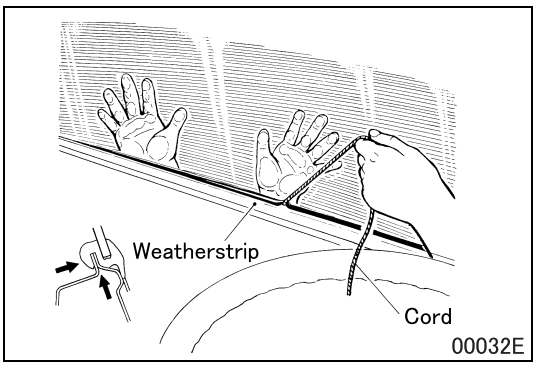


■Installation: Windshield weatherstrip and windshield glass

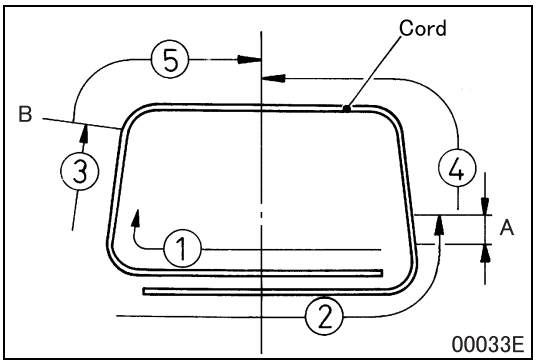
- Install the weatherstrip with its center reference point aligned with the center of the cut at each corner of the glass.



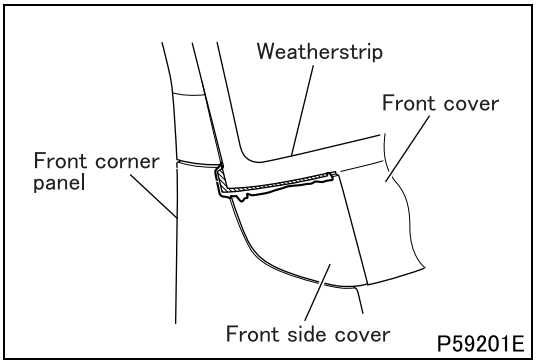
- Put a piece of strong cord in the cab flange fitting groove in the weatherstrip with its end portions overlapped.



- With the glass strongly pushed from outside, pull out the cord by its ends from inside the cab to gradually fit the flange of the cab in the inner groove of the weatherstrip.



- Pull the cord in the numerical order of steps as shown. At the same time, while tapping with a rubber-headed mallet from outside the cab, settle the windshield glass in place in the weatherstrip.
  A: Approx. 100 mm {3.9 in.} from the beginning of straight portion
  B: Up to the end of straight portion



- To ensure watertightness, put the hatched part of the weatherstrip inside between the cab and the front cover, front side cover and front corner panel.

INDEX

SEAT
<DRIVER>.....52-2
<PASSENGER>.....52-4

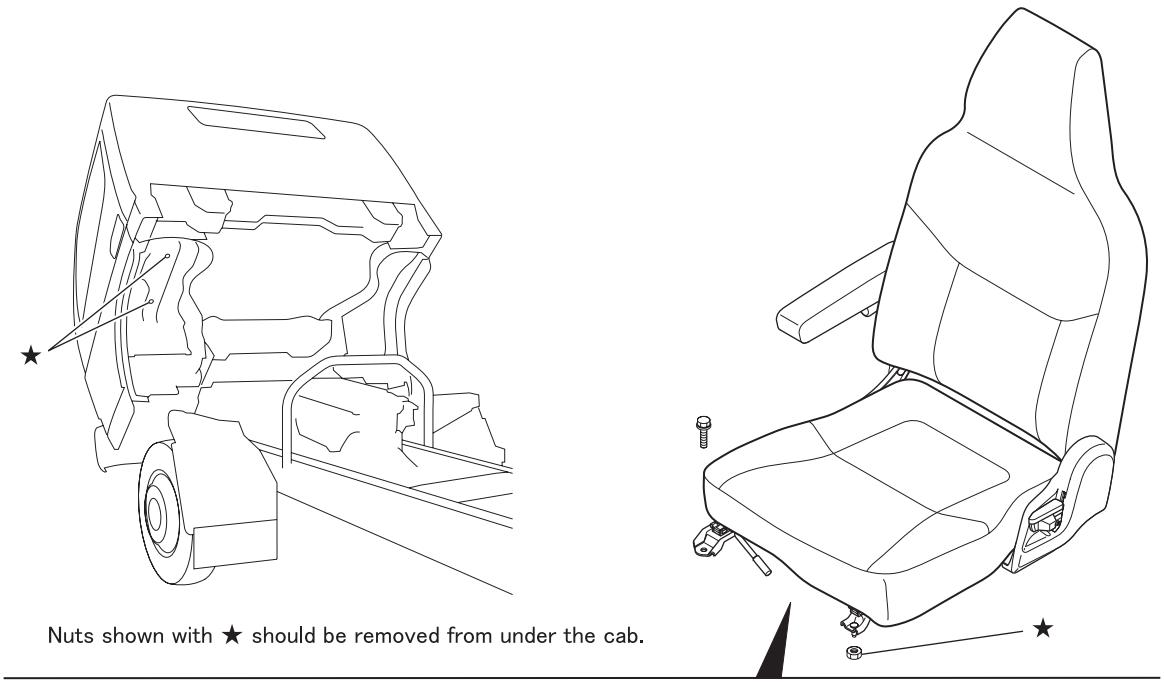
SEAT BELT 52-6

INSTRUMENT PANEL 52-8

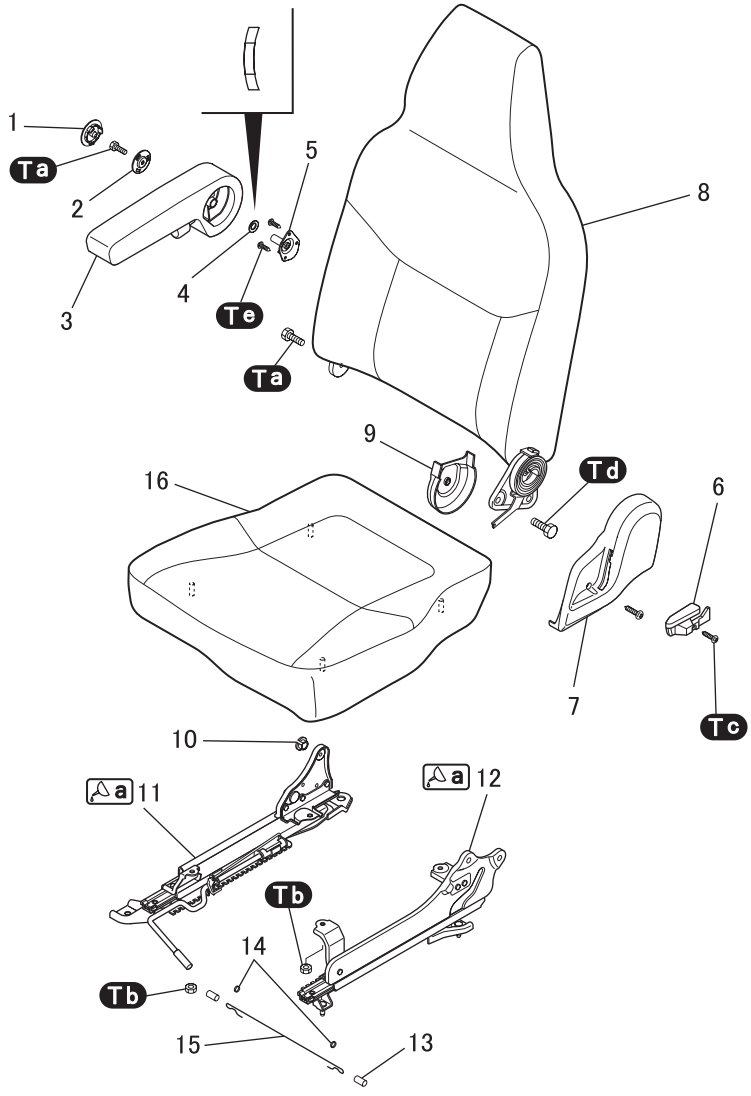
TRIM AND SCUFF PLATE 52-24

HEAD LINING.....52-26

SEAT <DRIVER>



Nuts shown with ★ should be removed from under the cab.



P103151E

●Removal sequence

1 Cover
2 Plate
3 Armrest
4 Washer
5 Armrest bracket
6 Knob
7 Reclining cover
8 Back cushion
9 Inner cover
10 Bushing
11 Seat adjuster (right-hand)
12 Seat adjuster (left-hand)
13 Tube
14 Clip
15 Wire
16 Seat cushion

●Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- **When installing the seat adjusters, be sure to engage the locking device before fitting them onto the seat cushion.**

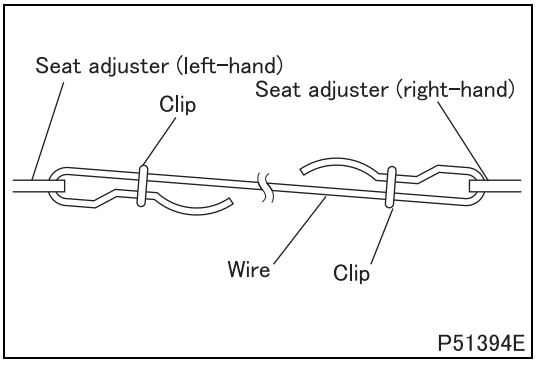
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (plate mounting)	10 to 15 {7.4 to 11, 1.0 to 1.5}	–
	Bolt (back cushion mounting)		
Tb	Screw (armrest bracket mounting)	4 to 6 {2.95 to 4.43, 0.4 to 0.6}	–
	Nut (seat adjuster mounting)	11 to 17 {8.11 to 12.5, 1.1 to 1.7}	–
Tc	Screw (knob mounting)	1.4 {1.0, 0.14}	–
Td	Bolt (back cushion mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	–
Te	Screw (armrest bracket mounting)	4 to 6 {2.95 to 4.43, 0.4 to 0.6}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Sliding surface of seat adjuster	Chassis grease [NLGI No. 1 (Li soap)]	As required

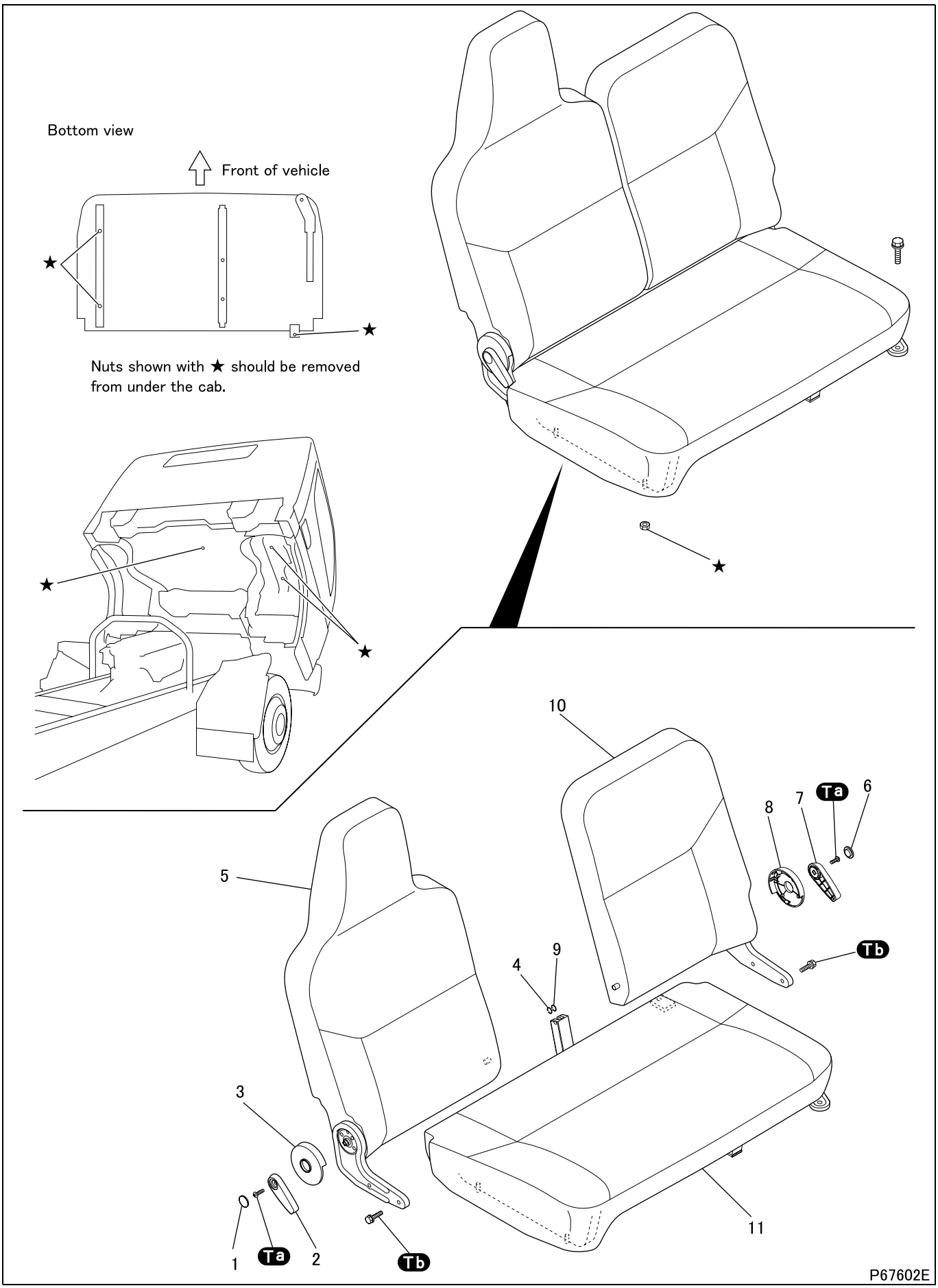
◆Installation procedure◆



■Installation: Wire

- Install one end of the wire onto the seat adjuster (left-hand). Then, twist the wire a half turn before fitting the other end onto the seat adjuster (right-hand).

SEAT <PASSENGER>



● Removal sequence

1 Cap
2 Knob
3 Reclining cover (right-hand)
4 Snap ring
5 Side back cushion
6 Cap
7 Knob
8 Reclining cover (left-hand)
9 Snap ring
10 Center back cushion
11 Seat cushion

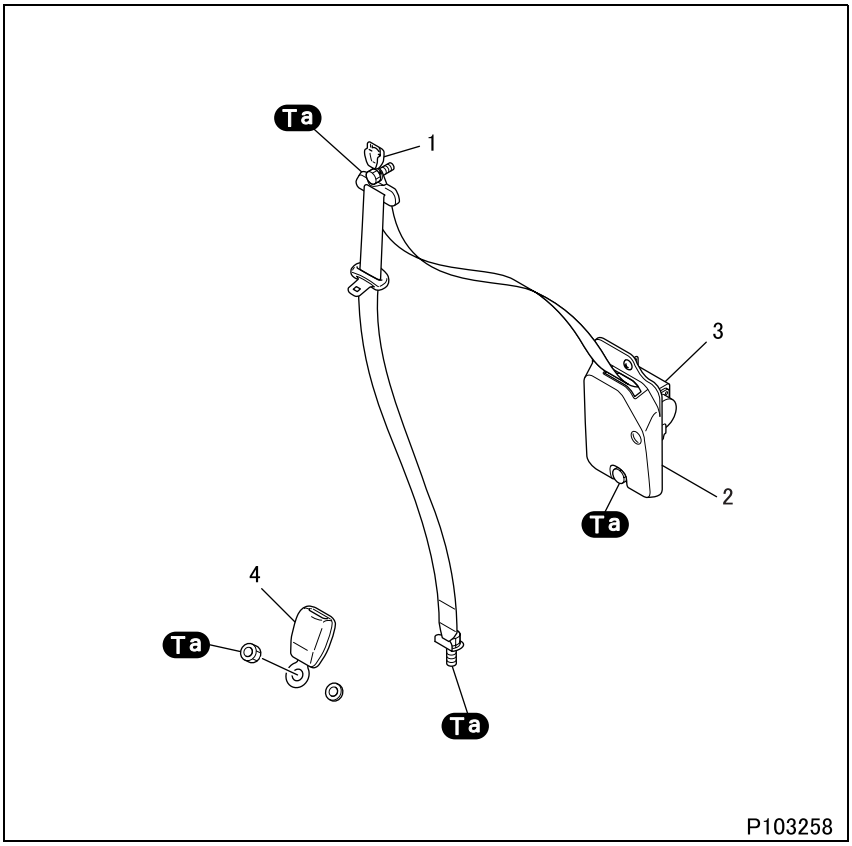
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (knob mounting)	1.3 {0.96, 0.13}	–
Tb	Bolt (back cushion mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	–

<Driver>



●Removal sequence

1 Shoulder anchor cover
2 Emergency locking retractor cover
3 Emergency locking retractor
4 Buckle

●Installation sequence

Follow the removal sequence in reverse.

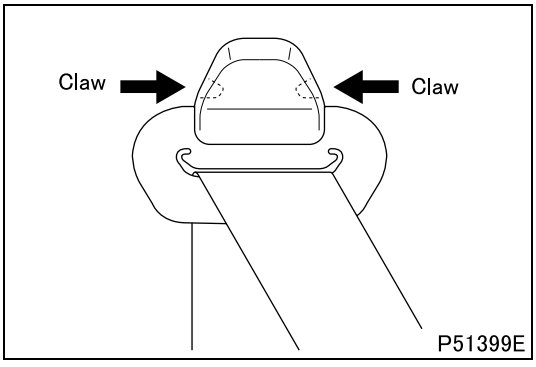
CAUTION ⚠

- **Never disassemble the emergency locking retractor, or buckle.**

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

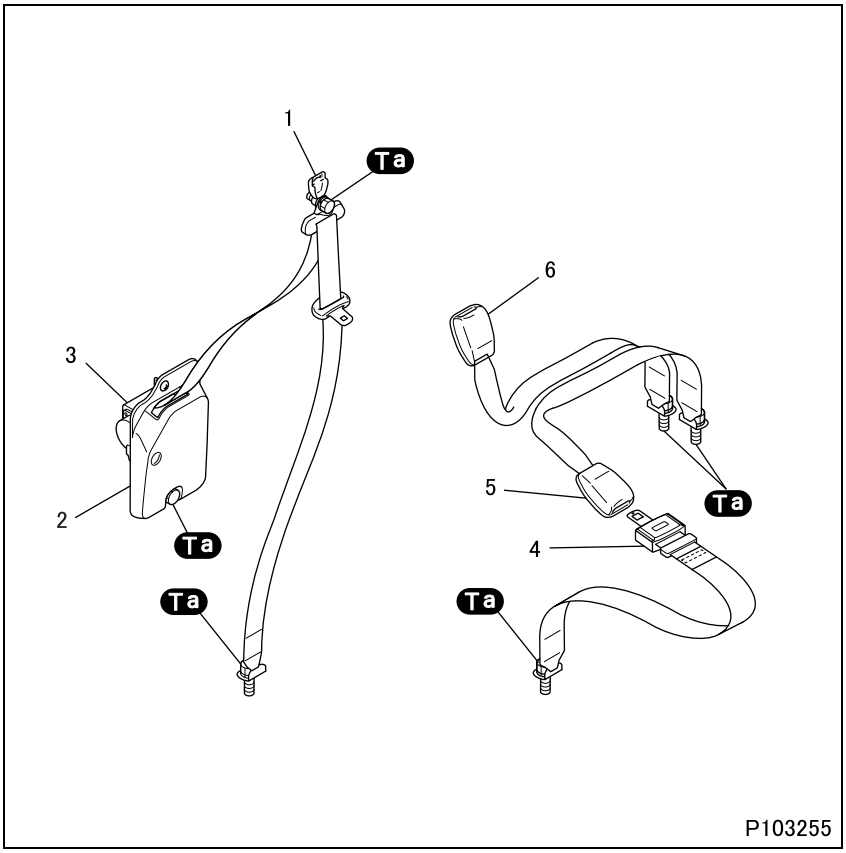
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (floor anchor mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	–
	Bolt (shoulder anchor mounting)		
	Bolt (emergency locking retractor mounting)		
	Nut (buckle mounting)		

◆Removal procedure◆



■Removal: Shoulder anchor cover

<Passenger>



● Removal sequence

1 Shoulder anchor cover
2 Emergency locking retractor cover
3 Emergency locking retractor
4 Buckle
5 Tongue
6 Buckle

● Installation sequence

Follow the removal sequence in reverse.

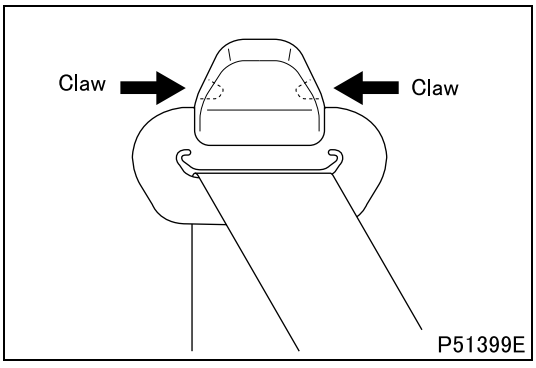
CAUTION ⚠

- **Never disassemble the emergency locking retractor, or buckle.**

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (floor anchor mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	–
	Bolt (shoulder anchor mounting)		
	Bolt (emergency locking retractor mounting)		
	Bolt (buckle mounting)		
	Bolt (tongue mounting)		

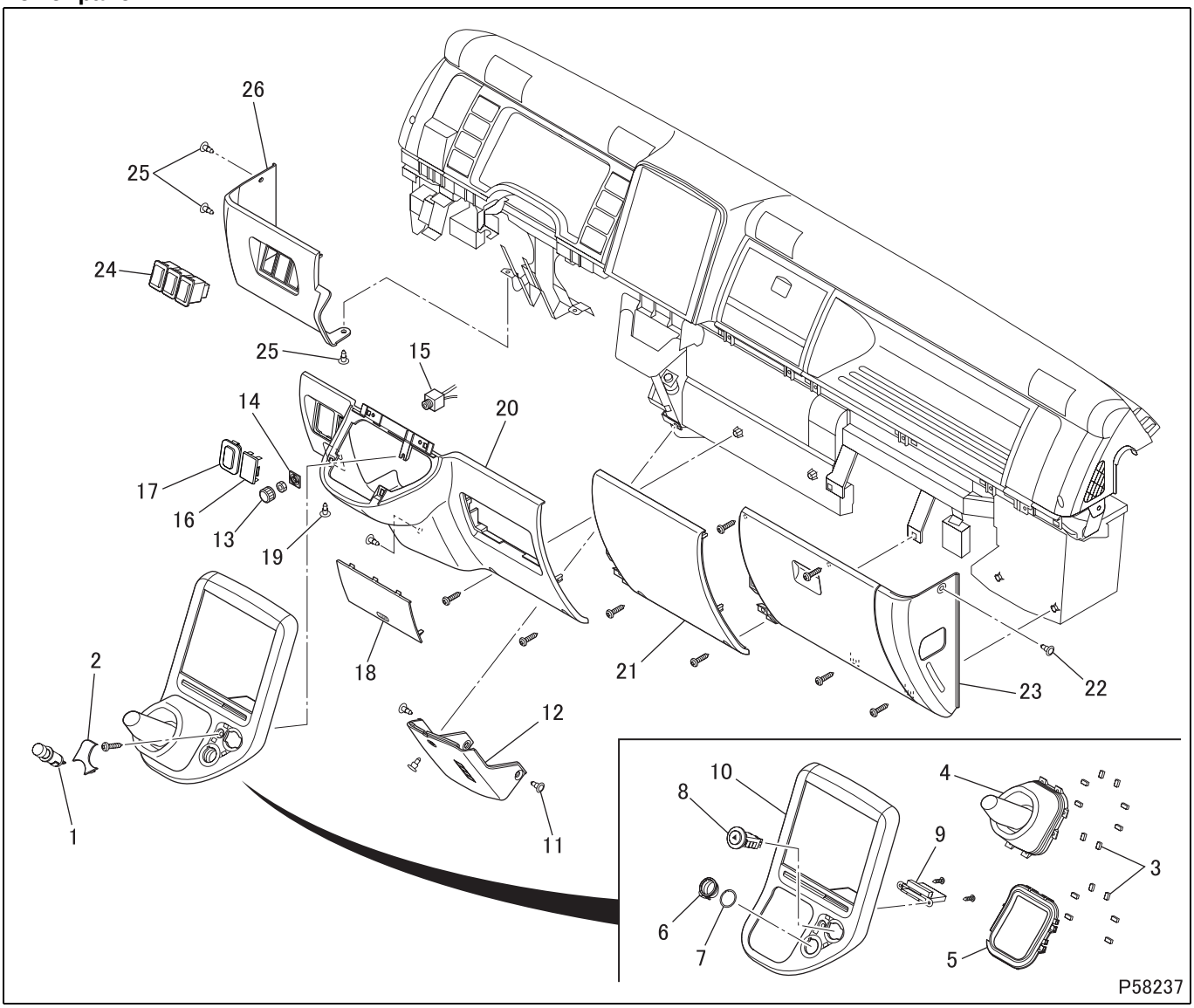
◆Removal procedure◆



■ Removal: Shoulder anchor cover

INSTRUMENT PANEL

Lower panel



● Removal sequence

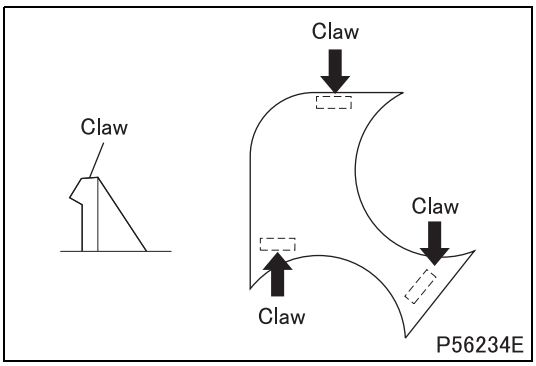
1 Cigarette lighter
2 Panel cover
3 Push-on nut (× 8 <M/T>, × 6 <A/T>)
4 Shift lever boots <M/T>
5 A/T cover <A/T>
6 Cigarette lighter ring
7 Cigarette lighter protector
8 Hazard switch
9 Card holder
10 Upper center panel
11 Clip
12 Gear shift lever cover
13 Knob
14 Plate
15 Idle speed adjuster
16 Plug
17 Plug
18 Lid (for inspection of fuses)
19 Clip
20 Lower center panel
21 Passenger panel B
22 Clip
23 Passenger panel A
24 Switch or plug
25 Clip (× 3)
26 Driver panel

M/T: Manual transmission
A/T: Automatic transmission

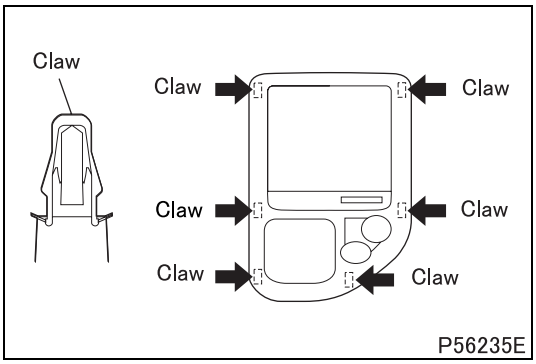
● Installation sequence

Follow the removal sequence in reverse.

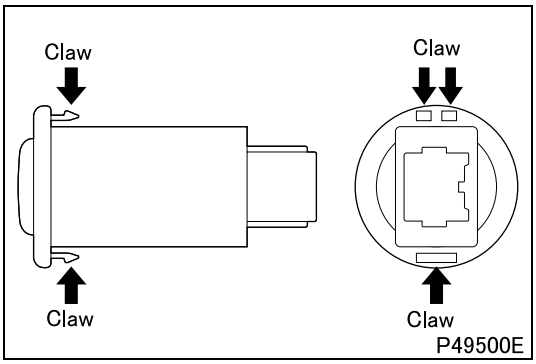
◆Removal procedure◆



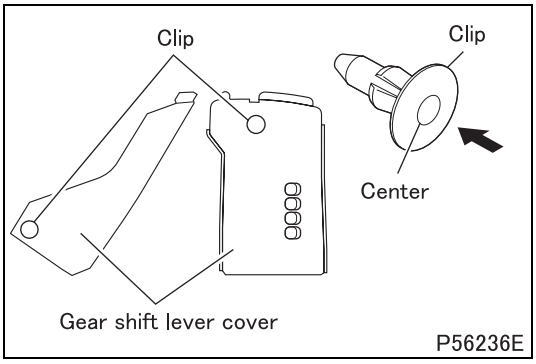
■ **Removal: Panel cover**



■ **Removal: Upper center panel**

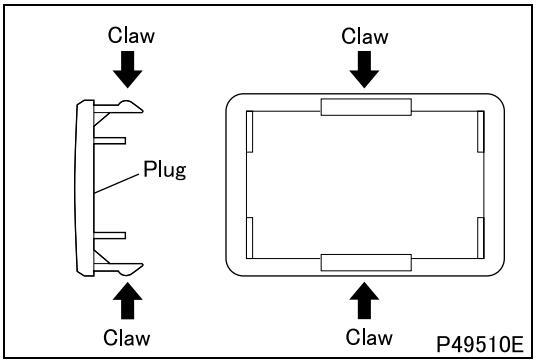


■ **Removal: Hazard switch**

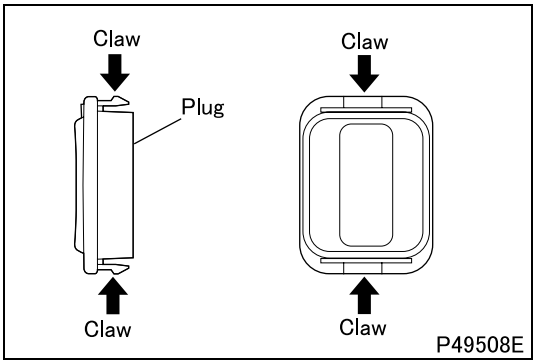


■ **Removal: Gear shift lever cover**

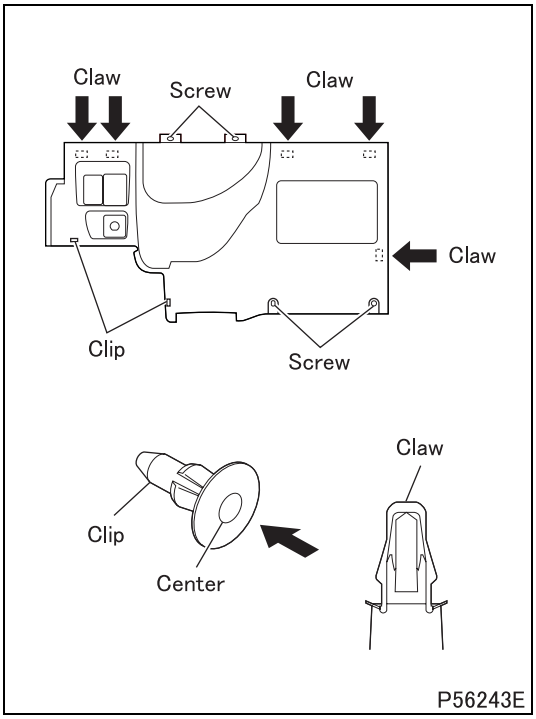
- Push the clips (× 3) in the center to disengage them from the gear shift lever cover.



■ **Removal: Plug**

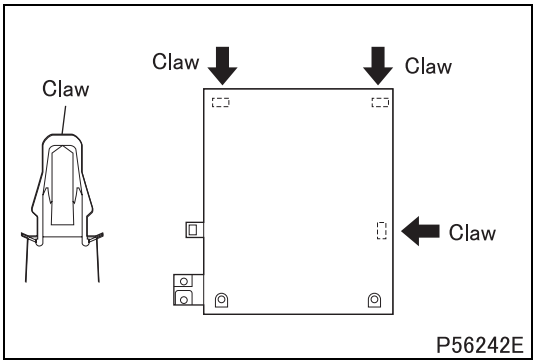


■ **Removal: Plug**

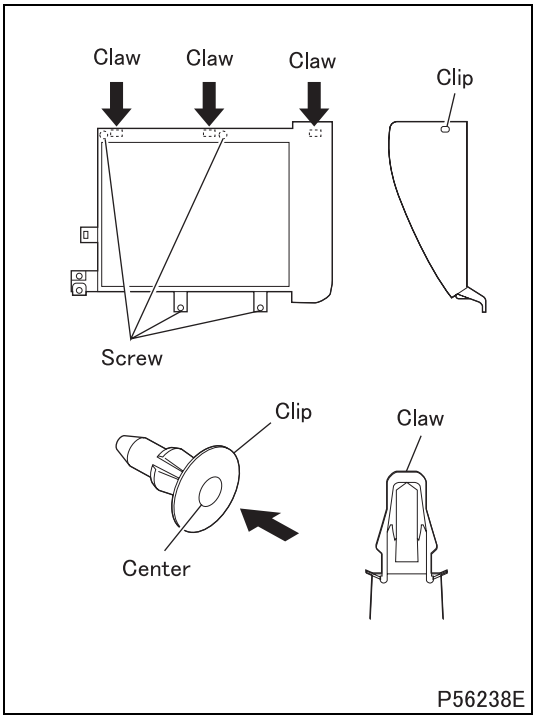


■ **Removal: Lower center panel**

- Remove the screws (× 4) from the lower center panel.
- Push the clips (× 2) in the center to disengage them from the lower center panel.

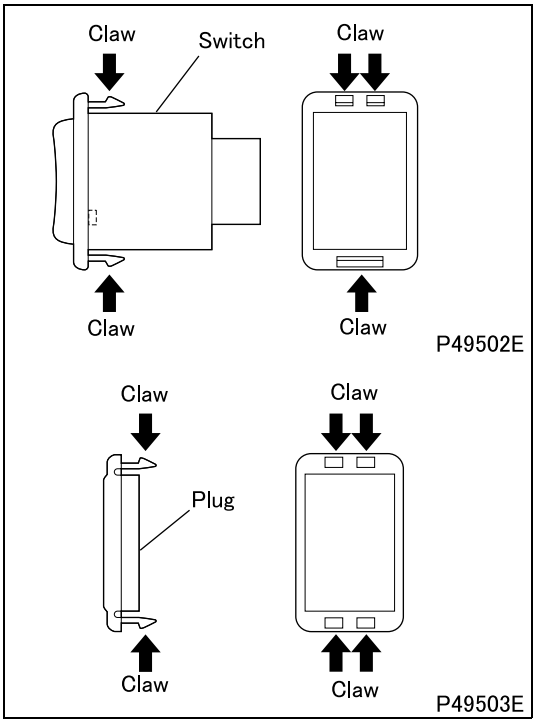


■ **Removal: Passenger panel B**

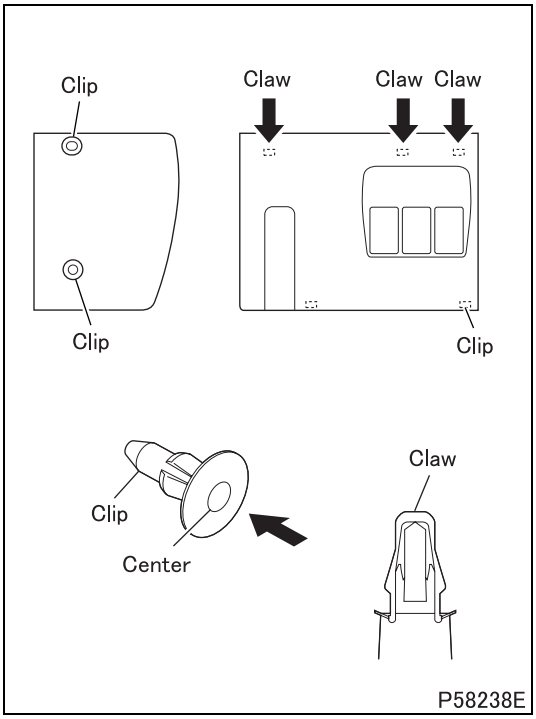


■ **Removal: Passenger panel A**

- Remove the screws (× 4) from the passenger panel.
- Push the clip (× 1) in the center to disengage it from the passenger panel.



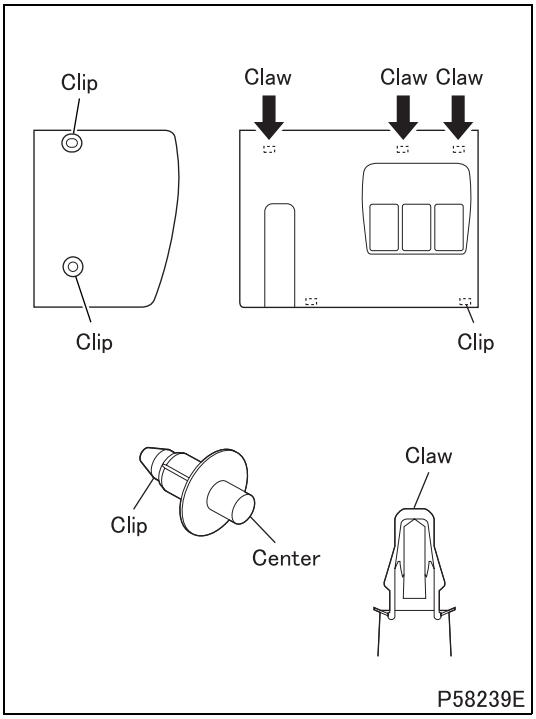
■ **Removal: Switch or plug**



■ **Removal: Driver panel**

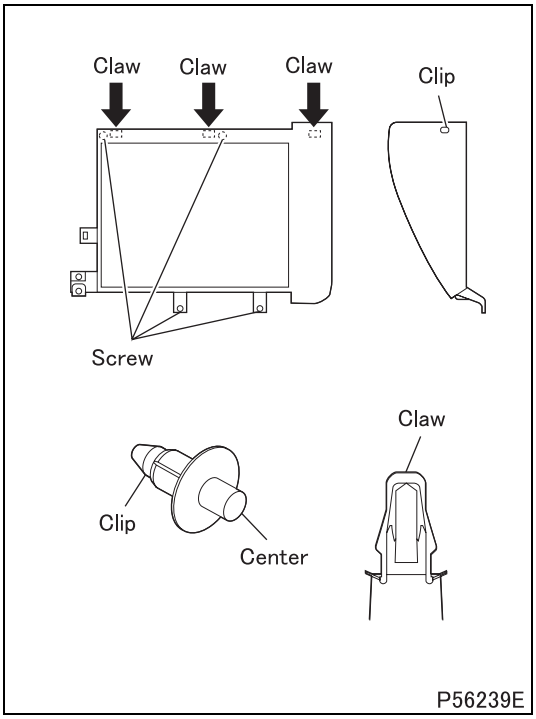
- Push the clips (× 3) in the center to disengage them from the driver panel.

◆**Installation procedure**◆



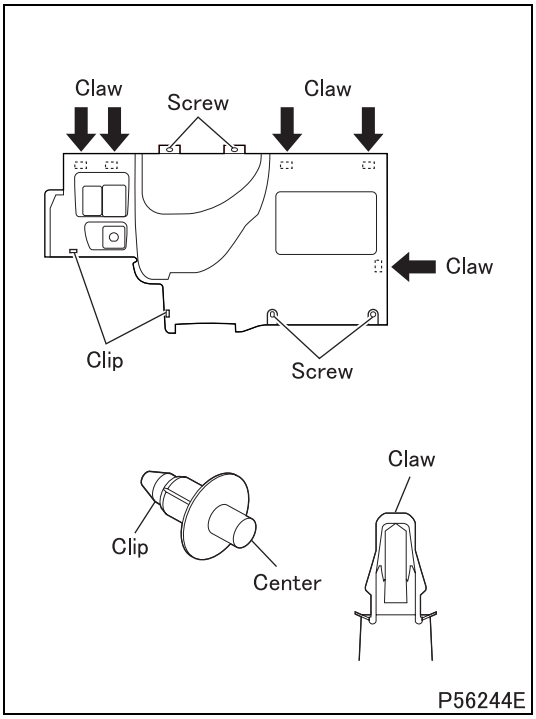
■ **Installation: Driver panel**

- Insert the clips (× 3) at the illustrated locations and push them in the center to engage into the driver panel.



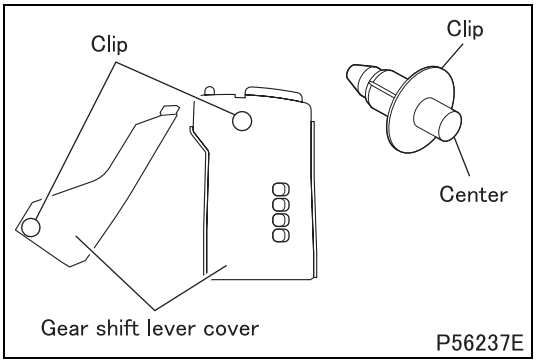
■ **Installation: Passenger panel A**

- Insert the clip (× 1) at the illustrated location and push it in the center to engage into the passenger panel.
- Install the screws (× 4) to the passenger panel.



■ **Installation: Lower center panel**

- Insert the clips (× 2) at the illustrated locations and push them in the center to engage into the lower center panel.
- Install the screws (× 4) to the lower center panel.

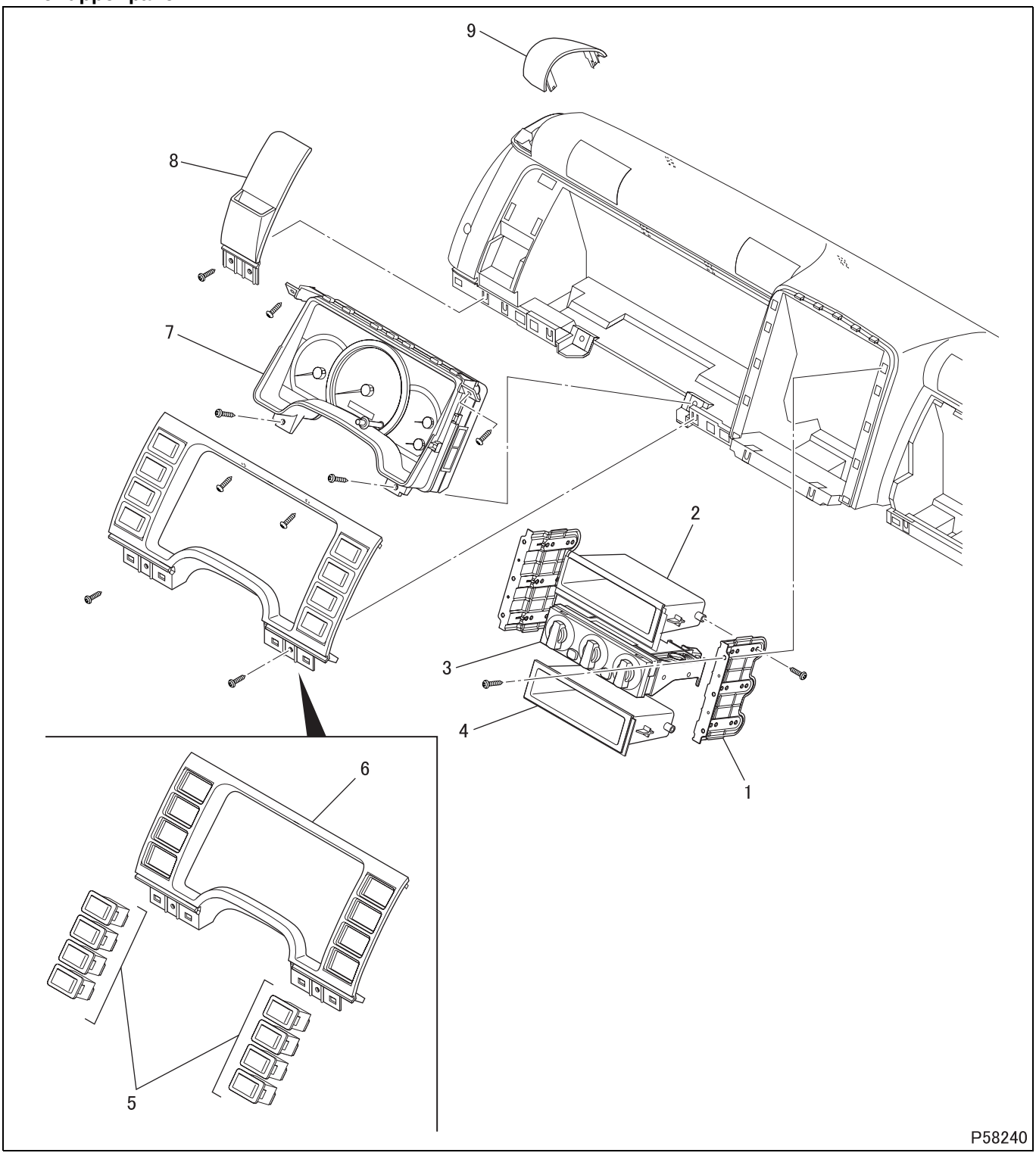


■ **Installation: Gear shift lever cover**

- Insert the clips (× 3) at the illustrated locations and push them in the center to engage into the gear shift lever cover.

INSTRUMENT PANEL

Driver upper panel



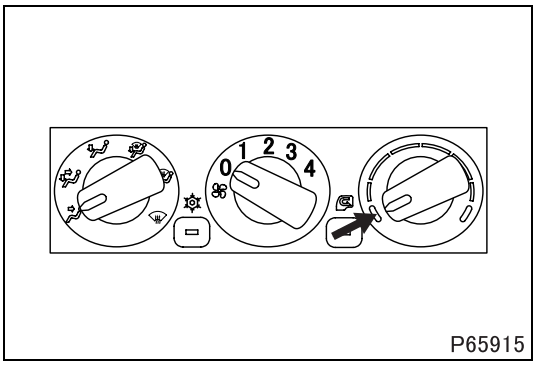
● Removal sequence

1 Radio bracket
2 Box
3 Heater controls
4 Box
5 Switch or plug
6 Meter bezel
7 Meter cluster
8 Lid (accessories box)
9 Lid (brake fluid tank)

● Installation sequence

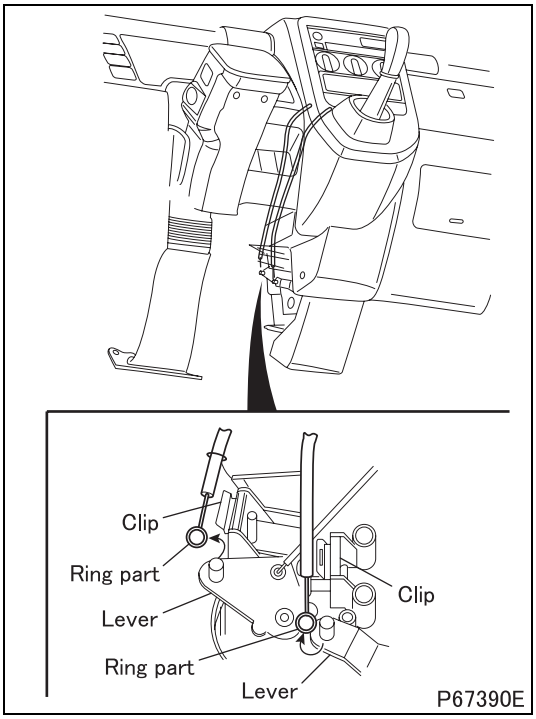
Follow the removal sequence in reverse.

◆Work before removal◆

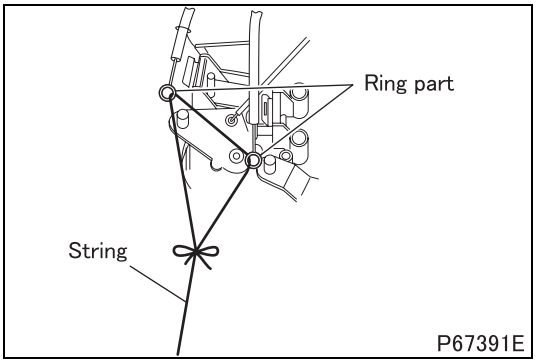


■ **Removal: Control cables**

- Turn the temperature control knob of the heater controls to the MAX-COOL position.

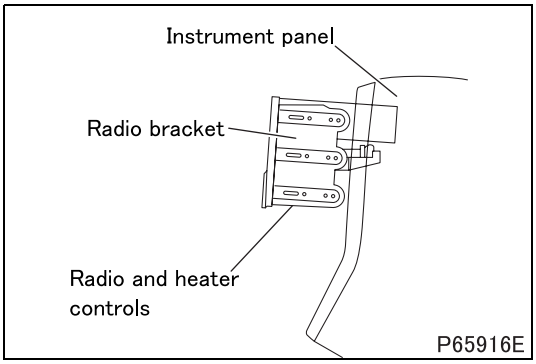


- Before disconnecting the cables from the levers, put pairing marks on each cable and its lever.
- Disconnect the control cables from the heater unit.



- In order that the control cables can be pulled back at the time of installation, attach string to the ring parts of the cables as shown in the illustration.

◆Removal procedure◆

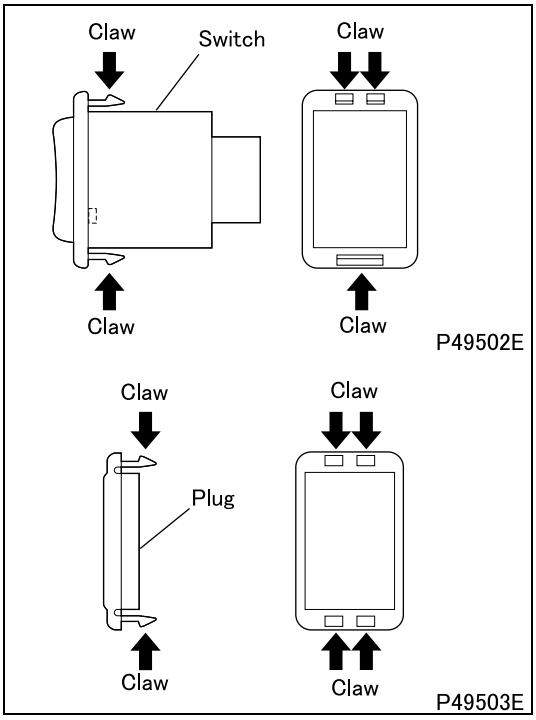


■Removal: Radio bracket

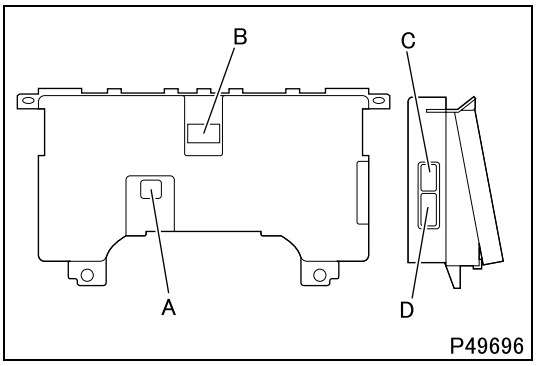
- Pull out the radio bracket for radio and heater controls until it completely comes out of the instrument panel as shown in the illustration.

CAUTION ⚠

- **Do not pull the bracket with a strong force. Pulling it strongly could give damage to the heater controls and control cables.**



■Removal: Meter cluster

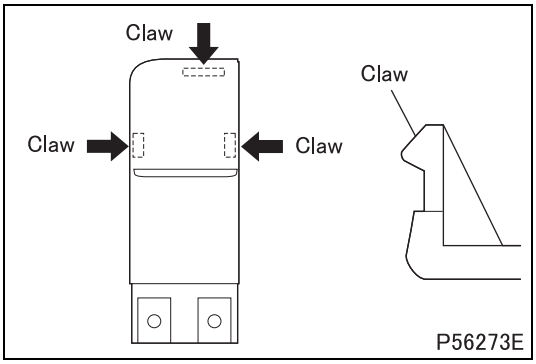


■Removal: Meter cluster

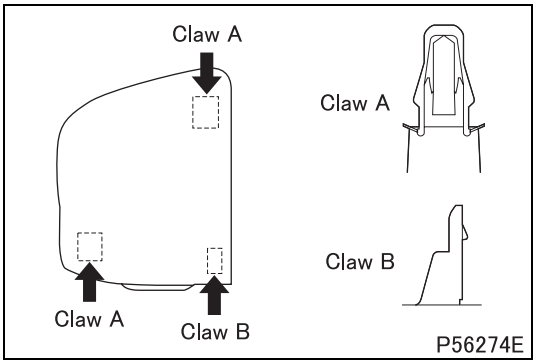
- Disconnect the cab harness connectors **A** to **D** from the meter cluster and remove the meter cluster from the instrument panel. (The illustration shows the rear face of the meter cluster.)

Connector poles

A	B	C	D
10	20	18	22

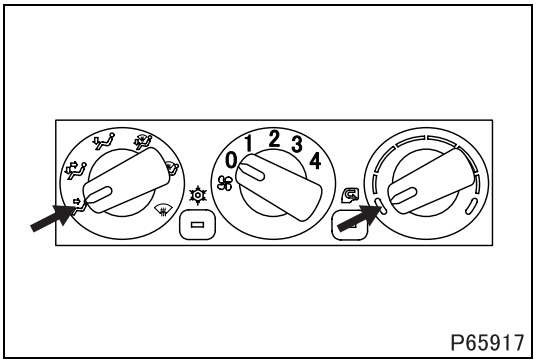


■ **Removal: Lid (accessories box)**



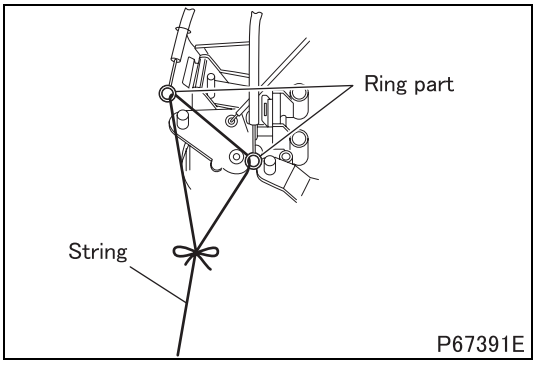
■ **Removal: Lid (brake fluid tank)**

◆Work after installation◆



■ **Installation: Control cables**

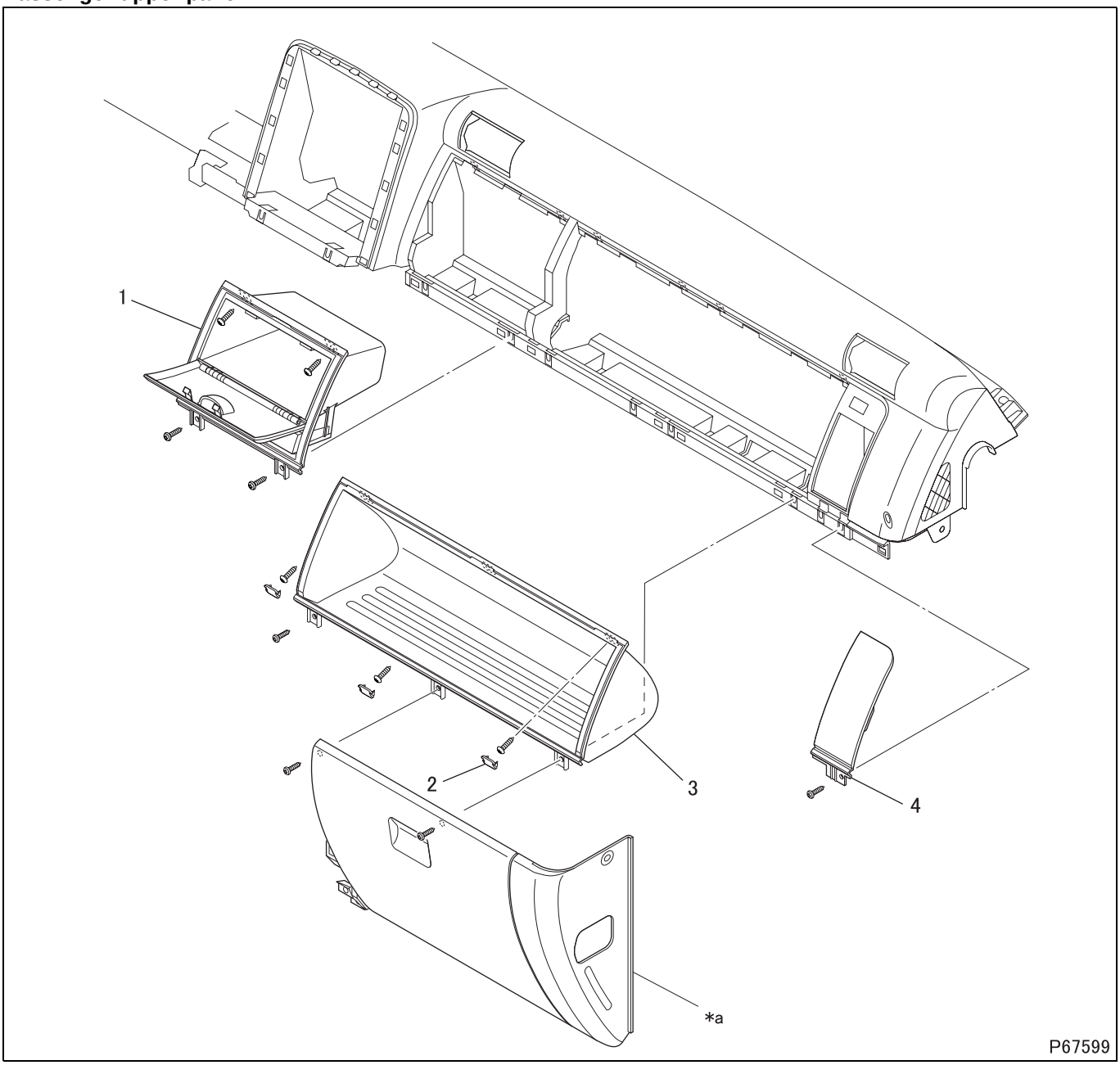
- Of the heater controls, turn the temperature control knob to the MAX-COOL position and also turn the mode selector knob to the face position.



- Pull out the control cables using the string that was attached to them at the time of removal.
- According to the pairing marks, reconnect the cables to the heater unit levers correctly. (See Gr 55.)

INSTRUMENT PANEL

Passenger upper panel



●Removal sequence

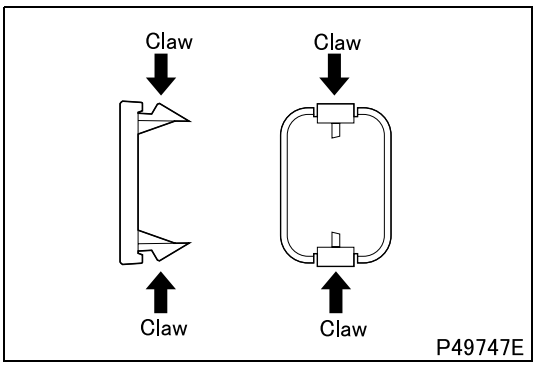
1 Glove box
2 Plug
3 Parcel tray
4 Lid (for inspection of relays)

***a**: Passenger panel

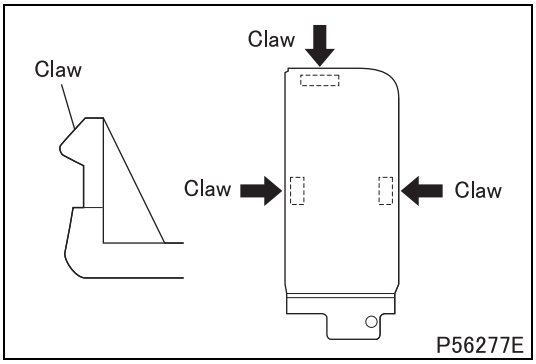
● Installation sequence

Follow the removal sequence in reverse.

◆Removal procedure◆



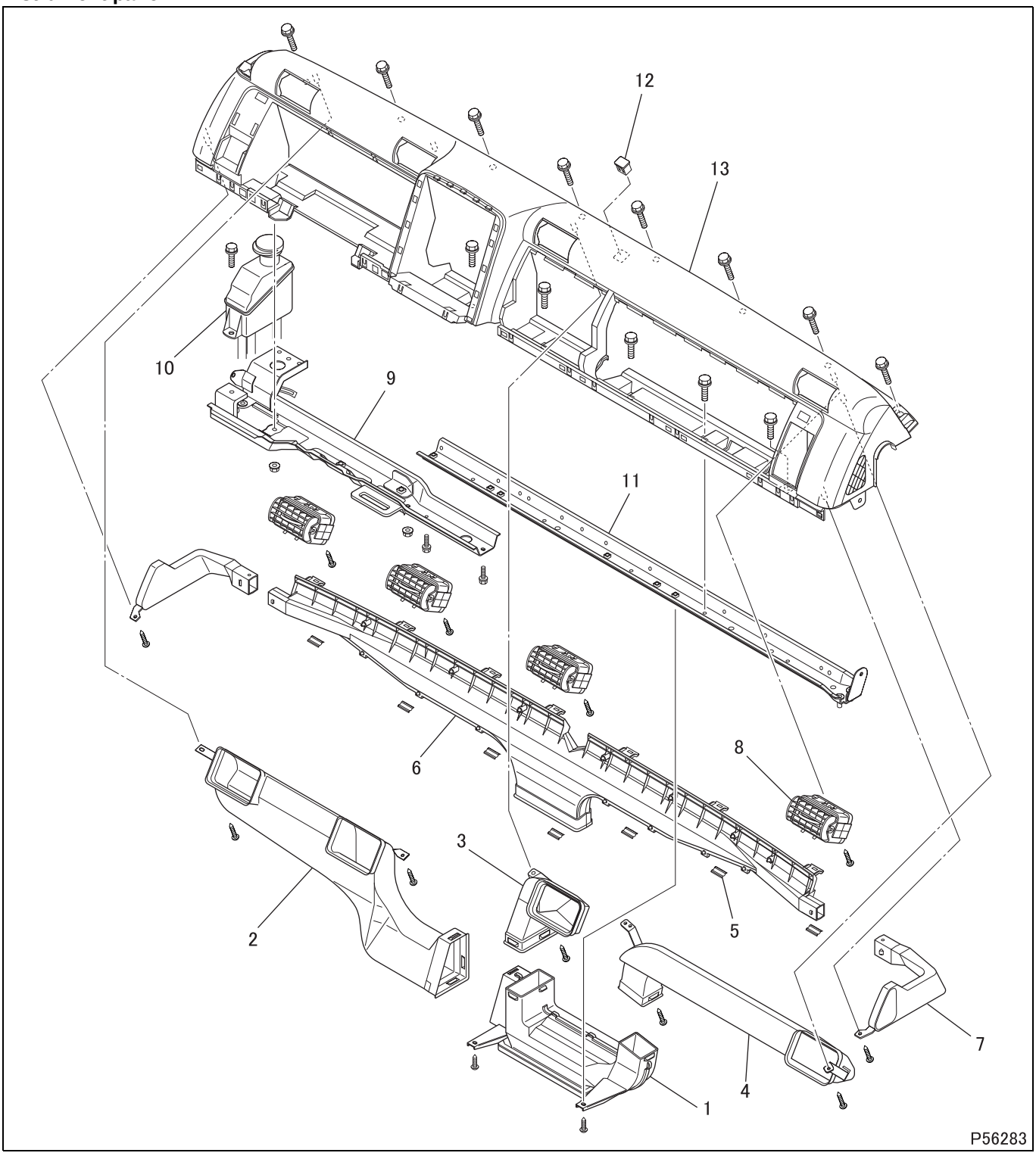
■ **Removal: Plug**



■ **Removal: Lid (for inspection of relays)**

INSTRUMENT PANEL

Instrument panel



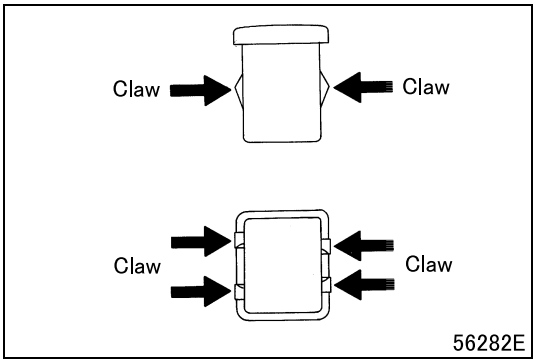
● Removal sequence

1 Center duct
2 Driver face duct
3 Center face duct
4 Passenger face duct
5 Clip (× 7)
6 Front defroster duct
7 Side defroster duct
8 Air outlet grille
9 Driver instrument panel frame
10 Brake fluid tank
11 Passenger instrument panel frame
12 Plug
13 Instrument panel

●Installation sequence

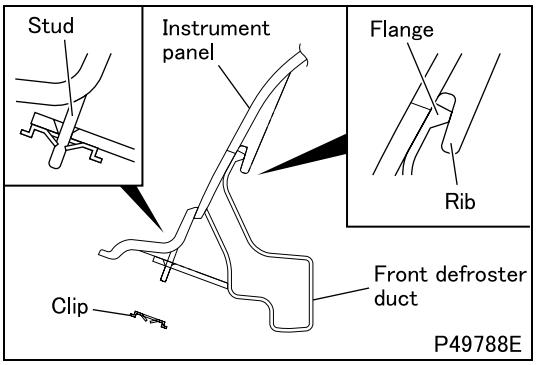
Follow the removal sequence in reverse.

◆Removal procedure◆



■ **Removal: Plug**

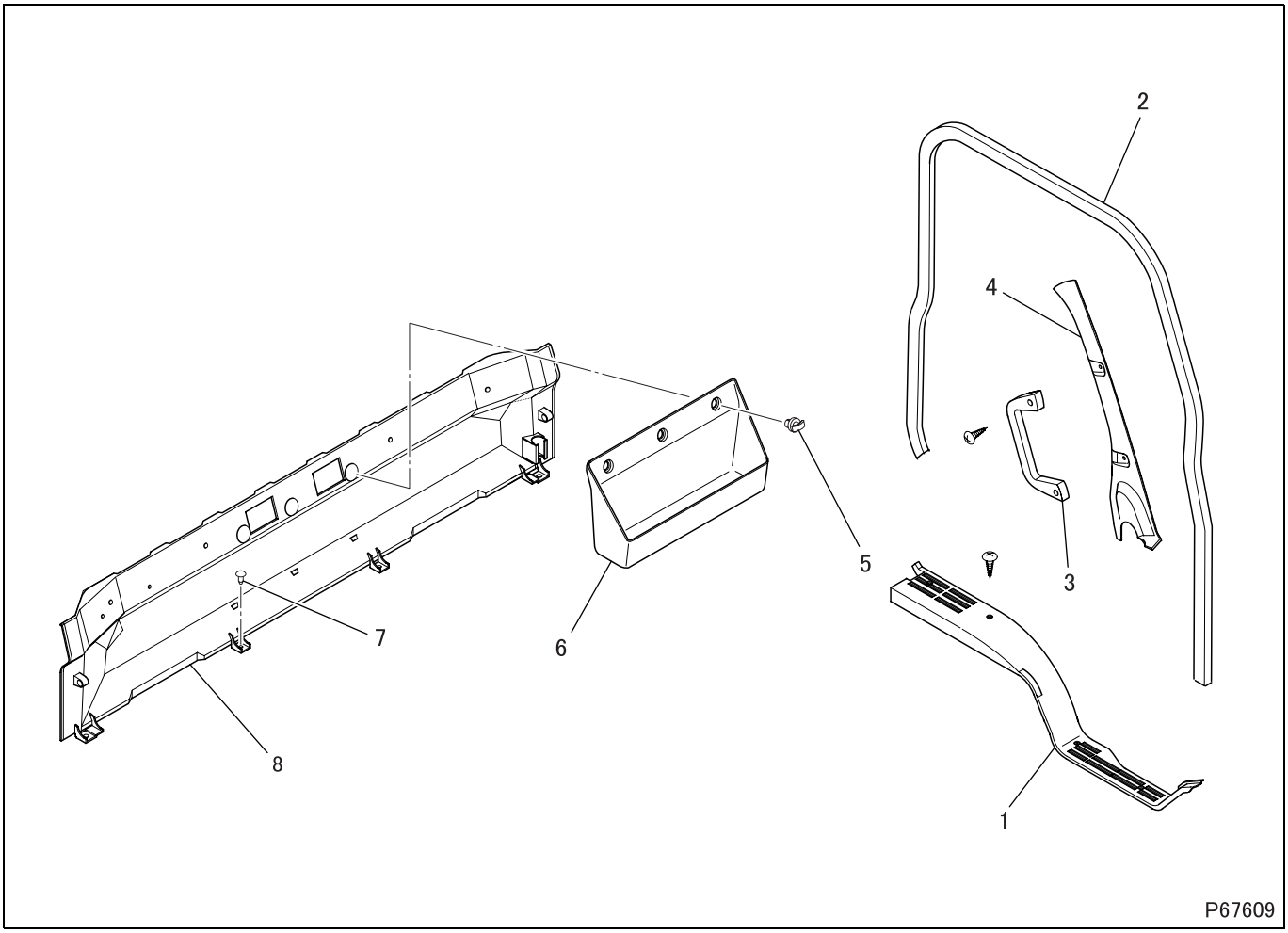
◆Installation procedure◆



■ **Installation: Front defroster duct**

- Insert the front defroster duct flanges into the instrument panel ribs.
- Insert the instrument panel studs into the front defroster duct holes and clip them together.

INSTRUMENT PANEL



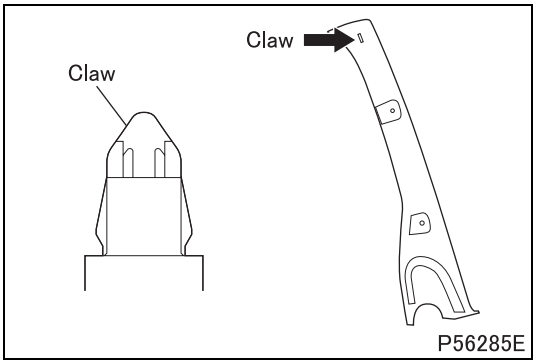
●Removal sequence

1 Scuff plate
2 Weatherstrip
3 Grip
4 Front pillar trim
5 Hook (× 3)
6 Back panel tray
7 Clip
8 Lower rear trim

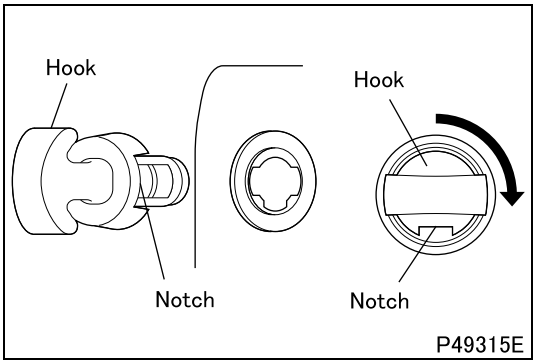
●Installation sequence

Follow the removal sequence in reverse.

◆Removal procedure◆



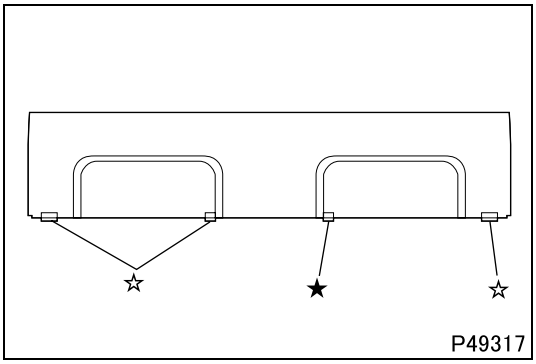
■Removal: Front pillar trim



■ **Removal: Hook**

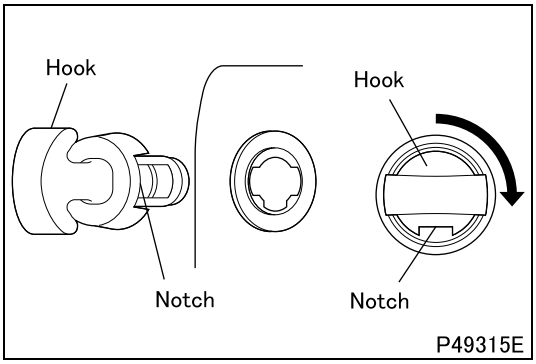
- Turn the hook 90° to disengage it.

◆Installation procedure◆



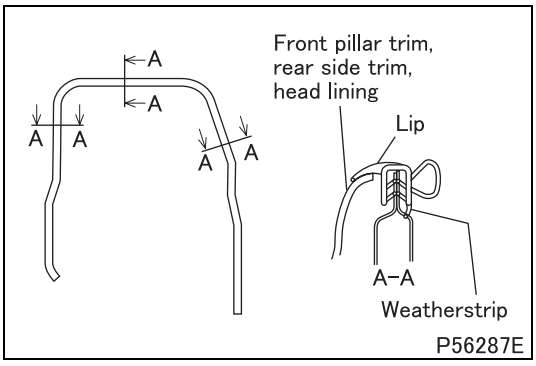
■ **Installation: Lower rear trim**

- Locate the lower rear trim correctly in position by installing a clip into the hole ★.
- Install 3 clips into the holes ☆ to completely fix the lower rear trim in position.



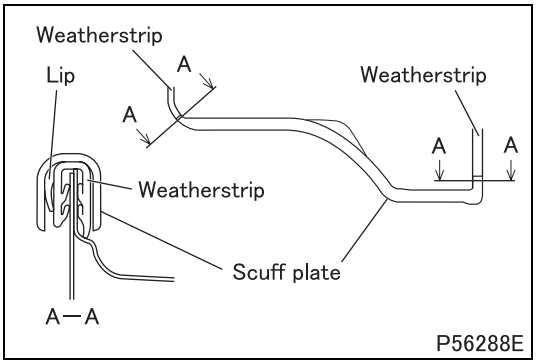
■ **Installation: Hook**

- With the notch facing in the illustrated direction, insert the hook into the lower rear trim.
- To engage the hook, turn it 90° until the notch faces downwards.



■ **Installation: Weatherstrip**

- Install the weatherstrip in such a manner that the lip of the strip holds down the front pillar trim, rear side trim, and head lining.

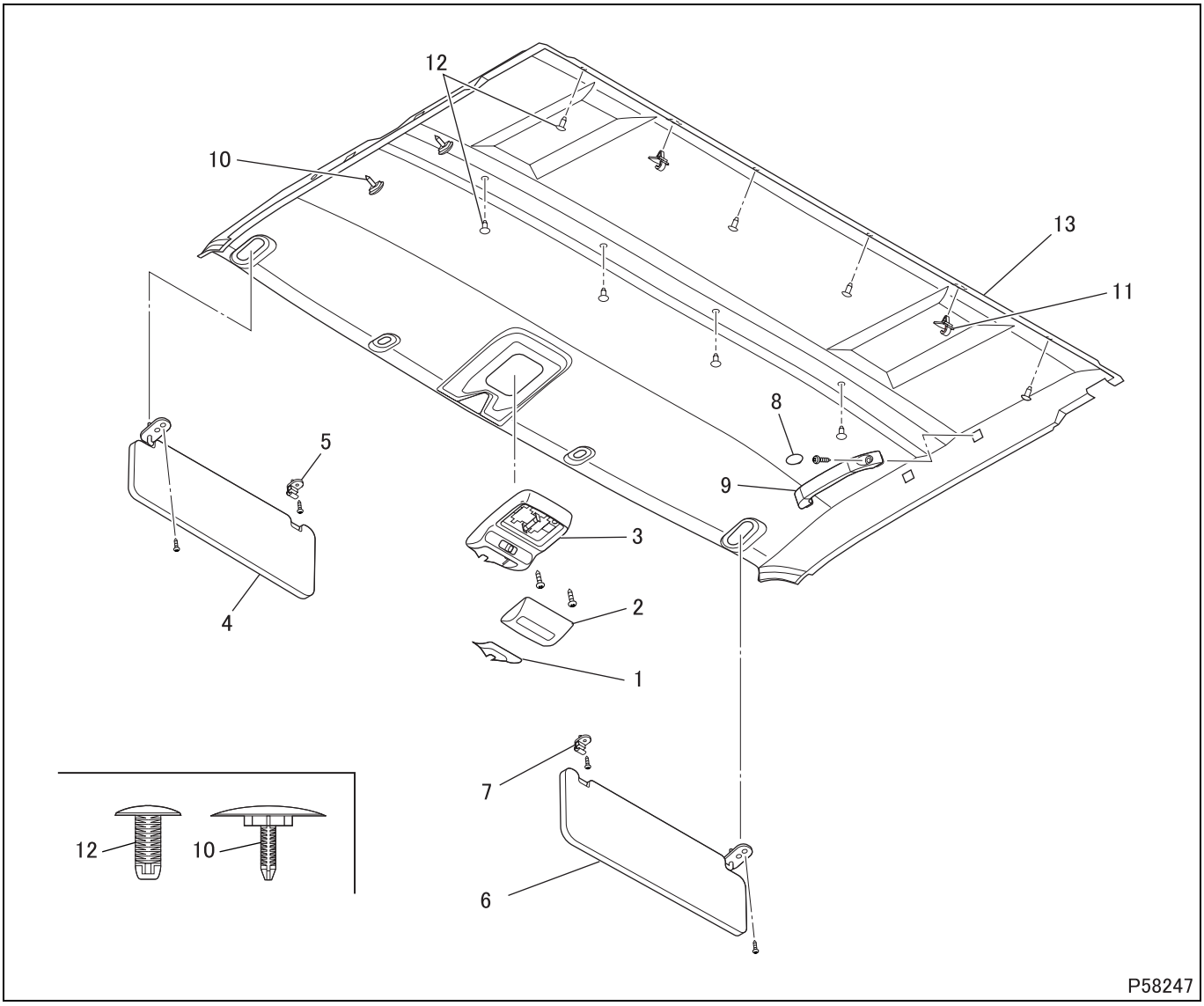


■ **Installation: Scuff plate**

- Install the scuff plate in such a manner that it holds down the lip of the weatherstrip.

M E M O

HEAD LINING



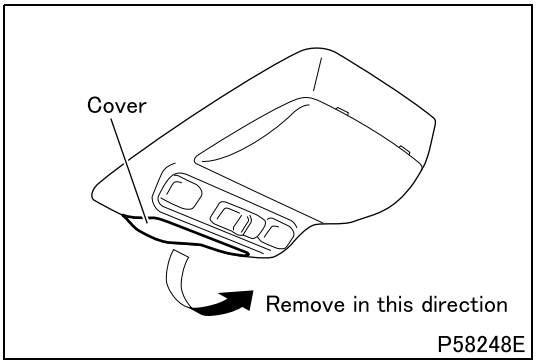
● Removal sequence

1 Cover
2 Lens
3 Room lamp
4 Sun visor (left-hand)
5 Sun visor hook
6 Sun visor (right-hand)
7 Sun visor hook
8 Cap
9 Grip
10 Plug
11 Coat hanger
12 Clip (× 8)
13 Head lining

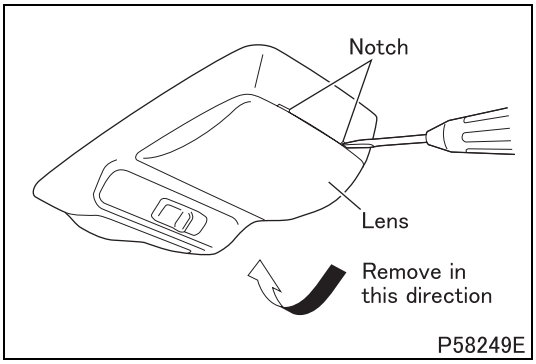
● Installation sequence

Follow the removal sequence in reverse.

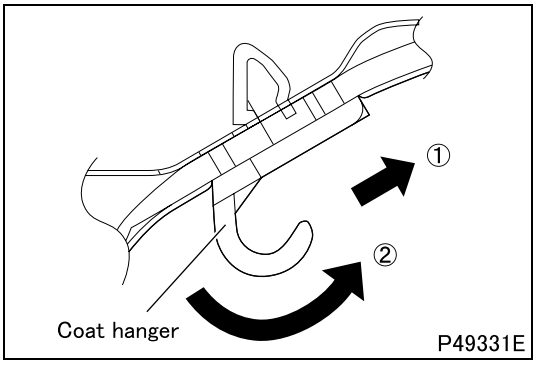
◆Removal procedure◆



■ **Removal: Cover**



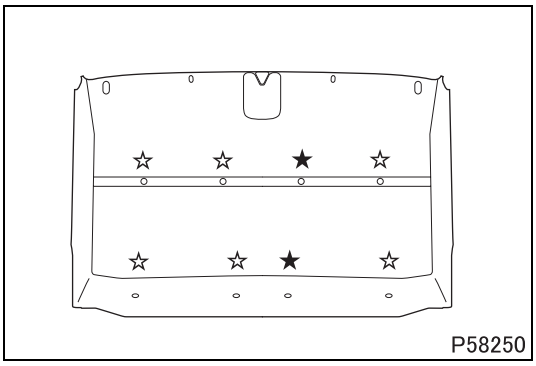
■ **Removal: Lens**



■ **Removal: Coat hanger**

- Remove the coat hanger from the head lining by pulling it in the direction of “2” while pressing it in the direction of “1”.

◆Installation procedure◆



■ **Installation: Head lining**

- Locate the head lining correctly onto the cab by installing clips at the locations ★ (× 2). Install clips at the locations ☆ (× 6).

INDEX

HOW TO READ THIS GROUP 1

54-00A GENERAL

PRECAUTIONS FOR MAINTENANCE OPERATION 54-00A-2

54-00B SPECIFICATIONS

SPECIFICATIONS..... 54-00B-2

54-00C STRUCTURE AND OPERATION

1. Starter 54-00C-2
2. Alternator..... 54-00C-3
3. Headlamps..... 54-00C-6
4. Meter Cluster..... 54-00C-7
5. Daytime Running Light System..... 54-00C-14
6. Wiper Control 54-00C-16
7. Starter Continuous Energizing Preventing Function and Preheating Function..... 54-00C-18

54-00D TROUBLESHOOTING

TROUBLESHOOTING 54-00D-2

54-01 POWER, CHARGE AND GROUND CIRCUIT

HIGH-CURRENT FUSE BOX..... 54-01-2

FUSE BOX 54-01-4

(110) POWER CIRCUIT 54-01-6

(115) RESERVE POWER CIRCUIT 54-01-16

(125) BATTERY CHARGING CIRCUIT..... 54-01-17

(130) GROUND..... 54-01-18

54-02 STARTING CIRCUIT

(210) ENGINE STARTING CIRCUIT..... 54-02-2

(215) ENGINE STOPPING CIRCUIT.....(See Gr13E)

(220) ENGINE PREHEATING CIRCUIT . 54-02-3

54-03 LIGHTING CIRCUIT

(310) HEADLAMP CIRCUIT 54-03-2

(313) DAYTIME RUNNING LIGHT CIRCUIT..... 54-03-4

(320) TAIL, CLEARANCE AND LICENSE PLATE LAMPS CIRCUIT 54-03-6

(325) STOP LAMP CIRCUIT..... 54-03-7

(330) TURN SIGNAL AND HAZARD LAMP CIRCUIT..... 54-03-8

(340) BACKUP LAMP CIRCUIT 54-03-10

(345) CAB LAMP CIRCUIT..... 54-03-11

(348) ILLUMINATION LAMP CIRCUIT..... 54-03-12

(349) IDENTIFICATION LAMP AND SIDE MARKER LAMP CIRCUIT..... 54-03-13

(352) VAN BODY DOME LIGHT CIRCUIT..... 54-03-14

54-04 METER CIRCUIT

(401) METER CLUSTER INTERNAL CIRCUIT..... 54-04-2

(410) TACHOMETER CIRCUIT .....(See Gr13E)

(412) SPEEDOMETER CIRCUIT 54-04-4

(420) FUEL GAUGE CIRCUIT 54-04-5

(425) WATER TEMPERATURE GAUGE CIRCUIT..... 54-04-6

54-05 INDICATOR AND WARNING LAMP CIRCUIT

(510) PARKING BRAKE INDICATOR CIRCUIT 54-05-2
(515) BRAKE WARNING CIRCUIT..... 54-05-4
(535) ENGINE OIL LEVEL WARNING CIRCUIT 54-05-6
(536) ENGINE OIL PRESSURE WARNING CIRCUIT 54-05-7
(537) OVERHEATING WARNING CIRCUIT 54-05-8
(540) BRAKE PAD WARNING CIRCUIT 54-05-9
(550) CAB TILT WARNING CIRCUIT ... 54-05-10
(566) FUEL FILTER WARNING CIRCUIT 54-05-11

54-06 CAB SIDE ELECTRICAL CIRCUIT

(610) CIGARETTE LIGHTER CIRCUIT .. 54-06-2
(612) AUDIO CIRCUIT 54-06-3
(614) WIPER AND WASHER CIRCUIT 54-06-4
(616) HORN CIRCUIT 54-06-5
(620) AIR-CONDITIONER CIRCUIT 54-06-6
(622) POWER WINDOW AND CENTRAL DOOR LOCK CIRCUIT 54-06-8
(629) MIRROR HEATER CIRCUIT..... 54-06-9

54-07 CHASSIS SIDE ELECTRICAL CIRCUIT

(710) EXHAUST BRAKE CIRCUIT 54-07-2

54-08 ENGINE AND TRANSMISSION SIDE ELECTRICAL CIRCUIT

(850) TRANSMISSION POWER TAKE-OFF CIRCUIT..... 54-08-2

54-09 OTHER CIRCUIT

(905) JOINT CONNECTOR (J/C)..... 54-09-2
(907) DIAGNOSIS SWITCH AND MEMORY CLEAR SWITCH..... 54-09-7
COMMON RAIL SYSTEM ELECTRIC CIRCUIT DIAGRAM .....(See Gr13E)
EXHAUST GAS RECIRCULATION ELECTRIC CIRCUIT DIAGRAM ..... (See Gr17)
AUTOMATIC TRANSMISSION SYSTEM ELECTRIC CIRCUIT DIAGRAM ..... (See Gr23)
ANTI-LOCK BRAKE SYSTEM ELECTRIC CIRCUIT DIAGRAM .....(See Gr35E)

54-10 ELECTRICAL EQUIPMENT INSTALLATION POSITIONS

Cab side

[A] SWITCH 54-10-2
[B] RELAY AND ELECTRONIC CONTROL UNIT 54-10-5
[C] FUSE, METER, SENSOR, BUZZER, MOTOR AND ACTUATOR..... 54-10-6
[D] AIR-CONDITIONER <OPTION>..... 54-10-7
[E] DOOR 54-10-8
[F] ROOF..... 54-10-9
[J] JOINTS OF MAIN HARNESS CONNECTORS..... 54-10-10

Engine and transmission

[R] ENGINE 54-10-11
[S] TRANSMISSION..... 54-10-12

Chassis side

T SWITCH AND SENSOR 54-10-13
U FUSE, RELAY AND CONNECTORS.....54-10-14
V MAGNETIC VALVE AND MOTOR.. 54-10-16
W BUZZER AND CONNECTORS 54-10-16

54-11 INSPECTION OF ELECTRICAL EQUIPMENT

#001 to #179 SWITCH 54-11-2
#180 to #249 RELAY 54-11-8
#250 to #349 SENSOR 54-11-10
#350 to #409 CONTROL UNIT 54-11-11
#410 to #509 MOTOR 54-11-12
#510 to #539 ACTUATOR 54-11-13
#560 to #609 MAGNETIC VALVE 54-11-14
#610 to #649 BUZZER, HORN 54-11-15
#650 to #699 LAMP 54-11-17
#750 to #859 OTHER..... 54-11-18
#860 BATTERY..... 54-11-20
#890 METER 54-11-23

54-12 STARTER AND ALTERNATOR

#930 STARTER..... 54-12-2
#940 ALTERNATOR 54-12-16

54-13 ON-VEHICLE INSPECTION AND ADJUSTMENT

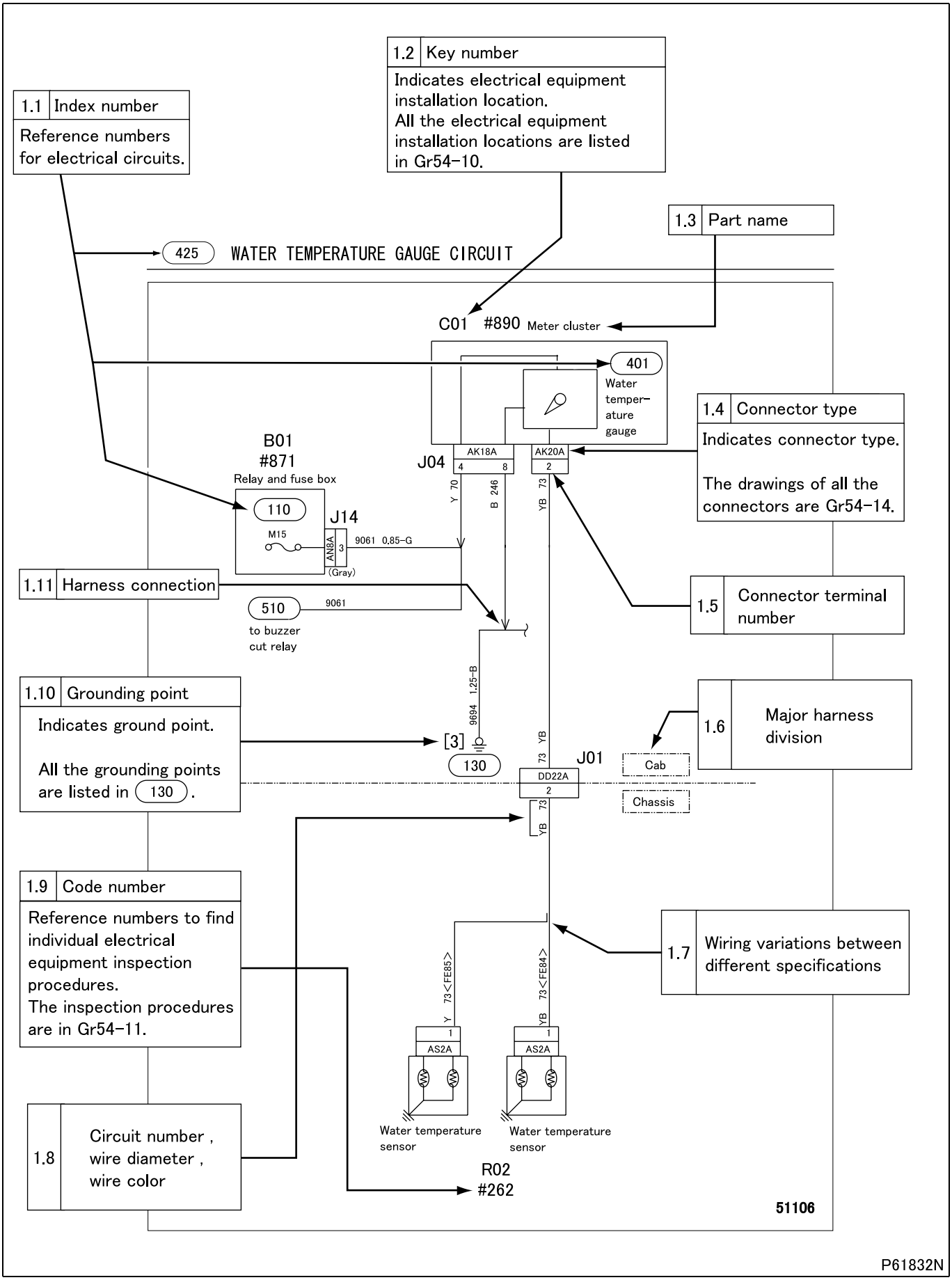
#950 INSPECTION OF ALTERNATOR .. 54-13-2
#951 INSPECTION OF REGULATOR 54-13-3
#955 INSPECTION OF PREHEATING SYSTEM..... 54-13-4
#956 INSPECTION OF STARTER CONTINUOUS ENERGIZING PREVENTING FUNCTION..... 54-13-8
#960 HEADLAMP AIMING 54-13-12

54-14 CONNECTOR CONFIGURATION CHART

CONNECTOR CONFIGURATION CHART 54-14-2

HOW TO READ THIS GROUP

HOW TO READ CIRCUITS (ELECTRICAL)



1.1 Index number: (100) to (999)

- Index numbers are used as reference numbers for electrical circuits. Each electrical circuit has been assigned its own index number.

1.2 Key number: A01 to Z99

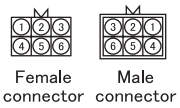
- Key numbers indicate parts installation locations. The installation location of a part can be easily found using its key number shown in a circuit diagram.
  All of the electrical equipment installation locations are listed in Gr54-10.

1.3 Part name

1.4 Connector type (type indication)

- A list of the connectors used is included in Gr54-14.

1.5 Connector terminal number



Connector terminal numbering starts with the upper left corner for female connectors and with the upper right corner for male connectors.

P50678E

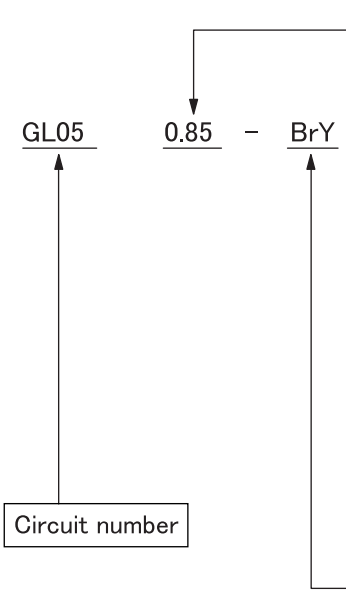
1.6 Major harness division

- Major harness divisions are shown.

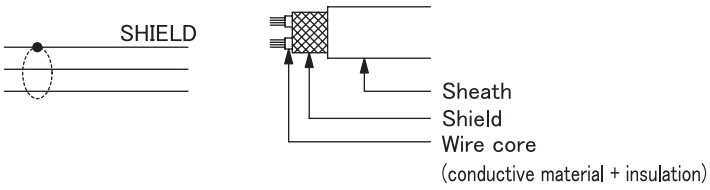
1.7 Wiring variations between different specifications

- Variations in wiring/circuit between different vehicle specifications are clearly indicated as shown.

1.8 Circuit number, wire diameter, wire color



"Wire diameter" represents the cross section of the wire's conductive material. For example, "0.85" corresponds to 0.85 mm^2. On the circuit diagrams, the unit "mm^2" is omitted. Wires with a conductive cross section of 0.5 mm^2 are shown without the wire diameter or unit. As indicated below, shielding wires are marked with "SHIELD," and shielded wires are circled by a dotted line.



On the circuit drawings, twisted wires are indicated as shown below.

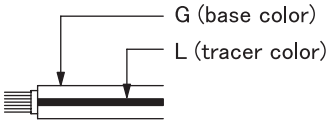
Wire colors are represented by the first letter of the color.
Colors that all start with the letter "B" are indicated as follows.

- BLACK → B
- BLUE → L
- BROWN → Br

Wires that have both base and tracer colors are indicated by two letters.

RY (Yellow tracer on Red base)

GL (Blue tracer on Green base)



P50680E

1.9 Code number: #001 to #999

- Code numbers are reference numbers to find individual electrical equipment inspection procedures. The inspection procedure for a electrical equipment can be found using its code number shown in a circuit diagram.

HOW TO READ THIS GROUP

1.10 Grounding point: [1] to [99]

- Locations where wires are grounded to the vehicle. All of the grounding points are listed in (130).

1.11 Harness connection

- The arrow in the wiring diagram indicates where harnesses are connected, and NOT the flow of electricity.

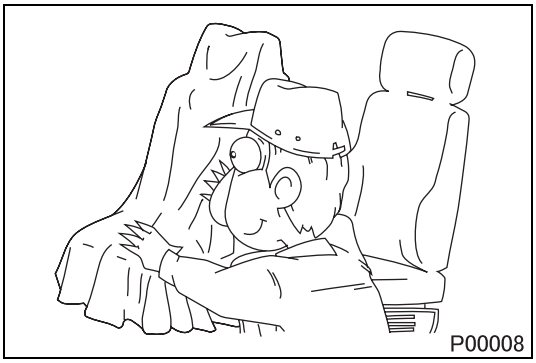
Wire color

Wire color		Base color + tracer											
B	Black	BW	Black/ white	BY	Black/ yellow	BR	Black/red	BG	Black/ green	BL	Black/ blue		
Br	Brown	BrW	Brown/ white	BrB	Brown/ black	BrY	Brown/ yellow	BrR	Brown/ red	BrG	Brown/ green		
G	Green	GW	Green/ white	GR	Green/ red	GY	Green/ yellow	GB	Green/ black	GL	Green/ blue	GO	Green/ orange
Gr Gy	Gray	GrL GyL	Gray/ blue	GrR GyR	Gray/ red								
L	Blue	LW	Blue/ white	LR	Blue/red	LY	Blue/ yellow	LB	Blue/ black	LO	Blue/ orange	LG	Blue/ green
Lg	Light green	LgR	Light green/ red	LgY	Light green/ yellow	LgB	Light green/ black	LgW	Light green/ white				
O	Orange	OL	Orange/ blue	OB	Orange/ black	OG	Orange/ green						
P	Pink	PB	Pink/ black	PG	Pink/ green	PL	Pink/ blue	PN	Pink/ white				
Pu	Purple												
R	Red	RW	Red/ white	RB	Red/ black	RY	Red/ yellow	RG	Red/ green	RL	Red/blue	RO	Red/ orange
Sb	Sky blue												
V	Violet	VY	Violet/ yellow	VW	Violet/ white	VR	Violet/red	VG	Violet/ green				
W	White	WR	White/ red	WB	White/ black	WL	White/ blue	WG	White/ green	WO	White/ orange		
Y	Yellow	YR	Yellow/ red	YB	Yellow/ black	YG	Yellow/ green	YL	Yellow/ blue	YW	Yellow/ white	YO	Yellow/ orange
		YP	Yellow/ pink	YV	Yellow/ violet								

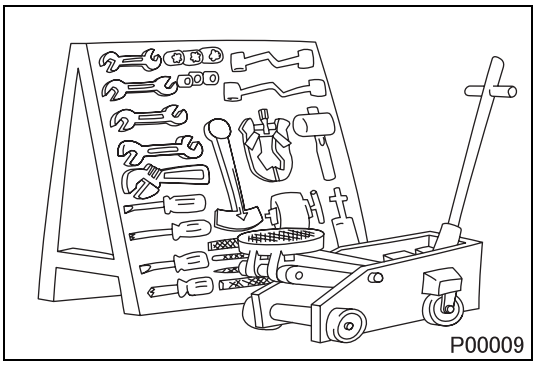
54-00A GENERAL

PRECAUTIONS FOR MAINTENANCE OPERATION

- Before performing service operations, inquire into the customer's complaints and ascertain the condition by checking the total distance travelled, the conditions under which the vehicle is operated, and other relevant factors about the vehicle. And note the necessary information. This information will help you to service the vehicle efficiently.
- Check the location of the fault, and identify its cause. Based on your findings, determine whether parts must be removed or disassembled. Then, follow the service procedure given in this manual.


P00008

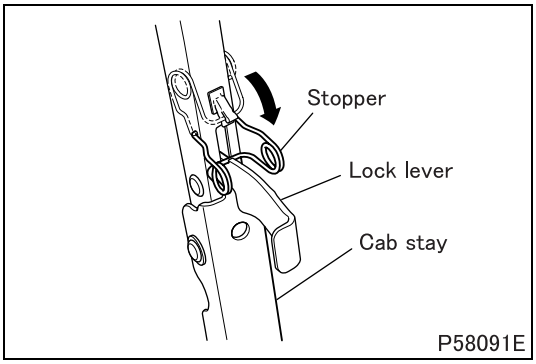
- Perform service operations on a level surface. Before starting, take the following preparatory steps:
  - To prevent soiling and damage, place covers over the seats, trim and floor in the cab and over the paintwork of the body.


P00009

- Prepare all the general and special tools necessary for the job.

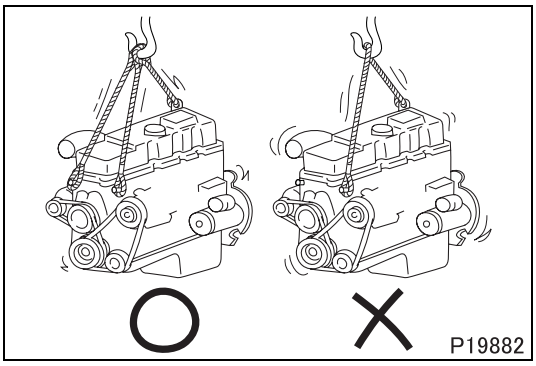
WARNING ⚠

- **Special tools must be used wherever specified in this manual. Do not attempt to use other tools since they could cause injuries and/or vehicle damage.**

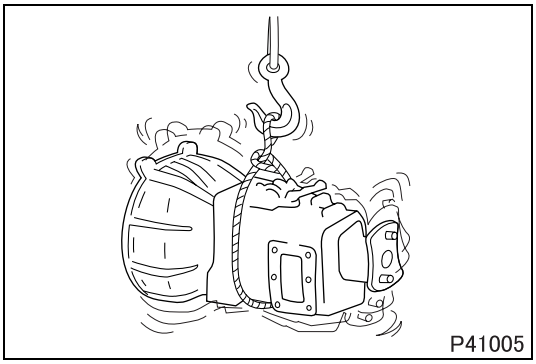


P58091E

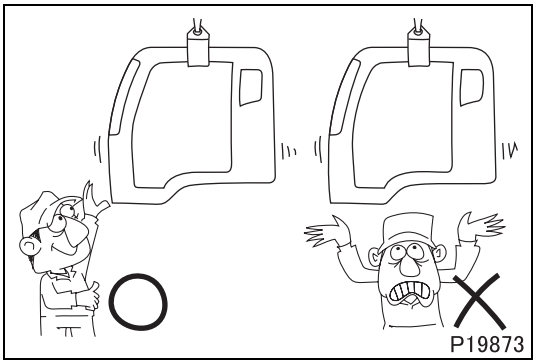
- After tilting the manual tilt type cab, be sure to engage the stopper with the lock lever to lock the cab stay securely.


P19882

- Take extreme care when removing/installing heavy items such as engine, transmission and axle. When lifting heavy items using a cable etc., observe the following precautions.
  - Identify the mass of the item being lifted. Use tha cable that is strong enough to support the mass.

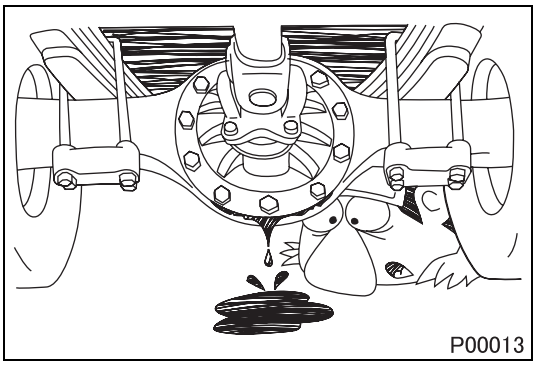


- If lifting eyes are not provided on the item being lifted, tie a cable around the item taking into account the item's center of gravity.

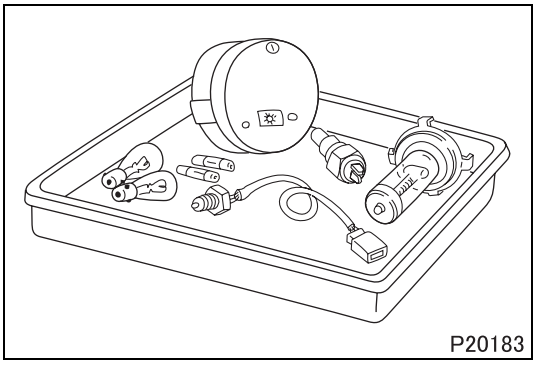


- Do not allow anyone to pass or stay under a lifted item which may possibly fall.

- Never work in shoes that have oily soles.
  When working with a partner or in a group, use pre-arranged signals and pay constant attention to safety. Be careful not to touch switches and levers unintentionally.

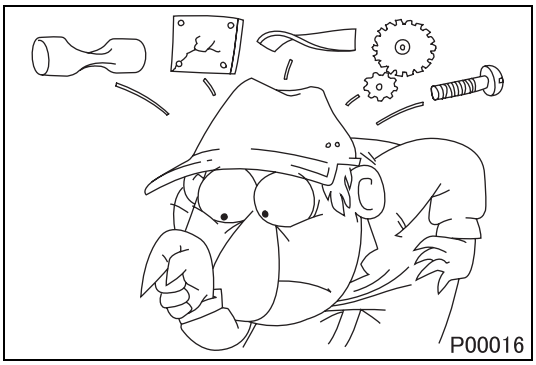


- Inspect for oil leakage etc. before washing the vehicle. If the order is reversed, any oil leakage or fault that may exist could go unnoticed during inspection.

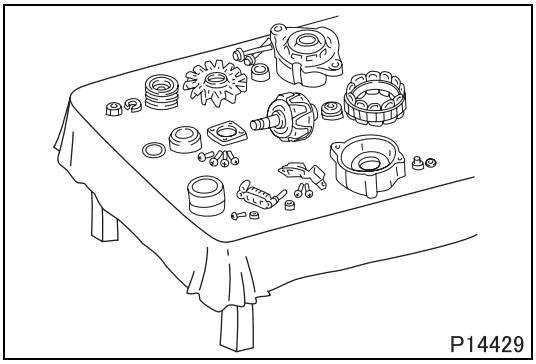


- Prepare replacement parts ready for installation.

- Oil seals, packings, O-rings and other rubber parts, gaskets, and split pins must be replaced with new ones after removal. Use only approved replacement parts.



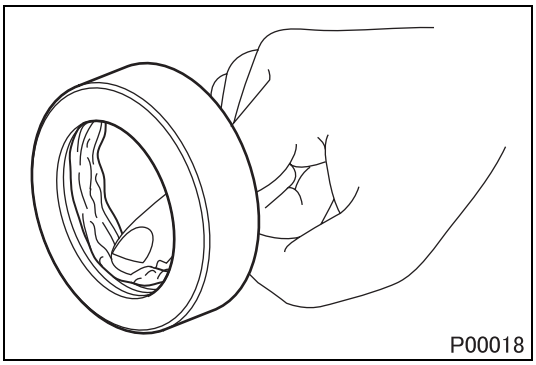
- When disassembling parts, visually check them for wear, cracks, damage, deformation, deterioration, rust, corrosion, defective rotation, fatigue, clogging and any other possible defect.



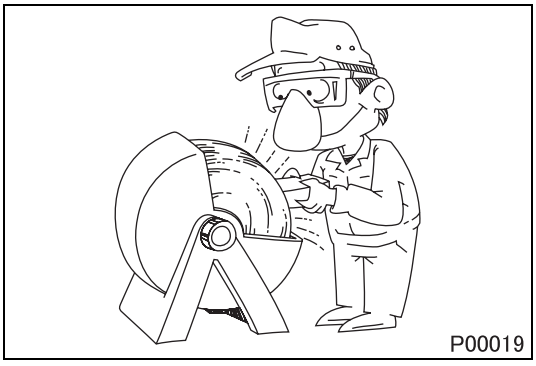
- To facilitate correct reassembly of parts, make alignment marks on them before disassembly and arrange disassembled parts neatly. Make punch marks and other alignment marks where they will not detract from parts' functionality and appearance.
- After removing parts from the vehicle, cover the area to keep it free of dust.

CAUTION ⚠

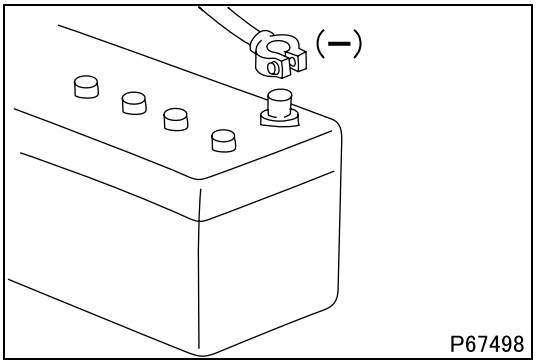
- **Be careful not to mix up identical parts, similar parts and parts that have left/right alignments.**
- **Keep new replacement parts and original (removed) parts separately.**



- Apply the specified oil or grease to U-seals, oil seals, dust seals and bearings before reassembly.
- Always use the specified oils and greases when performing inspection or replacement. Immediately wipe away any excess oil or grease with a rag.



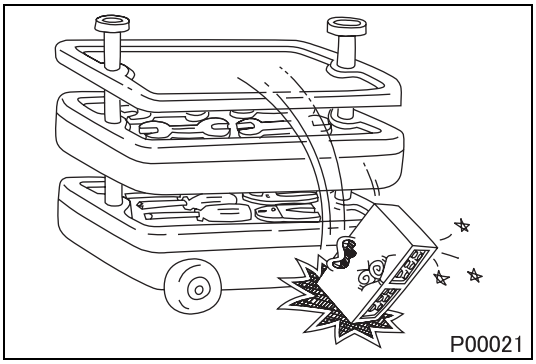
- Wear safety goggles when using a grinder or welder. Wear gloves when necessary, and watch out for sharp edges and other items that might wound your hands.



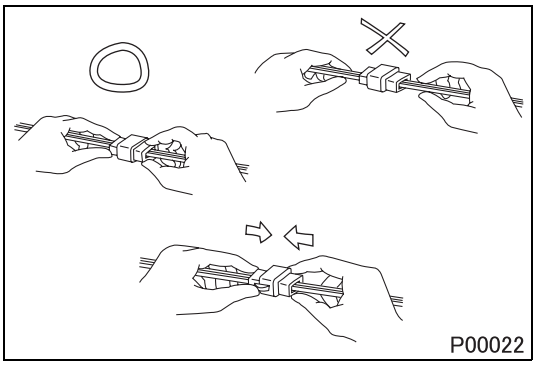
- Before working on the electrical system, disconnect the (–) battery cable to prevent short circuits.

CAUTION ⚠

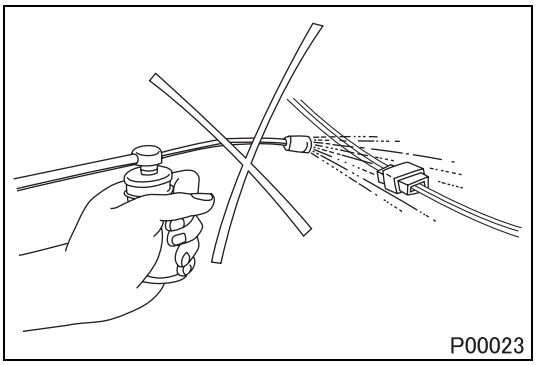
- **Make sure the starter switch and lighting switches are OFF before disconnecting or connecting battery cable. Semiconductor components may otherwise be damaged.**



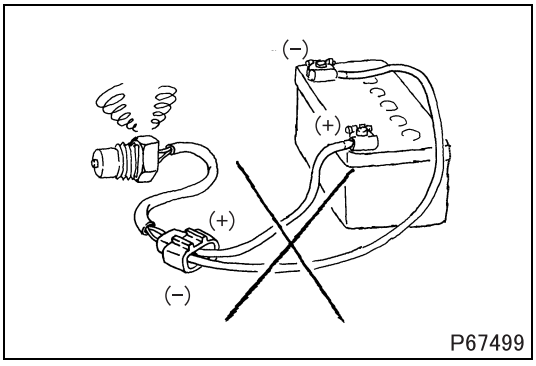
- Carefully handle sensors relays, and other items that are sensitive to shock and heat. Do not remove or paint the cover of any control unit.



- When separating connectors, grasp the connectors themselves rather than the harnesses.
- To separate locking connectors, first push them in the direction of the arrows. To reconnect locking connectors, push them together until they click.

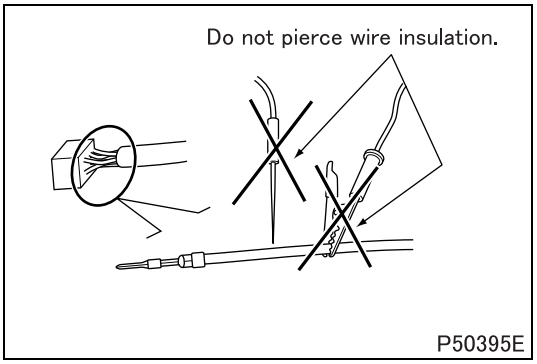


- Before washing the vehicle, cover electrical parts to keep them dry. (Use plastic sheets or the like.) Keep water away from harness connectors and sensors and immediately wipe off any water that gets on them.



- When applying a voltage to a part for inspection purposes, check that the (+) and (–) cables are connected properly then gradually increase the voltage from zero. Do not exceed the specified voltage.
  Remember that control units and sensors do not necessarily operate on the battery voltage.

1. Handling Precautions for Electric Circuits



CAUTION ⚠

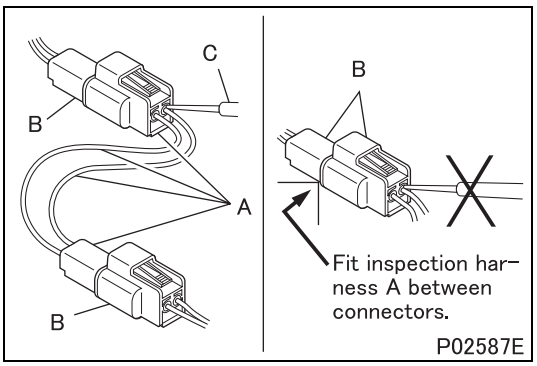
- **Do not pierce wire insulation with test probes or alligator clips when performing electrical inspections. Doing so can, particularly with the chassis harness, hasten corrosion.**

1.1 Inspection of harnesses

(1) Inspections with connectors fitted together

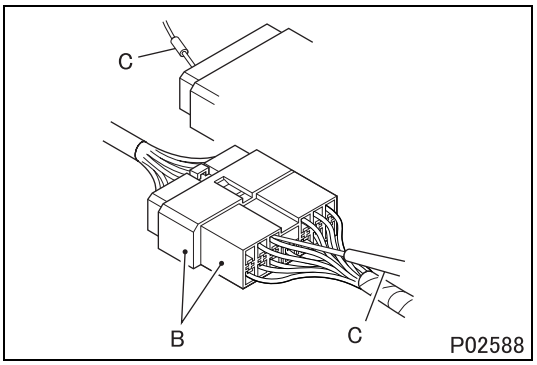
(1.1) Waterproof connectors

- Connect an inspection harness and connector **A** between the connectors **B** of the circuit to be inspected. Perform the inspection by applying a test probe **C** to the connectors of the inspection harness. Do not insert the test probe **C** into the wire-entry sides of the waterproof connectors since this would damage their waterproof seals and lead to rust.



(1.2) Non-waterproof connectors

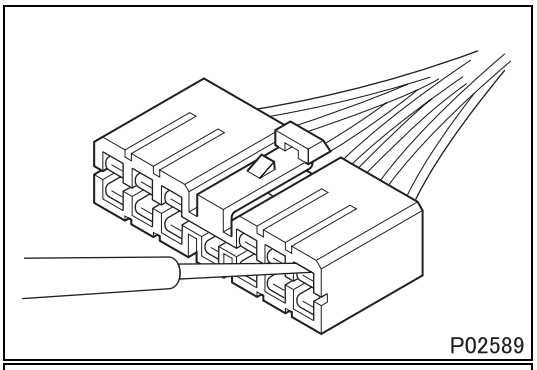
- Perform the inspection by inserting a test probe **C** into the wire-entry sides of the connectors. An extra-narrow probe is required for control unit connectors, which are smaller than other types of connector. Do not force a regular-size probe into control unit connectors since this would cause damage.



(2) Inspections with connectors separated

(2.1) Inspections on female terminals

- Perform the inspection by carefully inserting a test probe into the terminals. Do not force the test probe into the terminals since this could deform them and cause poor connections.

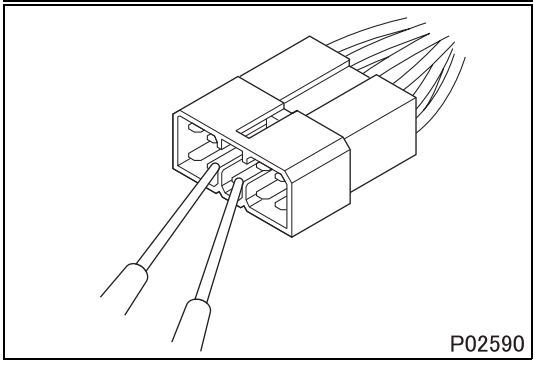


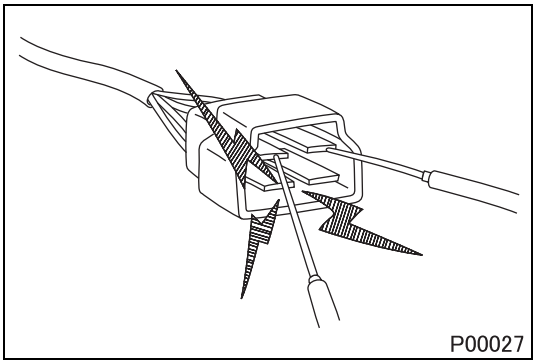
(2.2) Inspections on male terminals

- Perform the inspection by applying test probes directly to the pins.

CAUTION ⚠

- **Be careful not to short-circuit pins together with the test probes. With control unit connectors, short-circuiting of pins can cause damage to the control unit's internal circuitry.**

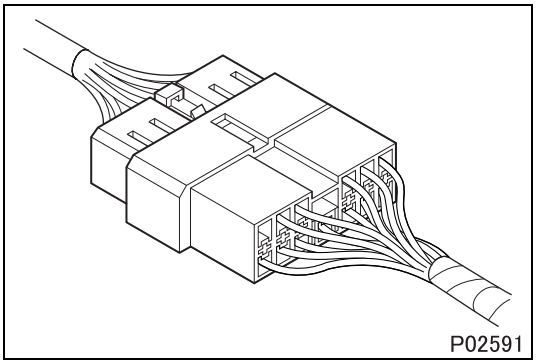




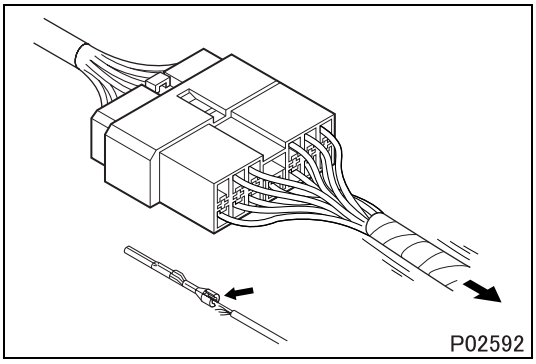
- When using a multimeter to check continuity, do not allow the test probes to touch the wrong terminals.

1.2 Inspection of connectors

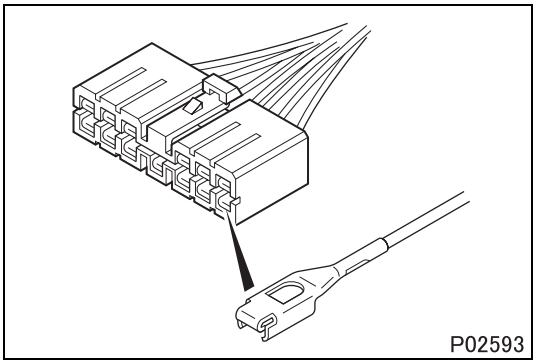
(1) Visual inspection



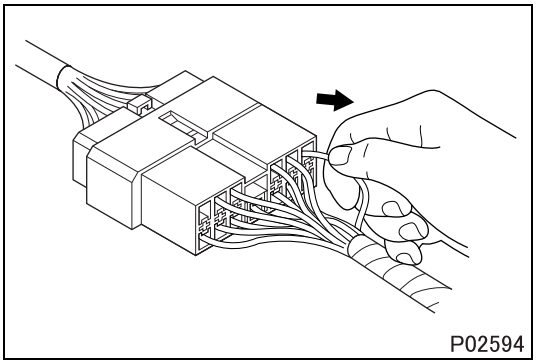
- Check that the connectors are fitted together securely.



- Check whether wires have been separated from their terminals due to pulling of the harness.

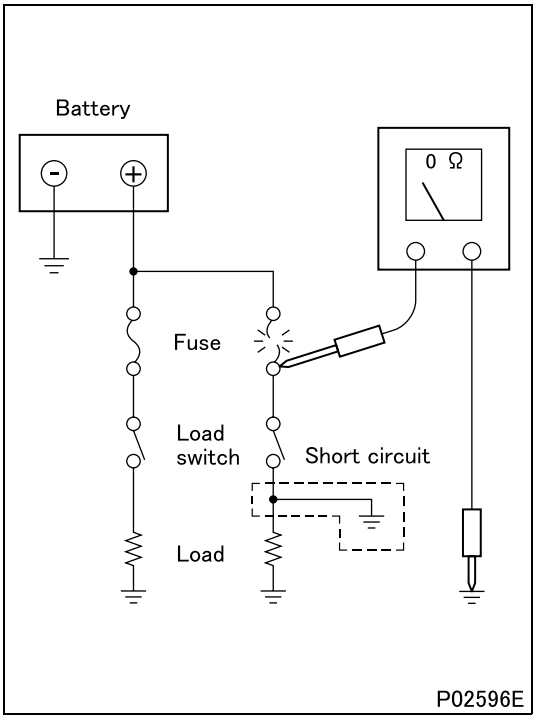


- Check that male and female terminals fit together tightly.
- Check for defective connections caused by loose terminals, by rust on terminals, or by contamination of terminals by foreign substances.



(2) Checking for loose terminals

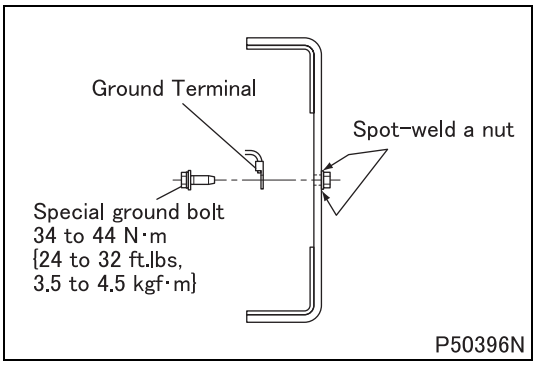
- If connector terminal retainers become damaged, male and female terminals may not mate with each other when the connector bodies are fitted together. To check for such terminals, gently pull each wire and see whether any terminals slip out of their connector housings.



1.3 Inspections when a fuse blows

- Remove the fuse, then measure the resistance between ground and the fuse's load side.
  Next, close the switch of each circuit connected to the fuse. If the resistance measurement between any switch and ground is zero, there is a short circuit between the switch and the load. If the resistance measurement is not zero, the circuit is not currently short-circuited; the fuse probably blew due to a momentary short circuit.

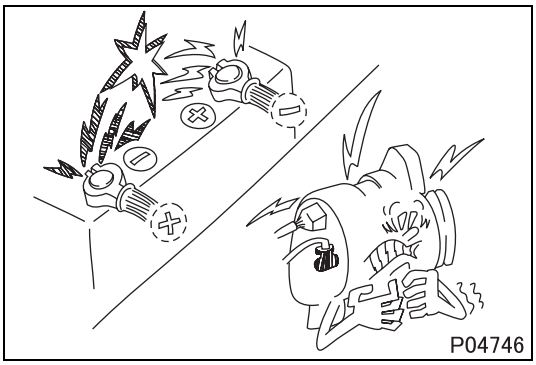
- The main causes of short circuits are as follows:
  - Harnesses trapped between chassis parts
  - Harness insulation damage due to friction or heat
  - Moisture in connectors or circuitry
  - Human error (accidental short-circuiting of components)



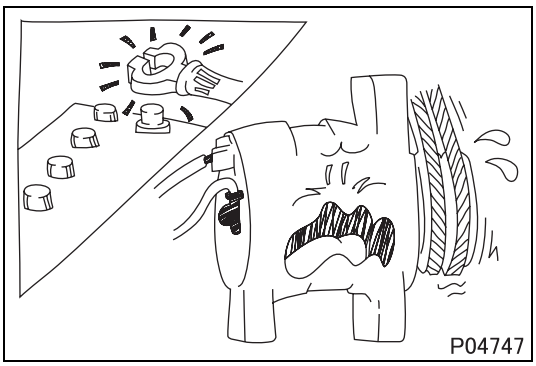
1.4 Inspection of chassis ground

- A special ground bolt is used to tighten a ground terminal. When servicing the ground point, be sure to follow the procedures described below:
  - When reinstalling the ground bolt
    Tighten the ground bolt to the specified torque.
  - When relocating the ground point
    A special ground bolt must be used. Spot-weld a nut to a frame and tighten the ground bolt to the specified torque. Be sure to apply touch-up paint to the welded point.

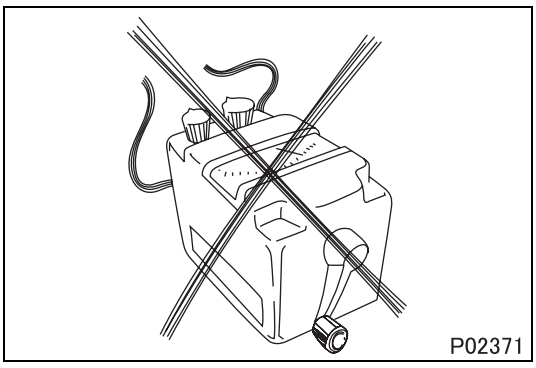
2. Service Precautions for Alternators



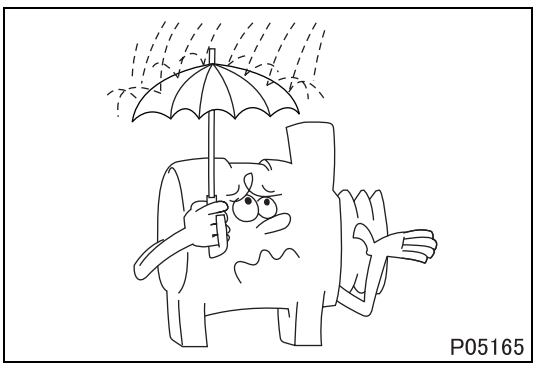
- When servicing alternators, observe the following precautions:
  - Never reverse the polarity of battery connections.
    If the polarity of the battery connections were to be reversed, a large current would flow from the battery to the alternator, damaging the diodes and regulator.



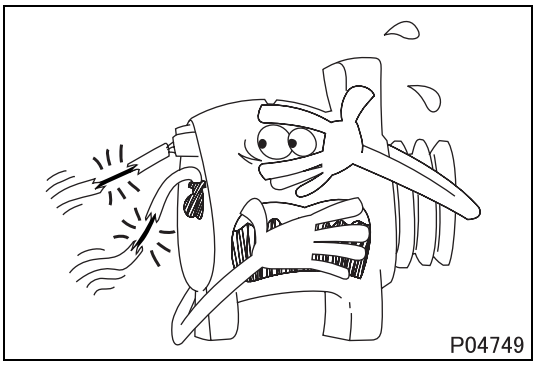
- Never disconnect the battery cables with the engine running.
  Disconnection of the battery cables during engine operation would cause a surge voltage, leading to deterioration of the diodes and regulator.



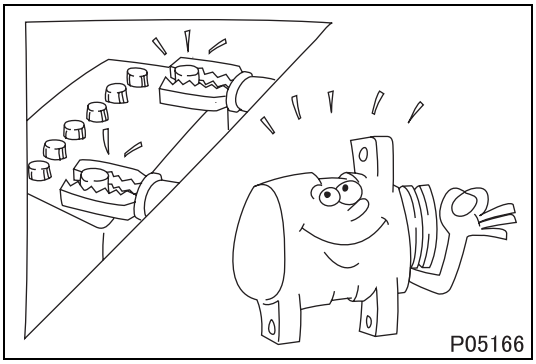
- Never perform inspections using a high-voltage multimeter.
  The use of a high-voltage multimeter could damage the diodes and regulator.



- Keep alternators dry.
  Water on alternators can cause internal short circuits and damage.

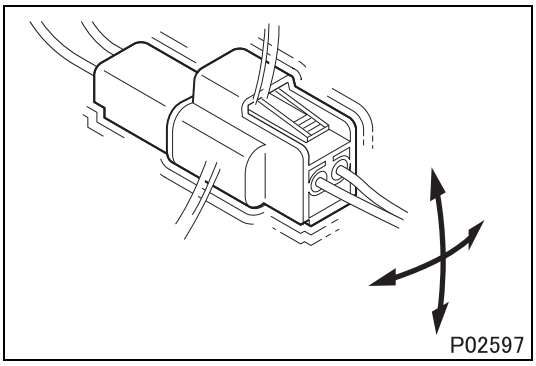


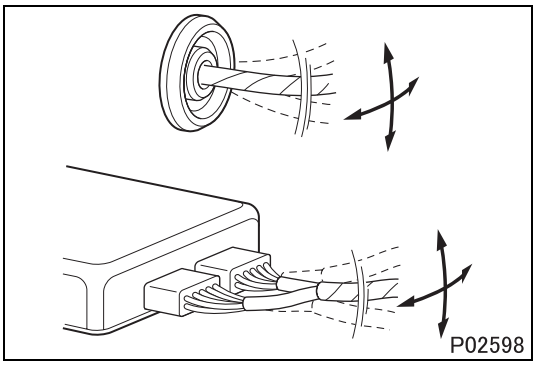
- Never operate an alternator with the B and L terminals short-circuited. Operation with the B and L terminals connected together would damage the diode trio.

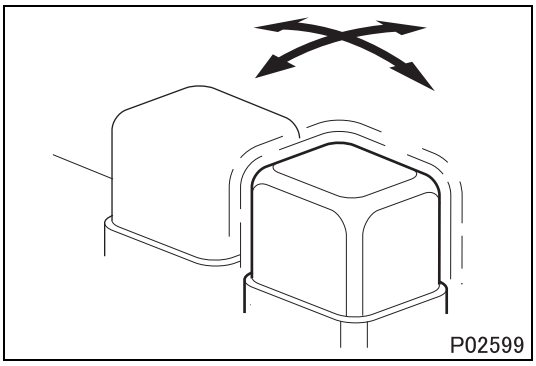


- Disconnect the battery cables (+) and (–) before quick-charging the battery with a quick charger.
  Unless the battery cables are disconnected, quick-charging can damage the diodes and regulator.

3. Intermittent Faults





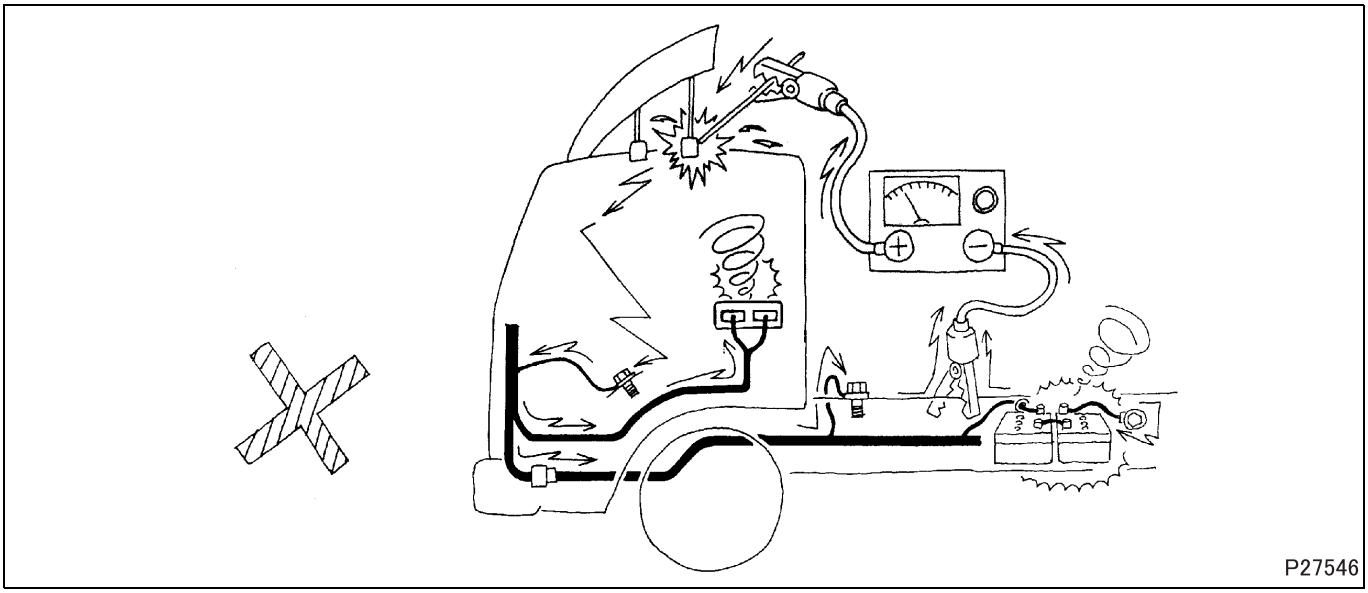


- An intermittent fault typically occurs only under certain operating conditions. Once these conditions have been identified, the cause of the intermittent fault can be ascertained easily. First, ask the customer about the vehicle operating conditions and weather conditions under which the fault occurs. Also ask about the frequency with which the fault occurs and about the fault symptoms. Then, reproduce the fault based on this information.
  In accordance with the conditions under which the fault occurs, determine whether the fault is caused by vibration, heat or other factors. if vibration is a possible factor, see if the fault can be reproduced by performing the following checks on individual connectors and other parts:
  - Gently move connectors up and down and to left and right.
  - Gently move wiring harnesses up and down and to left and right.
  - Gently wiggle sensors and other devices by hand.
  - Gently wiggle wiring harnesses on suspension systems and other moving parts.

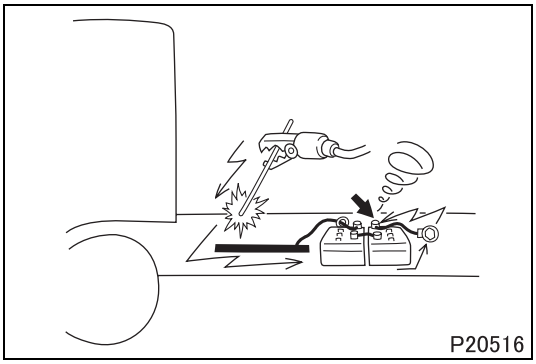
- Connectors and other parts to be checked are those included or given as likely fault locations in inspection procedures corresponding to diagnosis codes and/or fault symptoms.

4. Precautions for Arc Welding

- When arc welding is performed, current from the welder flows to ground via the vehicle's metal parts. Unless appropriate steps are taken, this current can damage control units, other electrical devices and wiring harnesses. And any electrical device near the point on the vehicle to which the (–) cable of the welder is connected, might be largely damaged.



- Current flows backward as shown below.



4.1 From battery (–) cable

To prevent damage to the battery and to electrical devices that are connected directly to the battery, it is essential to disconnect the battery's (–) cable.

4.2 Procedure

- Turn the starter switch to the LOCK position.
  ↓
- Disconnect the battery's (–) cable.
  ↓
- Cover all parts of the vehicle that may be damaged by welding sparks.
  ↓
- Connect the welder's (–) cable to the vehicle as close as possible to the area being welded. Do not connect the welder's (–) cable to the cab if the frame is being welded, and vice versa.
  ↓
- Set the welding current in accordance with the part being welded.

54-00B SPECIFICATIONS

SPECIFICATIONS

Battery

Item		Specifications
Model		130E41L
Voltage × Quantity	V	12 × 2
Capacity (5-hour rating)	Ah	92
Cold Cranking Amperage		799

Alternator

Item		Specifications
Manufacturer		MITSUBISHI ELECTRIC
Type		Alternator with built-in regulator (without brush, external fan)
Model		A4TU1593
Output	V-A	12–100

Starter

Item			Specifications
Starter	Manufacturer		MITSUBISHI ELECTRIC
	Model		M8T55371
	Output	V-kW	12–3.0
	Reduction gear mechanism		Planetary gears
	Magnetic switch operating voltage	V	8 or less
Starter relay	Model		U001X13972
	Excitation current	V-A	12–4
	Closing voltage	V	8 or less
	Opening voltage	V	3.5 or less
	Allowable cutoff current	A	200
Glow relay	Model		U1T11872
	Excitation current	V-A	12–4
	Closing voltage	V	8 or less
	Opening voltage	V	3.5 or less
	Allowable cutoff current	A	60
	Temperature fuse capacity	A	127
Glow plug	Model		Sheathed type
	Excitation current	V-A	11–5

Lighting

Item			Specifications
Headlamp	Model		Unconventional, rectangular, 2-lamp-system, semi-sealed beam
	Type		Parabola reflector type
	Upper beam (HIGH)	W	HB2 halogen 60/55 (HIGH/LOW)
	Lower beam (LOW)	W	
	Parking lamp	W	5
Front side turn signal lamp (serving also as hazard warning lamp)		W	21
Clearance and side marker lamp		W	7.5
Rear combination lamp	Stop and tail lamp (stop/tail)	W	21/5 (double filament type)
	Rear turn signal lamp (serving also as hazard warning lamp)	W	21
	Backup lamp	W	21
License plate lamp		W	7.5
Identification lamp		W	7.5
Cab lamp		W	10

Meter

Item			Specifications
Meter cluster	Manufacturer		DENSO
	Voltage	V	12
	Speedometer indicating range	km/h {MPH}	Meter reading $^{+2}_{0}$ to $^{+6.5}_{0}$ { $^{+2}_{0}$ to $^{+3}_{0}$ }
	Tachometer indicating range	rpm	Meter reading ± 150
	Water temperature gauge indicating range		<M/T> 103°C {217°F}, 70 to 96°C {158 to 205°F}, 50°C {122°F}, C, H — P58273N <A/T> 103°C {217°F}, 70 to 96°C {158 to 205°F}, 50°C {122°F}, C, H — P57939N
	Meter warning buzzer — Rated current	mA	50 or less
	Meter warning buzzer — Sound pressure	dB	60 $^{+6}_{0}$ (at 1 m {3.3 ft.})

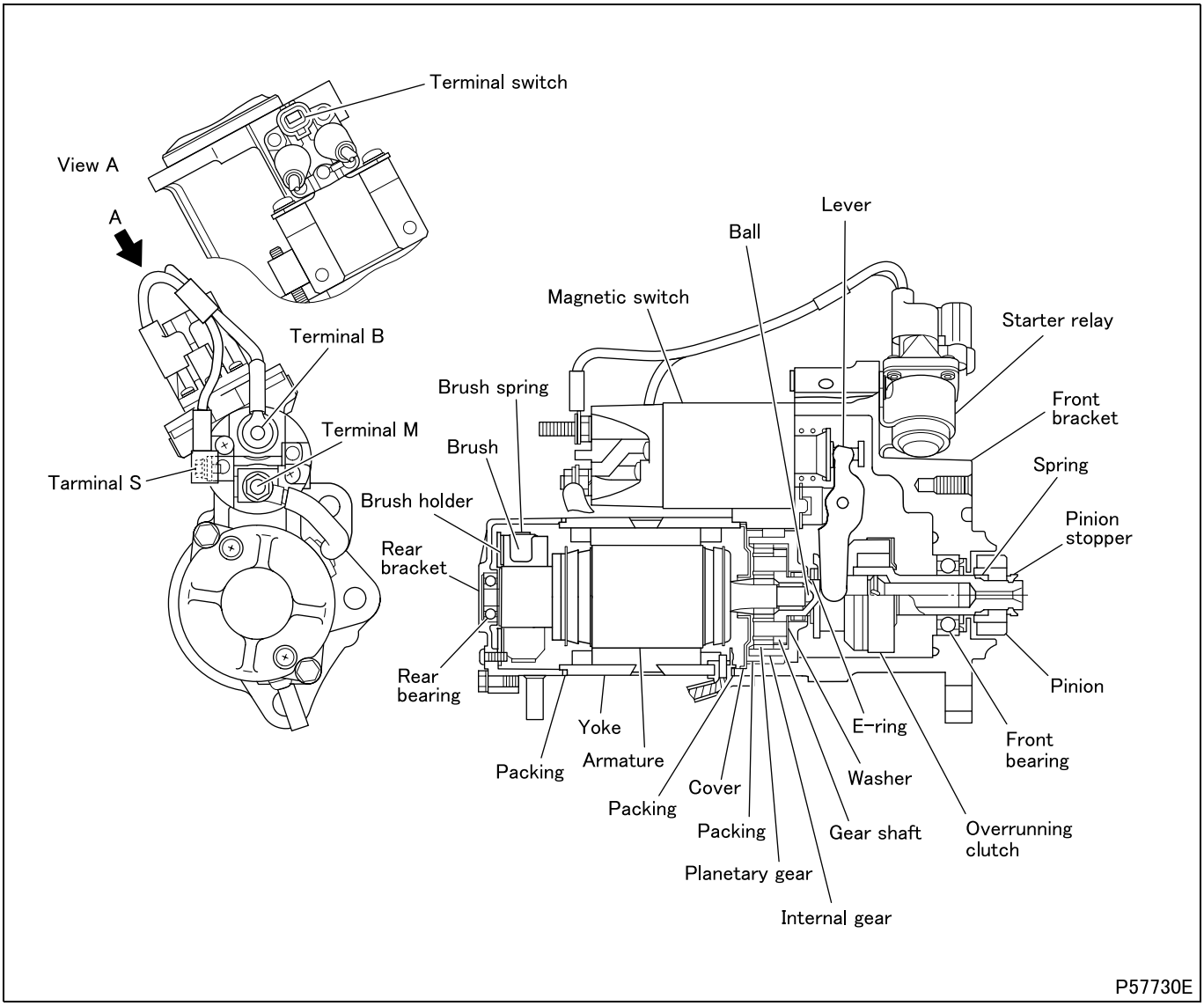
A/T: Automatic transmission
M/T: Manual transmission

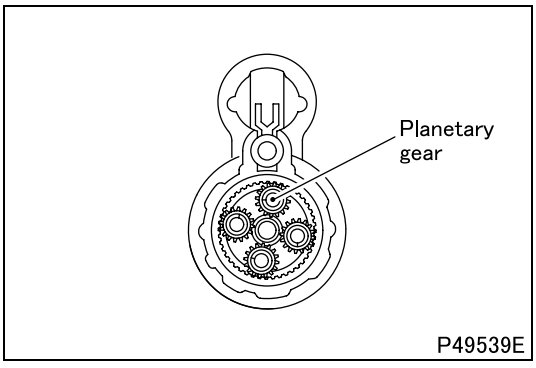
Relay, Radio, Motor, Horn, Buzzer

Item			Specifications
Minimum operating voltage of relay		V	8 or less
Loudspeaker	Rated input	W	15
	Maximum input	W	25
	Impedance	Ω	4 ± 0.6
Wiper motor	Rated voltage	V	12
	No-load current	A	4 or less
	Bound current	A	30 or less
Washer motor	Rated voltage	V	12
	Rated current	A	3.8 or less
Power window motor	Rated voltage	V	12
	Rated current	A	5 or less
Electric horn	Rated voltage	V	12
	Current consumption	A	3 or less
	Sound pressure	dB	110 ± 5 (at 2 m {6.6 ft.})
Back buzzer	Rated voltage	V	12
	Rated current	mA	50 or less
	Sound pressure	dB	85 ± 10 (at 1 m {3.3 ft.})
Cab tilt buzzer	Rated voltage	V	12
	Rated current	mA	66 or less
	Sound pressure	dB	73 ± 10 (at 1 m {3.3 ft.})
Hydraulic warning buzzer (only attached hydraulic brake)	Rated voltage	V	12
	Rated current	mA	100 or less
	Sound pressure	dB	90 to 105 (at 1 m {3.3 ft.})

54-00C STRUCTURE AND OPERATION

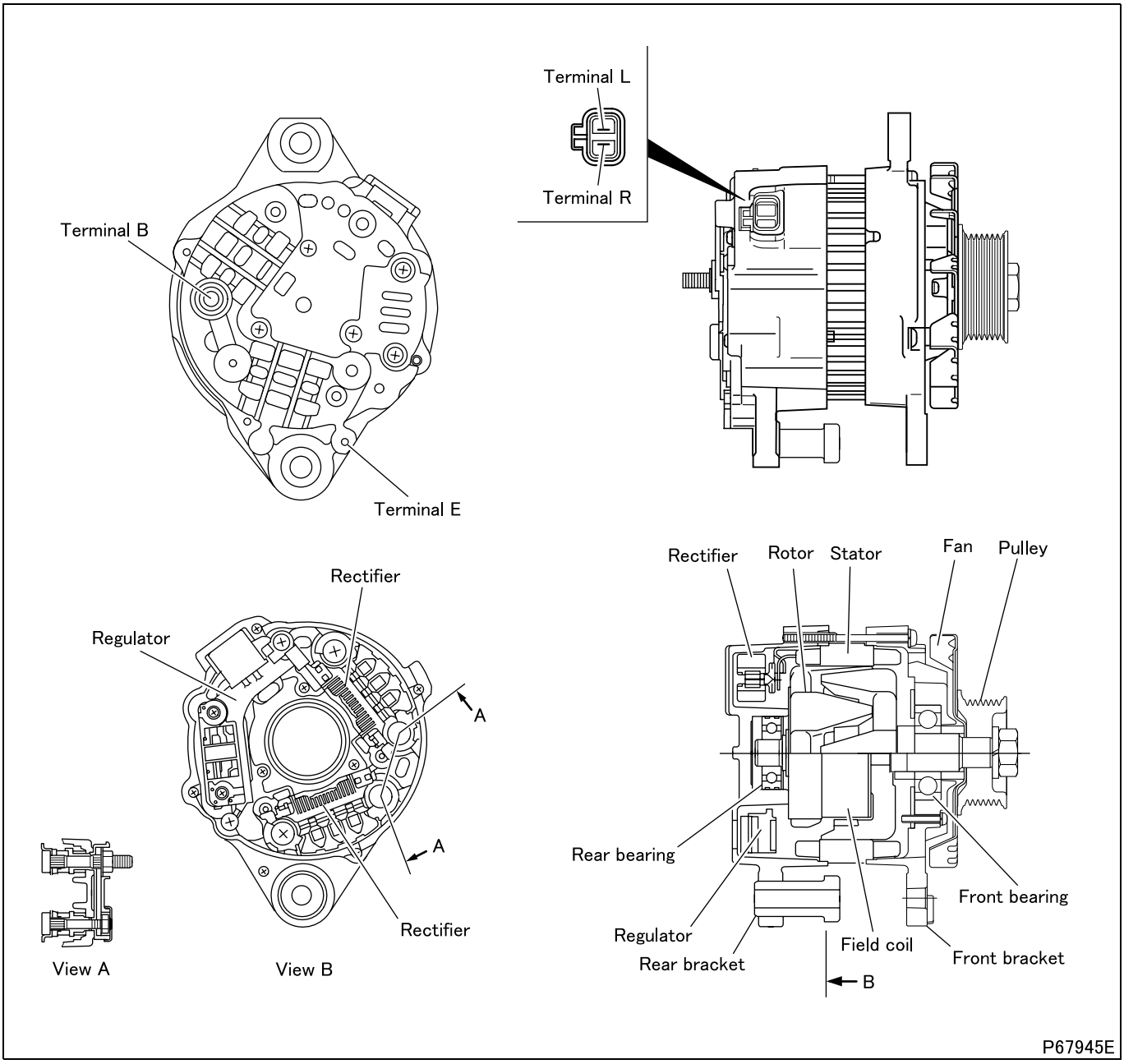
1. Starter

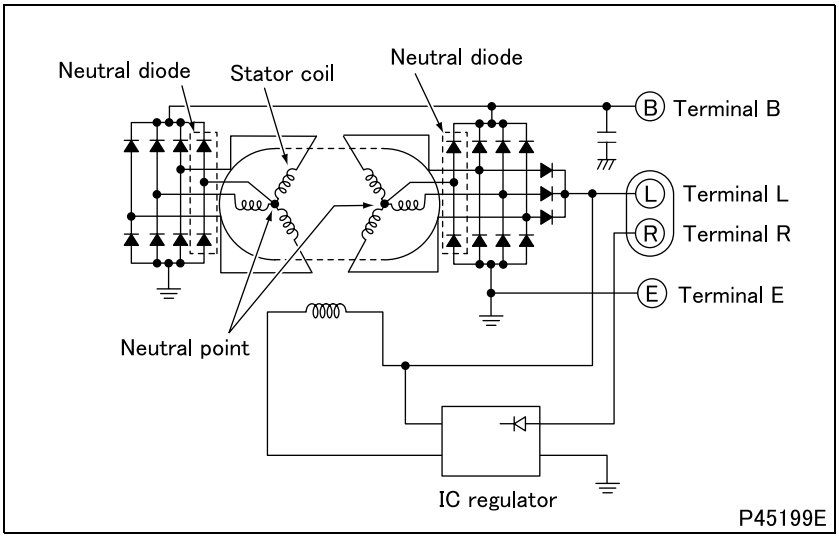




- This starter uses planetary gears as its reduction gearing mechanism.

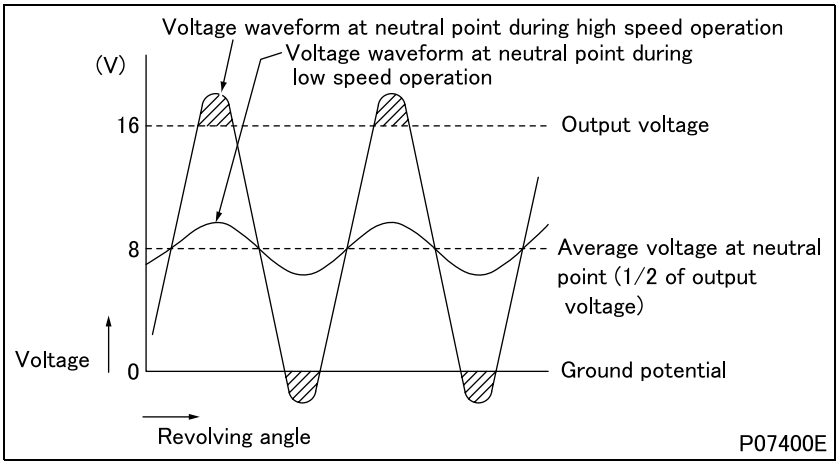
2. Alternator





2.1 Features of alternator with neutral diodes

- The alternator is the same as the current alternator except that neutral diodes have been added.
- These neutral diodes enable this alternator to provide higher DC output during operation at high speeds than the alternator without neutral diodes.

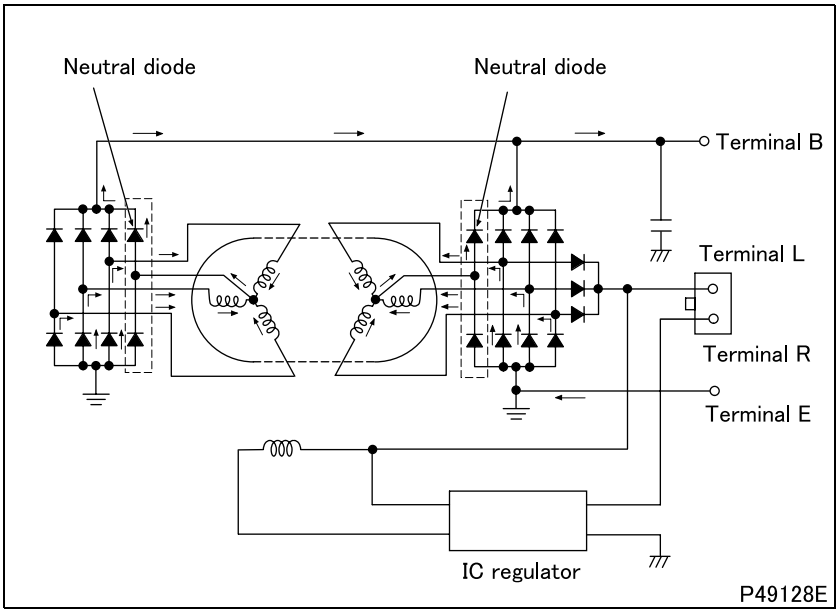


2.2 Variations of voltage at neutral point and operation of neutral diodes

- The potential at the neutral point varies up and down with the neutral point DC voltage (1/2 of output voltage) as a center as shown.
- When the alternator is operated at high speeds, the voltage at the neutral point can increase to exceed the output voltage (16V) and decrease to become lower than the ground voltage (0V). To adjust these over-voltage and under-voltage (shaded portions of diagram) the current from the excess voltages is taken by neutral diodes and added to the DC output.

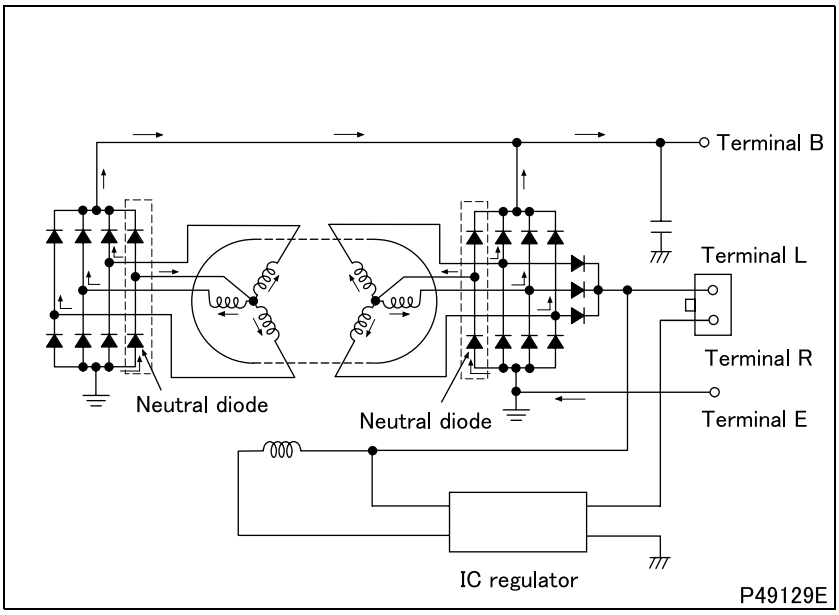
The operation of neutral diodes for each voltage and potential is as follows.

- When the voltage at neutral point is in the range from 0 to 16V, the other six diodes are operated. Neutral diodes are not operated.



2.3 When the voltage at neutral point exceeds 16V

- The positive neutral diode adds extra output to the DC output for supply to each electric equipment.

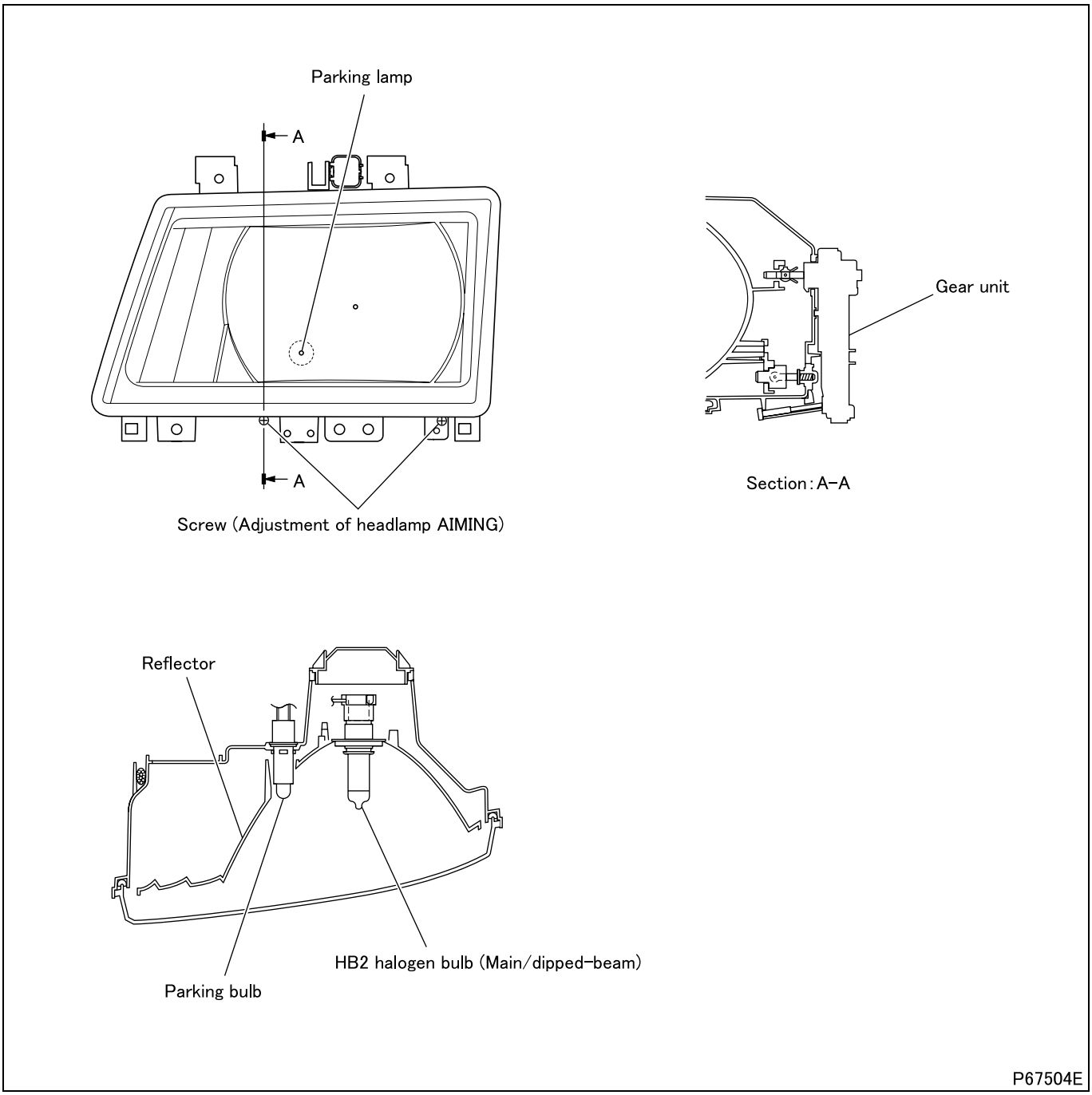


2.4 When the voltage at neutral point drops below 0V

- The negative neutral diode supplies the output from neutral point through other three diodes.

3. Headlamps

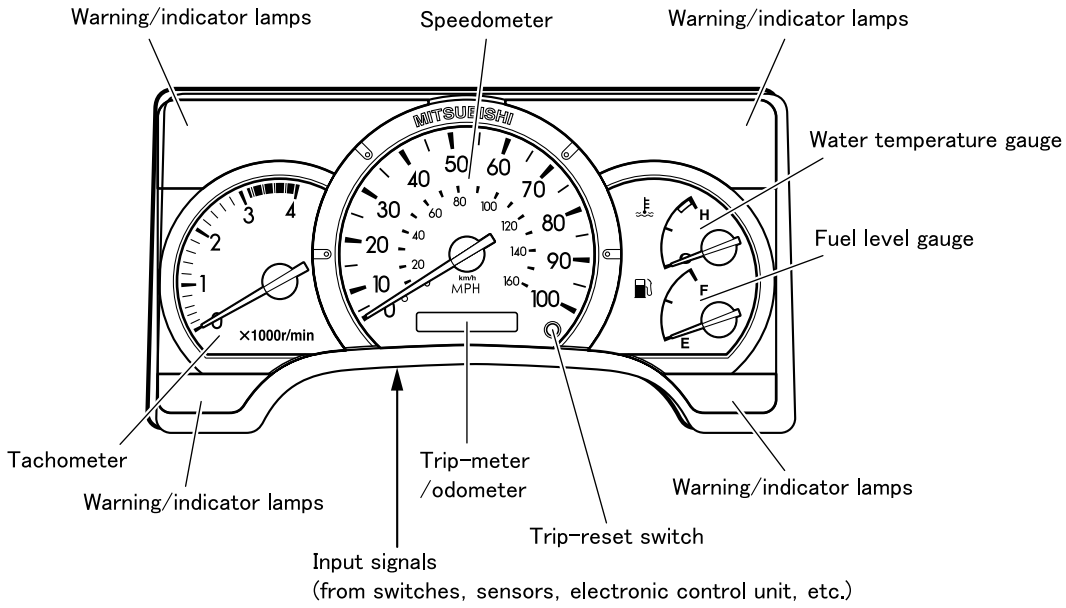
<Unconventional, rectangular 2-lamp halogen headlamp>



(Left headlamps are shown in this illustration)

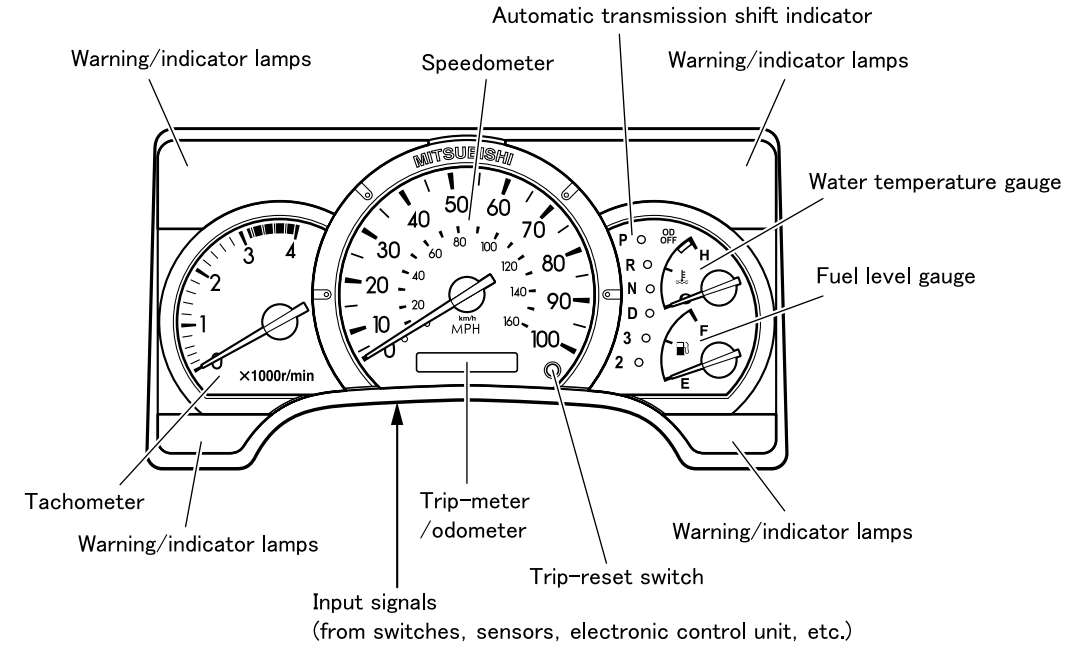
4. Meter Cluster

<Manual transmission>



P64157E

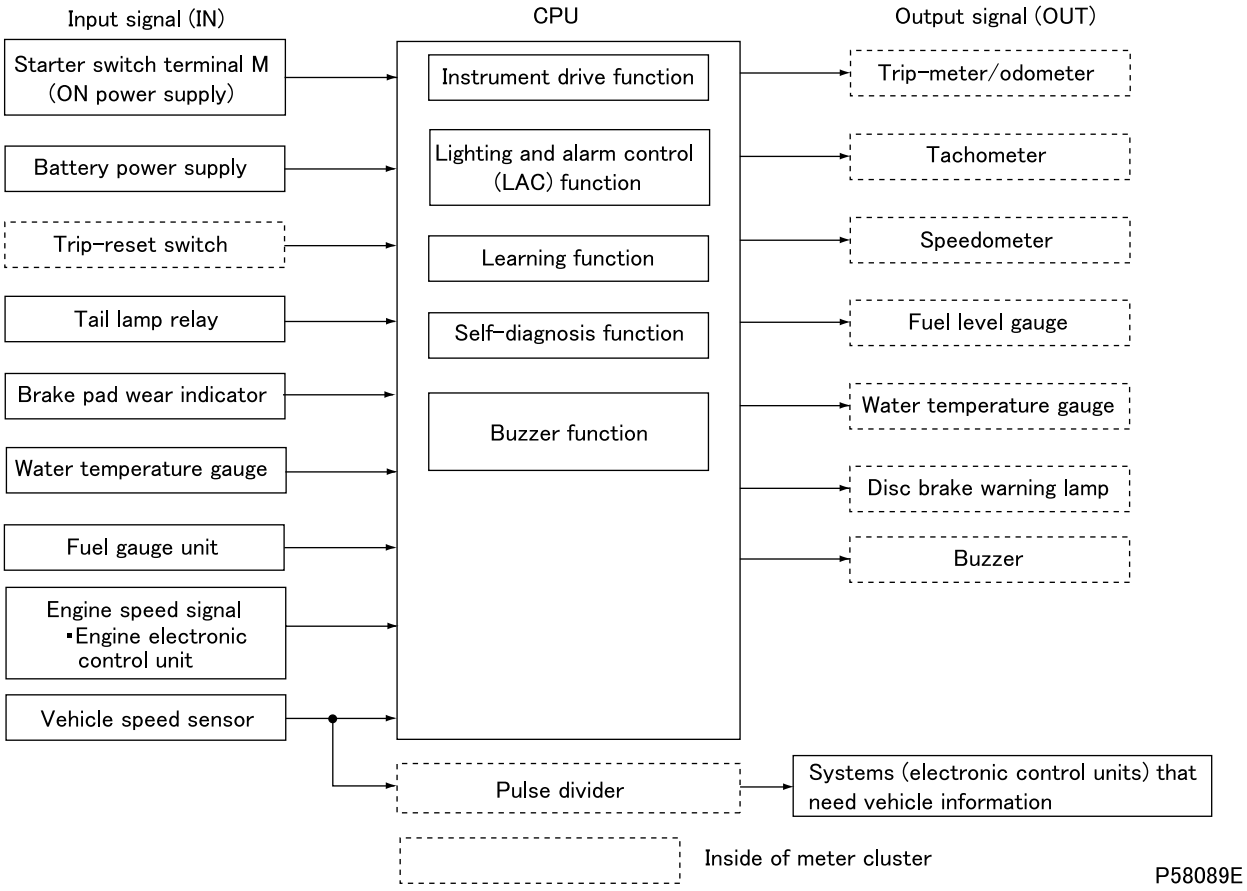
<Automatic transmission>



P64158E

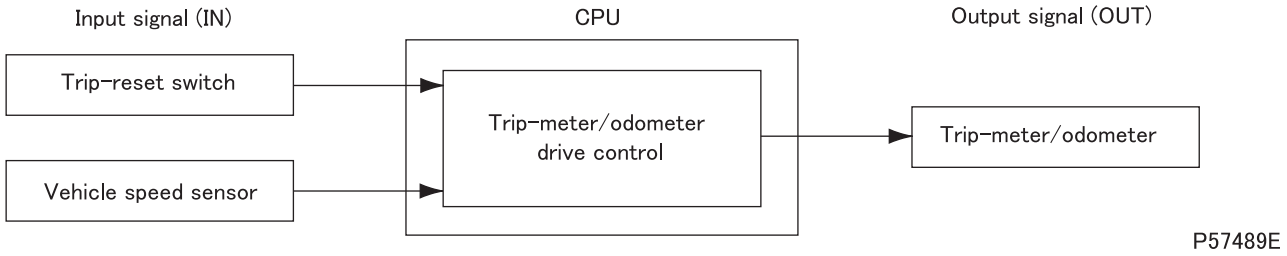
- The meter cluster incorporates a CPU, which contains the lighting and alarm control (LAC) function, learning function, and self-diagnosis function.

4.1 Electronic control unit in the meter cluster system block diagram

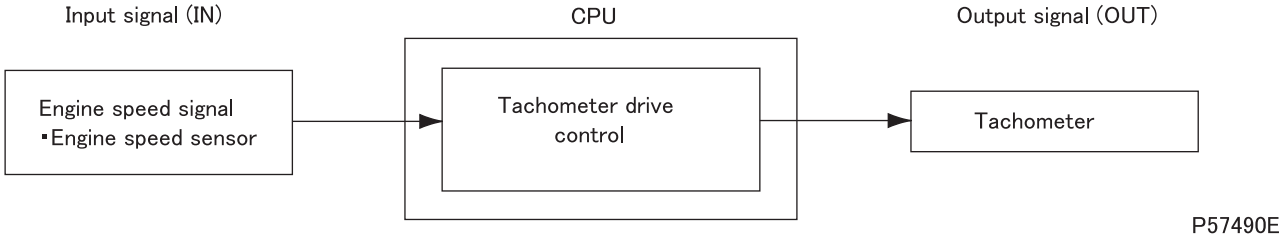


4.2 Instrument drive function

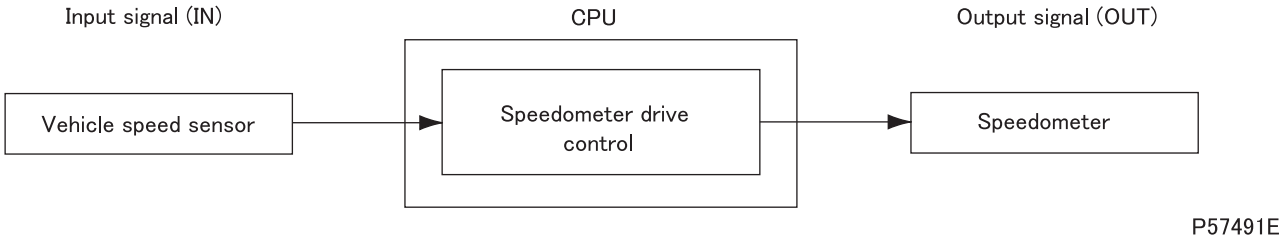
(1) Trip-meter/odometer



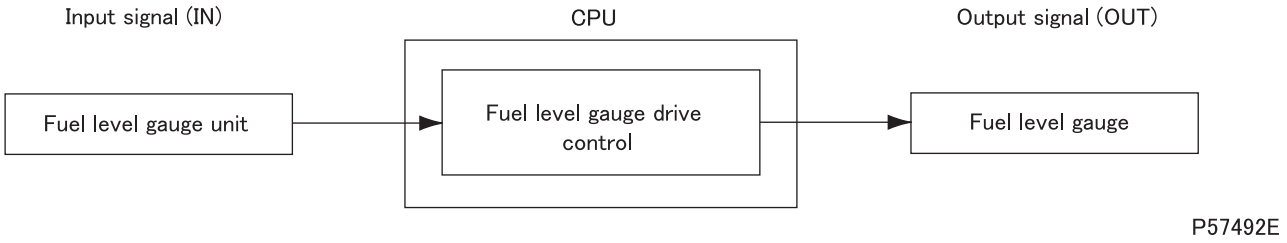
(2) Tachometer



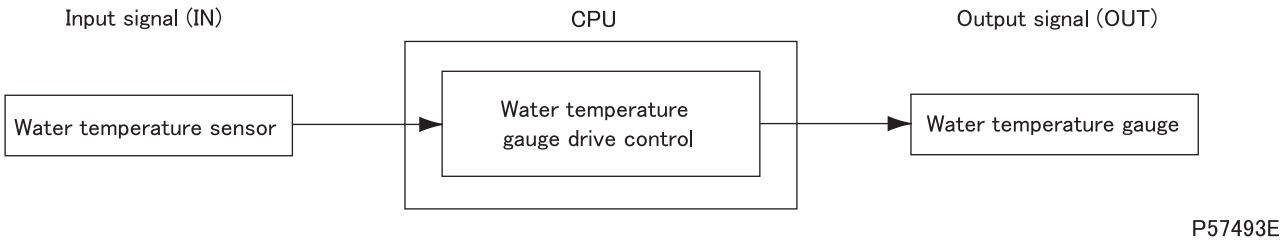
(3) Speedometer



(4) Fuel level gauge

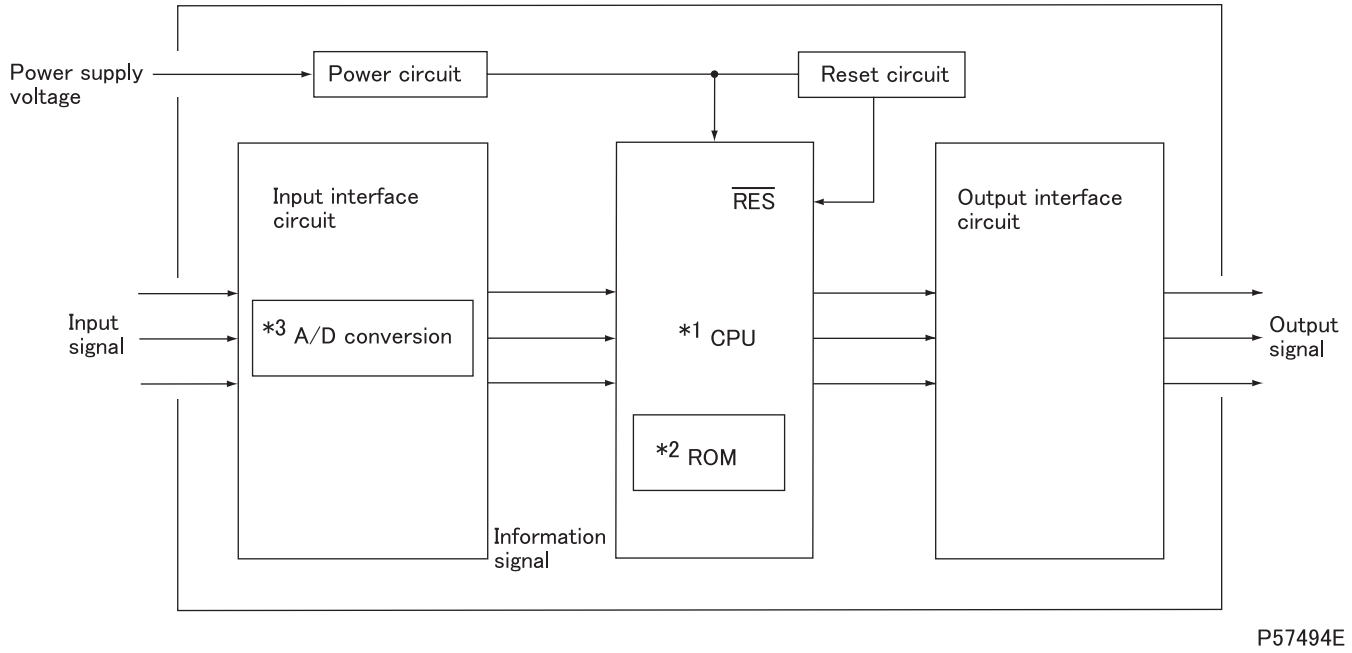


(5) Water temperature gauge



4.3 Lighting and alarm control (LAC) function

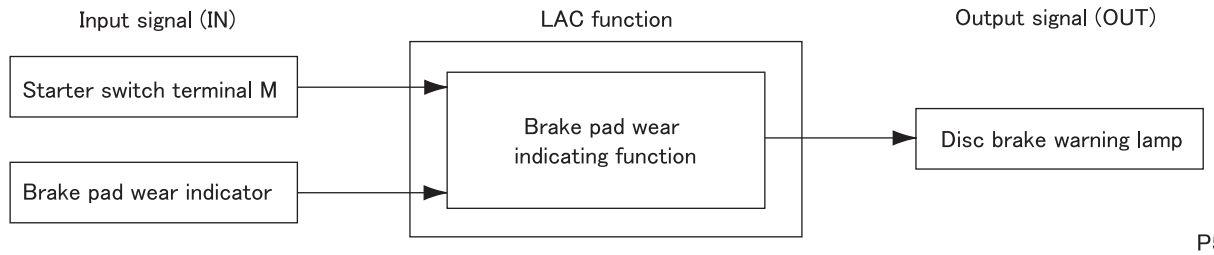
(1) Internal structure of LAC



P57494E

- Internally, the LAC is essentially made up of the input interface circuit, *1CPU, *2ROM, and output interface circuit.
  - *1CPU:
    An abbreviation for Central Processing Unit. It compares the input information and the information stored in the ROM, makes a decision and sends commands to the outputs.
  - *2ROM:
    An abbreviation for Read-Only Memory. Its contents are only for reading. It stores fixed data and programs, and such retained information is not deleted even after power is cut off.
- Information sources such as the sensor and switch send input signals to the input interface circuit.
- The input interface circuit performs *3A/D conversion of the input signals, and the converted signals are transmitted to the CPU as information signals.
  - *3A/D conversion:
    An abbreviation for Analog/Digital conversion. It converts analog signals to digital signals. This conversion enables calculation to be made in the CPU.
- The CPU compares the received signals with the data in the ROM, makes a decision, and sends the results to the output interface circuit.
- The output interface circuit transmits these results to each system as output signals to instruct operations.
- Performing these series of operations continuously enables optimum control of each function.

(2) LAC function system block diagram



P57495E

(3) Brake pad wear indicating function

- The LAC function determines ON or OFF state of the brake pad wear indicator, and causes the disc brake warning lamp to turn on if necessary.

4.4 Learning function

- The learning function makes the electronic control unit in the meter cluster recognize the specifications of the vehicle, without which the meter cluster cannot provide proper indications.
- There are the following two learning items:
  - "With" or "without" brake pad wear indicator.
  - "With" or "without" clutch disc wear indicator.

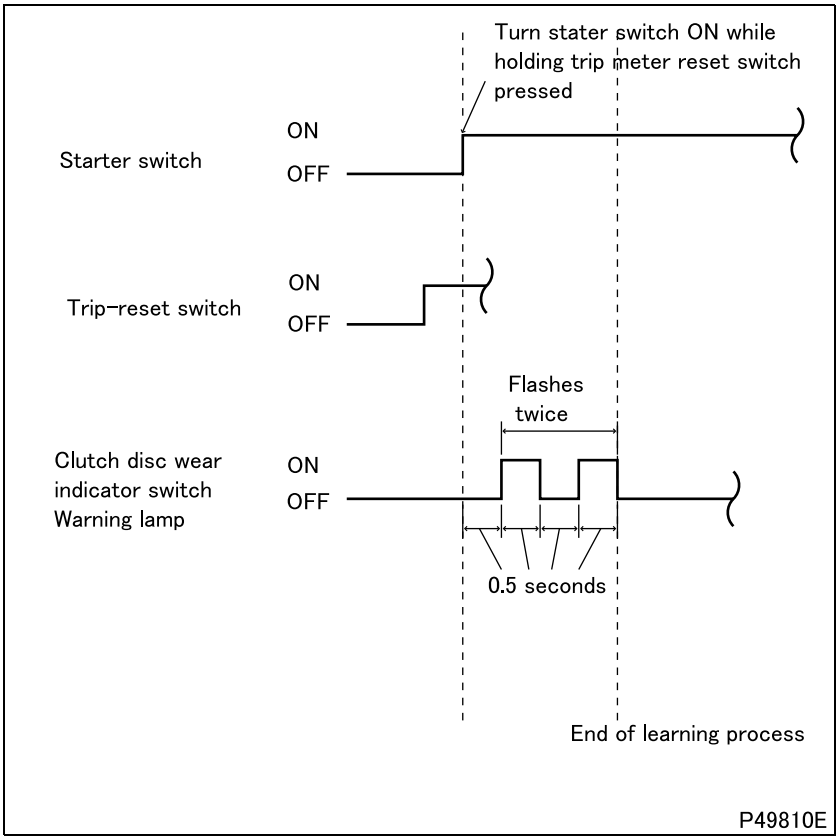
CAUTION ⚠

- **When making the electronic control unit recognize "with" for the clutch disc wear indicator, make sure that there is no open circuit in any of the relevant switch circuits. (If any circuit is found open, replace the corresponding switch.)**

(1) Learning operation

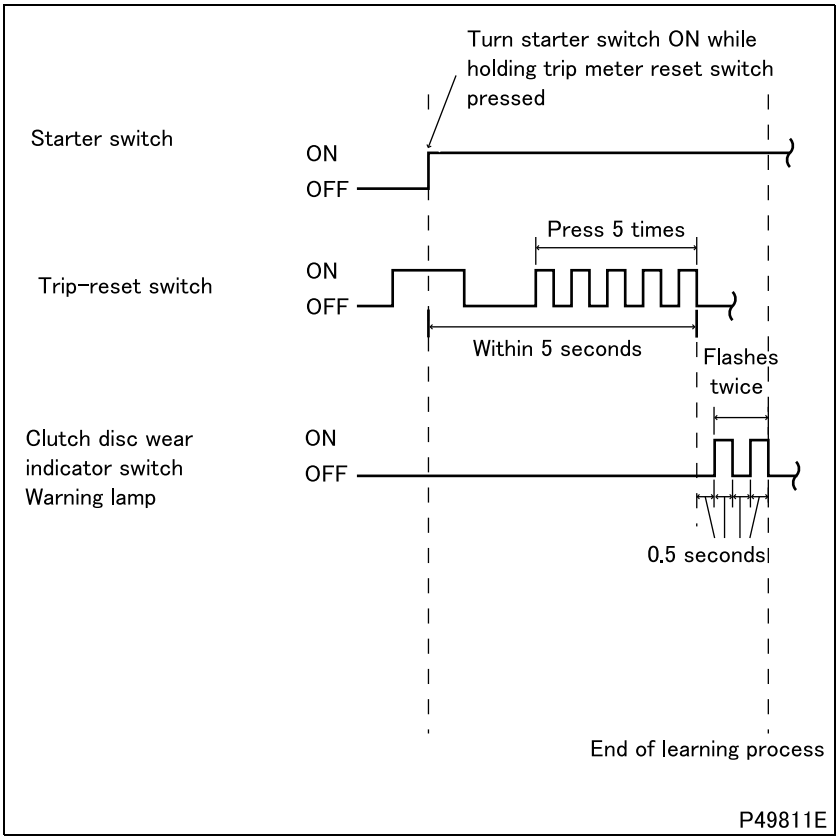
- The learning operation method differs depending on the odometer reading as follows:
  - Less than 3 km/h {1.86 mph} (for when the meter cluster is replaced with a new one).
  - 3 km/h {1.86 mph} or more (for when re-learning is required due to such a reason as wrong initial learning).

(2) Learning operation for odometer reading of less than 3 km/h {1.86 mph}



- Turn the starter switch to ON while holding the trip meter reset switch pressed, then release the reset switch.
- A 0.5 seconds later, the clutch disc wear indicator lamp will flash twice, indicating completion of the learning process.
- If "without" is learned for the clutch disc wear indicator, the indicator lamp neither flashes nor illuminates.

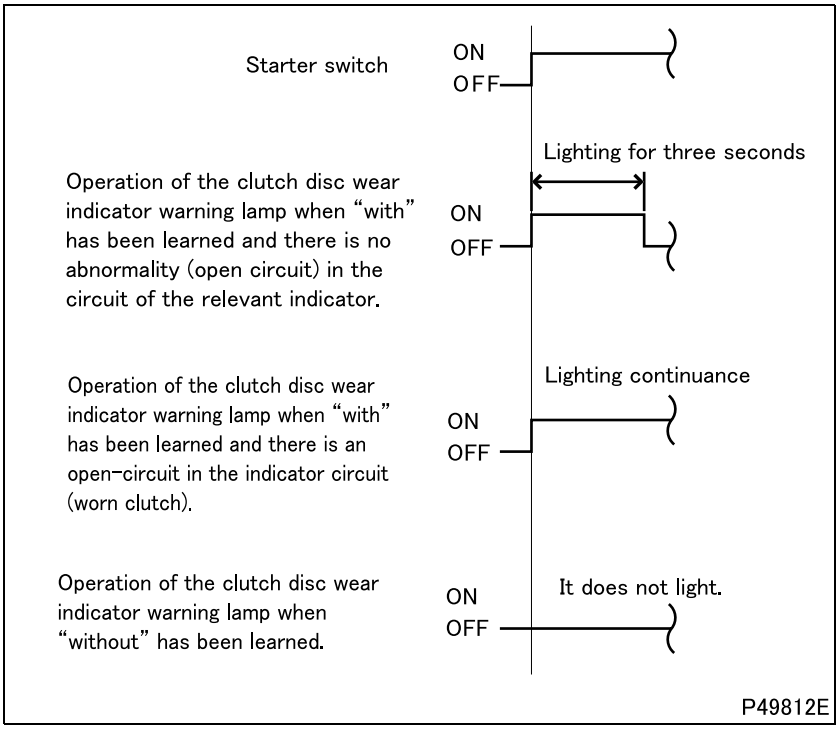
(3) Learning operation for odometer reading of 3 km/h {1.86 mph} or more



- Turn the starter switch to ON while holding the trip-reset switch pressed, then release the reset switch.
- Within 0.5 seconds after turning the starter switch to ON, press again the trip-reset switch 5 times.
- If “without” is learned for the clutch disc wear indicator, the indicator lamp neither flashes nor illuminates.

(4) Learning result confirmation and open-circuit checking

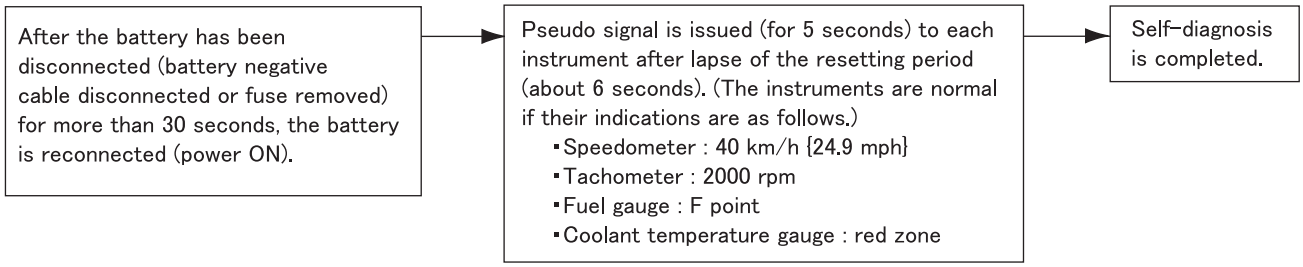
- After every learning operation, turn the starter switch to OFF and then to ON again to make sure that the indicator lamp for which “equipment” has been learnt illuminates.



- The open-circuit checking function checks that the indicator lamp(s) for which “equipment” has been learned illuminates normally when the starter switch is turned to ON.

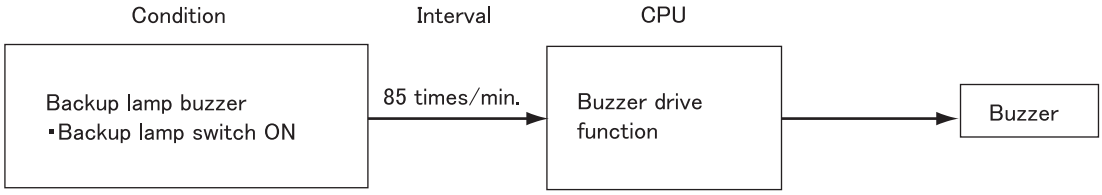
4.5 Self-diagnosis function

- The CPU performs the self-diagnosis function by sending a pseudo signal to each instrument, determining whether the instrument responds normally to the signal.



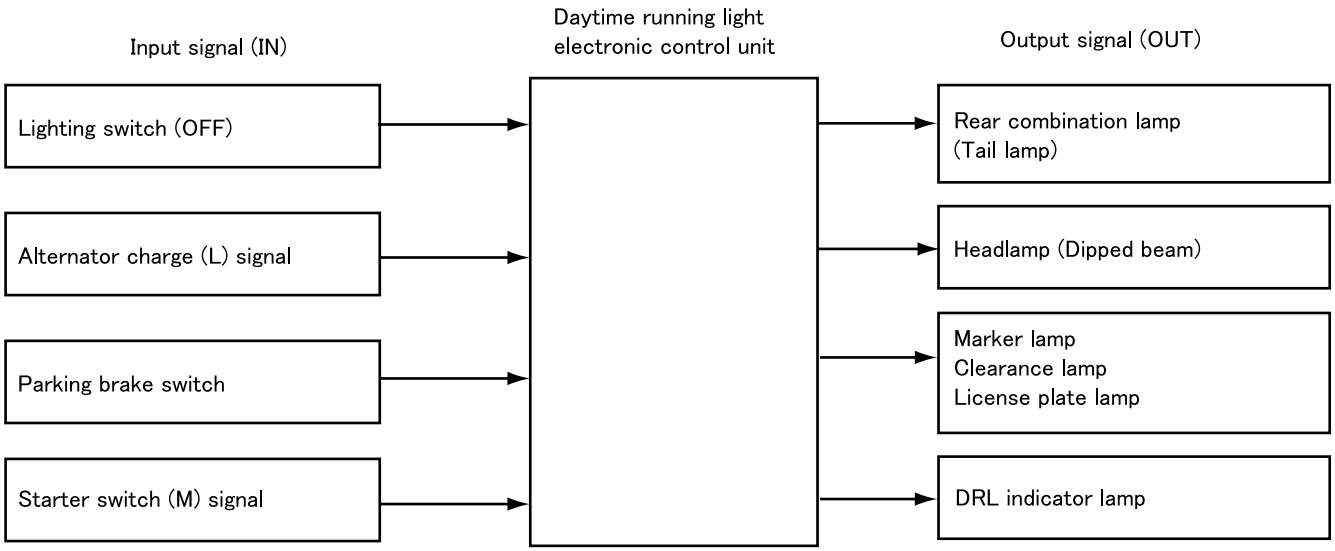
P57496N

4.6 Buzzer sounding function



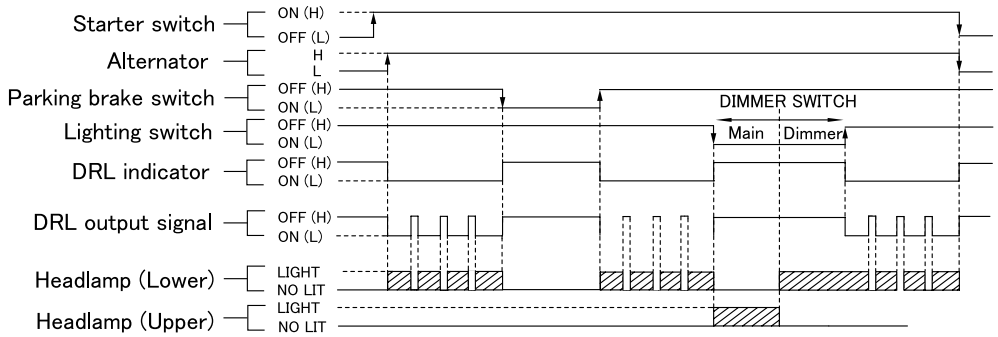
P62494E

5. Daytime Running Light System



- In a daytime running light system, regardless the position of lighting switch while engine is running, the dipped beam of the headlamp and the tail lamp of the rear combinations, position lamp, license plate lamp will light on.
- Except for that the lighting switch is OFF or when the passing switch is ON, the same lamps as usual switch operation will light.

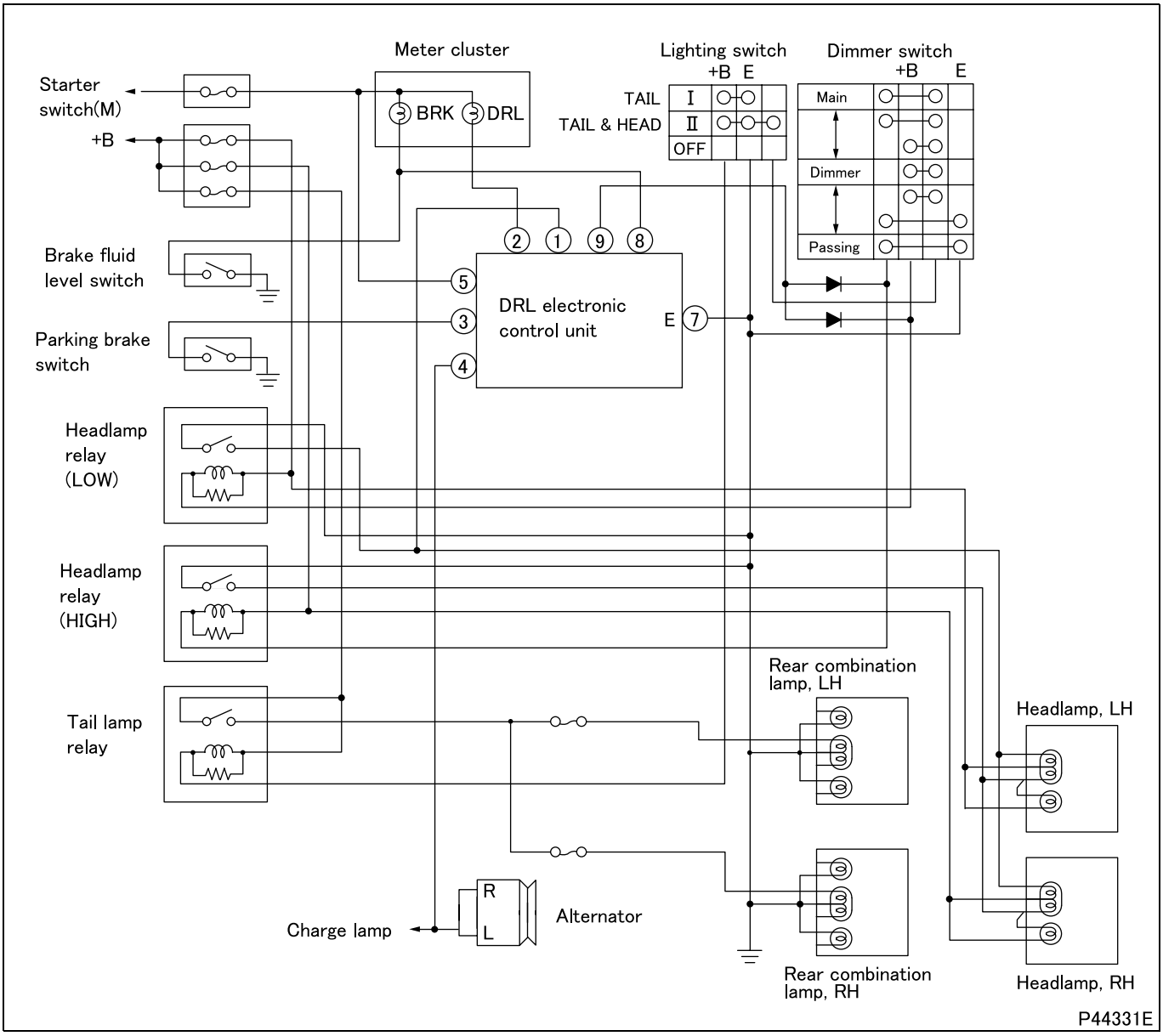
5.1 Timing chart



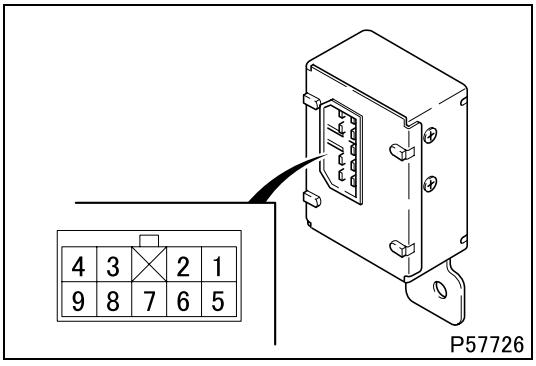
Headlamps repeat ON/OFF operations at 120 Hz according to the above timing chart. Because of the cyclic ON/OFF operations, the headlamps are dimmer than when the headlamp switch is ON.
Explanation of timing chart

- After the engine starts, when alternator begins generating electricity with starter switch in the ON position, headlamps light.
- When parking brake switch is ON, the DRL turns off to switch off the headlamps.

5.2 Daytime running light electronic control unit circuit diagram



5.3 DRL electronic control unit



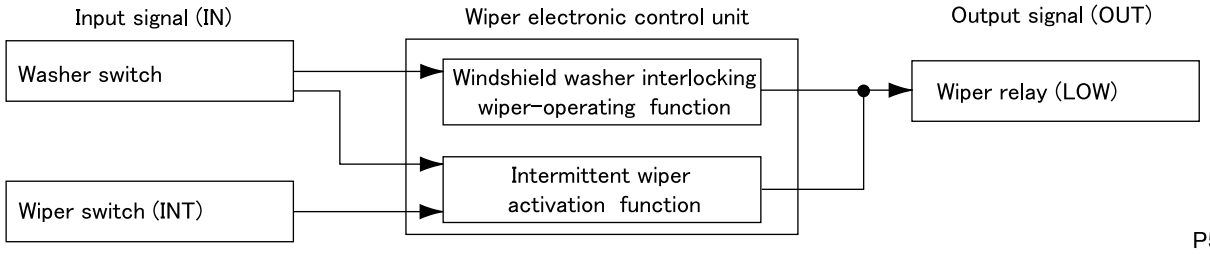
Terminal No.	Connecting destinations	Terminal No.	Connecting destinations
1	Head lamp (Dipped)	6	–
2	DRL indicator lamp	7	Ground
3	Parking brake switch	8	Parking brake indicator lamp
4	Alternator L terminal	9	Lighting switch
5	Starter switch M terminal	–	–

6. Wiper Control

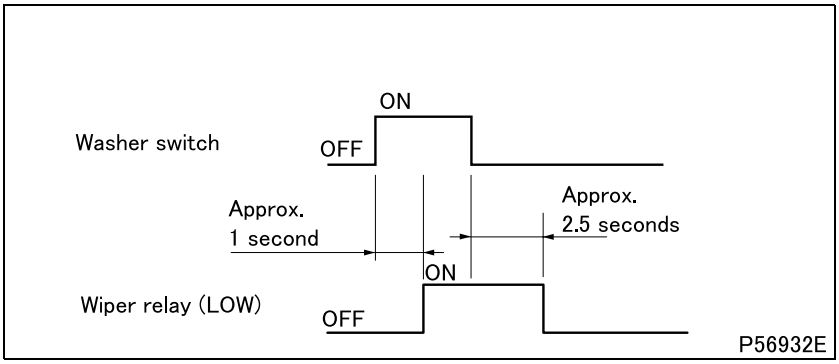
6.1 Outline

- This wiper electronic control unit is an integrated control unit controlling the following functions.
  - Windshield washer interlocking wiper-operating function.
  - Intermittent wiper activation function.

(1) System function schematic

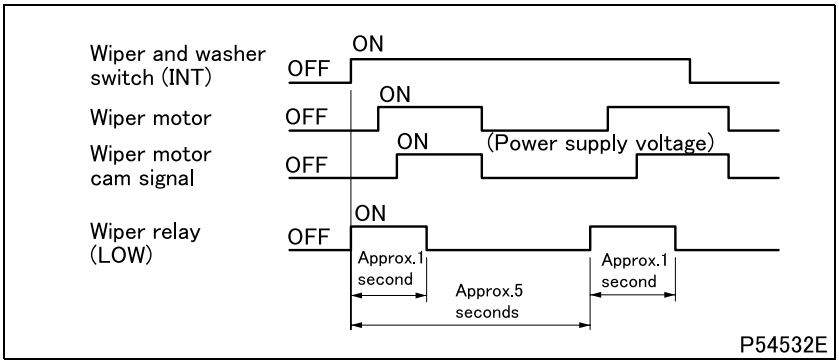


6.2 Windshield washer interlocking wiper-operating function



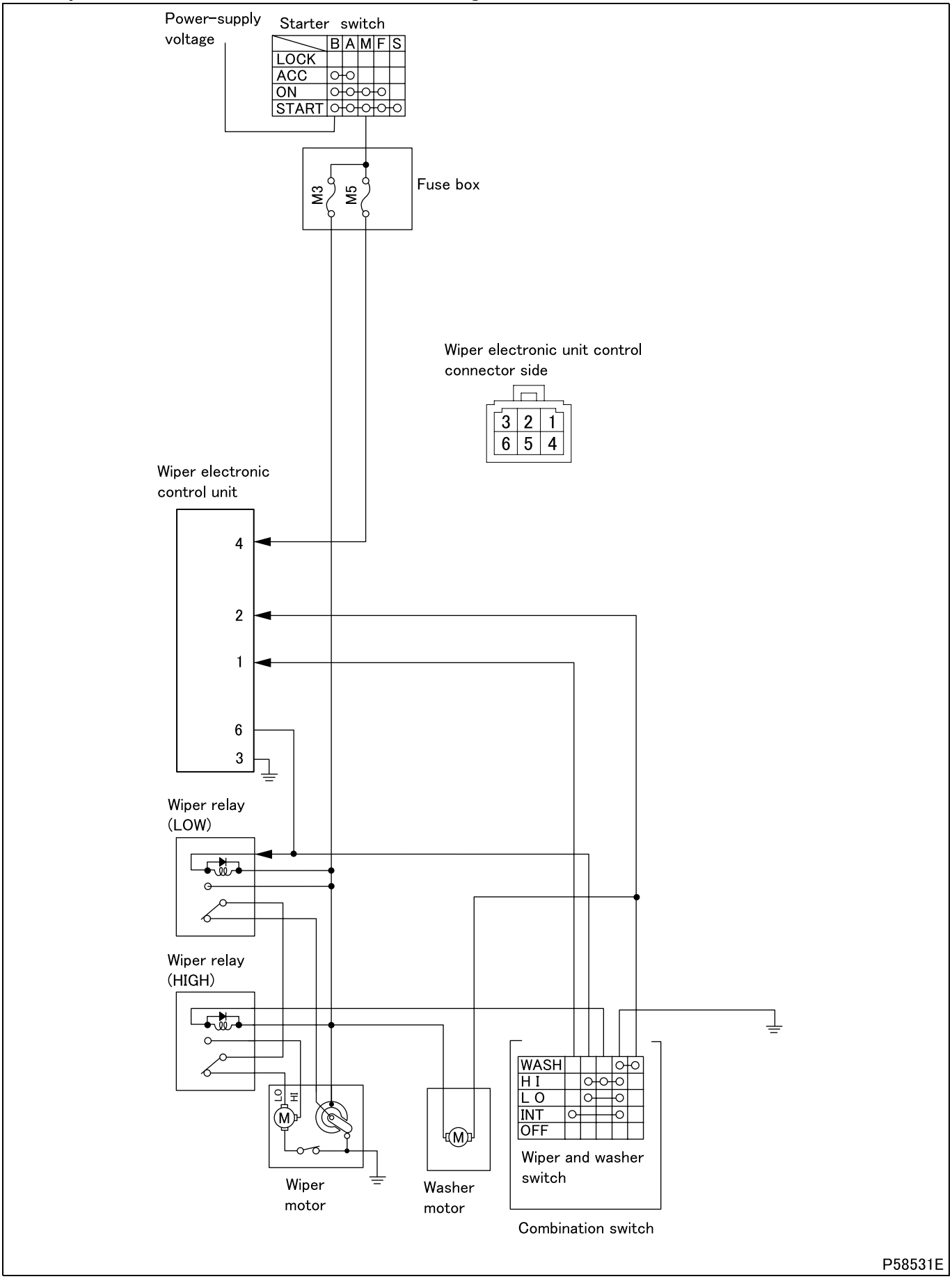
- This function causes the windshield wipers to operate a few times at low speed when the windshield washer switch is turned ON.
- As shown in the drawing, the wiper electronic control unit introduces a short delay between detecting the ON condition of the wiper and washer switch (washer switch) and activating the wiper relay.

6.3 Intermittent wiper activation function



- Wiper electronic control unit causes intermittent wiper operation to take place as shown in the drawing.

6.4 Wiper electronic control unit connection diagram

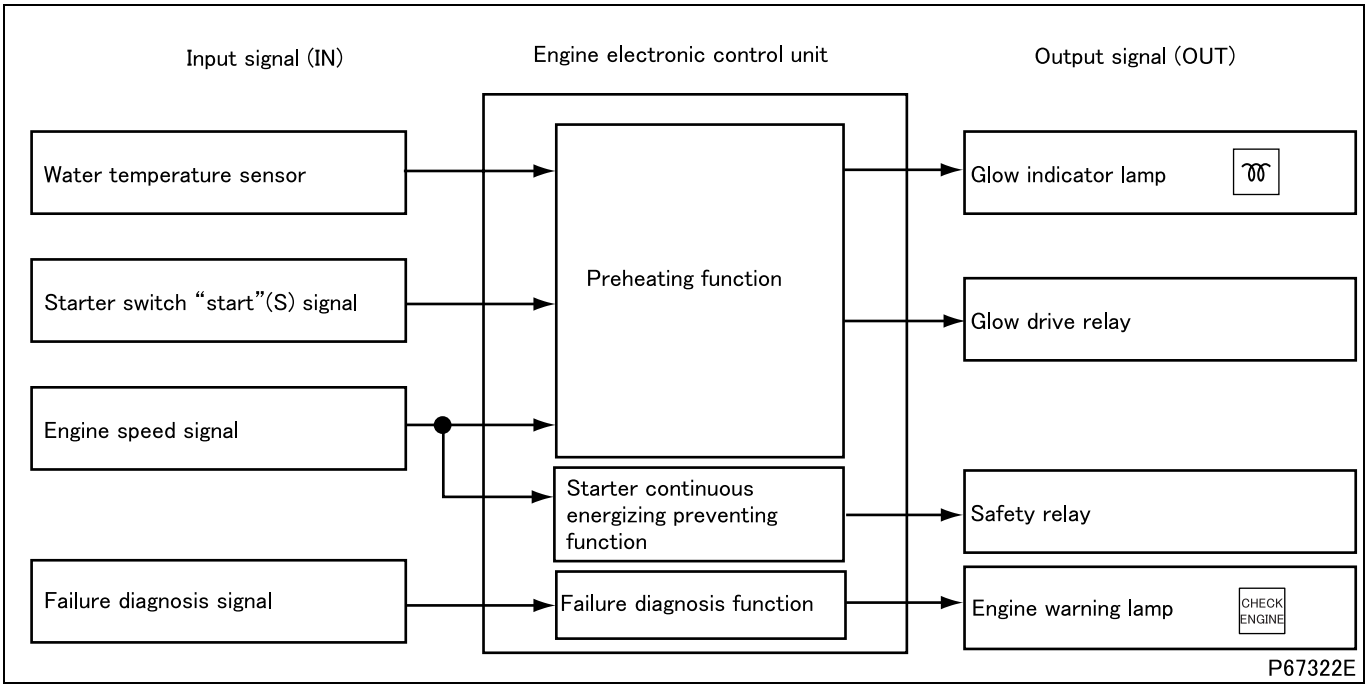


7. Starter Continuous Energizing Preventing Function and Preheating Function

7.1 Outline

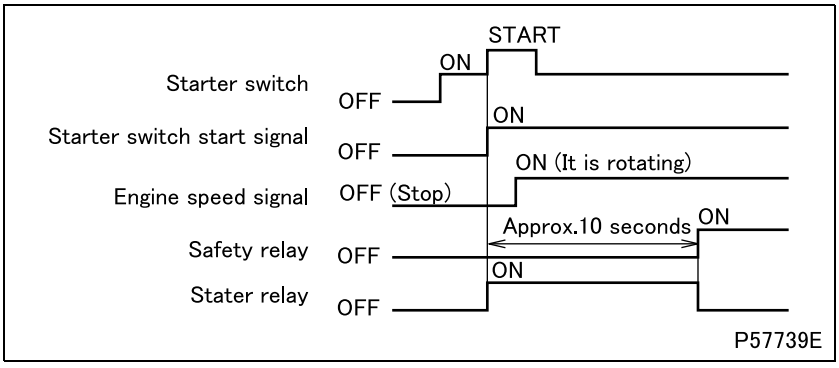
- These functions are controlled by the engine electronic control unit.

(1) System function schematic



Information signal	Parts name	Major function and operation
Engine water temperature signal	Water temperature sensor	Engine water temperature detection
Starter switch "start" (S) signal	Starter switch	Start position detection
Engine speed signal	Engine speed sensor	Engine speed detection
Failure diagnosis signal	Diagnosis switch	Output of diagnosis code
	Memory clear switch	Erasure of diagnosis code Transmission of past diagnostic code
Engine warning signal	Engine warning lamp	Abnormality of each function
Safety relay activation signal	Safety relay	Release of starter continuous energizing

7.2 Starter continuous energizing preventing function

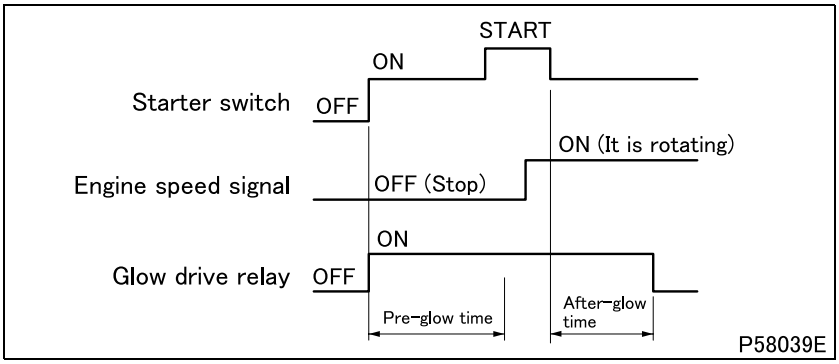


- This function is provided to prevent starter over-run.
- If the starter operates for longer than a predetermined period following engine startup, the Engine electronic control unit deems that it has been energized continuously for too long. The Engine electronic control unit then stops the flow of current to the starter and starter relay, thereby preventing the starter from seizing.

- If the engine electronic control unit determines, based on the engine speed signal it receives, that the engine has run at or above the specified speed for longer than the specified time period after start-up, the unit trips the safety relay open.

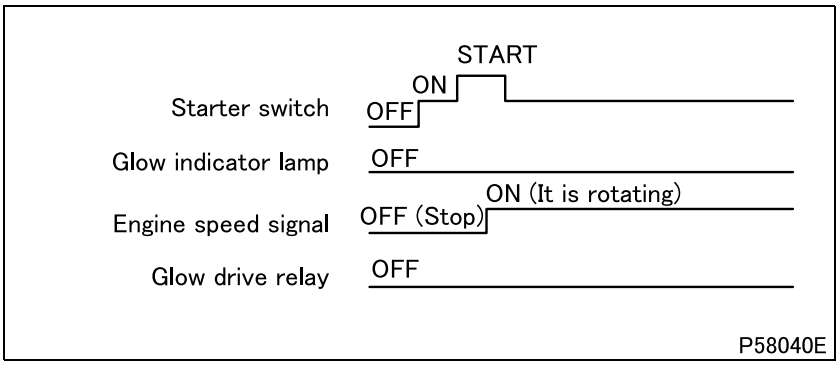
7.3 Preheating function

- This preheating function aims to enhance the engine start up when the engine coolant is low in cold weather or temperature.
  Engine electronic control unit the entire function as follows:



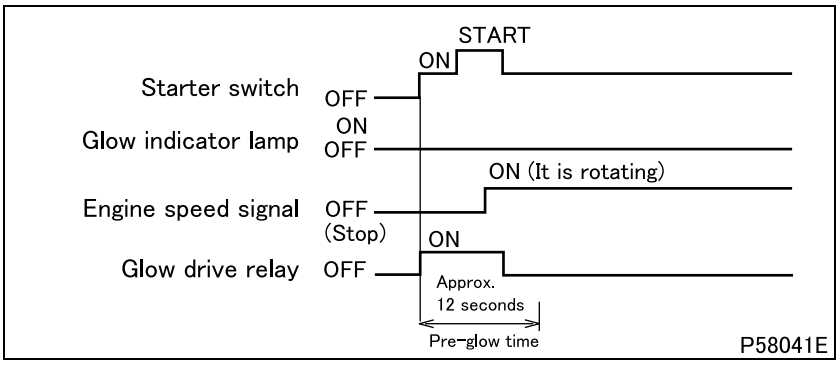
(1) Pre-glow and After-glow

The preheating is operated with a pre-glow before the engine starts and an after-glow after the engine starts. They are controlled by the starter switch (S terminal) signal, engine water temperature signal and the engine speed signal.

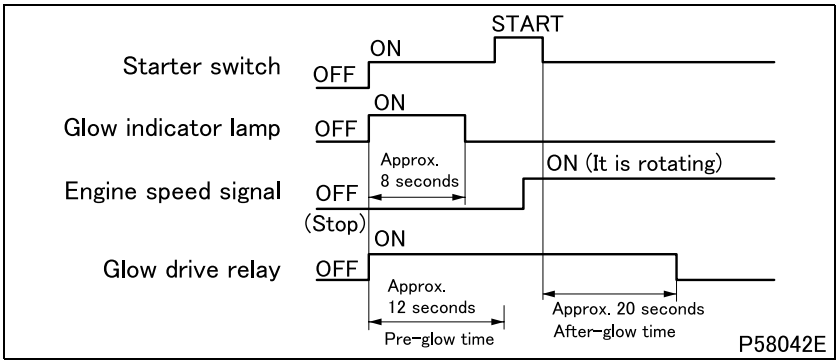


(2) Operation mode

- When the engine coolant temperature is 60°C {140°F} or more.



- When the engine coolant temperature is 0 to 60°C {32 to 140°F}.



- When the engine coolant temperature is 0°C {32°F} or less.

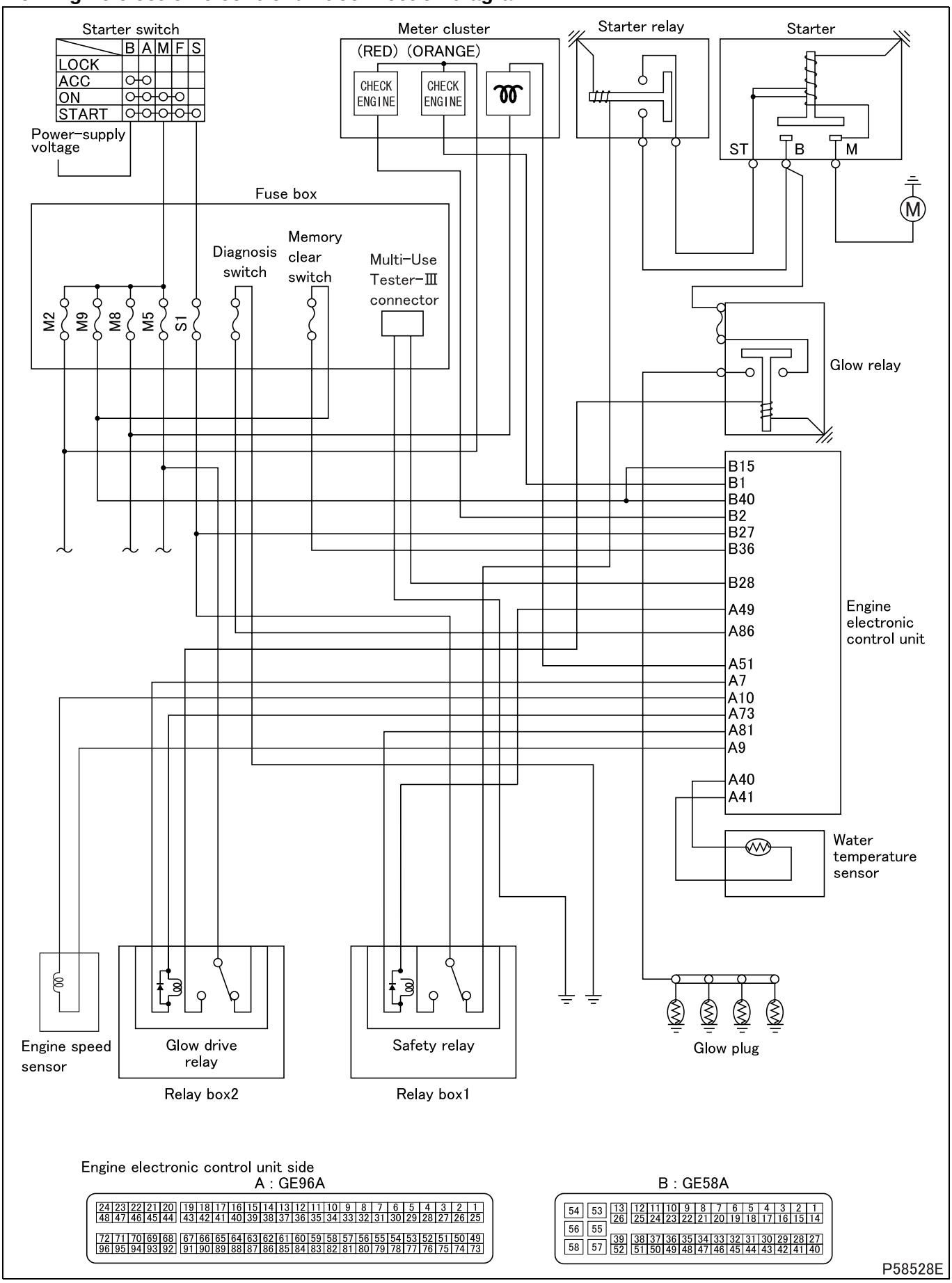
7.4 Fault diagnosis function

- While the starter switch is in the ON position, the sensors and other components are continuously monitored for faults. In the event that a component is found faulty, an indication is made in the meter cluster to alert the driver, the fault location is memorized in the form of a diagnosis code, and backup control necessitated by the fault is initiated.
- While the backup control is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.

NOTE

- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

7.5 Engine electronic control unit connection diagram



54-00D TROUBLESHOOTING

1. Power and Charging

Symptoms / Possible causes		Battery electrolyte decreases too early.	Battery overheating.	Battery is normal but over-discharged.	Charge warning lamp does not light when starter switch is turned ON, with engine stopped.	Alternator is normal but battery over-discharged.	Reference Gr
Connector connection faulty, harness broken, grounding faulty				O		O	
Fuse blown				O	O	O	
V-belts loose				O		O	Gr14
V-belts damaged				O		O	Gr14
Battery faulty		O				O	
Alternator	Stator coil broken			O			
	Stator coil short-circuited with core			O			
	Field coil broken			O			
	Rectifier faulty			O			
	Regulator faulty		O	O	O		
	Wiring faulty			O			
Meter cluster faulty					O		

2. Engine Starting

Symptoms / Possible causes		Starter does not operate.	Starter operates but engine does not start: Pinion does not engage with ring gear.	Starter operates but engine does not start: Pinion engages with ring gear but does not rotate.	Starter operates but engine does not start: Flywheel rotates but engine does not start.	Engine does not stop.	Engine cannot be preheated.	Engine is hard to start.	Engine warm-up function does not operate.	Reference Gr
Connector connection faulty, harness broken, grounding faulty		O			O	O	O		O	
High-current fuse blown		O								
Fuse blown		O				O	O		O	
Battery insufficiently charged		O		O						
Starter	Magnetic switch contacts stuck or fused together	O								
	Open circuit in magnetic switch coil	O								
	Overrunning clutch malfunctioning			O						
	Pinion worn or damaged		O							
Starter relay defective		O								
Starter switch defective		O				O				
Flywheel ring gear worn or damaged			O							Gr11
Glow plugs defective							O	O		
Glow relay defective							O	O		
Safety relay defective		O								
Water temperature sensor defective							O	O	O	
Engine electronic control unit defective		O					O	O	O	Gr13E
Exhaust brake system defective								O	O	Gr35
Faulty connection of connecting plate							O	O		
Transmission neutral switch defective									O	
Neutral start relay defective <A/T>		O								
Inhibitor switch defective <A/T>		O								
Warm-up switch defective									O	

A/T: Automatic transmission

3. Lighting

Symptoms / Possible causes		Headlamp				Tail lamp does not light.	Stop lamp does not light.	Identification lamp, clearance and side marker lamp	Parking lamp does not light.	License plate lamp does not light.	Backup lamp does not light.	Back buzzer does not sound.	Reference Gr
		Does not light.	Dim.	Does not switch to main beam.	Does not switch to dipped beam.								
Connector connection faulty, harness broken, grounding faulty		O				O	O	O	O	O	O	O	
Fuse blown		O				O	O	O	O	O	O	O	
Battery capacity insufficient			O										
Alternator output insufficient			O										
Bulb burnt-out		O				O	O	O	O	O	O	O	
Power (wattage) of bulb is lower than specified value													
Power (wattage) of bulb is higher than specified value													
Combination switch	Lighting switch faulty	O				O		O	O	O		O	
	Turn signal lamp switch faulty												
	Dimmer switch faulty			O	O								
Relay box	Headlamp relay (HIGH, LOW) faulty	O		O	O								
	Tail lamp relay faulty					O		O	O	O		O	
	Stop lamp relay faulty						O						
Stop lamp switch faulty							O						
Flasher unit faulty													
Backup lamp switch faulty											O		
Back buzzer faulty													
Cab lamp switch faulty													
Cab lamp faulty													
Door switch faulty													
Hazard warning lamp switch faulty													
Rheostat switch faulty													

Symptoms / Possible causes		Turn signal lamp (serving also as hazard warning lamp)					Cab lamp does not light.	Interior illumination lamps for meters, radio system, etc. do not light.	Reference Gr
		Does not blink.	Stay ON.	Blinks too slowly.	Blinks too quickly.	Blinks irregularly.			
Connector connection faulty, harness broken, grounding faulty		O					O	O	
Fuse blown		O					O		
Battery capacity insufficient			O						
Alternator output insufficient			O						
Bulb burnt-out		O			O		O	O	
Power (wattage) of bulb is lower than specified value					O				
Power (wattage) of bulb is higher than specified value				O					
Combination switch	Lighting switch faulty							O	
	Turn signal lamp switch faulty								
	Dimmer switch faulty								
Relay box	Headlamp relay (HIGH, LOW) faulty								
	Tail lamp relay faulty							O	
	Stop lamp relay faulty								
	Turn signal lamp relay faulty	O							
Stop lamp switch faulty									
Flasher unit faulty		O	O	O	O	O			
Backup lamp switch faulty									
Back buzzer faulty									
Cab lamp switch faulty							O		
Cab lamp faulty							O		
Door switch faulty							O		
Hazard warning lamp switch faulty		O	O						
Rheostat switch faulty								O	

Symptoms / Possible causes		Van body dome light does not light.	Daytime running light system does not operate after engine starts, and headlamps do not light.	Reference Gr
Connector connection faulty, harness broken, grounding faulty		O	O	
Fuse blown		O		
Battery capacity insufficient				
Alternator output insufficient				
Bulb burnt-out		O		
Power (wattage) of bulb is lower than specified value				
Power (wattage) of bulb is higher than specified value				
Combination switch	Lighting switch faulty	O		
	Turn signal lamp switch faulty			
	Dimmer switch faulty			
Relay box	Headlamp relay (HIGH, LOW) faulty		O	
	Tail lamp relay faulty		O	
	Stop lamp relay faulty			
	Turn signal lamp relay faulty			
	Daytime running light relay		O	
Stop lamp switch faulty				
Flasher unit faulty				
Backup lamp switch faulty				
Back buzzer faulty				
Cab lamp switch faulty				
Cab lamp faulty				
Door switch faulty				
Hazard warning lamp switch faulty				
Rheostat switch faulty				
Van body dome light relay faulty		O		
Van body dome light switch faulty		O		
Daytime running light electronic control unit faulty			O	

4. Meter

Symptoms / Possible causes		Pointer does not move.	Pointer movement unstable.	Indication error large.	Abnormal noise from meter.	Reference Gr
Connector connection faulty, harness broken, grounding faulty		O	O			
Fuse blown		O				
Internal circuits of meter cluster faulty		O	O	O		
Printed wiring board of meter cluster faulty		O				
Tachometer	Engine speed sensor coil open-circuited	O				
	Engine speed sensor improperly mounted	O	O			
	Tachometer faulty	O	O	O	O	
Speedometer or tachograph	Vehicle speed sensor faulty	O				
	Vehicle speed sensor improperly mounted		O			
	Specified tires not used			O		Gr31
	Tires worn or inflation pressure incorrect			O		Gr31
	Specified L-joint of transmission not used (difference in gear ratio)			O		Gr22
	Specified speedometer gear of transmission not used (difference in gear ratio)			O		Gr22
	Installation angle of speedometer gear bushing on transmission incorrect (not set at correct gear ratio position)			O		Gr22
	Speedometer or tachograph faulty	O	O	O	O	
Water temperature gauge	Water temperature sensor faulty	O		O		
	Water temperature gauge faulty	O		O		
	Thermostat does not close	O				Gr14
Fuel gauge	Fuel level sensor faulty	O		O		
	Fuel gauge faulty	O		O		

5. Cigarette Lighter and Audio

Symtoms / Possible causes	Cigarette lighter			Audio	Reference Gr
	Does not glow.	Does not return.	Night lamp does not light up.	Radio does not work.	
Connector connection faulty, harness disconnection, grounding faulty	O		O	O	
Fuse blown	O		O	O	
Cigarette lighter faulty	O	O			
Tail lamp relay faulty			O		
Antenna and antenna cable connection faulty				O	
Radio amplifier faulty				O	
Radio tuner faulty				O	
Cassette deck head and pinch roller faulty					
Speaker faulty				O	
Left and right speaker impedance different					

6. Accessory Noise Generation Source

Accessory	Noise	Symptoms
Alternator	Whistling	High pitch sound when accelerator pedal suddenly pressed (Stops soon after engine stopped)
Water temperature gauge	Scratching	Occurs when engine running (Continues for a while after engine stops)
Engine oil pressure switch	Rattling	Depends on engine speed (Does not occur during idling)
Fuel level sensor	Scratching	Occurs when engine suddenly revved, while running on rough roads, or starter switch turned ON
Flasher unit	Banging	When turn signal blinks
Horn	Hissing	Occurs when horn button pressed or released
Wiper motor	Whining	Depends on windshield wiper speed
Washer motor	Whining	When windshield washer operates

7. Horn

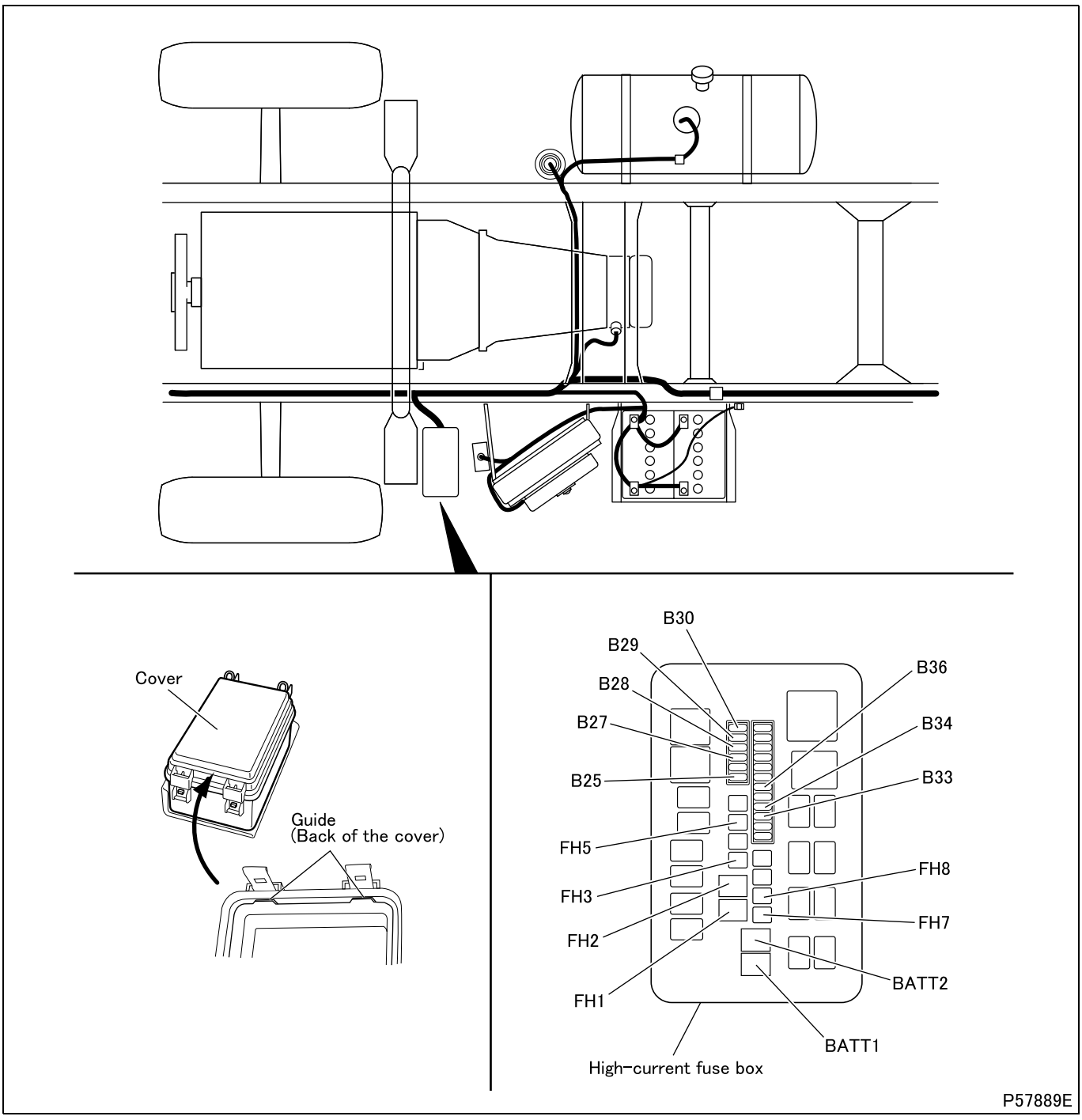
Symptoms / Possible causes	Horn				Reference Gr
	No sound	Continuous sound	Small sound	Sound quality poor	
Connector connection faulty, harness disconnection, grounding faulty	O				
Fuse blown	O				
Horn switch faulty	O	O			
Horn faulty	O		O	O	
Horn stay warped			O	O	
Battery voltage insufficient	O		O		

8. PREHEATING SYSTEM (See #955)

9. STARTER CONTINUOUS ENERGIZING PREVENTING FUNCTION (See #956)

54-01 POWER, CHARGE AND GROUND CIRCUIT

HIGH-CURRENT FUSE BOX



WARNING ⚠

- **To prevent possible injury, be sure to disconnect the negative (–) cable of the battery and insulate it with tape before removing high-current fuses. (See #860.)**
- **With the negative (–) cable of the battery connected, battery voltage is always applied to each fuse. The battery voltage is applied to the fuses under the following conditions: Always (directly connected to the battery)**

CAUTION ⚠

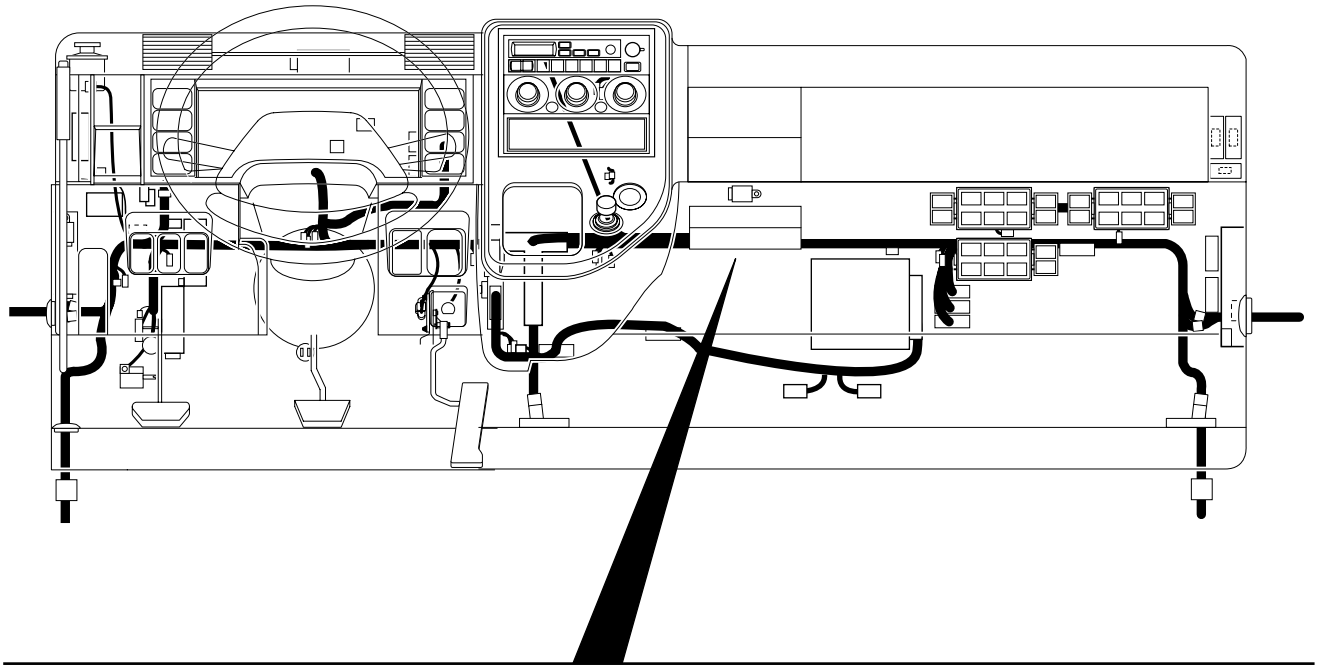
- **If a fuse blows out, identify and remedy the cause, then replace the fuse.**
- **Be sure to use the fuse with the specified ampere.**
- **When installing the cover on the high-current fuse box, lightly press the cover directly down until the guide on the cover securely fits in the guide on the fuse box. Do not push the cover inward with excessive force, as doing so could easily damage the guides.**

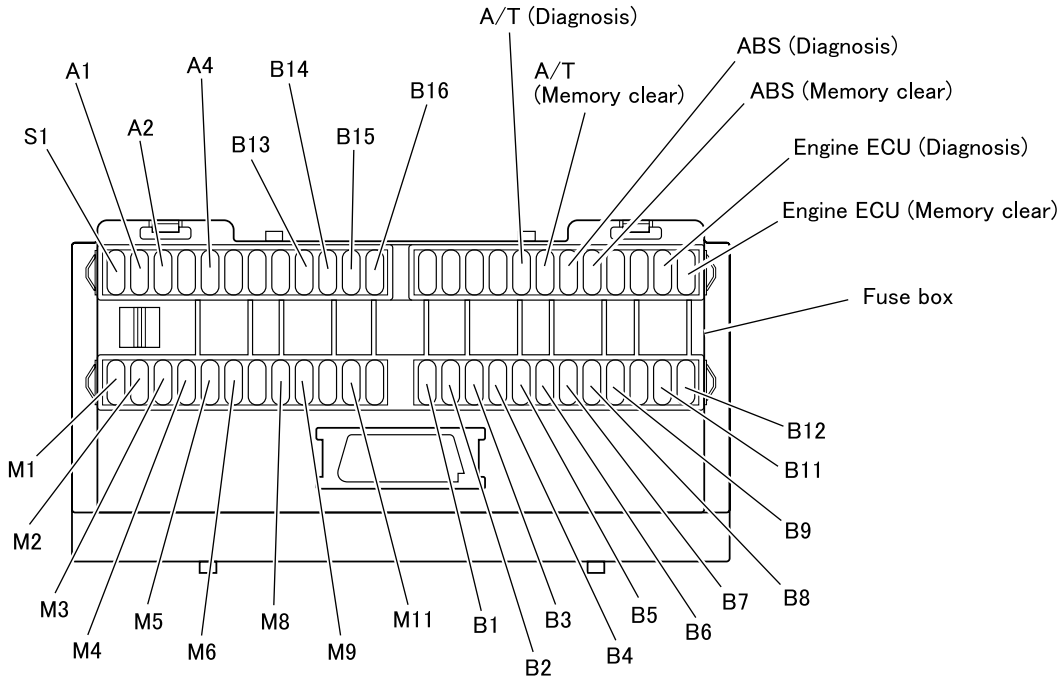
High-current fuse box

Fuse No.	Main load	Capacity
FH1	Fuse box (S1, A1 to A5, M1 to M12)	60A
FH2	Fuse box (B1 to B12)	60A
FH3	Fuse box (B13 to B16)	40A
FH5	Hydraulic booster	60A
FH7	ABS motor	40A
FH8	ABS solenoid	40A
B25	Tail lamp	15A
B27	Horn	10A
B28	Air-conditioner	10A
B29	Condenser fan	25A
B30	Blower fan	30A
B33	Van body dome light	10A
B34	ATF cooler fan	20A
B36	Engine electronic drive unit	20A
BATT1	Alternator	120A
BATT2	Alternator	120A

ABS: Anti-lock brake system
ATF: Automatic transmission fluid

FUSE BOX





ECU : Electronic control unit
A/T : Automatic transmission

P57900E

CAUTION ⚠

- **If a fuse blows out, identify and remedy the cause, then replace the fuse.**
- **Be sure to use the fuse with the specified ampere.**

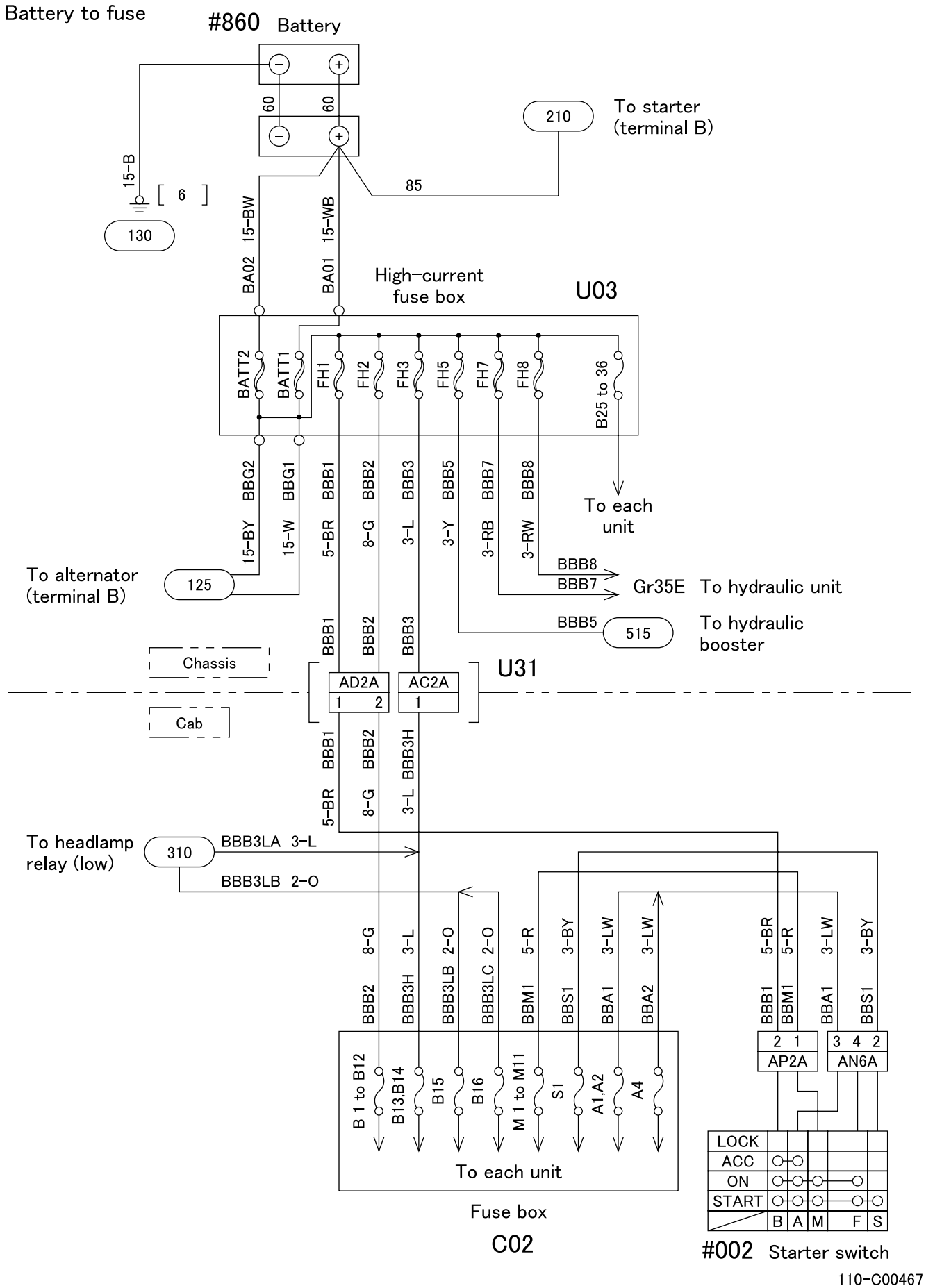
Fuse box

Fuse No.	Main load	Capacity
A1	Cigarette lighter	15A
A2	Audio	10A
A4	Opt (ACC)	10A
B1	Stop lamp	15A
B2	Meter	10A
B3	Turn signal lamp	15A
B4	Opt (B)	10A
B5	Audio	10A
B6	Cab lamp	10A
B7	Power window (driver)	30A
B8	Power window (assistant)	30A
B9	Engine electronic control unit	20A
B11	Mirror heater	20A
B12	Automatic transmission	10A
B13	Tester	15A
B14	Headlamp (HI)	20A
B15	Headlamp (LH/LO)	20A
B16	Headlamp (RH/LO)	20A
M1	Backup lamp	10A
M2	Meter	10A
M3	Wiper	15A
M4	Opt (M)	10A
M5	Relay control	10A
M6	Automatic transmission	10A
M8	Exhaust brake	10A
M9	Engine electronic control unit	5A
M11	ABS	10A
S1	Starter	10A

Diagnosis fuse

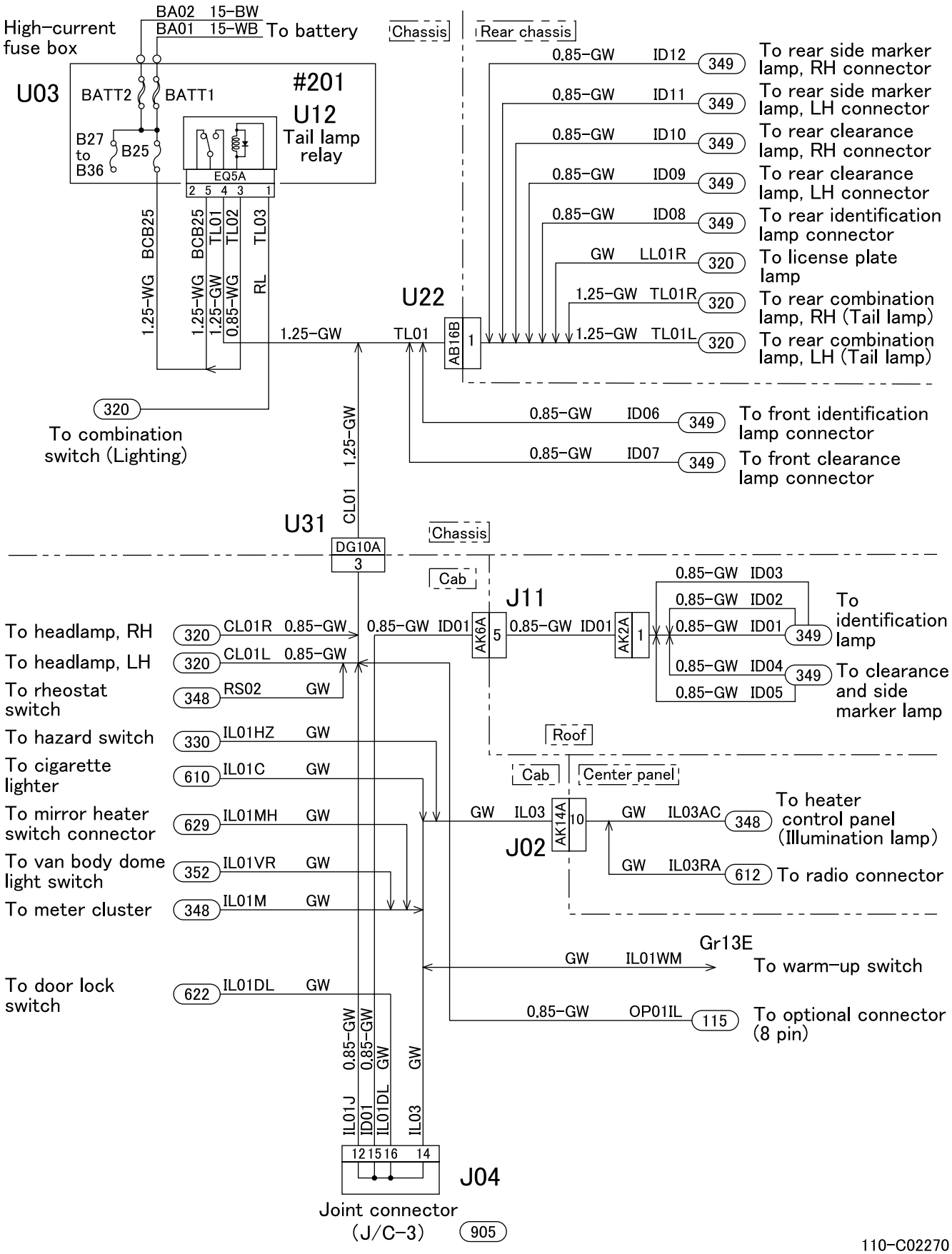
Fuse No.	Main load	Capacity
A/T	Diagnosis	5A
A/T	Memory clear	10A
ABS	Diagnosis	5A
ABS	Memory clear	10A
Engine ECU	Diagnosis	5A
Engine ECU	Memory clear	10A

ABS: Anti-lock brake system
A/T: Automatic transmission
ECU: Electronic control unit


Battery to fuse
#860 Battery
60
60
210
To starter
(terminal B)
85
15-B
[6]
130
15-BW
15-WB
BA02
BA01
High-current
fuse box
U03
BATT2
BATT1
FH1
FH2
FH3
FH5
FH7
FH8
B25 to 36
BBG2
BBG1
BBB1
BBB2
BBB3
BBB5
BBB7
BBB8
To each
unit
15-BY
15-W
5-BR
8-G
3-L
3-Y
3-RB
3-RW
BBB8
BBB7
Gr35E
To hydraulic unit
To alternator
(terminal B)
125
BBB5
515
To hydraulic
booster
Chassis
Cab
U31
AD2A
1 2
AC2A
1
BBB1
BBB2
BBB3H
5-BR
8-G
3-L
To headlamp
relay (low)
310
BBB3LA 3-L
BBB3LB 2-O
BBB2
BBB3H
BBB3LB
BBB3LC
BBM1
BBS1
BBA1
BBA2
8-G
3-L
2-O
2-O
5-R
3-BY
3-LW
3-LW
B 1 to B12
B13,B14
B15
B16
M 1 to M11
S1
A1,A2
A4
To each unit
Fuse box
C02
BBB1
BBM1
BBA1
BBS1
5-BR
5-R
3-LW
3-BY
2 1
AP2A
3 4 2
AN6A
LOCK
ACC
ON
START
B A M F S
#002 Starter switch

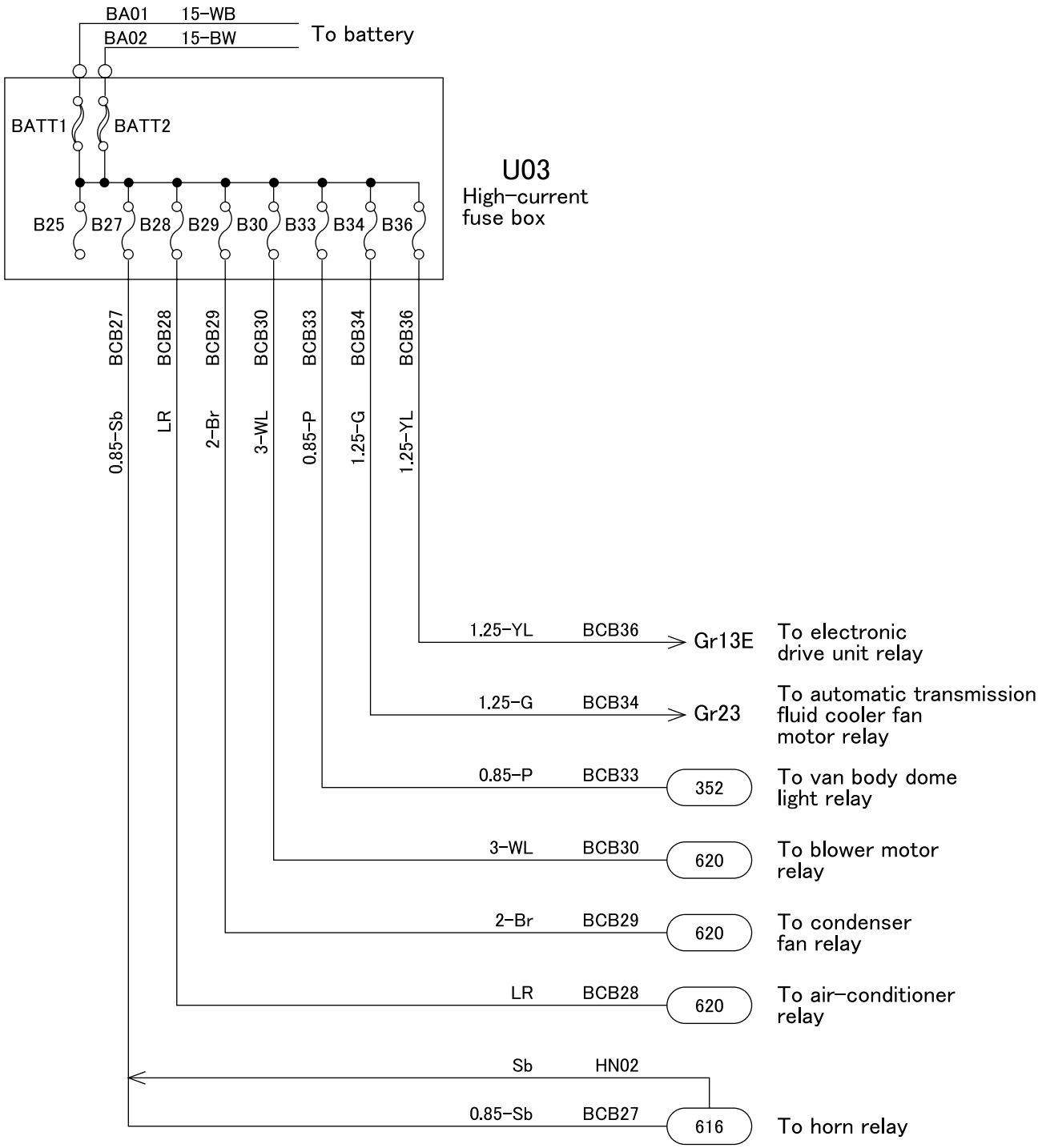
110-C00467

High-current fuse box
(Fuse B25)



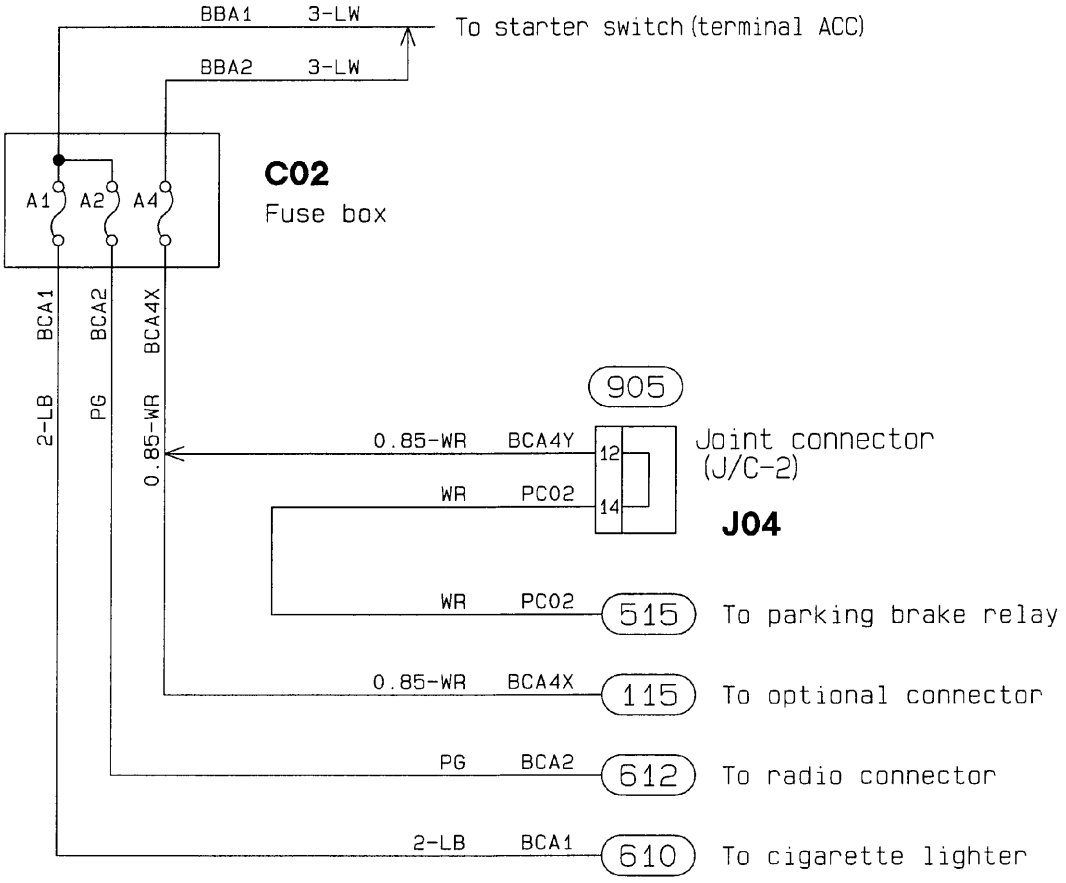
110-C02270

High-current fuse box
(Fuse B27 to B36)

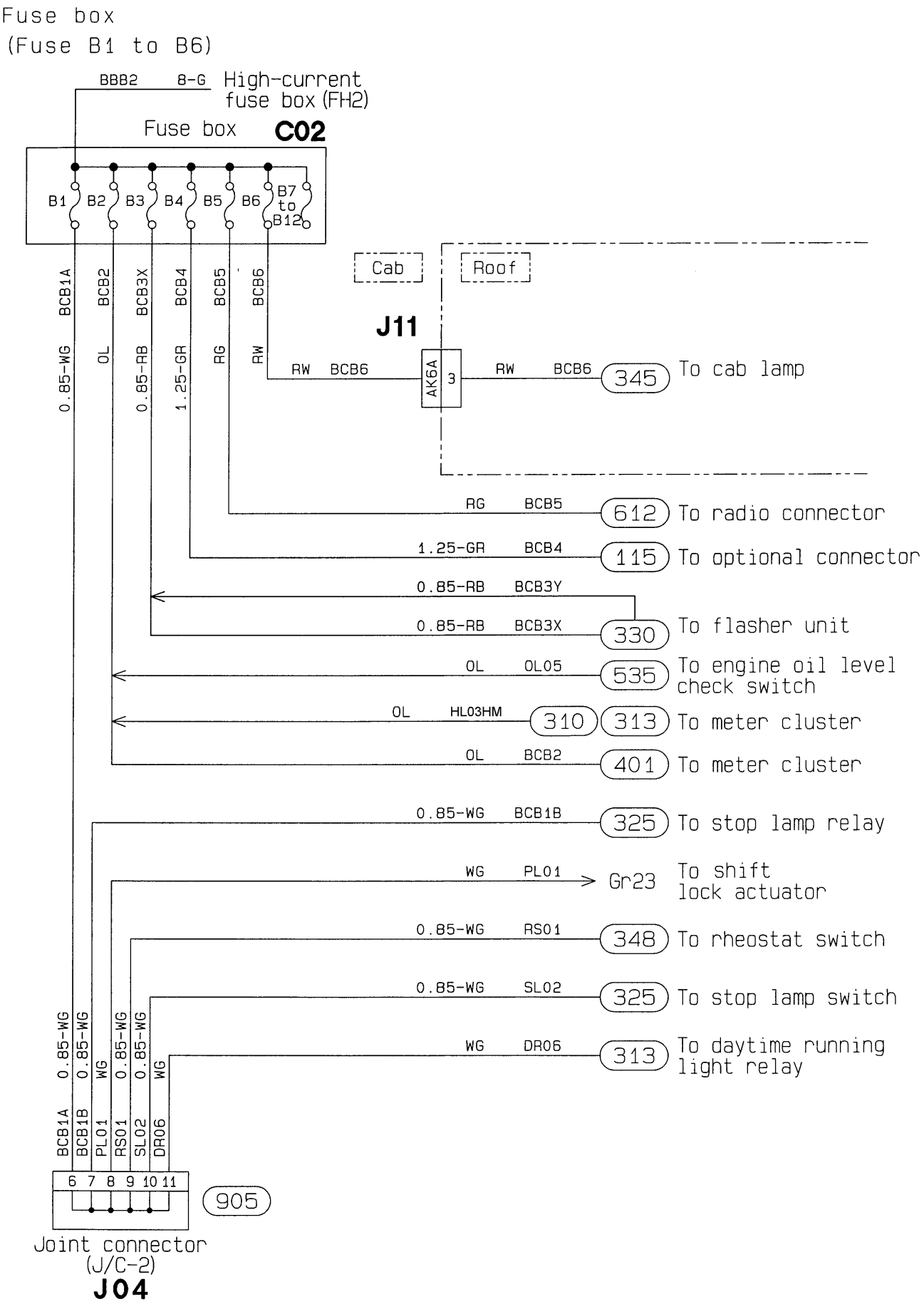


110-C00473

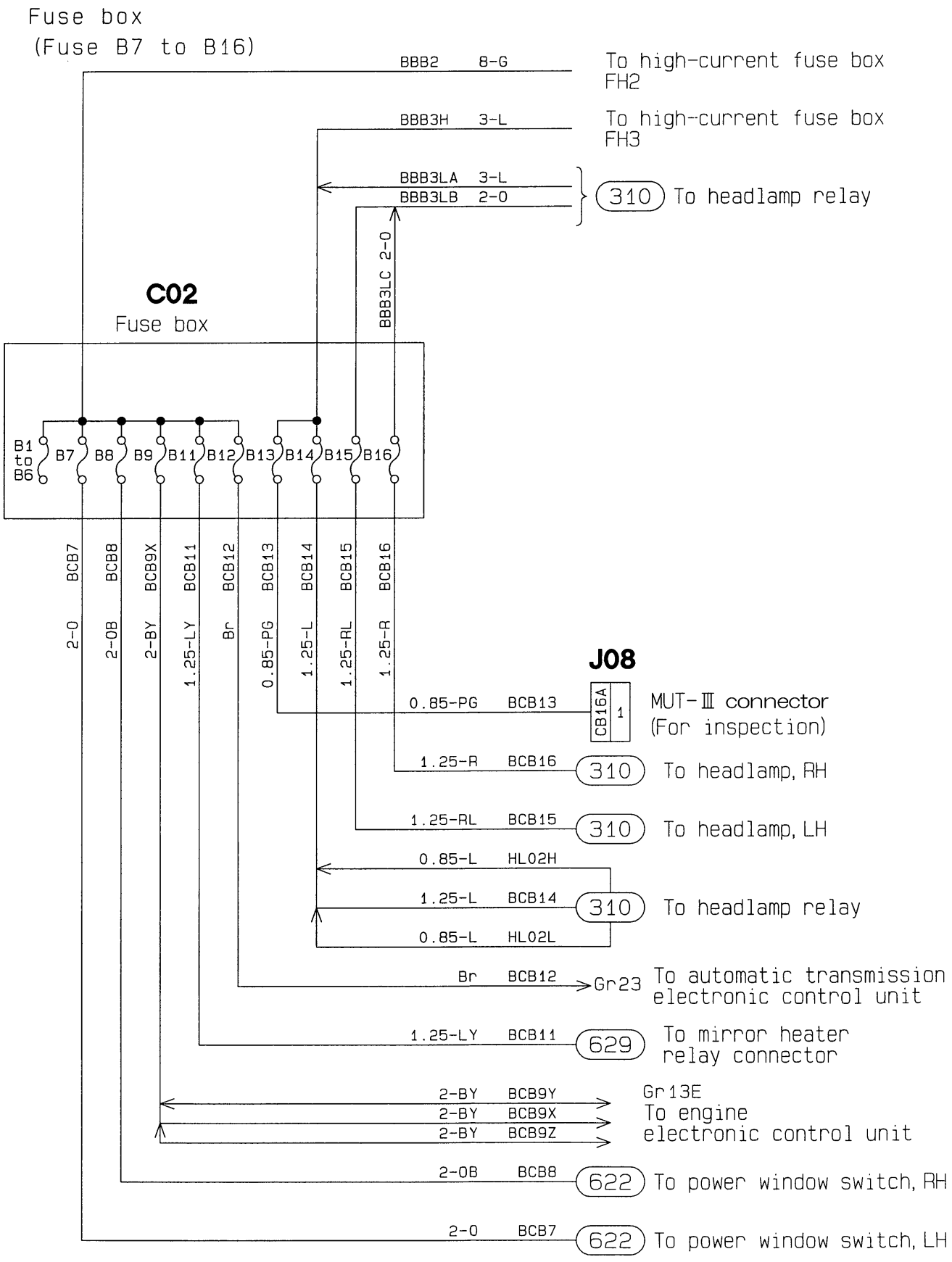
Fuse box
(Fuse A1 to A4)



C00469


Fuse box
(Fuse B1 to B6)
BBB2 8-G High-current fuse box (FH2)
Fuse box C02
B1 B2 B3 B4 B5 B6 B7 to B12
Cab
Roof
J11
AK6A 3
RW BCB6
RW BCB6 345 To cab lamp
RG BCB5 612 To radio connector
1.25-GR BCB4 115 To optional connector
0.85-RB BCB3Y
0.85-RB BCB3X 330 To flasher unit
OL OL05 535 To engine oil level check switch
OL HL03HM 310 313 To meter cluster
OL BCB2 401 To meter cluster
0.85-WG BCB1B 325 To stop lamp relay
WG PL01 Gr23 To shift lock actuator
0.85-WG RS01 348 To rheostat switch
0.85-WG SL02 325 To stop lamp switch
WG DR06 313 To daytime running light relay
BCB1A 0.85-WG
BCB1B 0.85-WG
PL01 WG
RS01 0.85-WG
SL02 0.85-WG
DR06 WG
6 7 8 9 10 11
905
Joint connector (J/C-2)
J04

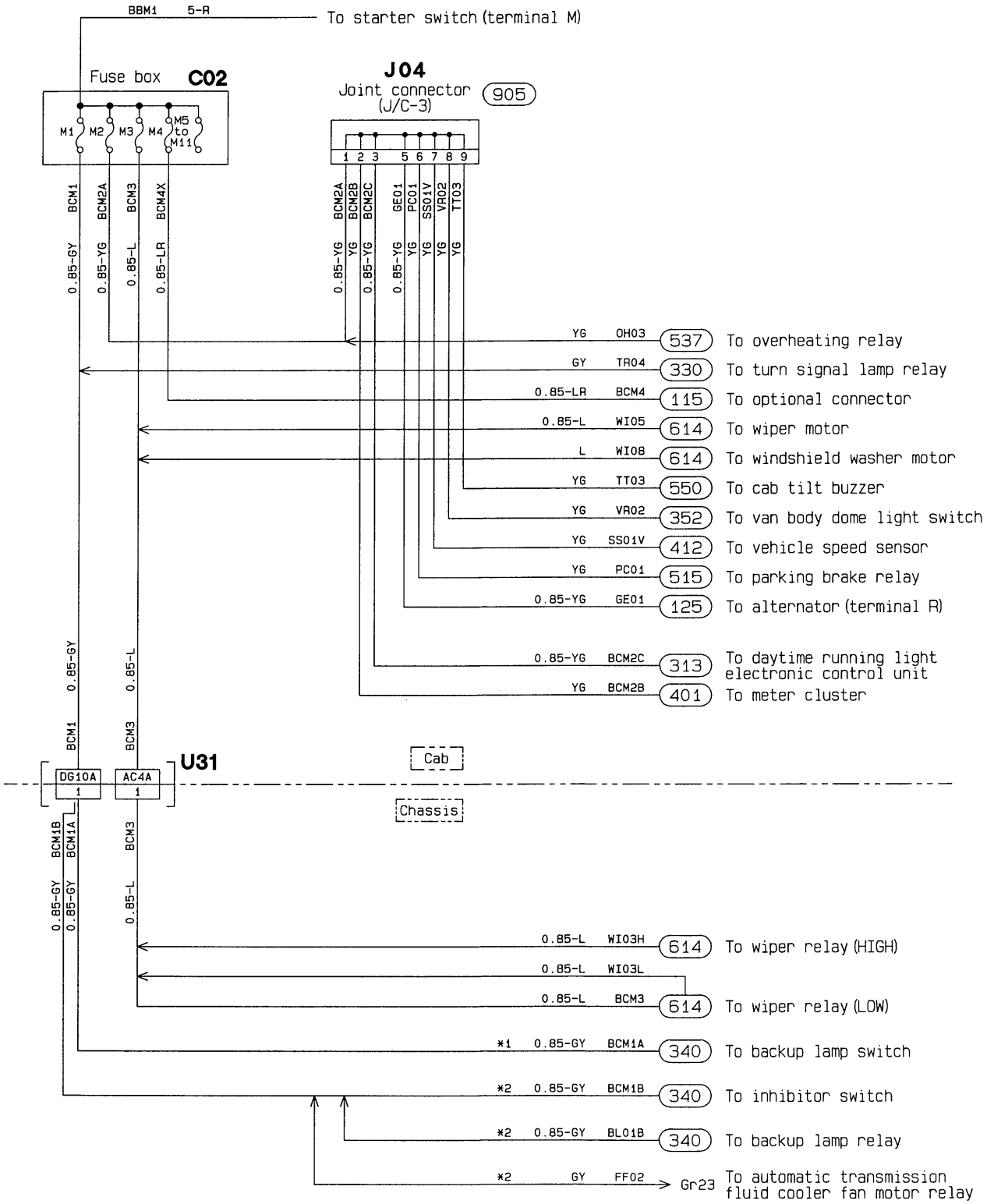
C02271



MUT : Multi-Use Tester

C00471

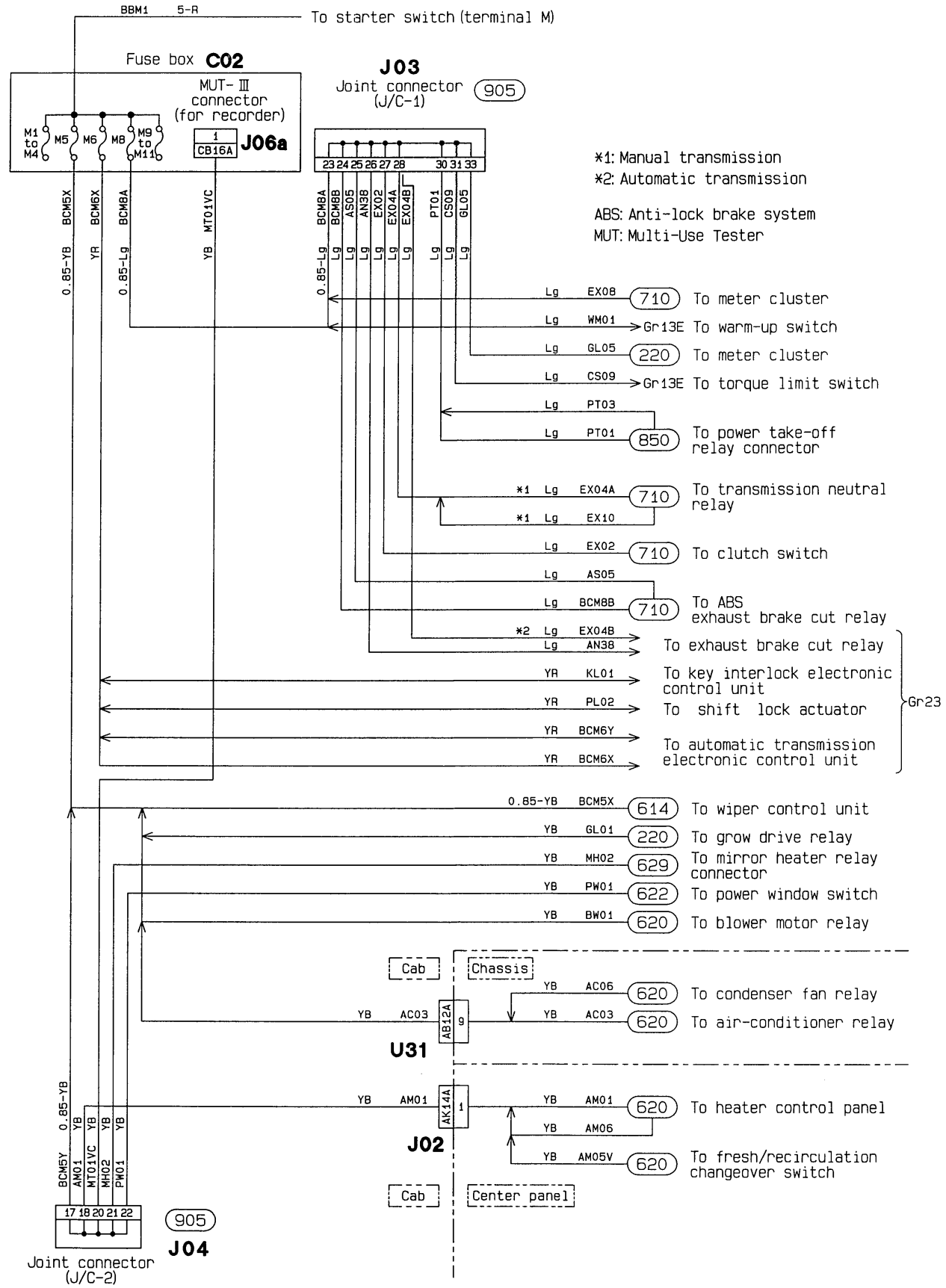
Fuse box
(Fuse M1 to M4)



*1 : Manual transmission
*2 : Automatic transmission

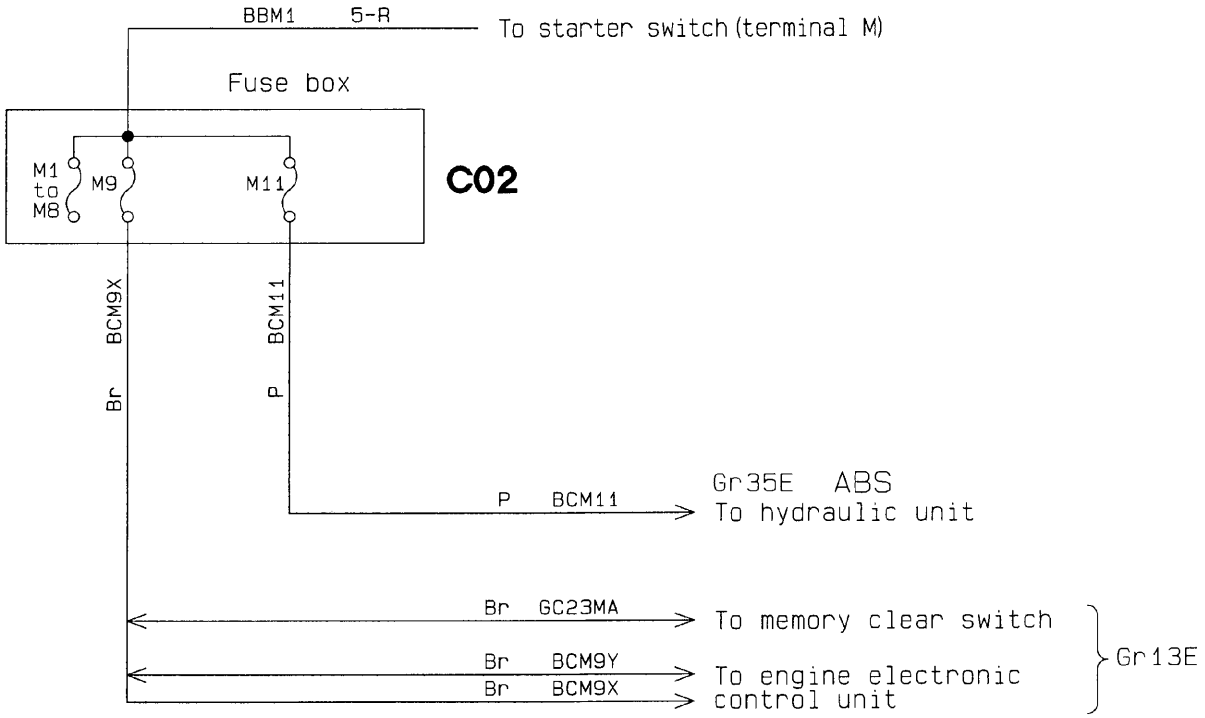
C02272

Fuse box
(Fuse M5 to M8)



C02273

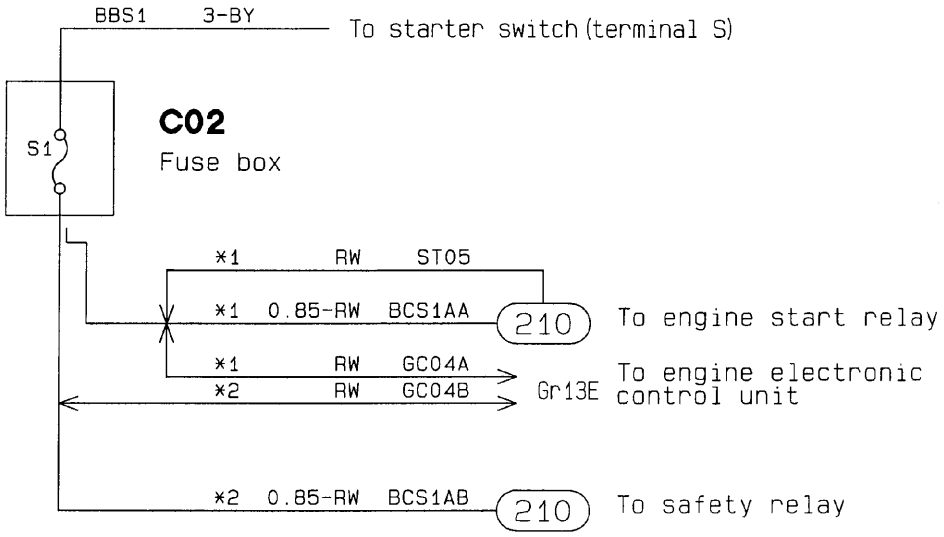
Fuse box
(Fuse M9 to M11)



ABS: Anti-lock brake system

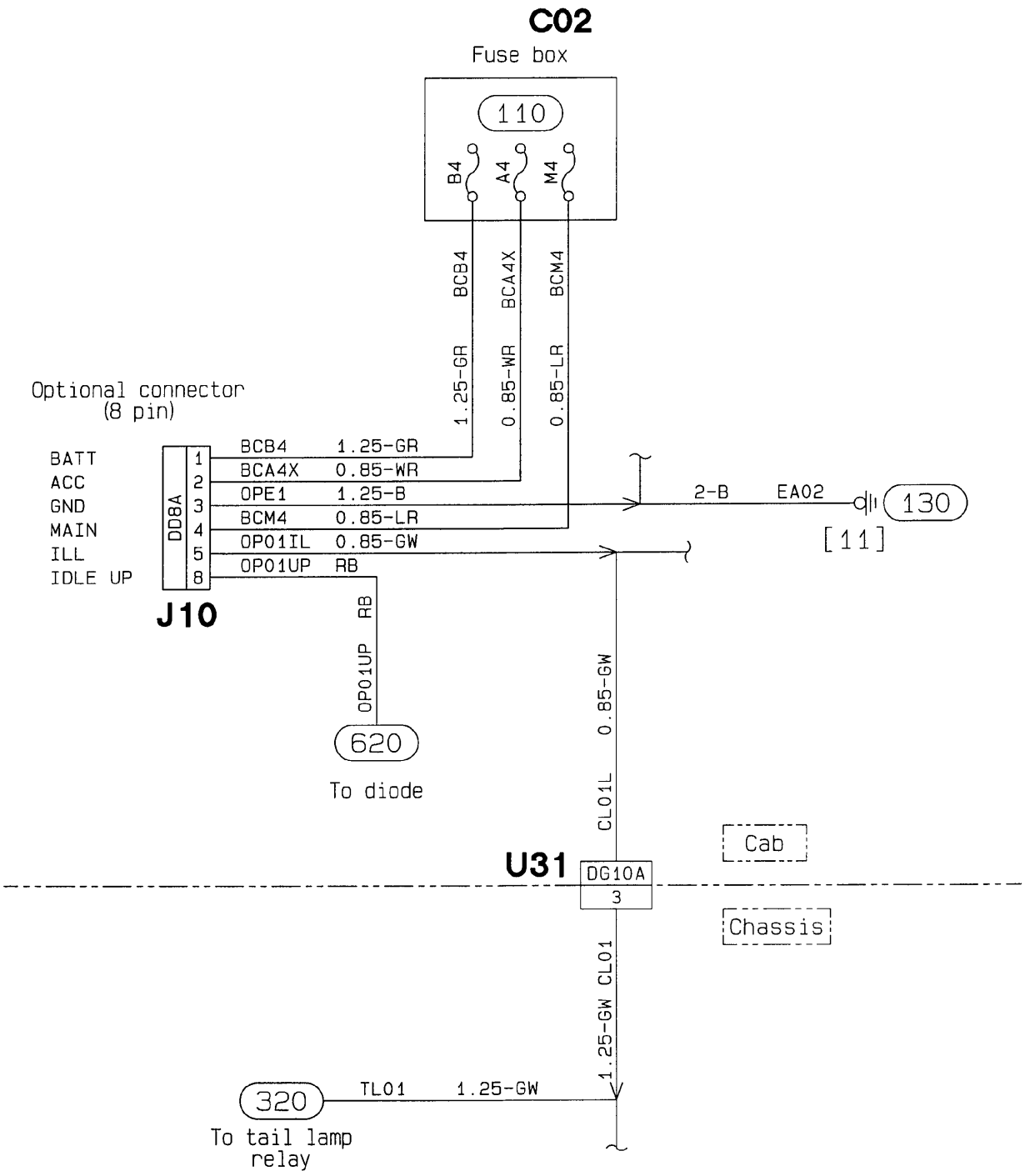
C00476

Fuse box
(Fuses S1)

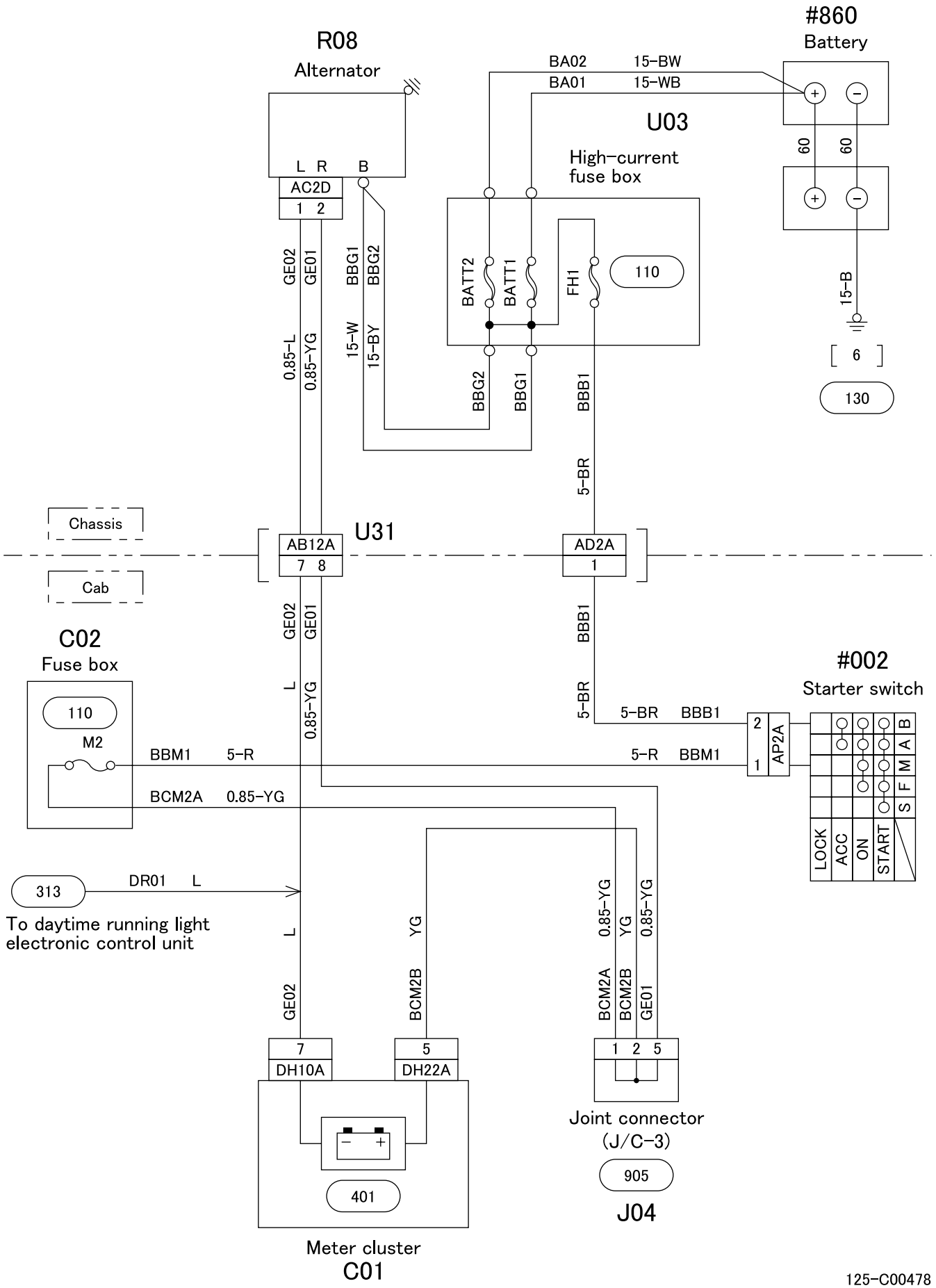


*1 : Manual transmission
*2 : Automatic transmission

C00468

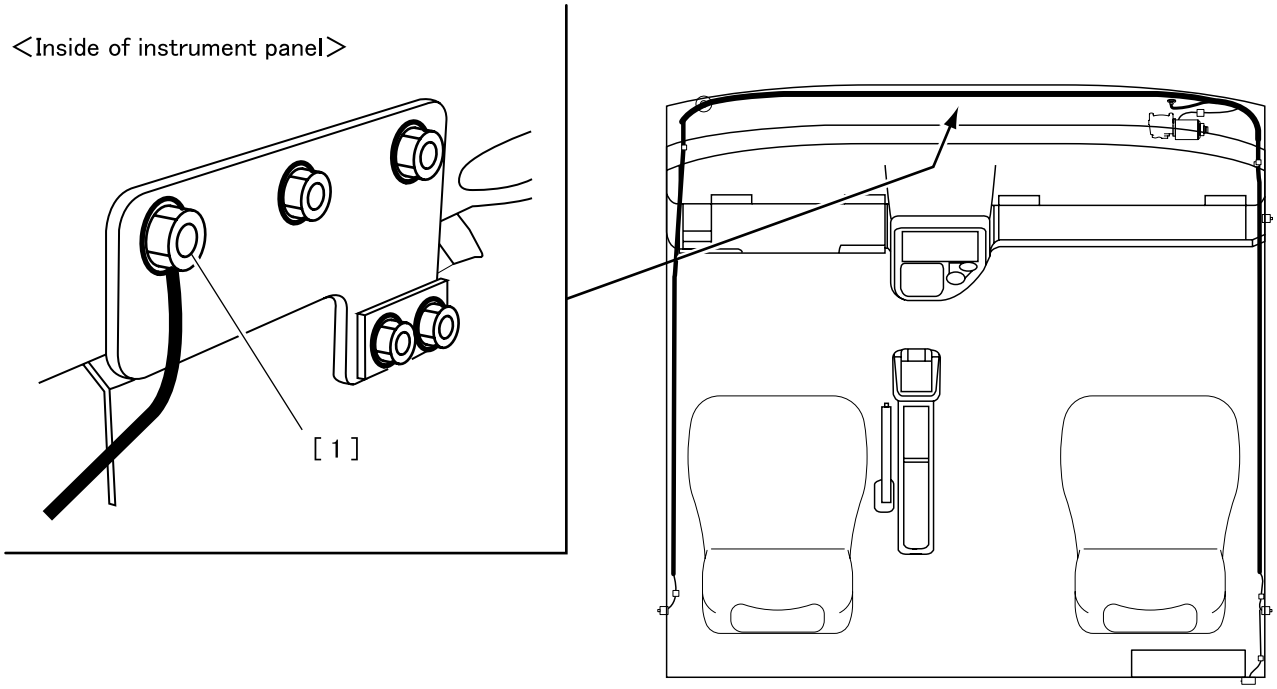

C02
Fuse box
110
B4
A4
M4
BCB4
BCA4X
BCM4
1.25-GR
0.85-WR
0.85-LR
Optional connector
(8 pin)
BATT
ACC
GND
MAIN
ILL
IDLE UP
DD8A
1
2
3
4
5
8
BCB4 1.25-GR
BCA4X 0.85-WR
OPE1 1.25-B
BCM4 0.85-LR
OP01IL 0.85-GW
OP01UP RB
J10
2-B EA02
130
[11]
RB
OP01UP
620
To diode
0.85-GW
CL01L
Cab
U31
DG10A
3
Chassis
1.25-GW CL01
320
TL01 1.25-GW
To tail lamp
relay

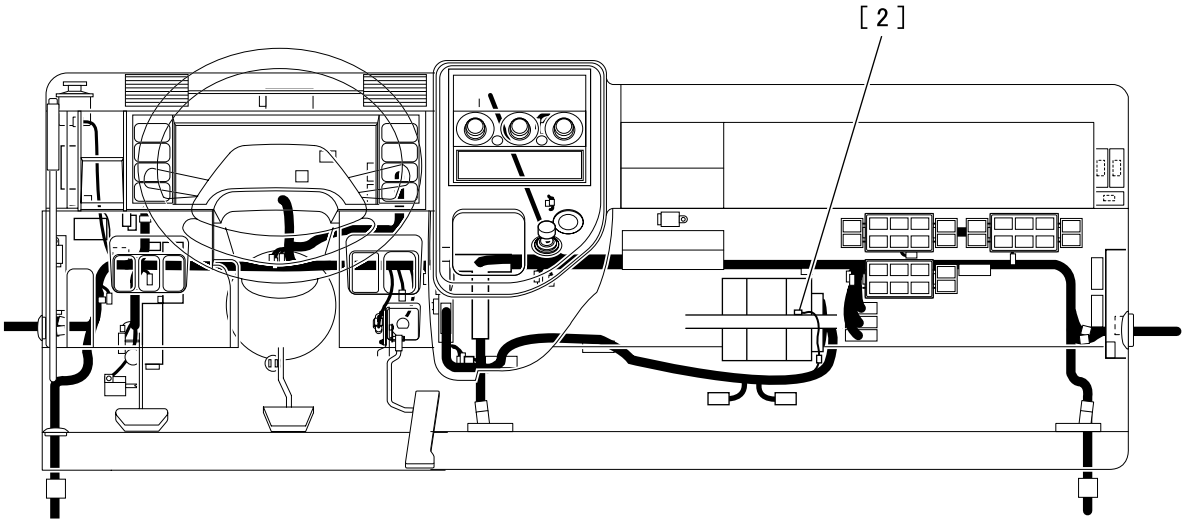
C00477


#860
Battery
R08
Alternator
BA02 15-BW
BA01 15-WB
U03
High-current fuse box
60
60
15-B
6
130
L R B
AC2D
1 2
GE02
GE01
BBG1
BBG2
0.85-L
0.85-YG
15-W
15-BY
BATT2
BATT1
FH1
110
BBG2
BBG1
BBB1
5-BR
Chassis
Cab
U31
AB12A
7 8
AD2A
1
C02
Fuse box
110
M2
BBM1 5-R
BCM2A 0.85-YG
5-BR BBB1
5-R BBM1
2
1
AP2A
#002
Starter switch
B
A
M
F
S
LOCK
ACC
ON
START
313
DR01 L
To daytime running light electronic control unit
L
YG
0.85-YG
BCM2A
BCM2B
GE01
GE02
7
DH10A
5
DH22A
1 2 5
Joint connector (J/C-3)
905
J04
401
Meter cluster
C01

125-C00478

[1] to [2] Cab ground

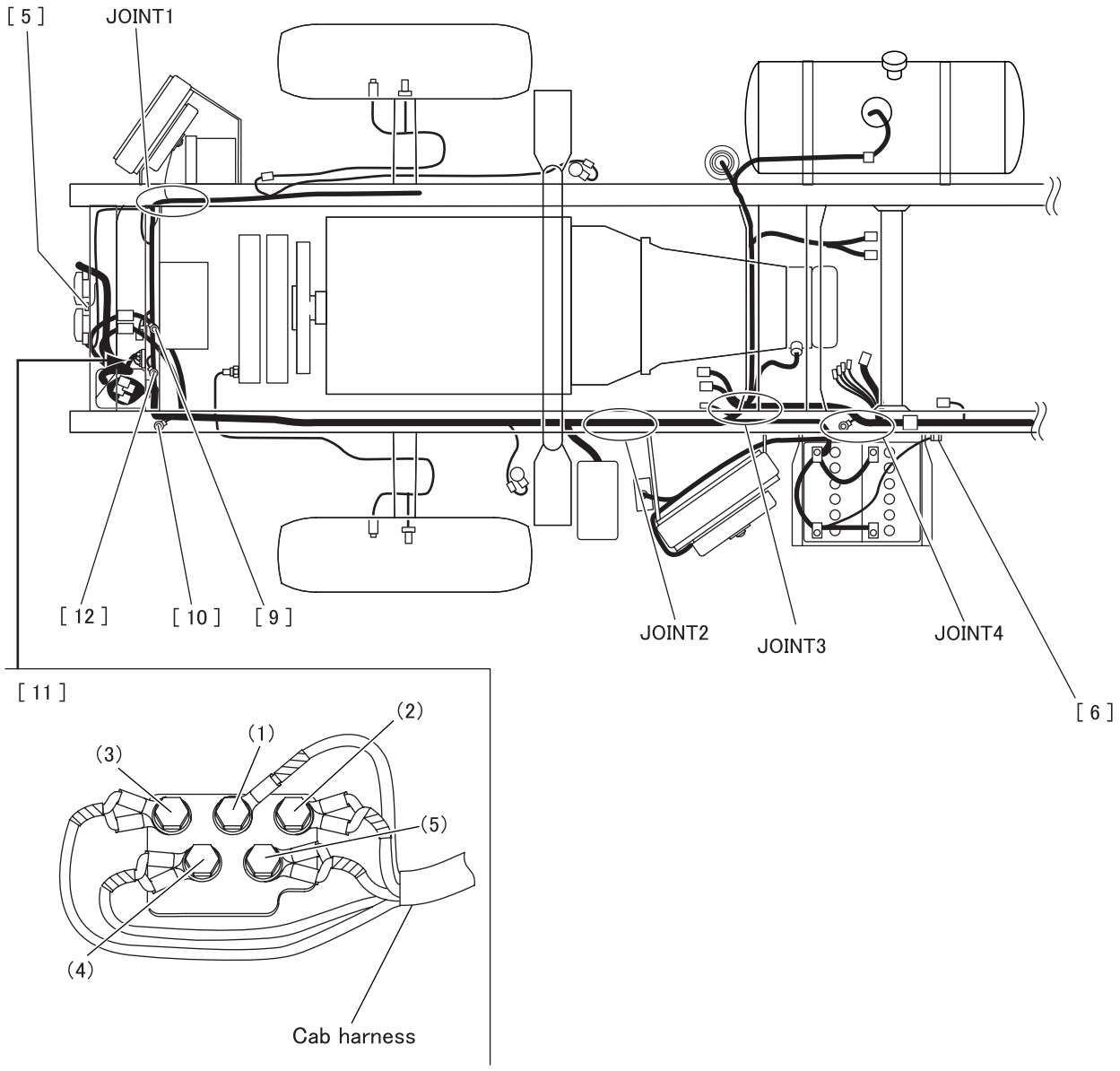




L00174

Location	Circuit No.	Wire diameter-wire color	Destination	Remarks
[1]	EA09	2-B	Joint connector (J/C-3)	–
	EA10	5-B	Frame ground	–
[2]	GCE5	1.25-B	Joint connector (J/C-3)	Engine electronic control unit case ground

[5] to [12] Chassis ground

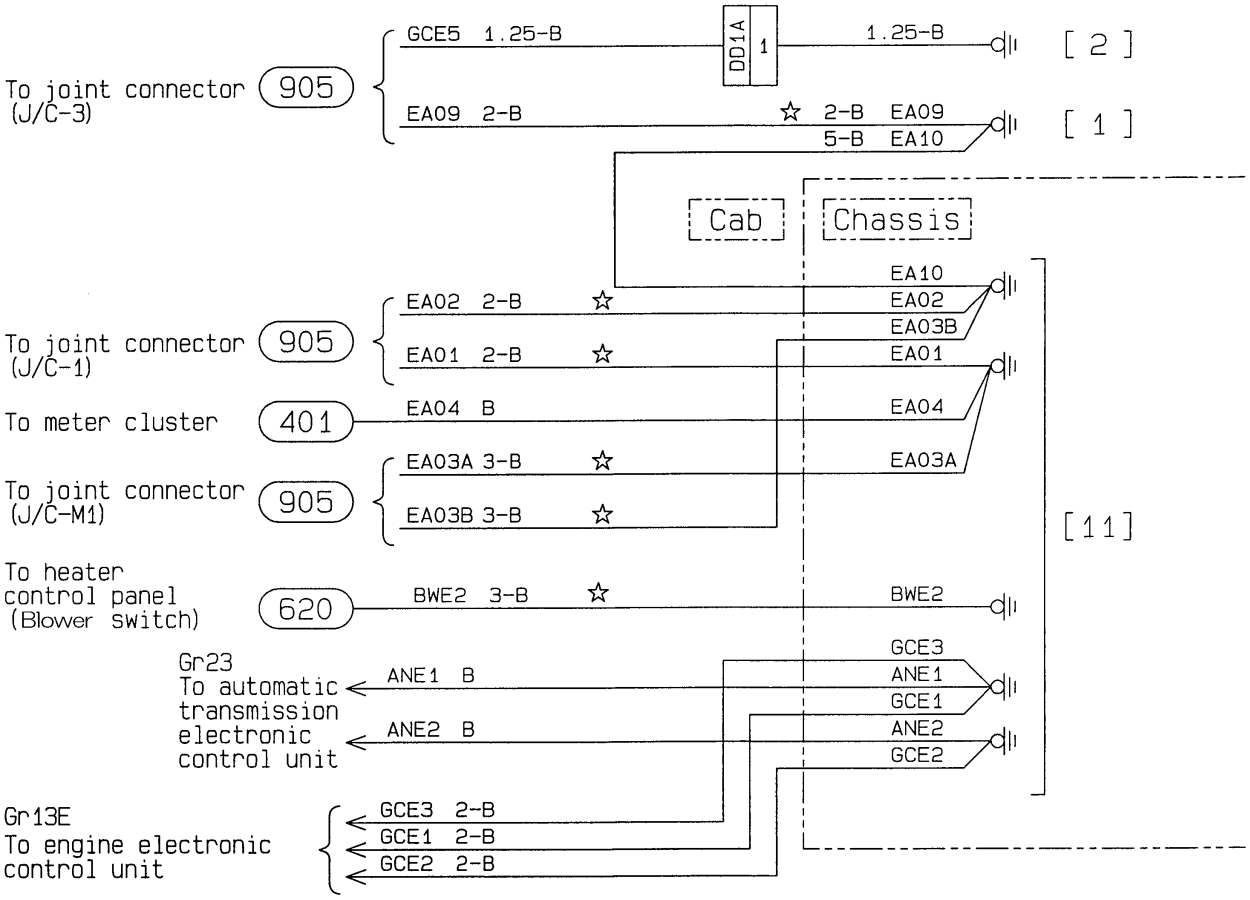


L01272

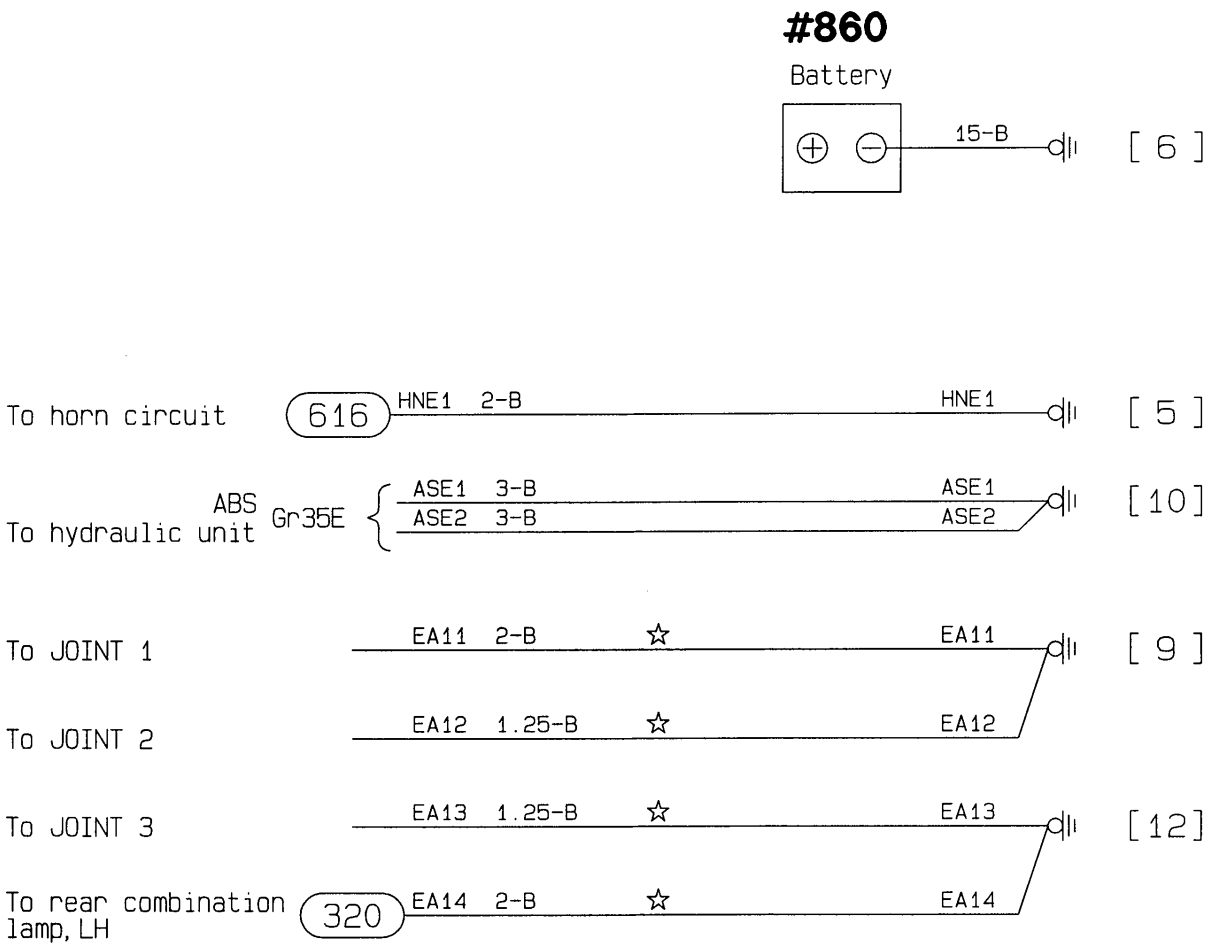
Location	Circuit No.	Wire diameter-wire color	Destination	Remarks
[5]	HNE1	2-B	Horn bracket	–
[6]	–	15-B	Battery	Battery ground (Frame ground)
[9]	EA11	2-B	Joint1	Frame ground
	EA12	1.25-B	Joint2	Frame ground
[10]	ASE1	3-B	Hydraulic unit	–
	ASE2	3-B	Hydraulic unit	–
[11](5)	ANE1	B	Automatic transmission electronic control unit	Automatic transmission
[11](4)	ANE2	B	Automatic transmission electronic control unit	Automatic transmission
[11](1)	BWE2	3-B	Center panel harness	–
[11](2)	EA01	2-B	Joint connector (J/C-1)	(Cab)
[11](3)	EA02	2-B	Joint connector (J/C-1)	(Cab)
[11](2)	EA03A	3-B	Joint connector (J/C-M1)	(Cab)
[11](3)	EA03B	3-B	Joint connector (J/C-M1)	(Cab)
[11](2)	EA04	B	Combination meter	(Cab)
[11](3)	EA10	5-B	Cab ground	–
[11](5)	GCE1	2-B	Engine electronic control unit	–
[11](4)	GCE2	2-B	Engine electronic control unit	–
[11](5)	GCE3	2-B	Engine electronic control unit	–
[12]	EA13	1.25-B	Joint3	Frame ground
	EA14	2-B	Rear chassis harness	Frame ground

Entire ground

- This diagram indicates grounding points.
- See the following pages for branching of grounding (wiring for ☆).
  (in circuit No. order)



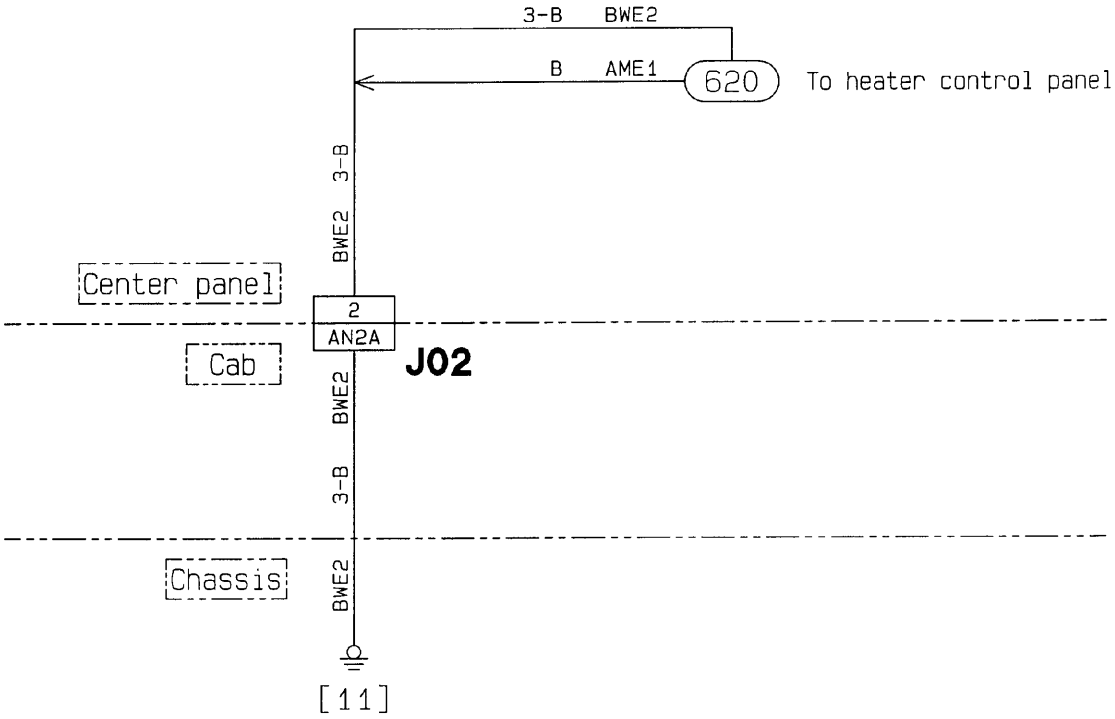
C02274-1



ABS : Anti-lock brake system

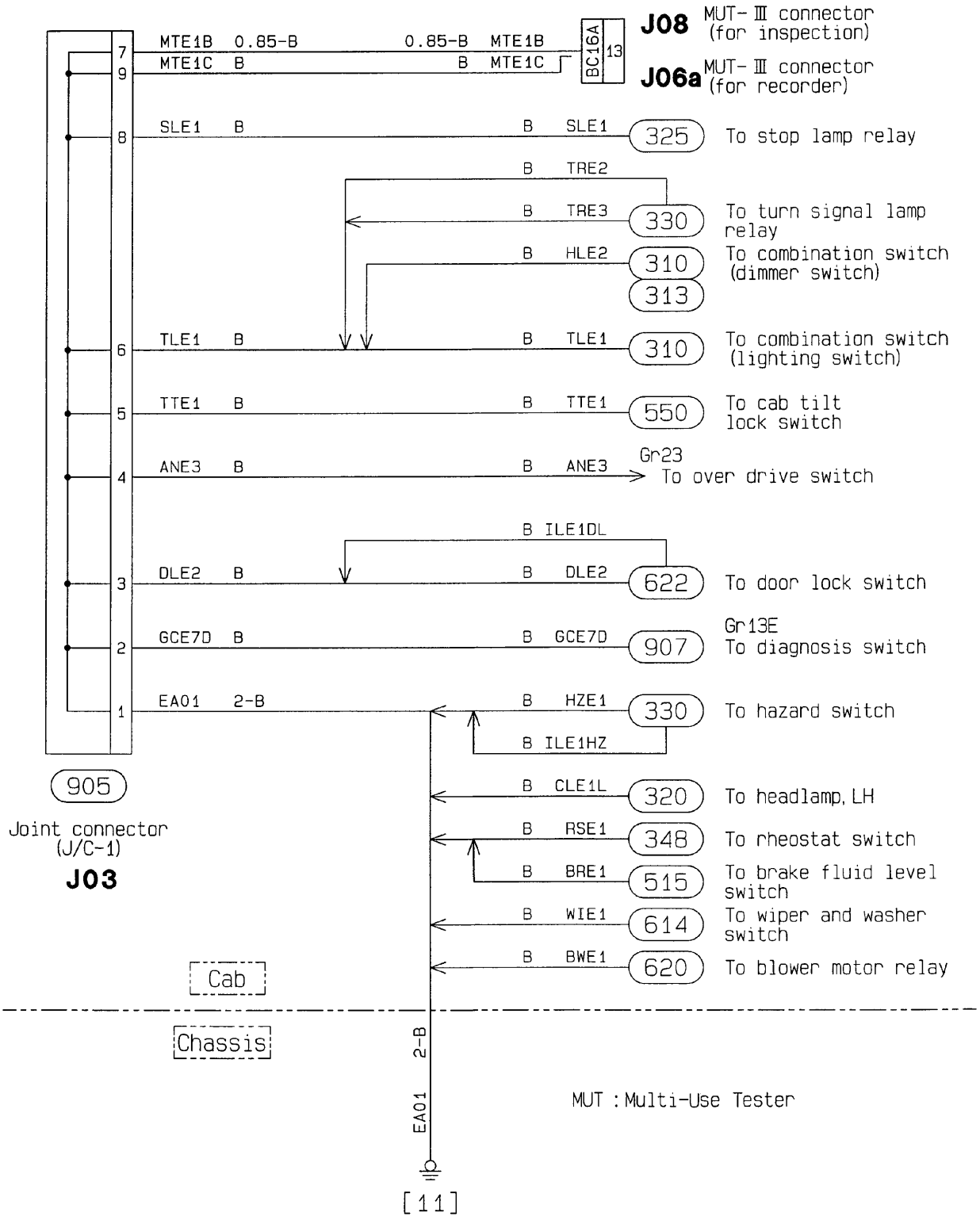
C02274-2

Circuit No.BWE2 chassis ground



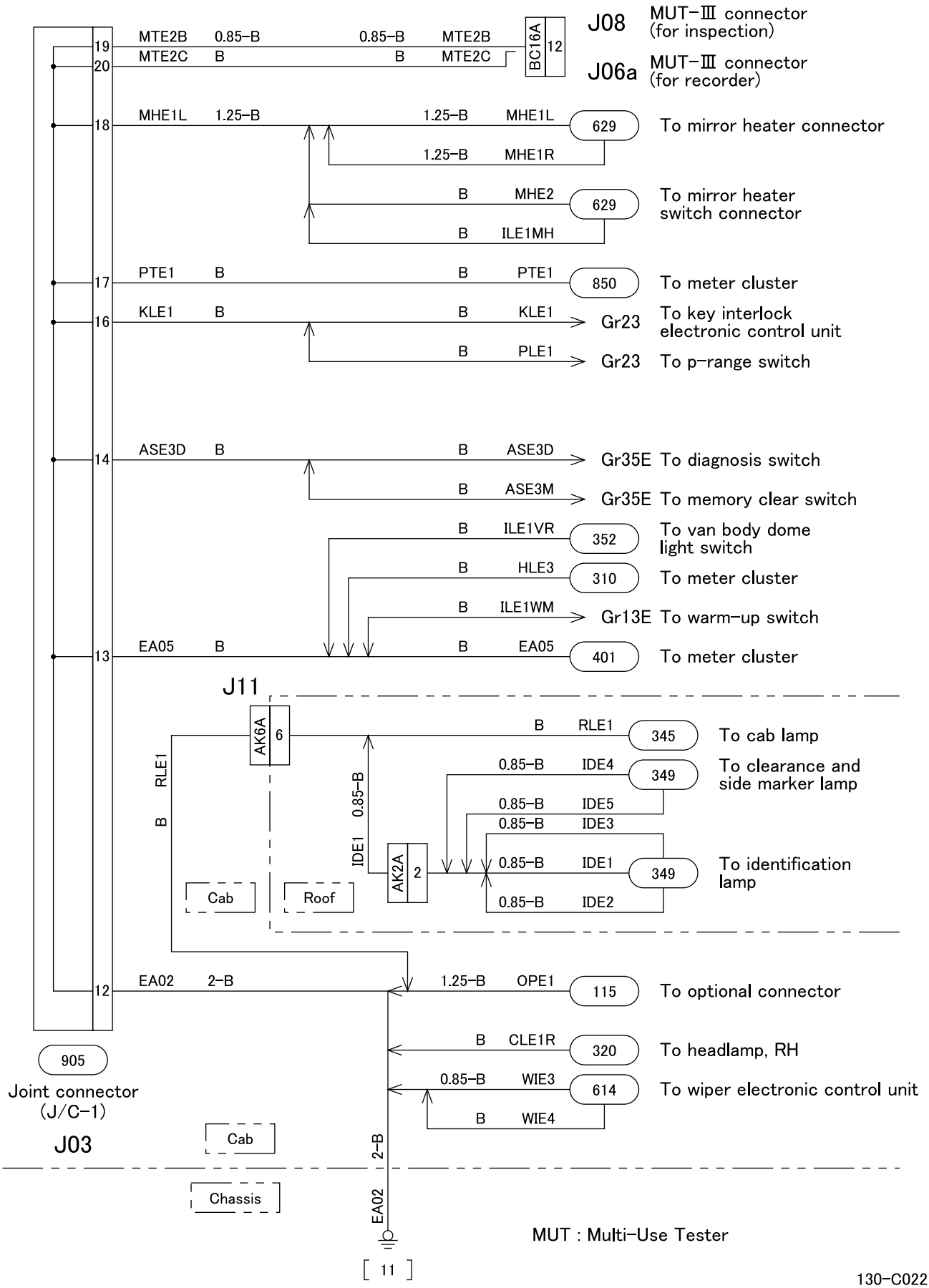
C00480

Circuit No.EA01 chassis ground



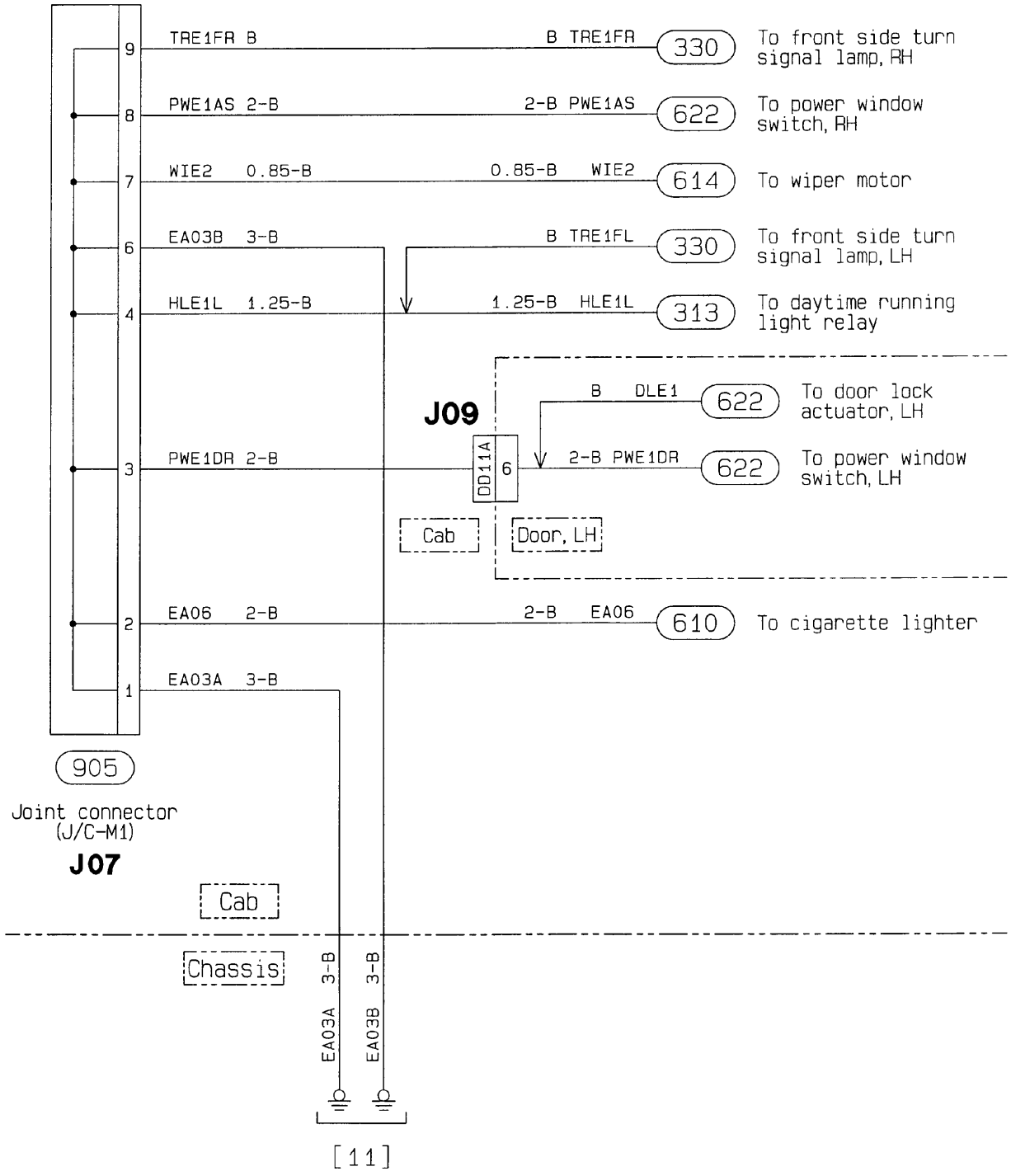
C00481

Circuit No.EA02 chassis ground



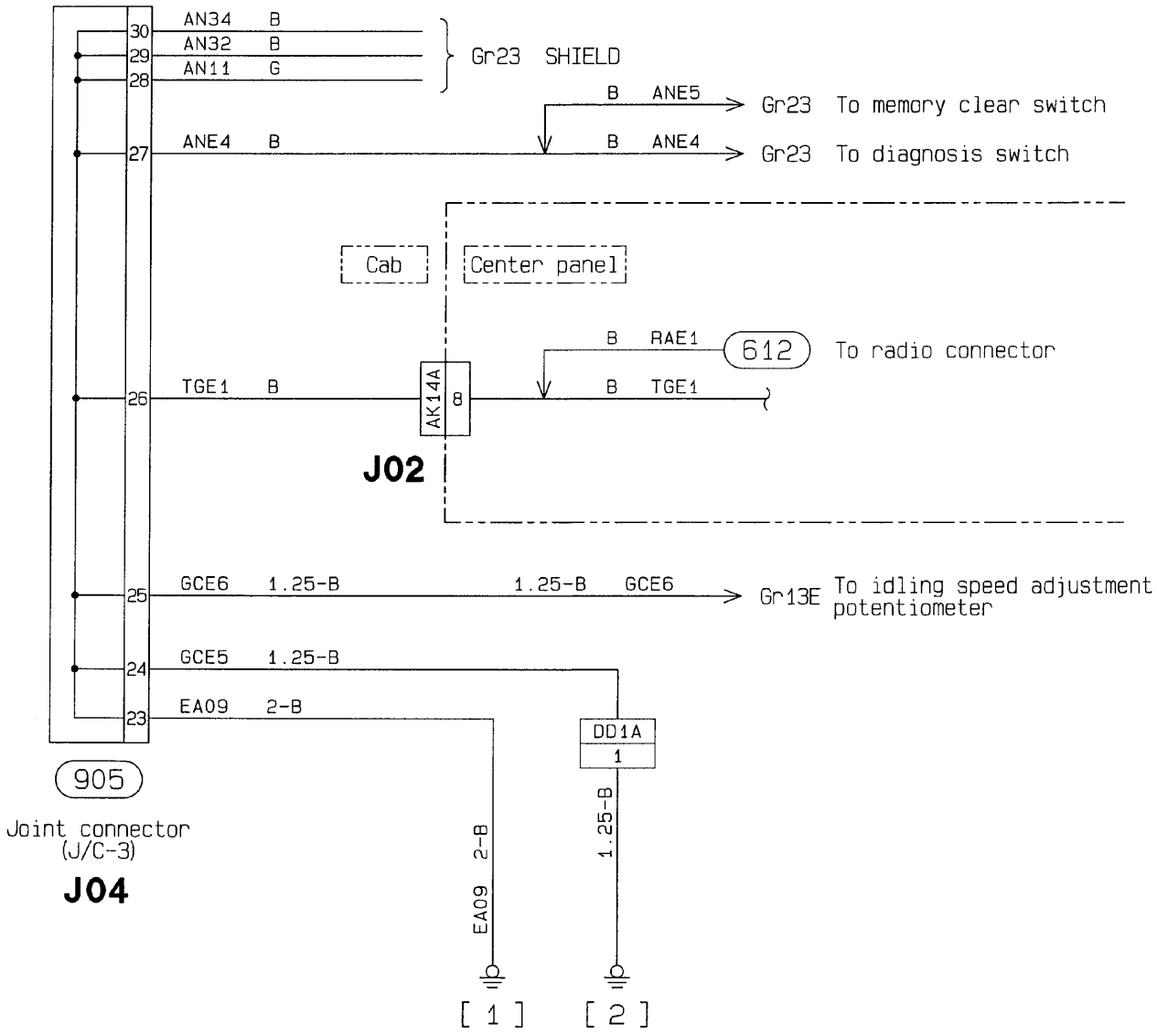
130-C02275

Circuit No.EA03A, EA03B chassis ground



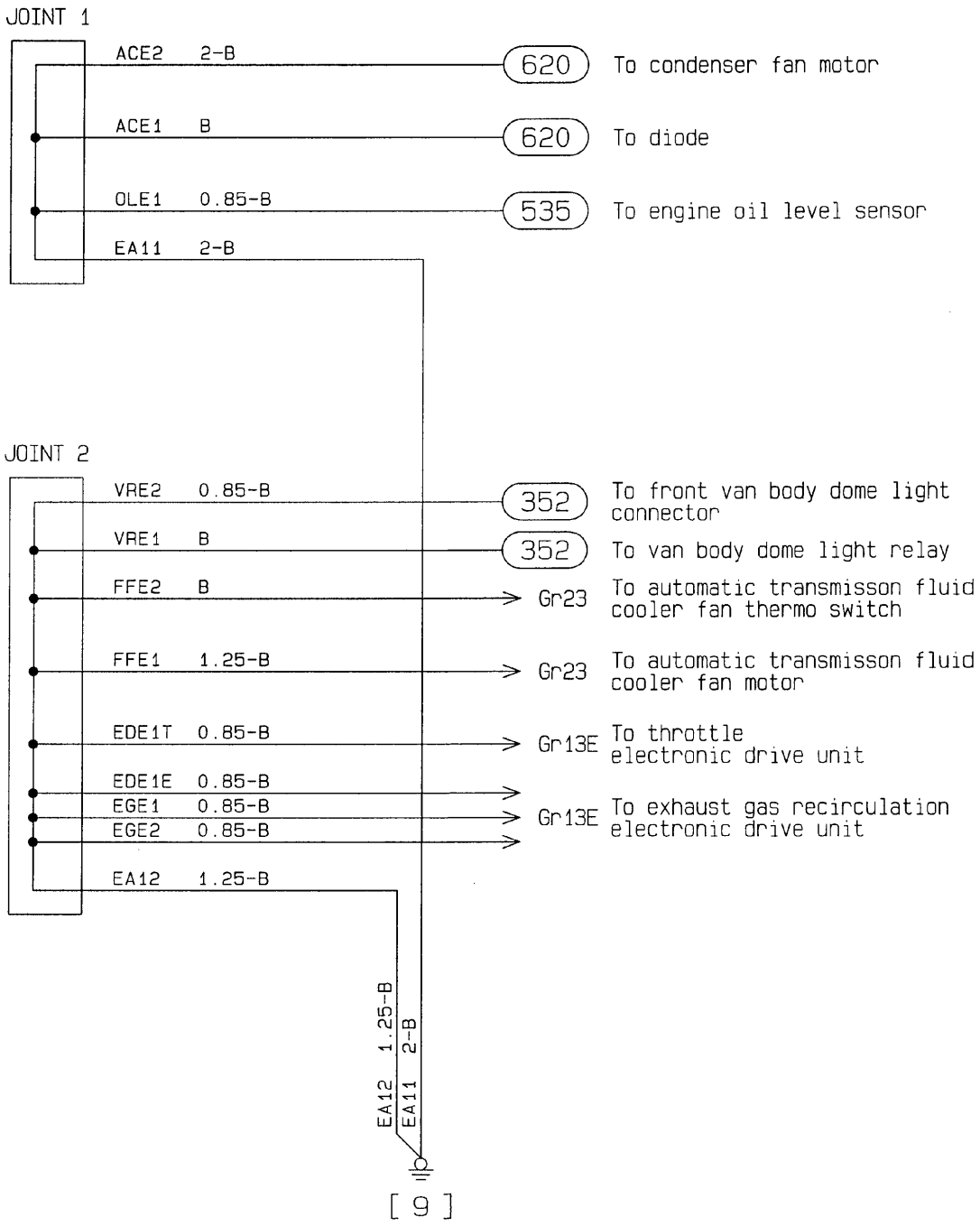
C00483

Circuit No.EA09 cab ground



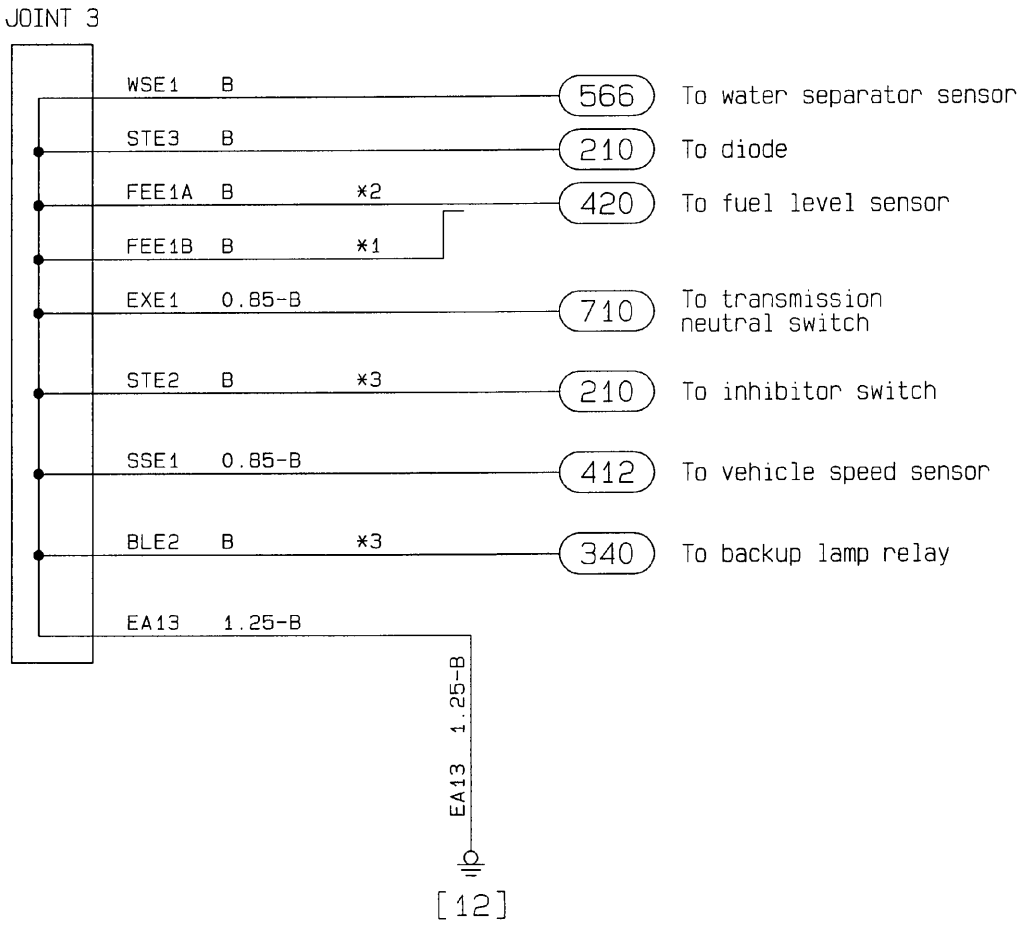
C00484

Circuit No.EA11, EA12 chassis ground



C00485

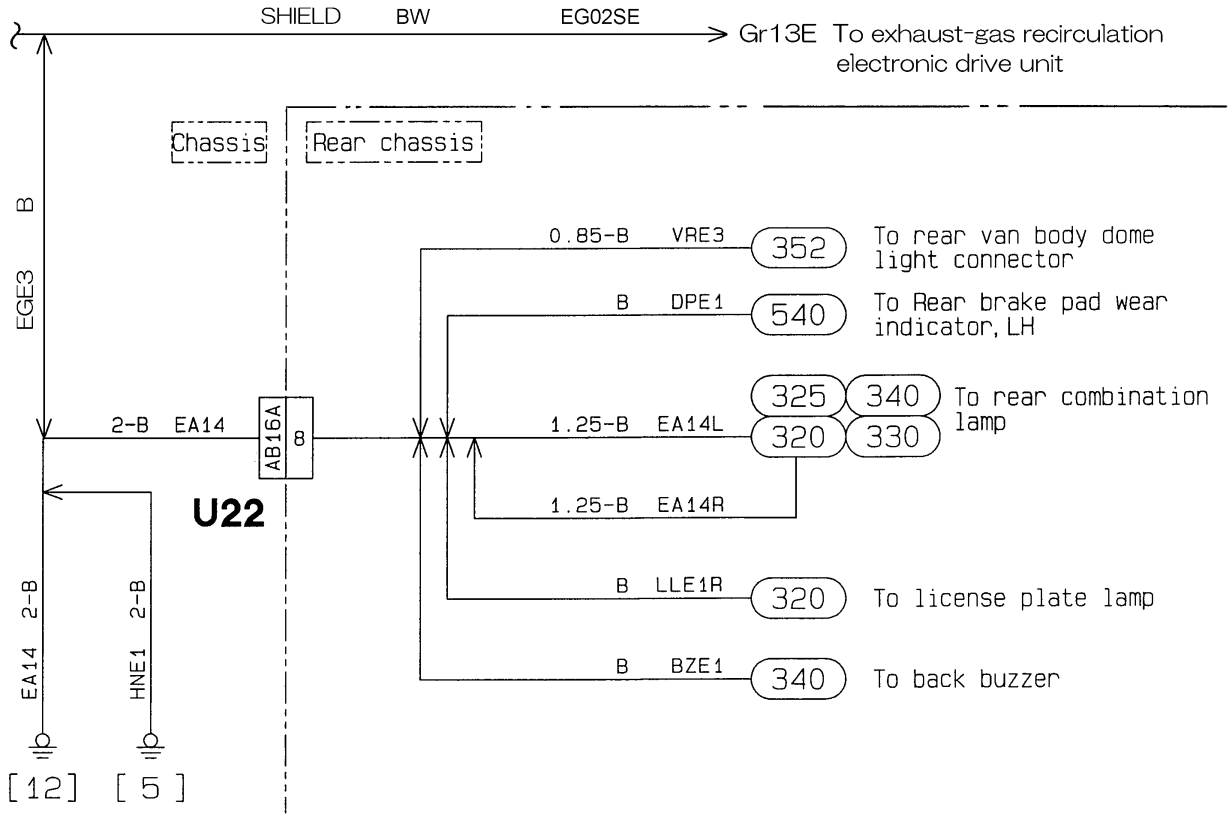
Circuit No.EA13 chassis ground



*1 : Fuel tank equipped rear overhang
*2 : Except *1
*3 : Automatic transmission

C00486

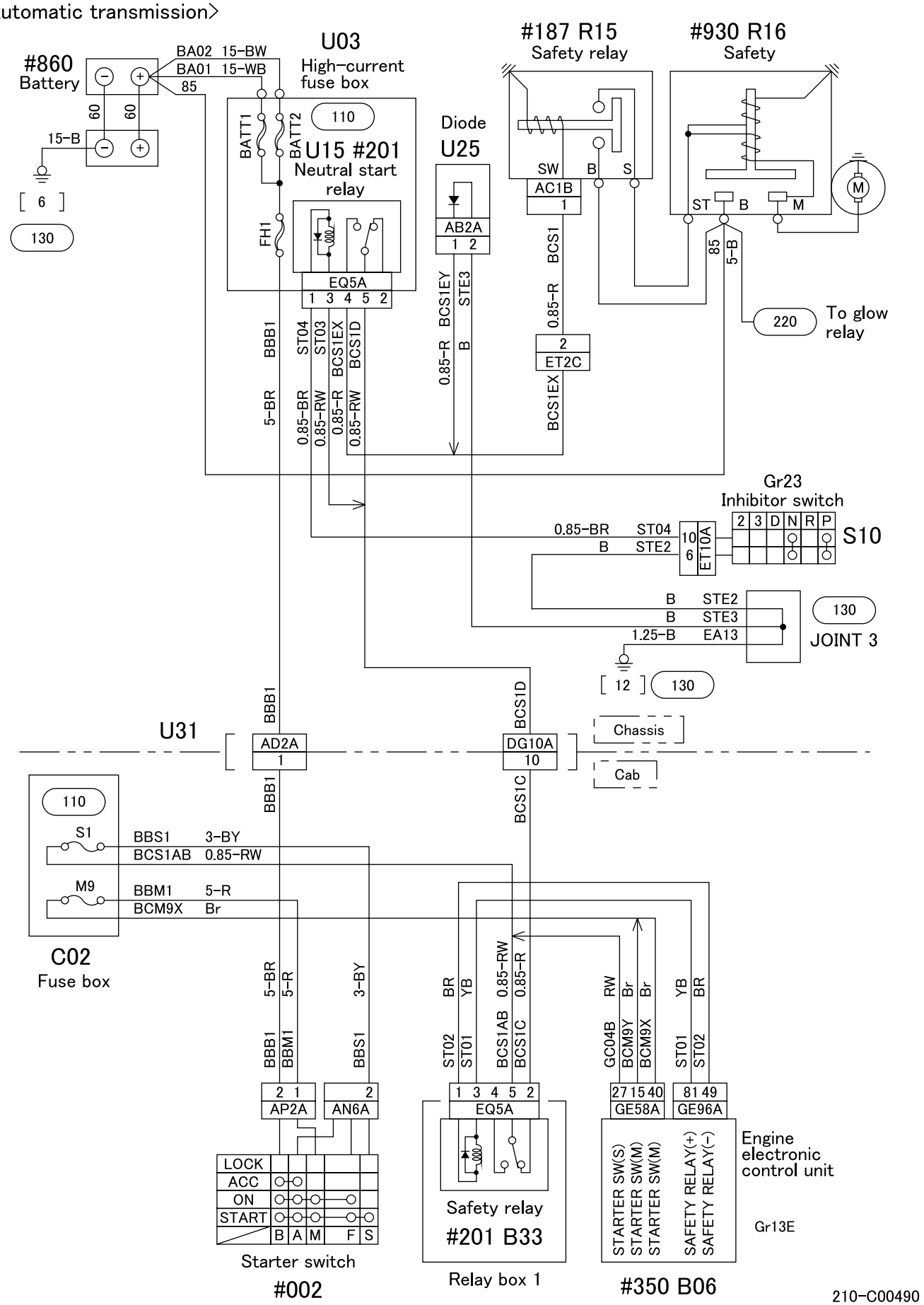
Circuit No.EA14 chassis ground

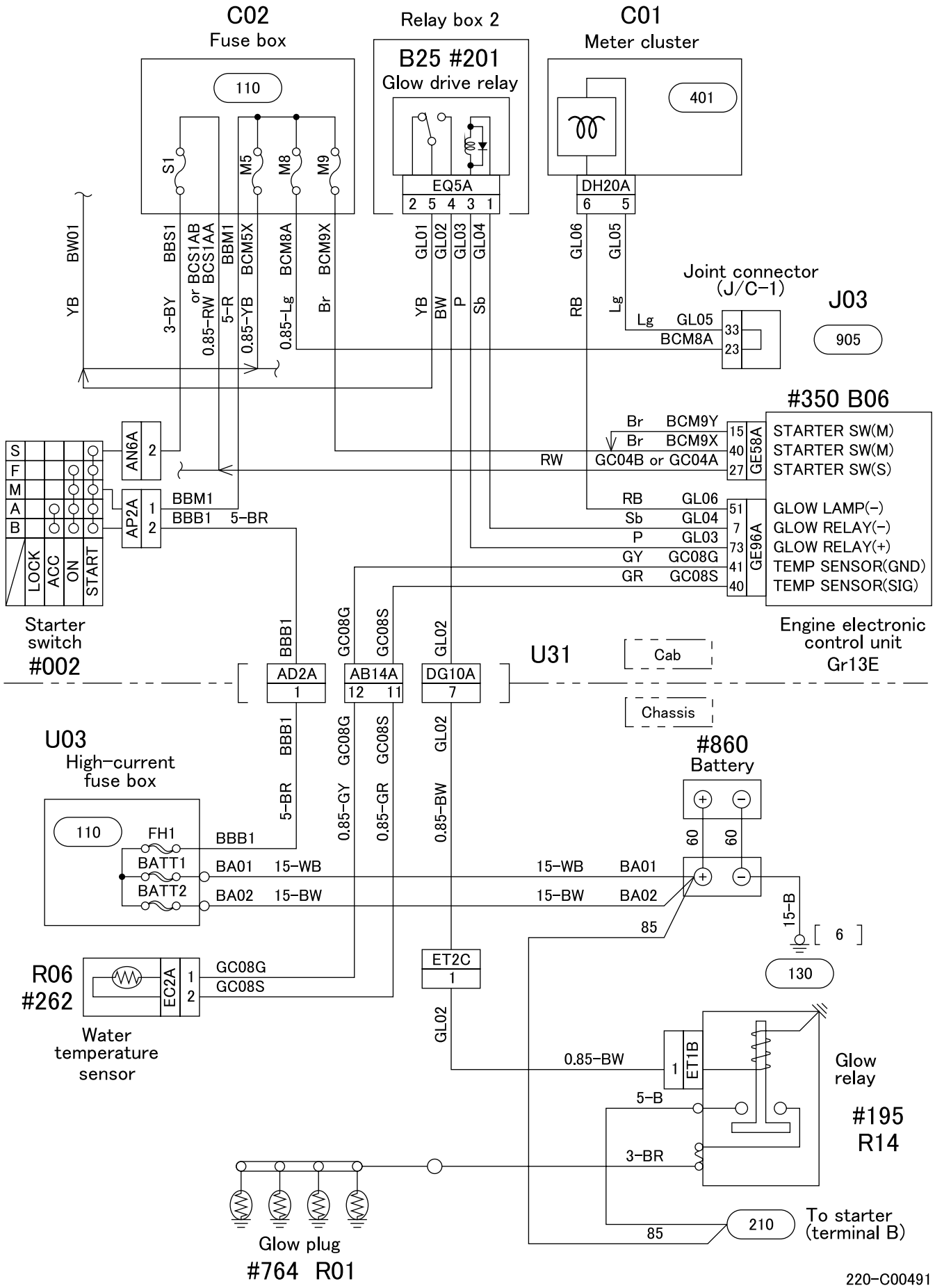


C02276

54-02 STARTING CIRCUIT

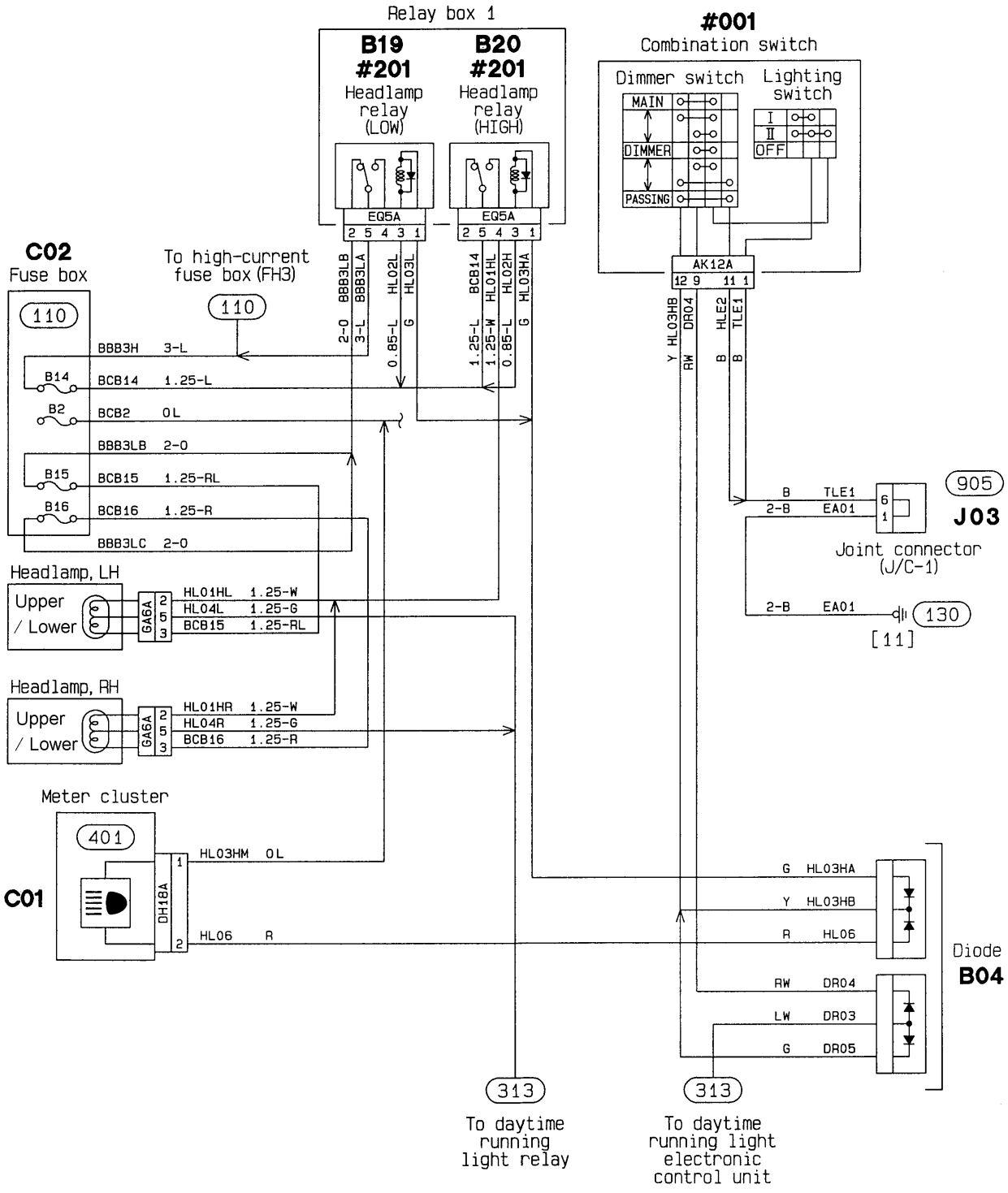
<Automatic transmission>




C02
Fuse box
110
S1
M5
M8
M9
Relay box 2
B25 #201
Glow drive relay
EQ5A
2 5 4 3 1
C01
Meter cluster
401
DH20A
6 5
BW01
YB
BBS1
3-BY
BCS1AB
or BCS1AA
0.85-RW
BBM1
5-R
BCM5X
0.85-YB
BCM8A
0.85-Lg
BCM9X
Br
GL01
YB
GL02
BW
GL03
P
GL04
Sb
GL06
RB
GL05
Lg
Joint connector
(J/C-1)
J03
905
Lg GL05
BCM8A
33
23
#350 B06
Br BCM9Y
Br BCM9X
RW GC04B or GC04A
15
40
27
GE58A
STARTER SW(M)
STARTER SW(M)
STARTER SW(S)
RB GL06
Sb GL04
P GL03
GY GC08G
GR GC08S
51
7
73
41
40
GE96A
GLOW LAMP(-)
GLOW RELAY(-)
GLOW RELAY(+)
TEMP SENSOR(GND)
TEMP SENSOR(SIG)
Engine electronic
control unit
Gr13E
S
F
M
A
B
LOCK
ACC
ON
START
AN6A
2
AP2A
1
2
BBM1
BBB1
5-BR
Starter
switch
#002
BBB1
GC08G
GC08S
GL02
AD2A
1
AB14A
12 11
DG10A
7
U31
Cab
Chassis
U03
High-current
fuse box
110
FH1
BATT1
BATT2
BBB1
BA01
15-WB
BA02
15-BW
5-BR
0.85-GY
0.85-GR
0.85-BW
#860
Battery
60
60
15-WB BA01
15-BW BA02
85
15-B
[6]
130
R06
#262
EC2A
1
2
GC08G
GC08S
Water
temperature
sensor
ET2C
1
GL02
0.85-BW
1
ET1B
5-B
3-BR
Glow
relay
#195
R14
Glow plug
#764 R01
85
210
To starter
(terminal B)

220-C00491

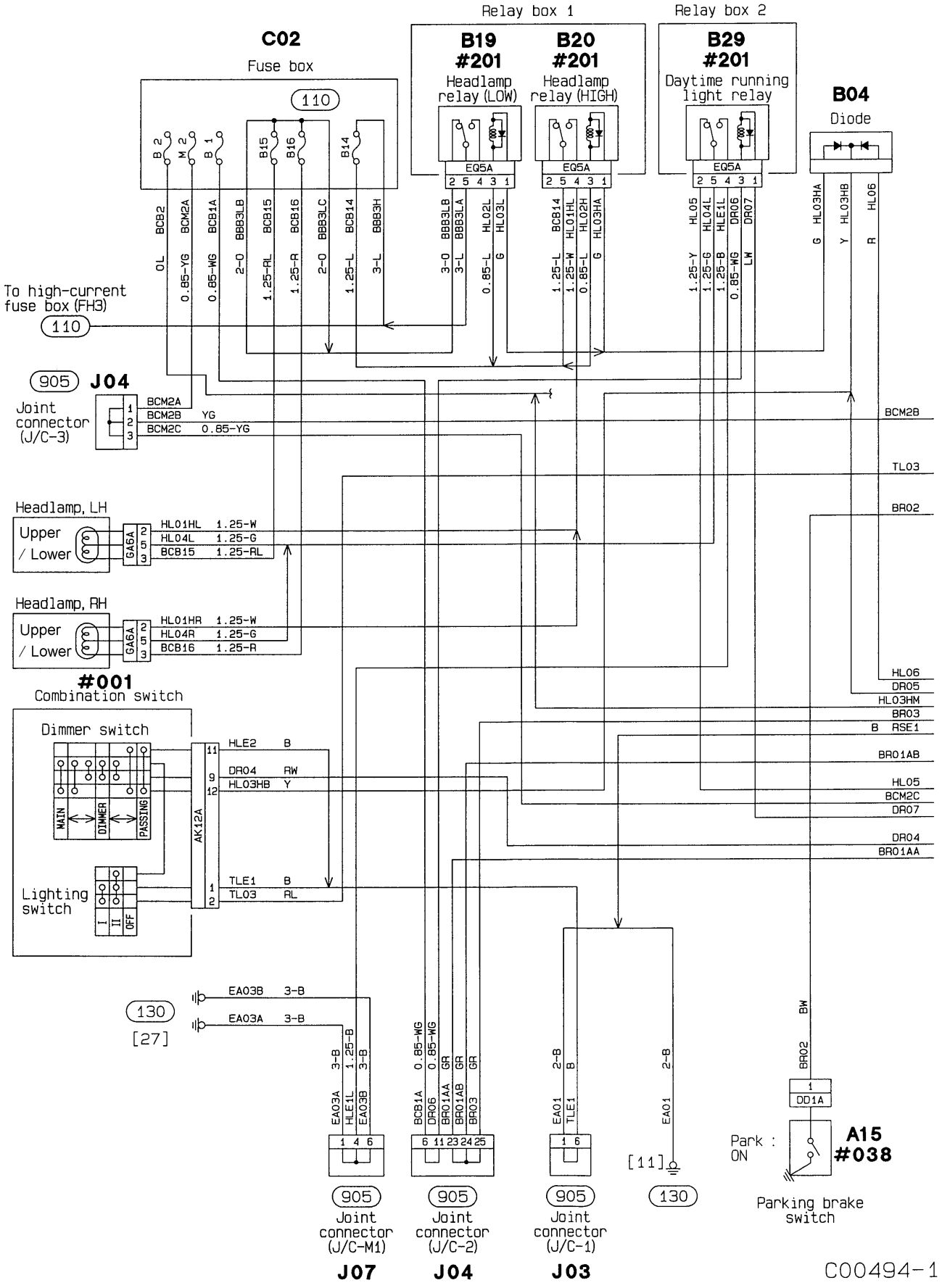
54-03 LIGHTING CIRCUIT

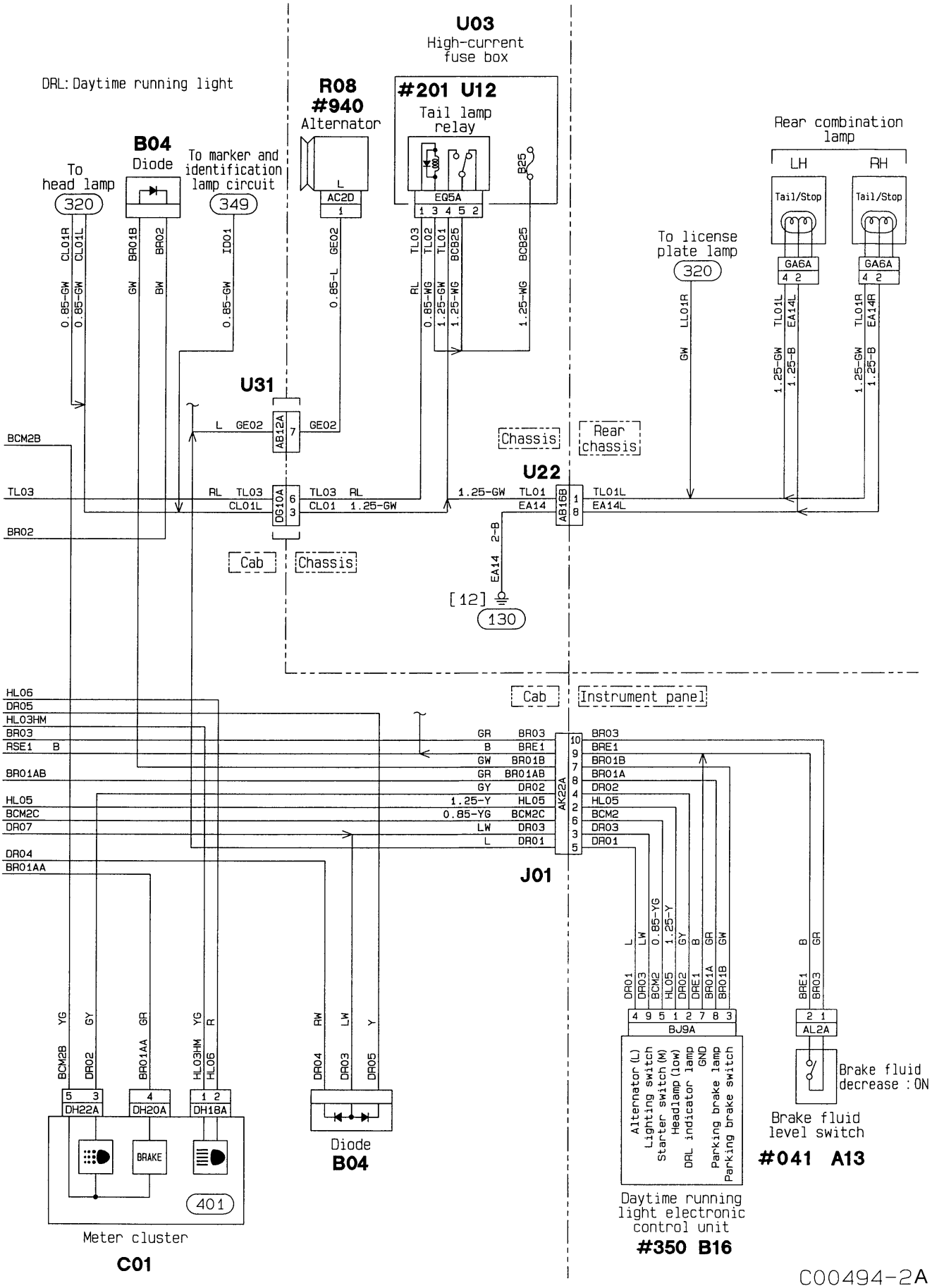

Relay box 1
B19
#201
Headlamp relay (LOW)
B20
#201
Headlamp relay (HIGH)
EQ5A
2 5 4 3 1
#001
Combination switch
Dimmer switch
Lighting switch
MAIN
DIMMER
PASSING
I
II
OFF
AK12A
12 9 11 1
C02
Fuse box
To high-current fuse box (FH3)
110
BBB3H 3-L
B14 BCB14 1.25-L
B2 BCB2 0L
BBB3LB 2-0
B15 BCB15 1.25-RL
B16 BCB16 1.25-R
BBB3LC 2-0
Headlamp, LH
Upper / Lower
GA6A
HL01HL 1.25-W
HL04L 1.25-G
BCB15 1.25-RL
Headlamp, RH
HL01HR 1.25-W
HL04R 1.25-G
BCB16 1.25-R
Meter cluster
401
C01
DH18A
HL03HM 0L
HL06 R
B TLE1
2-B EA01
905
J03
Joint connector (J/C-1)
2-B EA01
130
[11]
G HL03HA
Y HL03HB
R HL06
RW DR04
LW DR03
G DR05
Diode
B04
313
To daytime running light relay
313
To daytime running light electronic control unit

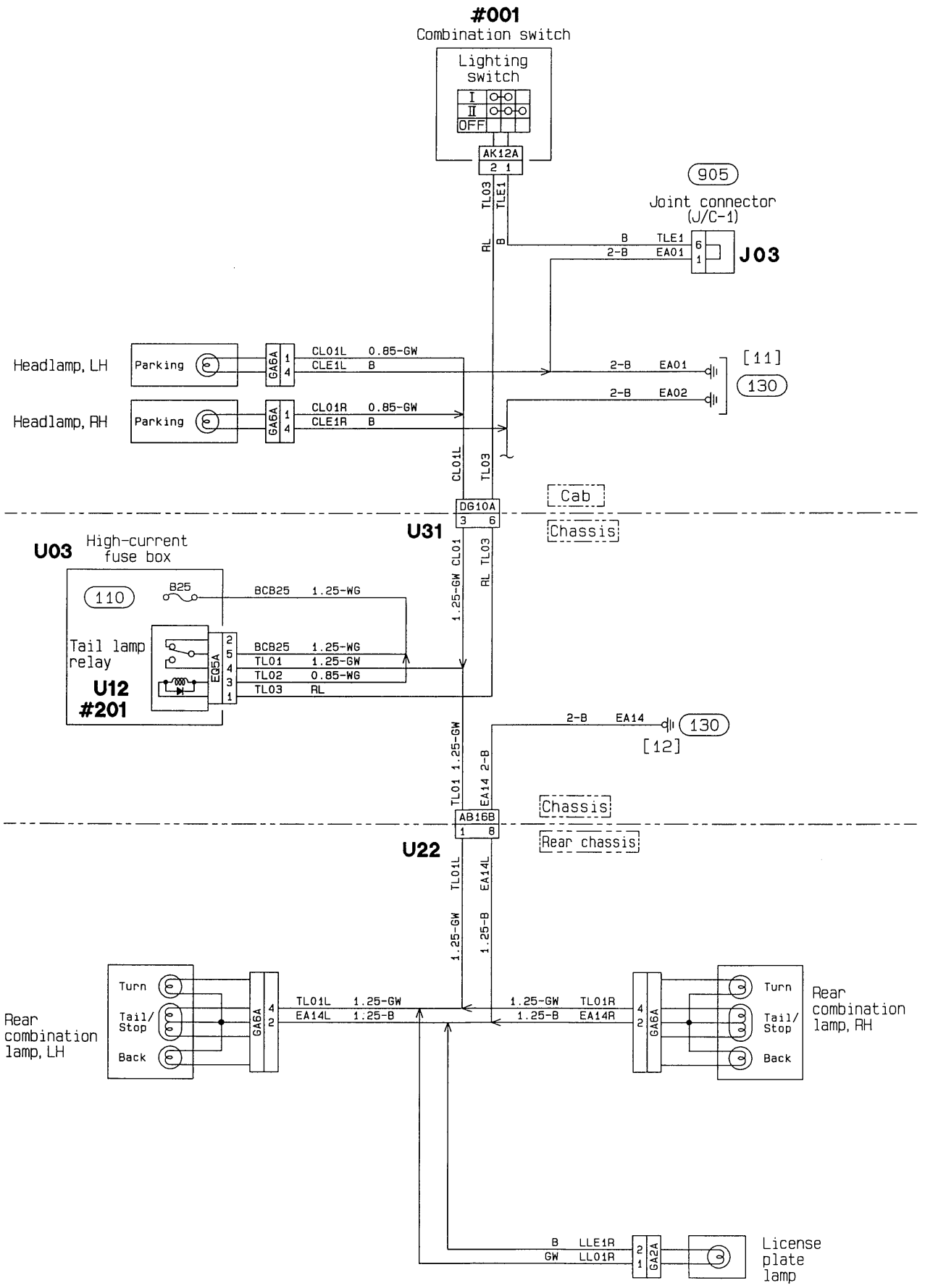
C00493

M E M O

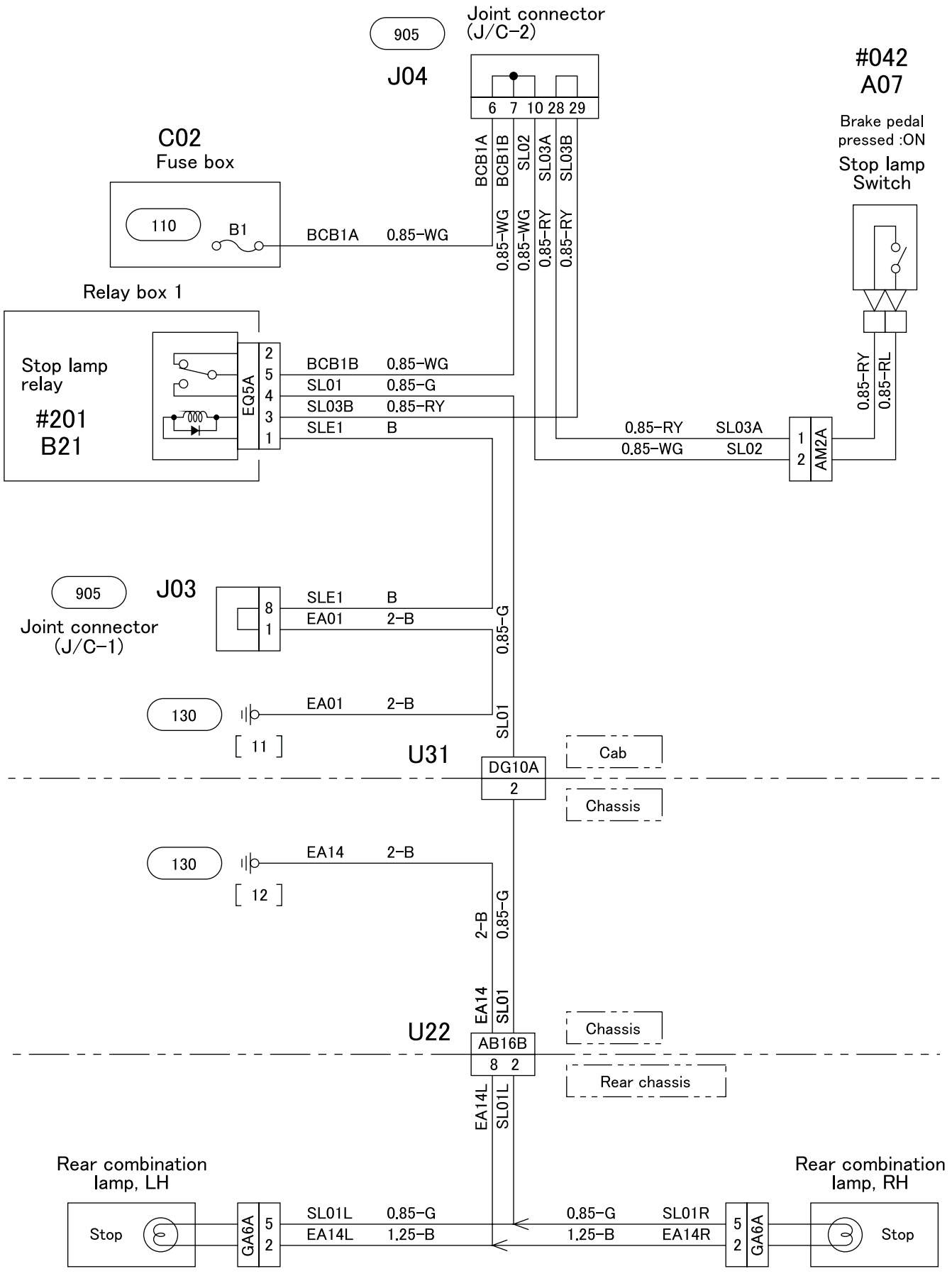
313 DAYTIME RUNNING LIGHT CIRCUIT




DRL: Daytime running light
U03
High-current fuse box
R08
#940
Alternator
#201 U12
Tail lamp relay
B04
Diode
To head lamp
320
To marker and identification lamp circuit
349
Rear combination lamp
LH
RH
Tail/Stop
GA6A
To license plate lamp
320
U31
U22
Chassis
Rear chassis
Cab
Chassis
[12]
130
Cab
Instrument panel
J01
Meter cluster
C01
Diode
B04
Daytime running light electronic control unit
#350 B16
Brake fluid level switch
#041 A13
Brake fluid decrease : ON
BRAKE
401
C00494-2A

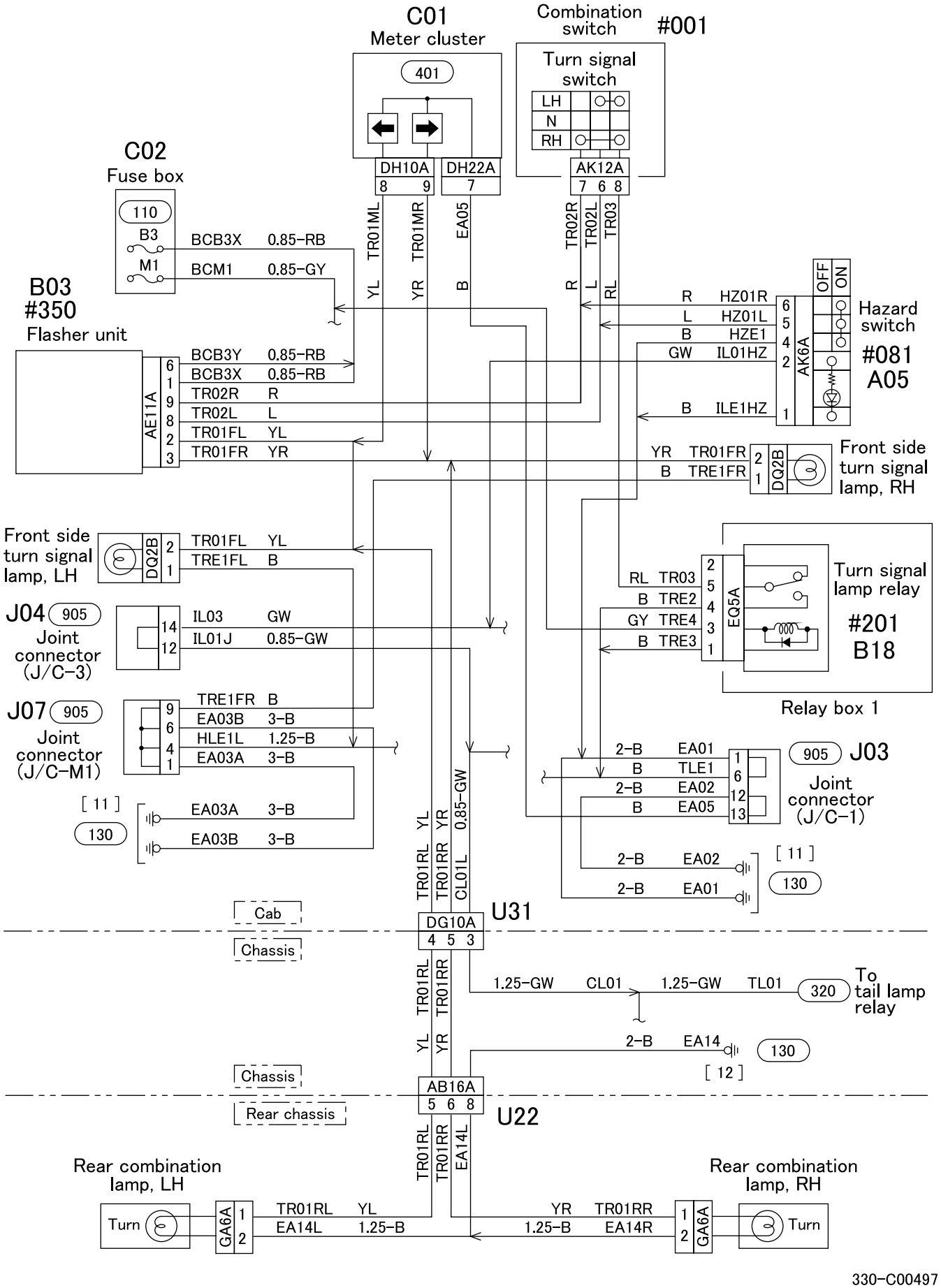

#001
Combination switch
Lighting switch
I
II
OFF
AK12A
2 1
905
Joint connector (J/C-1)
J03
TL03
TLE1
RL
B
TLE1
EA01
2-B
6
1
Headlamp, LH
Parking
GA6A
CL01L
0.85-GW
CLE1L
B
Headlamp, RH
CL01R
CLE1R
2-B
EA01
EA02
[11]
130
CL01L
TL03
Cab
DG10A
3 6
U31
Chassis
U03
High-current fuse box
110
B25
BCB25
1.25-WG
Tail lamp relay
U12
#201
EQ5A
TL01
TL02
0.85-WG
1.25-GW CL01
RL TL03
EA14
2-B
[12]
TL01 1.25-GW
EA14 2-B
AB16B
1 8
Rear chassis
U22
TL01L
EA14L
1.25-B
Rear combination lamp, LH
Turn
Tail/ Stop
Back
Rear combination lamp, RH
LLE1R
LL01R
GW
GA2A
License plate lamp

C02277


905
J04
Joint connector
(J/C-2)
6 7 10 28 29
#042
A07
Brake pedal
pressed :ON
Stop lamp
Switch
C02
Fuse box
110
B1
BCB1A 0.85-WG
BCB1A
BCB1B
SL02
SL03A
SL03B
0.85-WG
0.85-WG
0.85-RY
0.85-RY
Relay box 1
Stop lamp
relay
#201
B21
EQ5A
2
5
4
3
1
BCB1B 0.85-WG
SL01 0.85-G
SL03B 0.85-RY
SLE1 B
0.85-RY SL03A
0.85-WG SL02
1
2
AM2A
0.85-RY
0.85-RL
905
J03
Joint connector
(J/C-1)
8
1
SLE1 B
EA01 2-B
0.85-G
130
EA01 2-B
[11]
SL01
U31
DG10A
2
Cab
Chassis
130
EA14 2-B
[12]
2-B
0.85-G
EA14
SL01
U22
AB16B
8 2
Chassis
Rear chassis
EA14L
SL01L
Rear combination
lamp, LH
Stop
GA6A
5
2
SL01L 0.85-G
EA14L 1.25-B
0.85-G SL01R
1.25-B EA14R
5
2
GA6A
Rear combination
lamp, RH
Stop

325-C00496

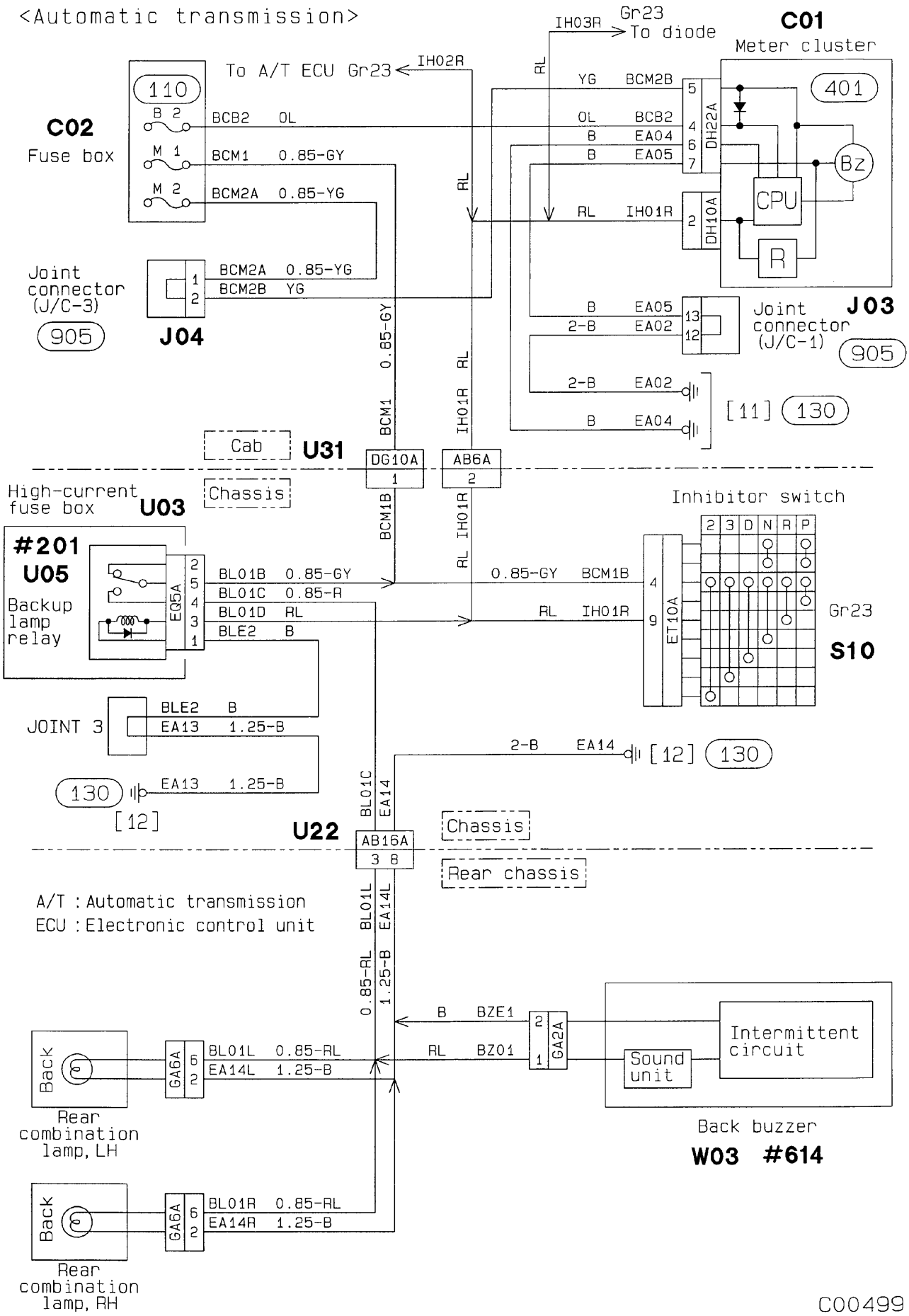
330 TURN SIGNAL AND HAZARD LAMP CIRCUIT

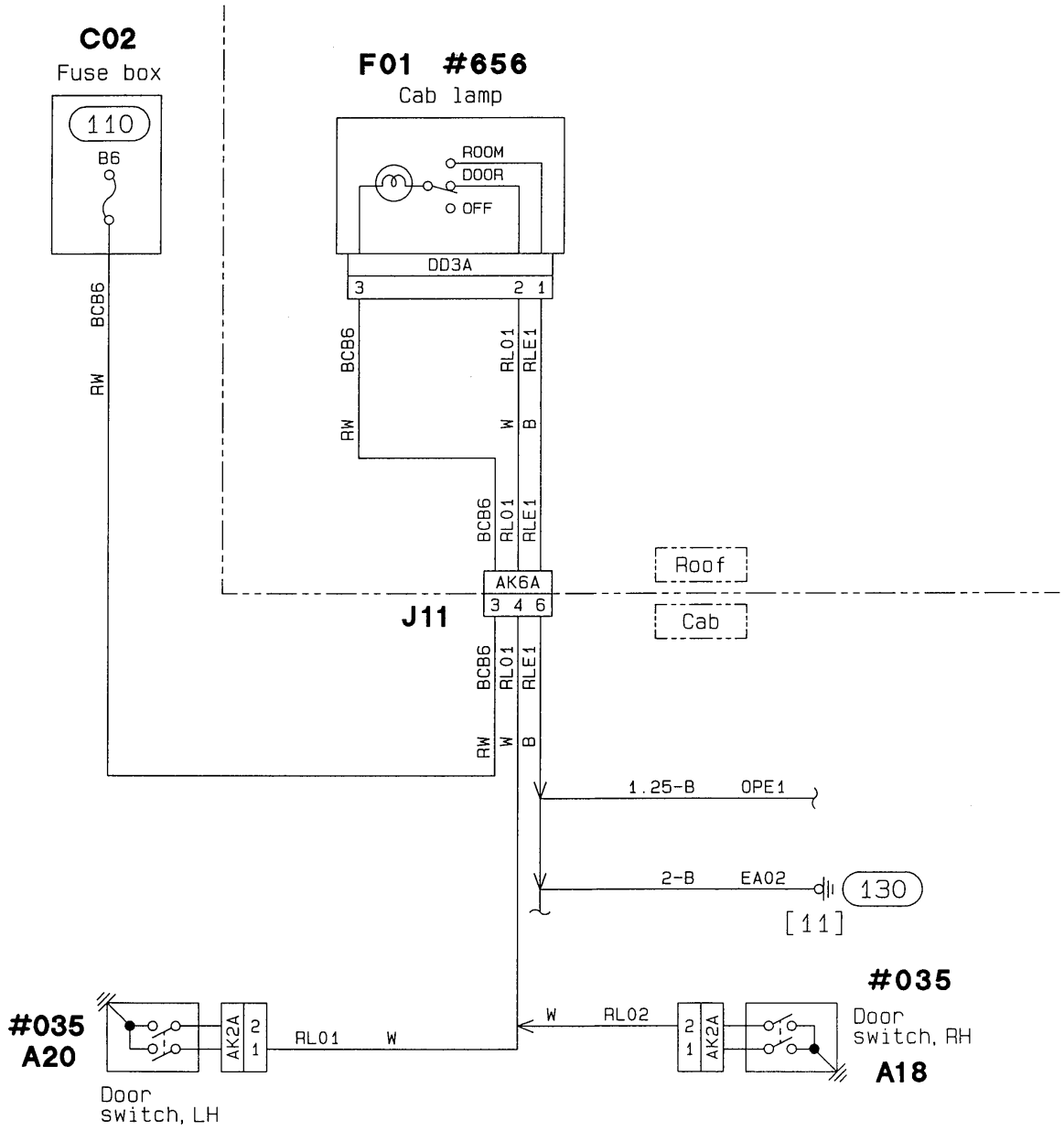


330-C00497

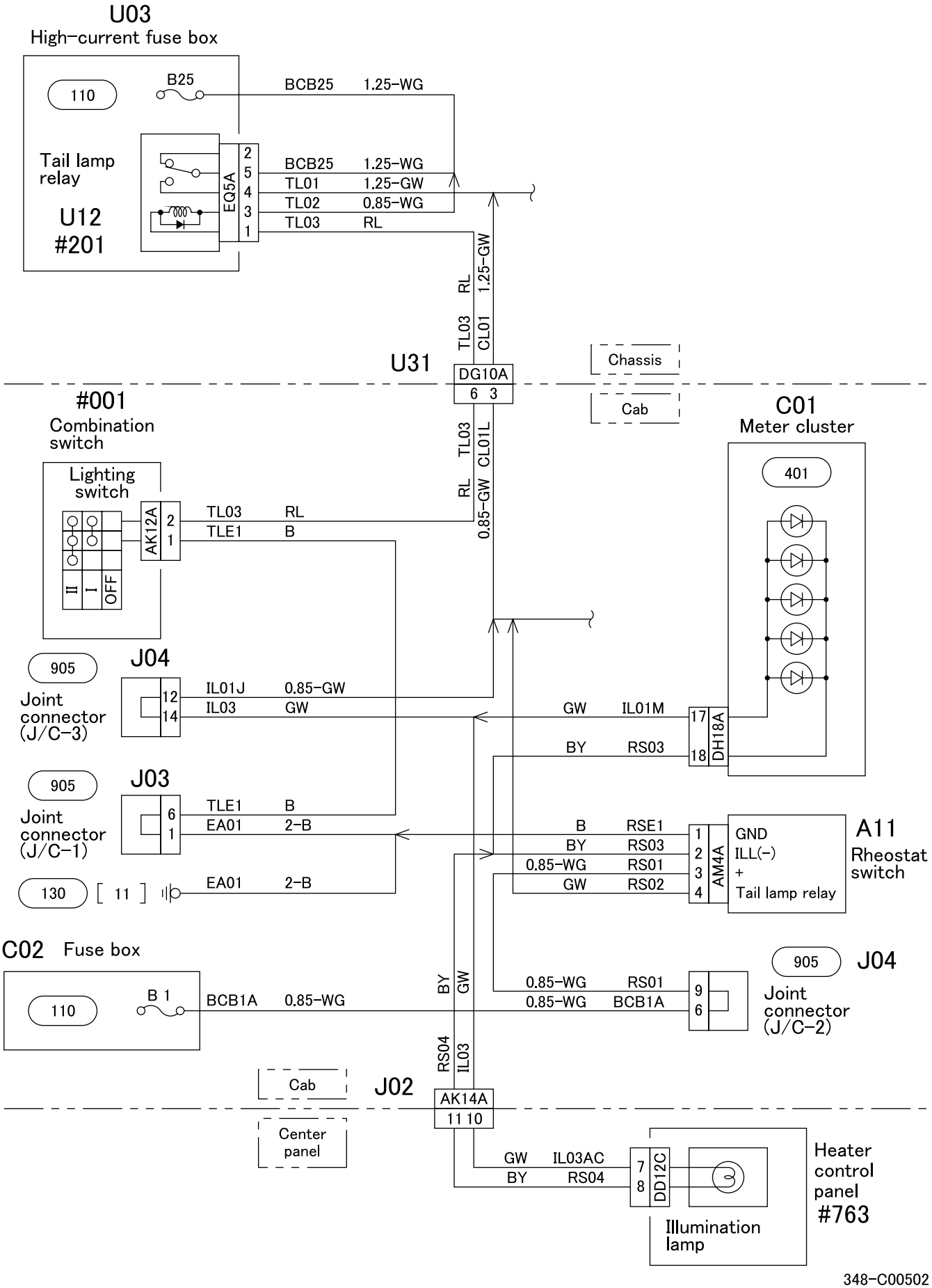
M E M O

340 BACKUP LAMP CIRCUIT

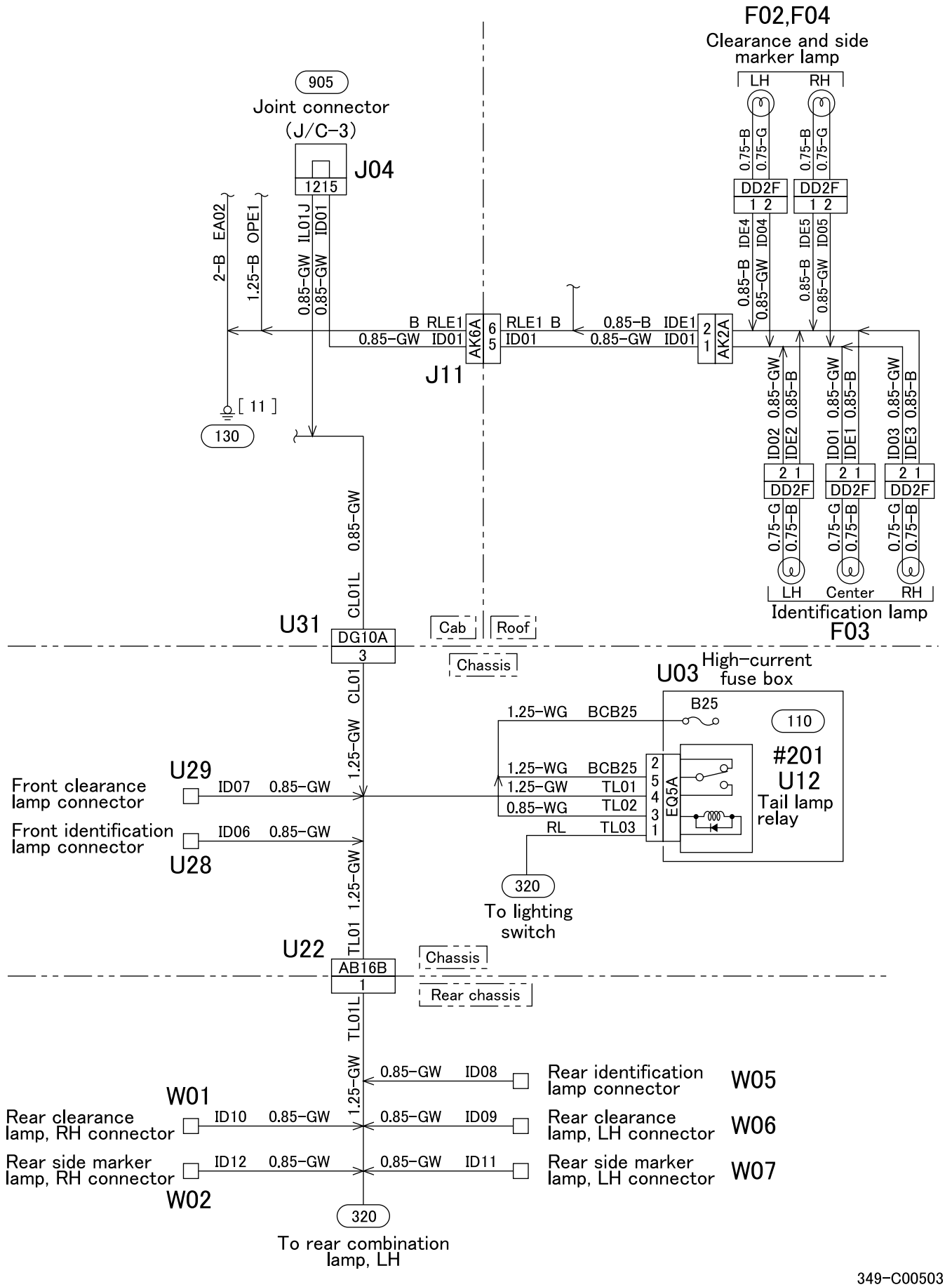



C02
Fuse box
110
B6
BCB6
RW
F01 #656
Cab lamp
ROOM
DOOR
OFF
DD3A
3
2 1
BCB6
RW
RL01
RLE1
W
B
AK6A
3 4 6
J11
Roof
Cab
1.25-B OPE1
2-B EA02
130
[11]
#035
A20
AK2A
2
1
RL01 W
W RL02
#035
Door
switch, RH
A18
Door
switch, LH

348 ILLUMINATION LAMP CIRCUIT

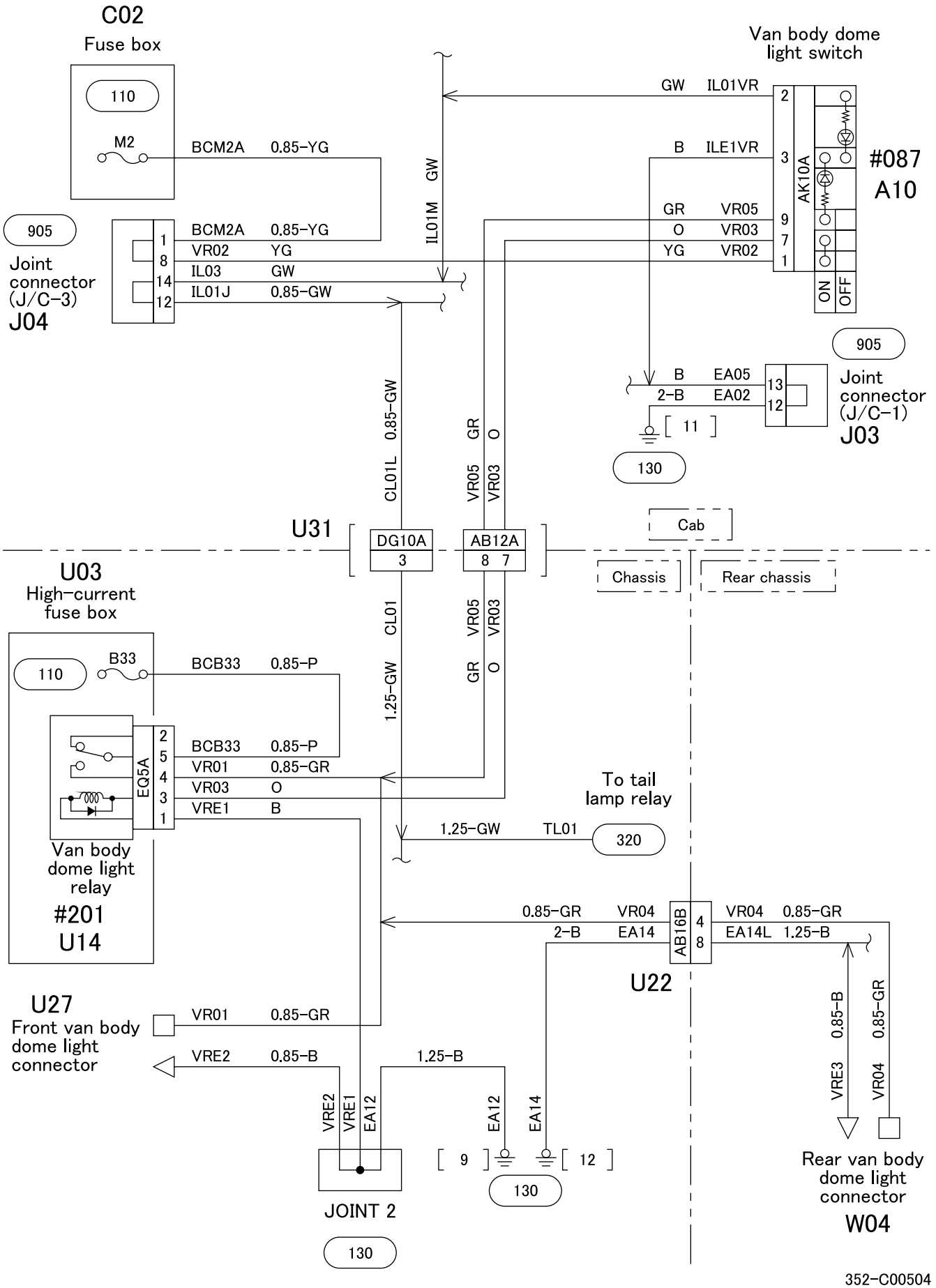


348-C00502


F02,F04
Clearance and side marker lamp
LH
RH
905
Joint connector
(J/C-3)
J04
1215
2-B EA02
1.25-B OPE1
0.85-GW IL01J
0.85-GW ID01
0.75-B
0.75-G
DD2F
1 2
IDE4 ID04
IDE5 ID05
0.85-B
0.85-GW
B RLE1
0.85-GW ID01
AK6A
6
5
RLE1 B
ID01
0.85-B IDE1
0.85-GW ID01
2
1
AK2A
J11
[11]
130
ID02 IDE2
ID01 IDE1
ID03 IDE3
0.85-GW
0.85-B
2 1
DD2F
LH
Center
RH
Identification lamp
F03
U31
DG10A
3
CL01L
0.85-GW
Cab
Roof
Chassis
CL01
1.25-GW
U03
High-current fuse box
B25
110
1.25-WG BCB25
#201
U12
Tail lamp relay
EQ5A
2
5
4
3
1
1.25-WG BCB25
1.25-GW TL01
0.85-WG TL02
RL TL03
U29
Front clearance lamp connector
ID07 0.85-GW
Front identification lamp connector
ID06 0.85-GW
U28
320
To lighting switch
TL01 1.25-GW
U22
AB16B
1
Chassis
Rear chassis
TL01L
1.25-GW
0.85-GW ID08
Rear identification lamp connector
W05
W01
Rear clearance lamp, RH connector
ID10 0.85-GW
0.85-GW ID09
Rear clearance lamp, LH connector
W06
Rear side marker lamp, RH connector
ID12 0.85-GW
0.85-GW ID11
Rear side marker lamp, LH connector
W07
W02
320
To rear combination lamp, LH

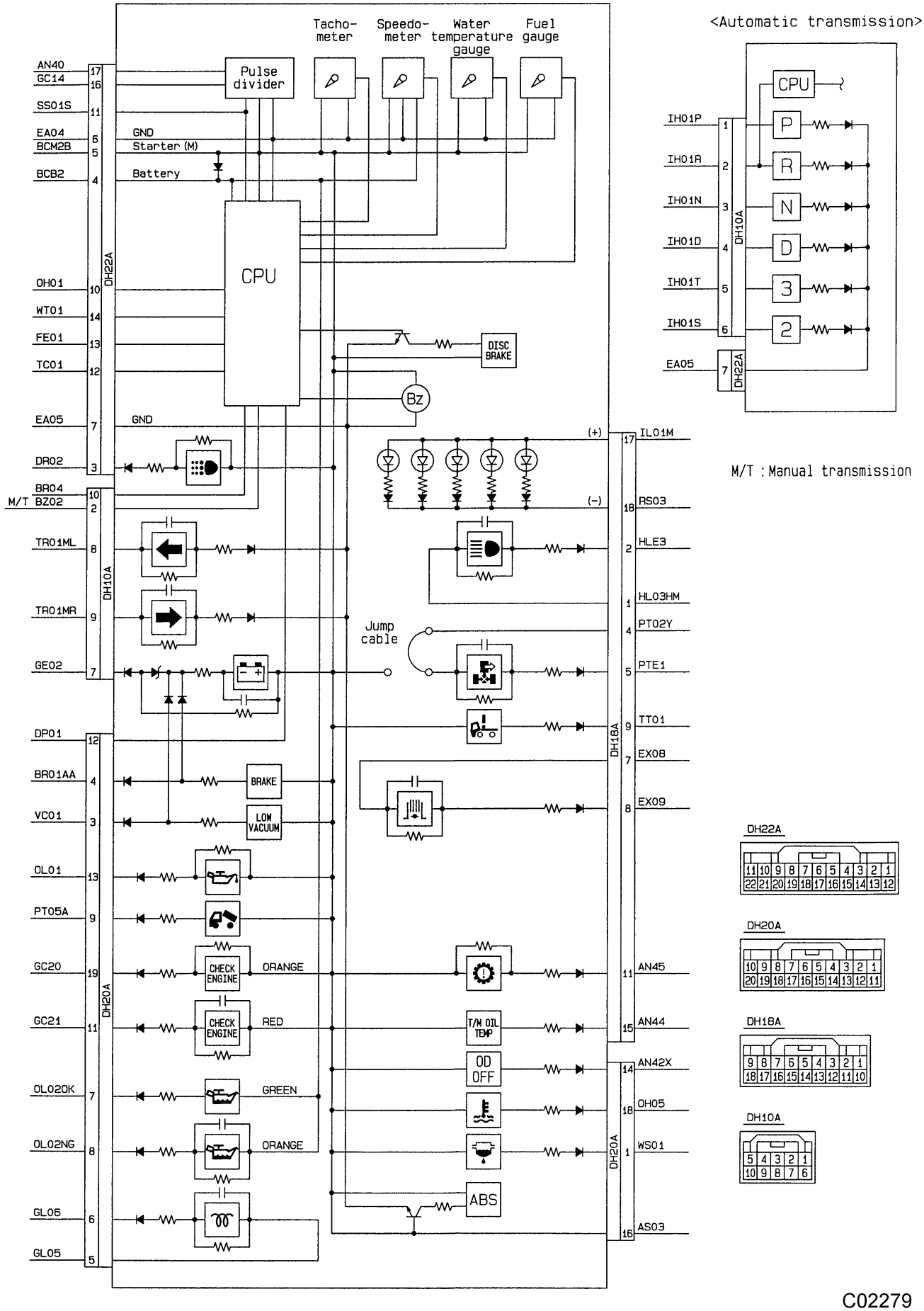
349-C00503

352 VAN BODY DOME LIGHT CIRCUIT



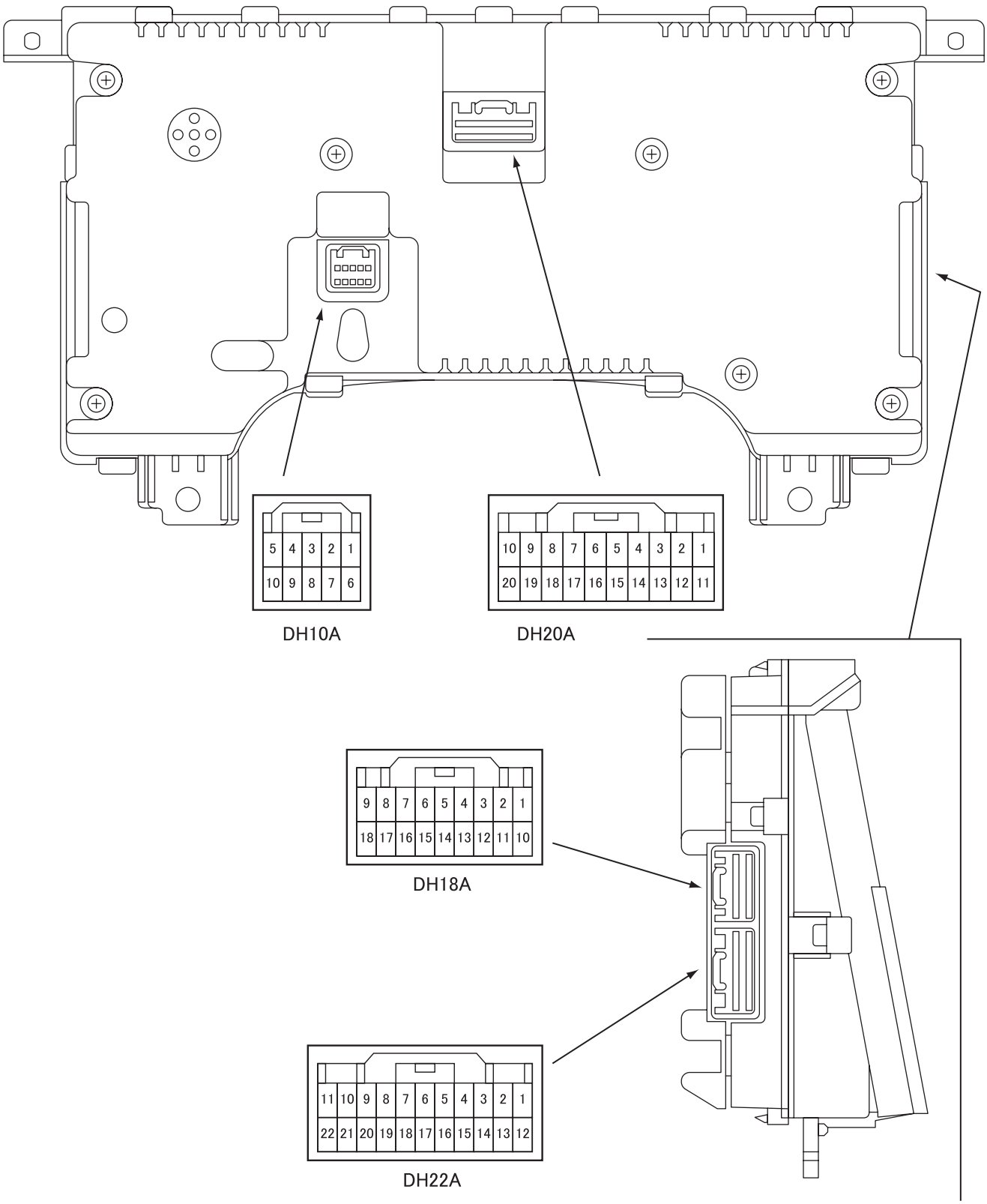
54-04 METER CIRCUIT

401 METER CLUSTER INTERNAL CIRCUIT

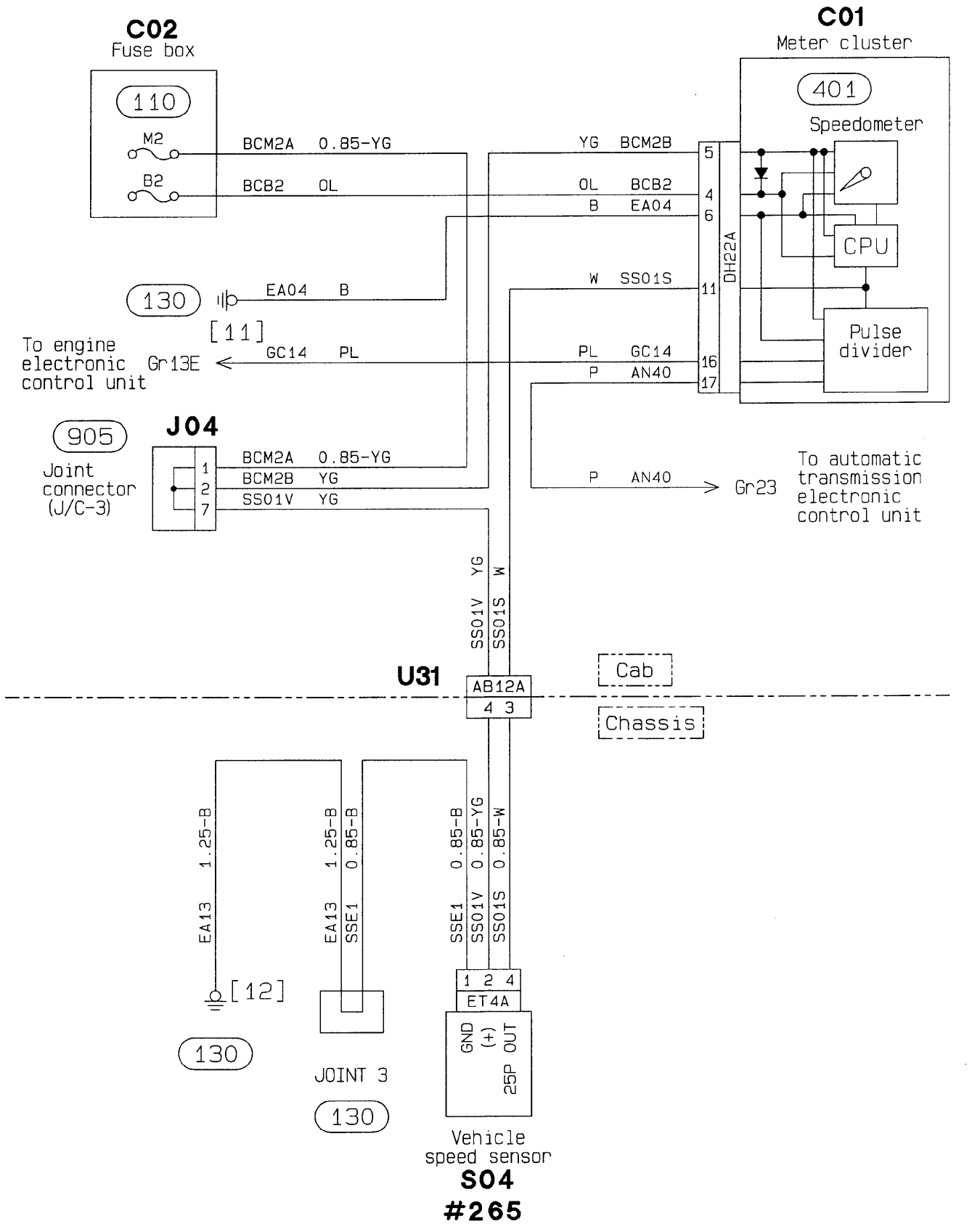


C02279

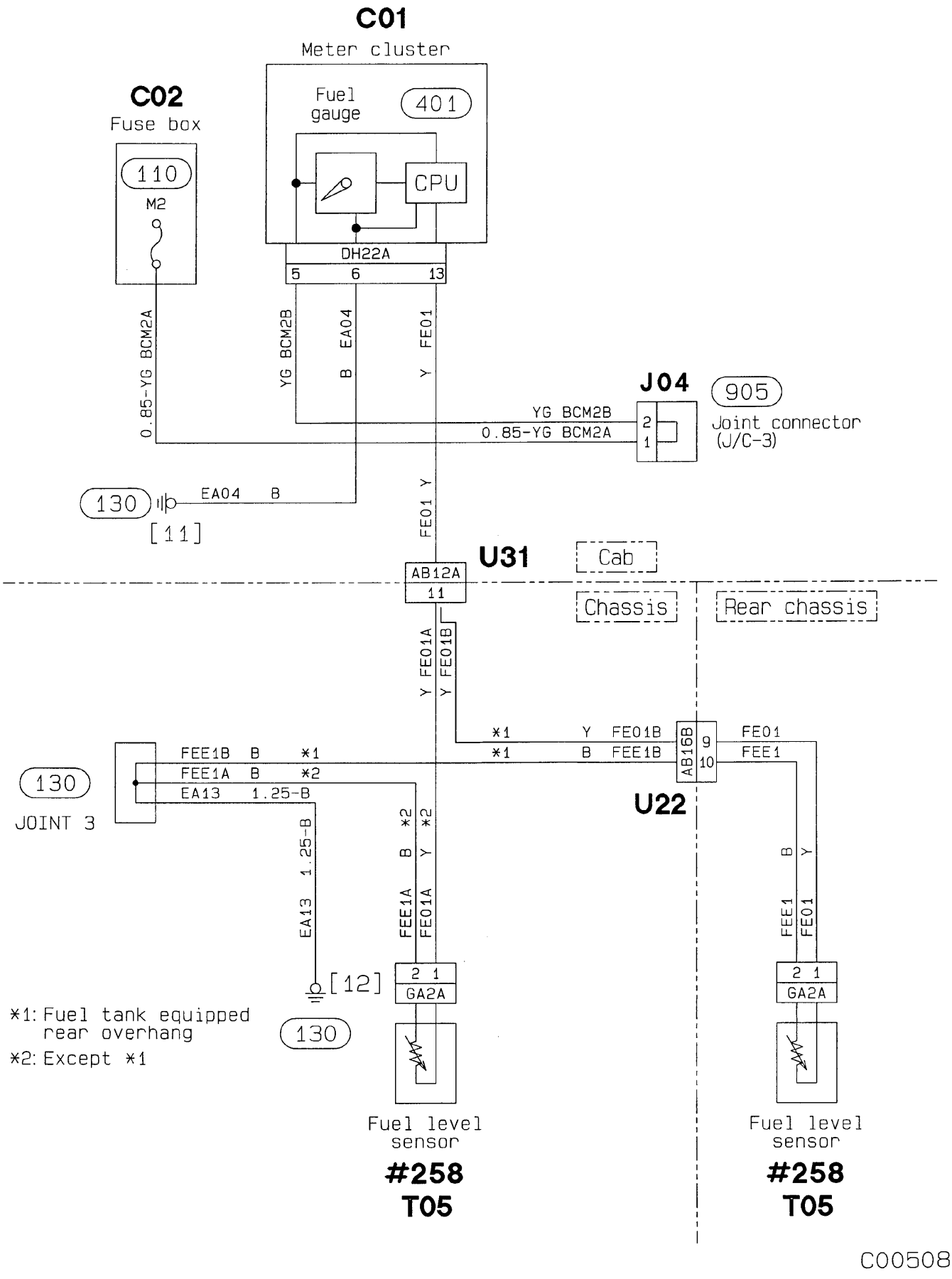
Meter cluster backward view



Because a CPU is built into the meter, the inner part of the meter body cannot be disassembled.

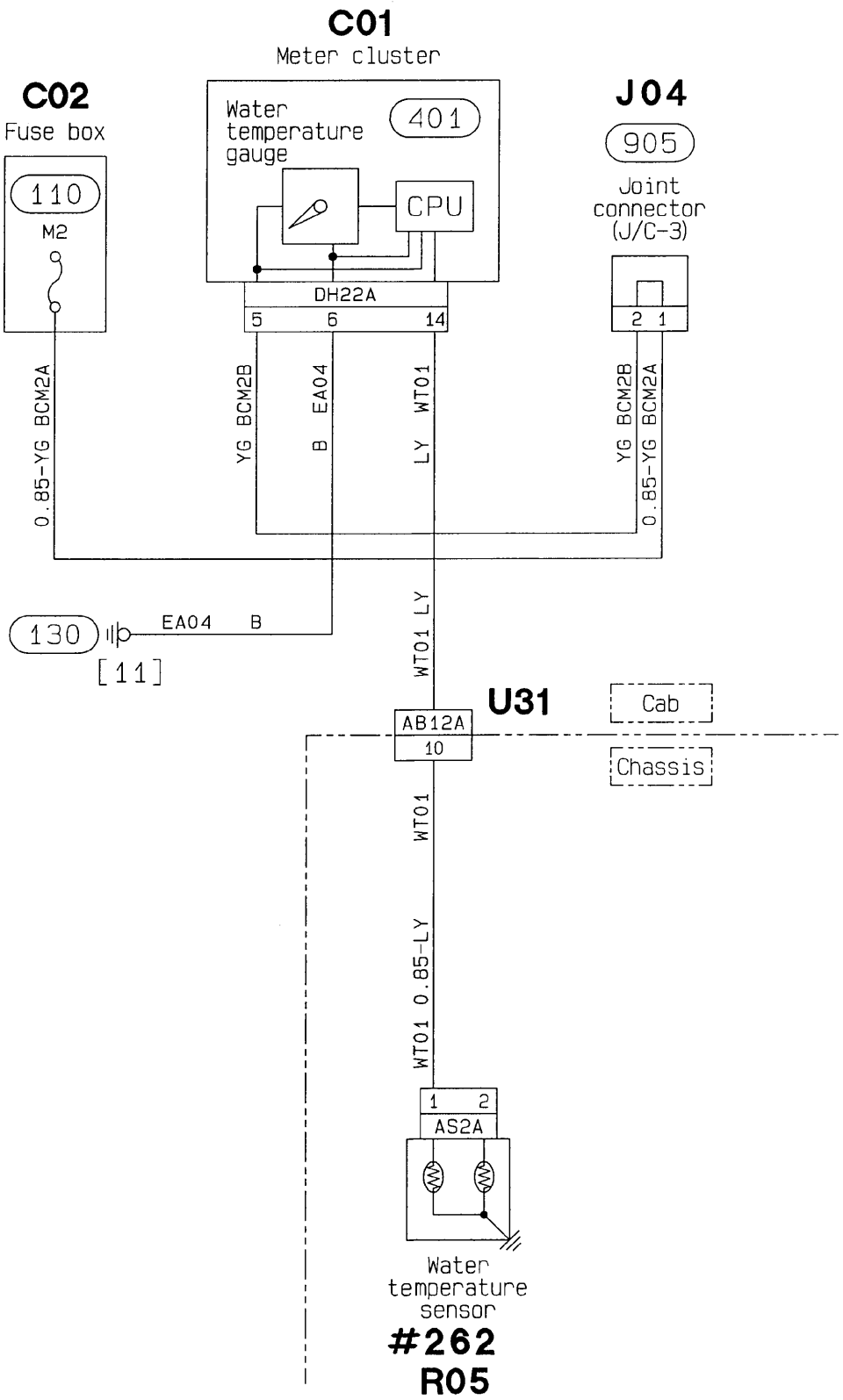

C02
Fuse box
110
M2
B2
BCM2A 0.85-YG
BCB2 OL
C01
Meter cluster
401
Speedometer
YG BCM2B
OL BCB2
B EA04
5
4
6
DH22A
CPU
Pulse divider
W SS01S
11
130
EA04 B
[11]
To engine electronic control unit
Gr13E
GC14 PL
PL GC14
P AN40
16
17
905
Joint connector (J/C-3)
J04
1
2
7
BCM2A 0.85-YG
BCM2B YG
SS01V YG
P AN40
Gr23
To automatic transmission electronic control unit
SS01V YG
SS01S W
U31
AB12A
4 3
Cab
Chassis
EA13 1.25-B
[12]
130
EA13 1.25-B
SSE1 0.85-B
JOINT 3
130
SSE1 0.85-B
SS01V 0.85-YG
SS01S 0.85-W
1 2 4
ET4A
GND (+)
25P OUT
Vehicle speed sensor
S04
#265

C00506


C01
Meter cluster
Fuel gauge
401
CPU
DH22A
5
6
13
C02
Fuse box
110
M2
0.85-YG BCM2A
YG BCM2B
B EA04
Y FE01
J04
905
Joint connector (J/C-3)
YG BCM2B
0.85-YG BCM2A
2
1
130
EA04 B
[11]
FE01 Y
U31
Cab
AB12A
11
Chassis
Rear chassis
Y FE01A
Y FE01B
*1 Y FE01B
*1 B FEE1B
AB16B
9
10
FE01
FEE1
FEE1B B *1
FEE1A B *2
EA13 1.25-B
130
JOINT 3
U22
EA13 1.25-B
FEE1A B *2
FE01A Y *2
[12]
2 1
GA2A
130
*1: Fuel tank equipped rear overhang
*2: Except *1
Fuel level sensor
#258
T05
FEE1 B
FE01 Y
Fuel level sensor
#258
T05

C00508

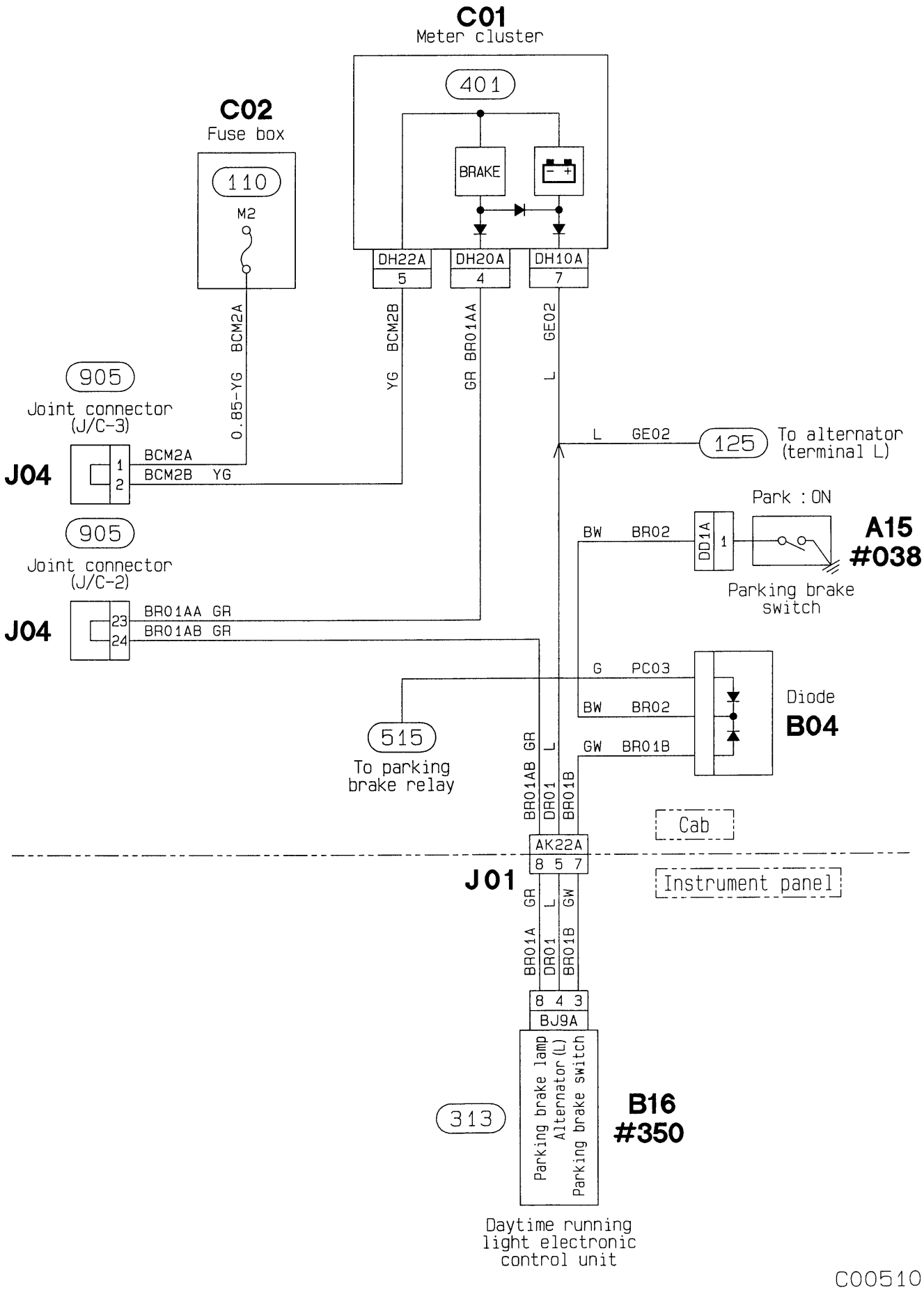
425 WATER TEMPERATURE GAUGE CIRCUIT



C00509

54-05 INDICATOR AND WARNING LAMP CIRCUIT

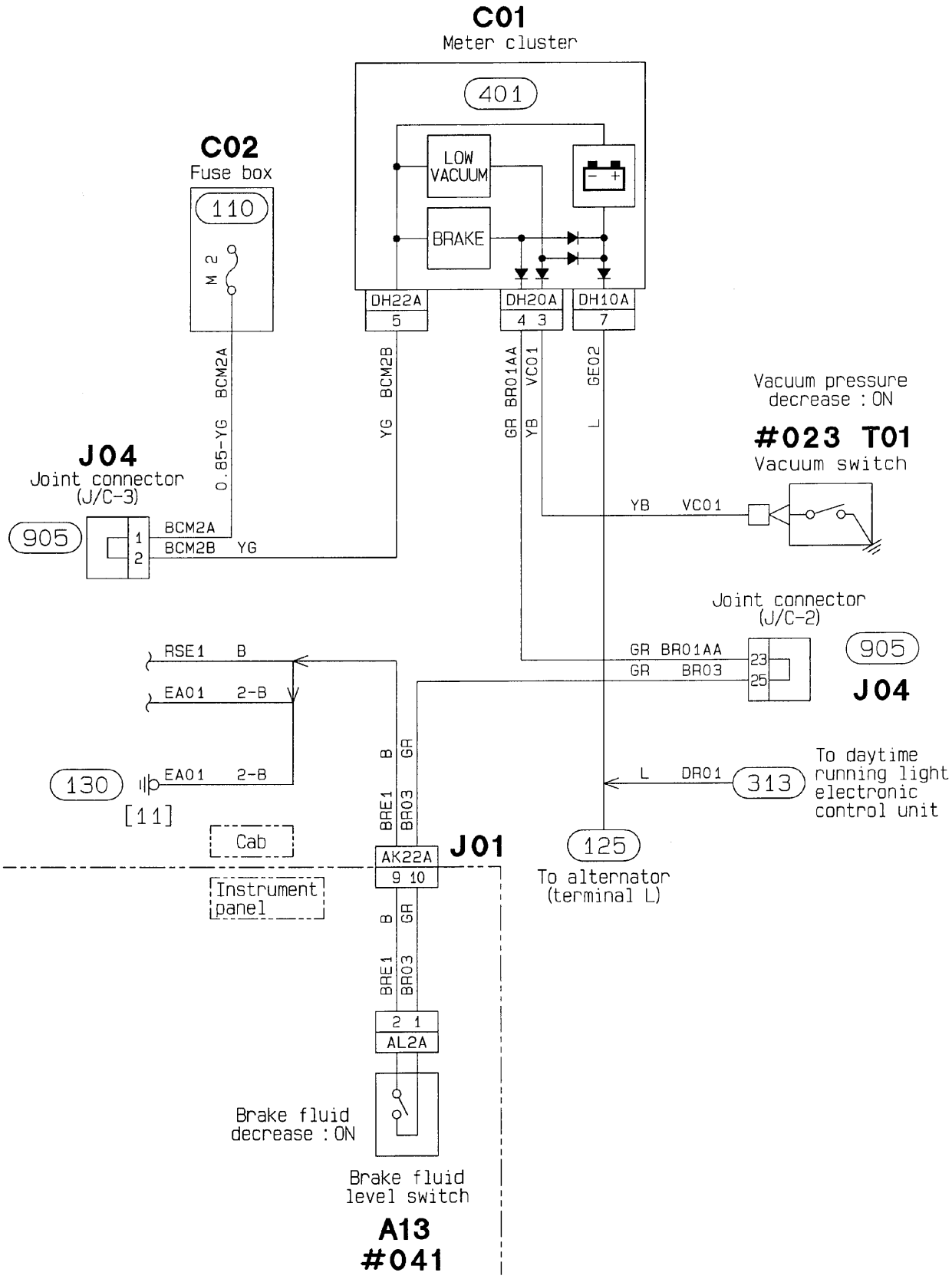
510 PARKING BRAKE INDICATOR CIRCUIT



M E M O

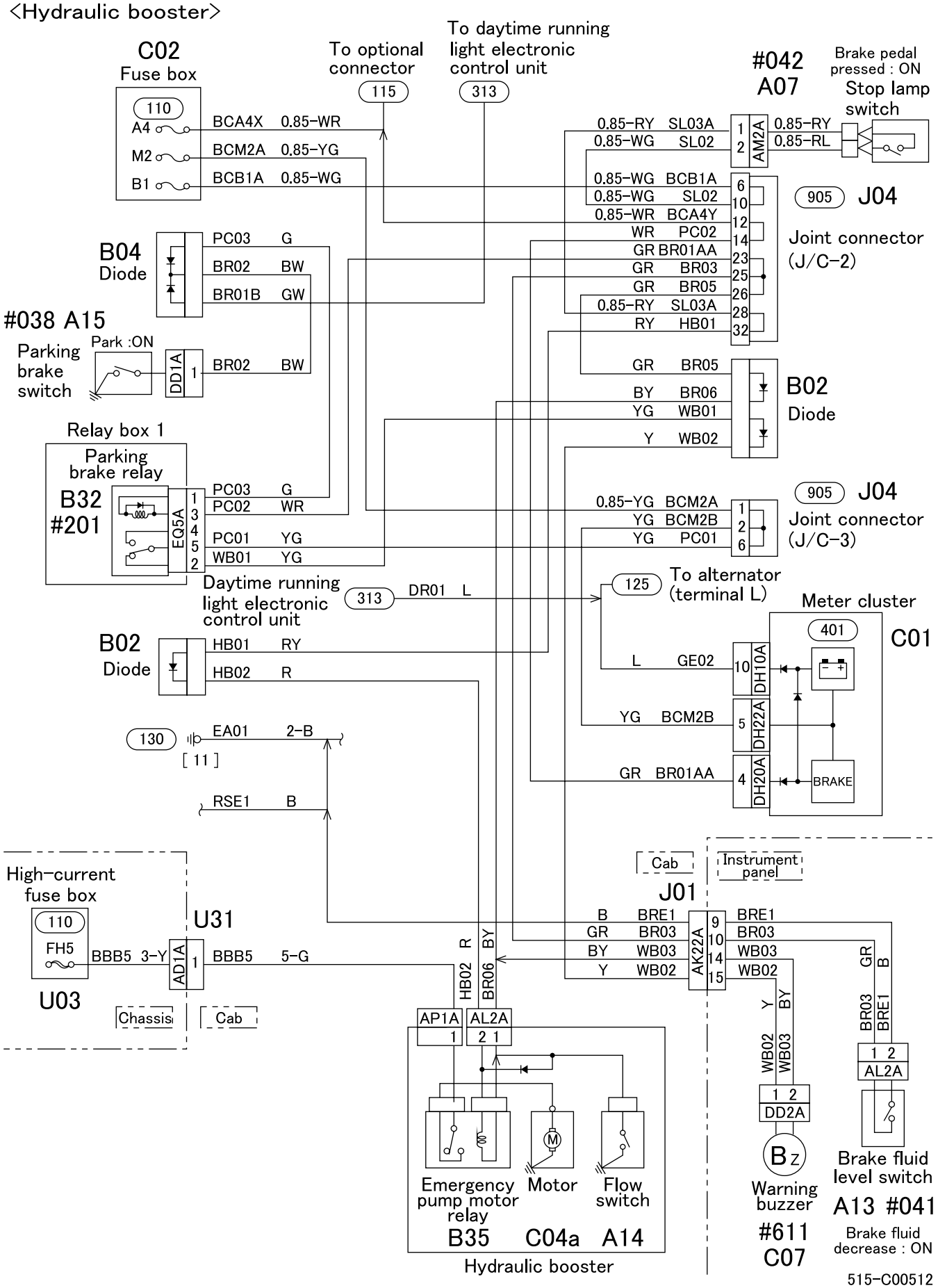
515 BRAKE WARNING CIRCUIT

<Except hydraulic booster>



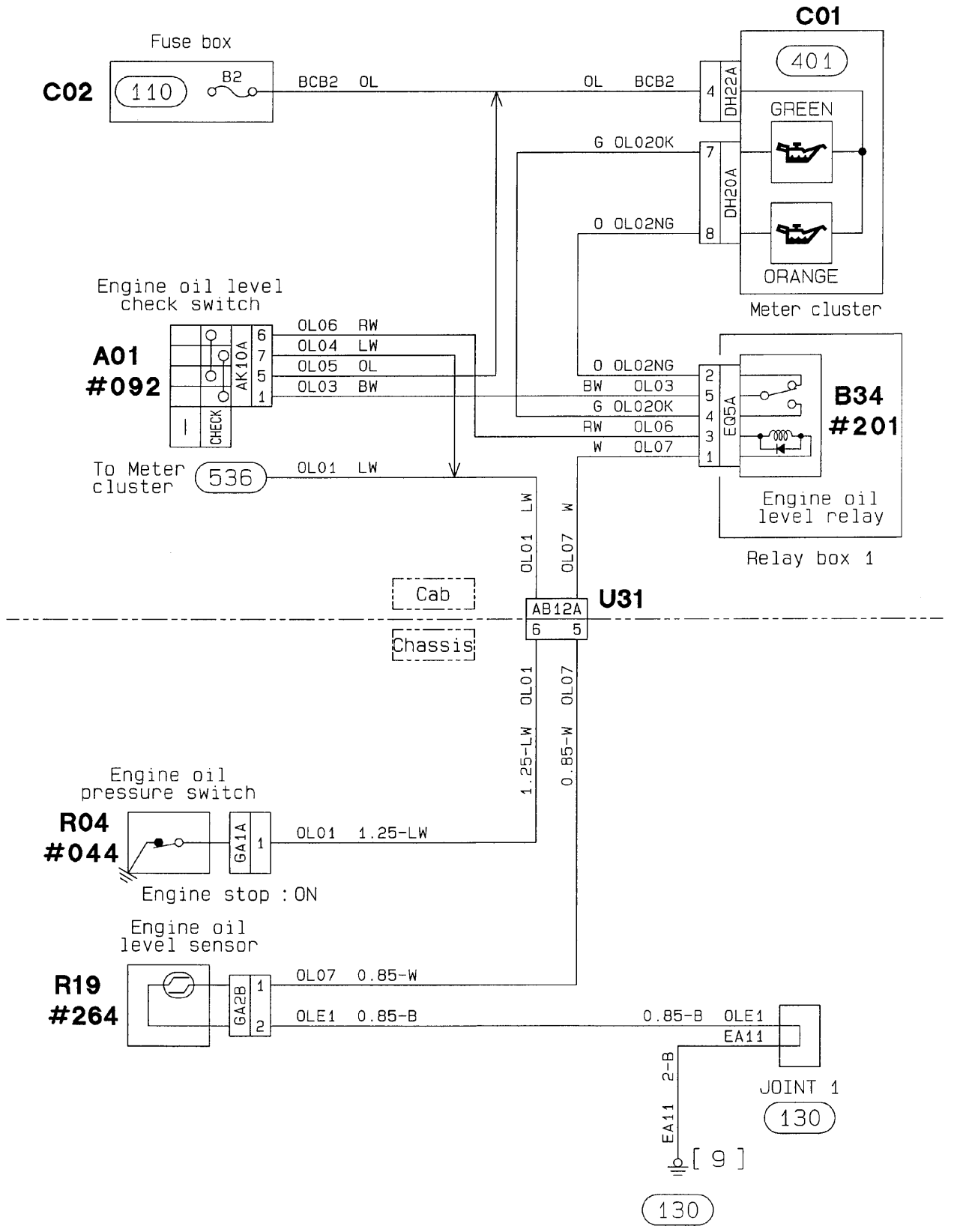
C00511

<Hydraulic booster>

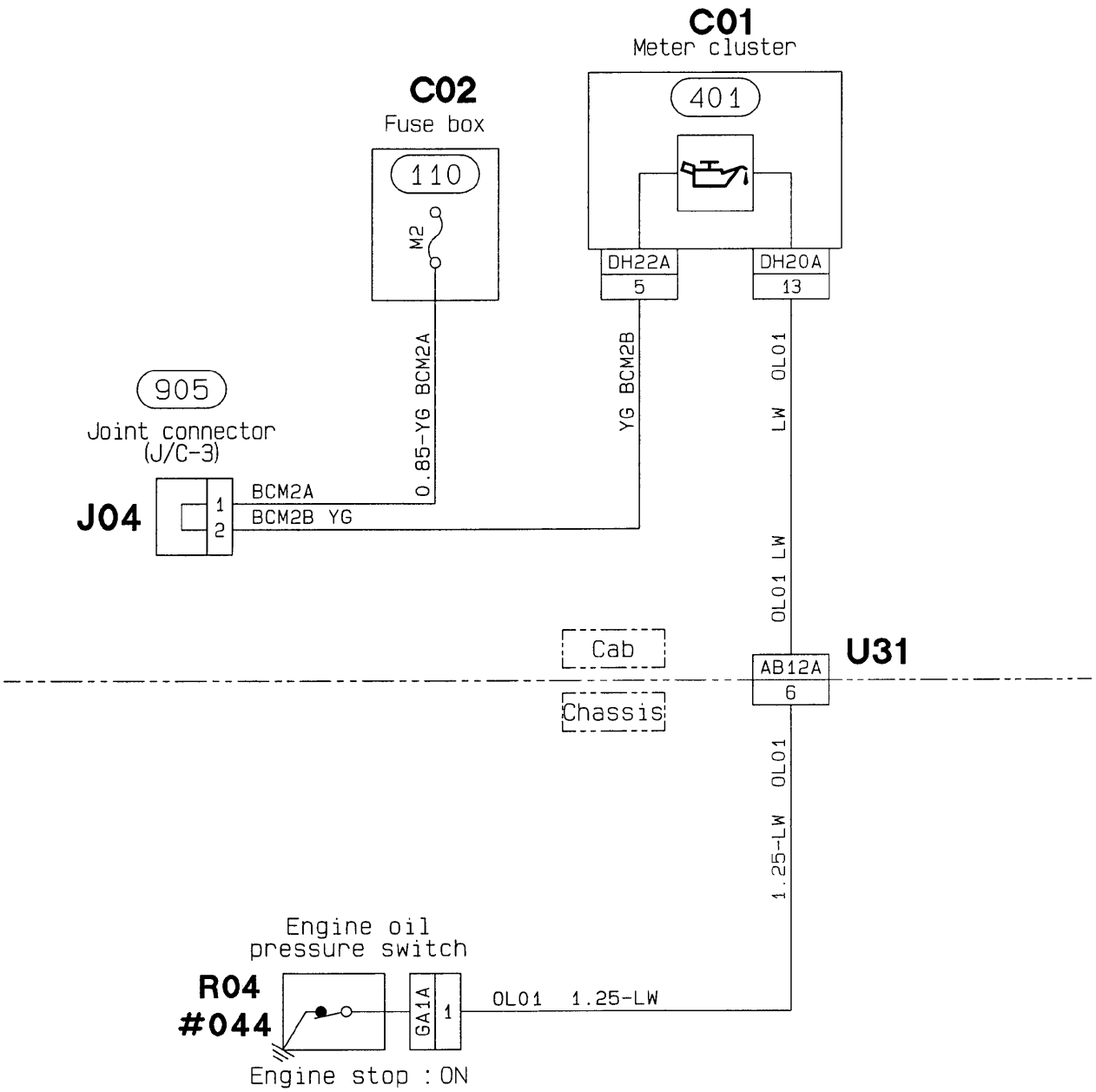


515-C00512

535 ENGINE OIL LEVEL WARNING CIRCUIT

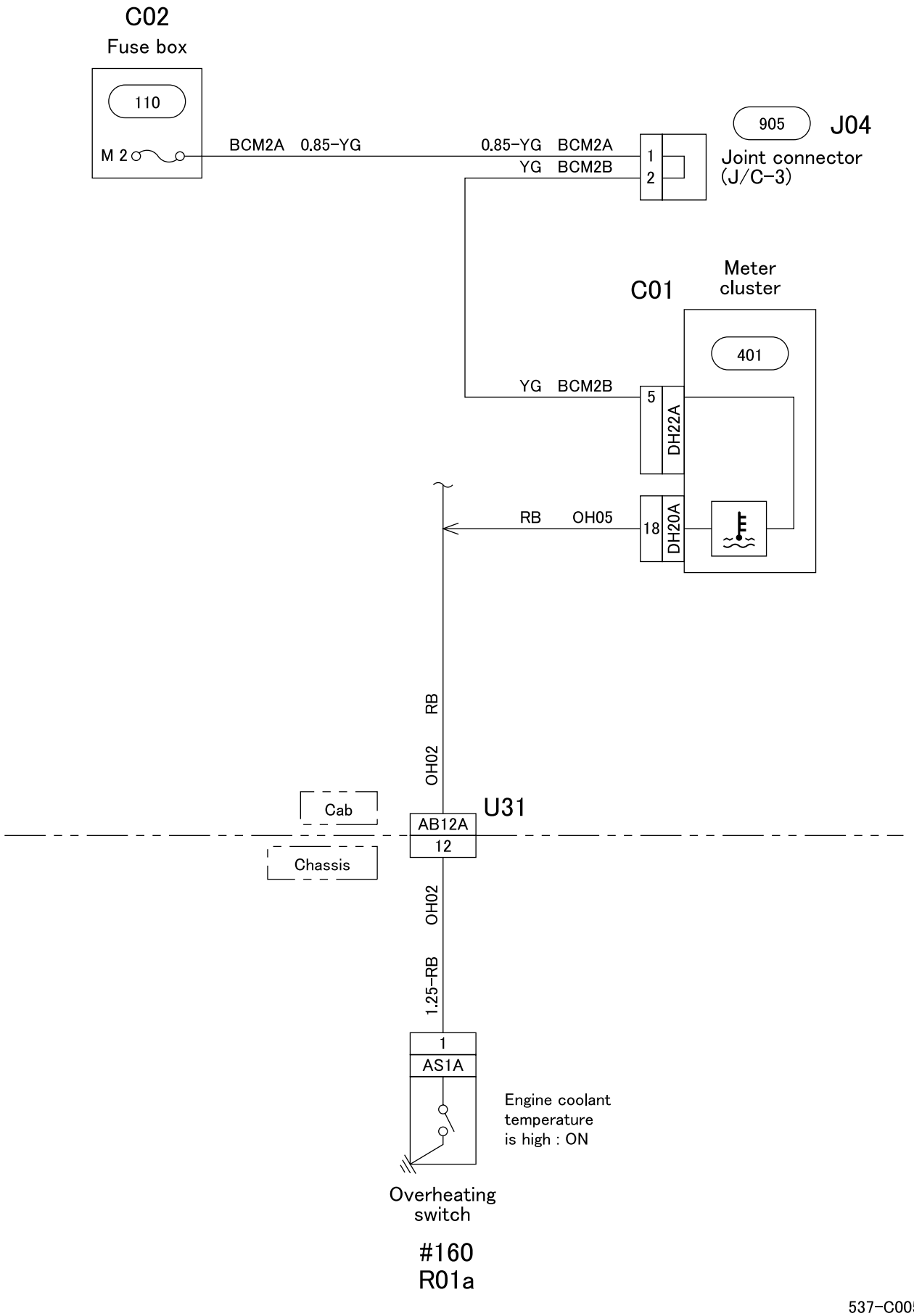


C00513

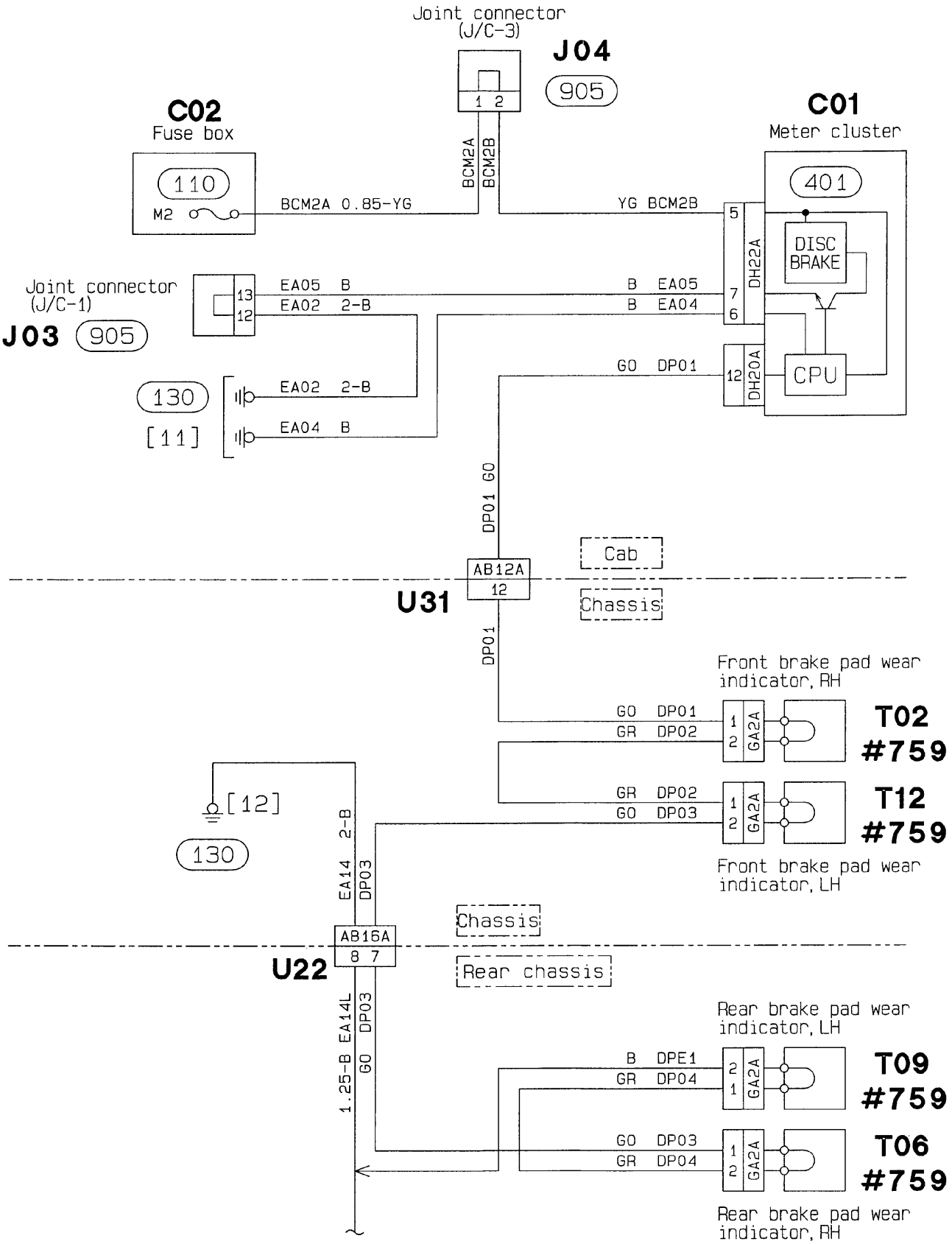

C01
Meter cluster
401
C02
Fuse box
110
M2
DH22A
5
DH20A
13
0.85-YG BCM2A
YG BCM2B
LW OL01
905
Joint connector
(J/C-3)
J04
1
2
BCM2A
BCM2B YG
OL01 LW
Cab
Chassis
U31
AB12A
6
1.25-LW OL01
Engine oil
pressure switch
R04
#044
GA1A
1
OL01 1.25-LW
Engine stop : ON

C00514

537 OVERHEATING WARNING CIRCUIT

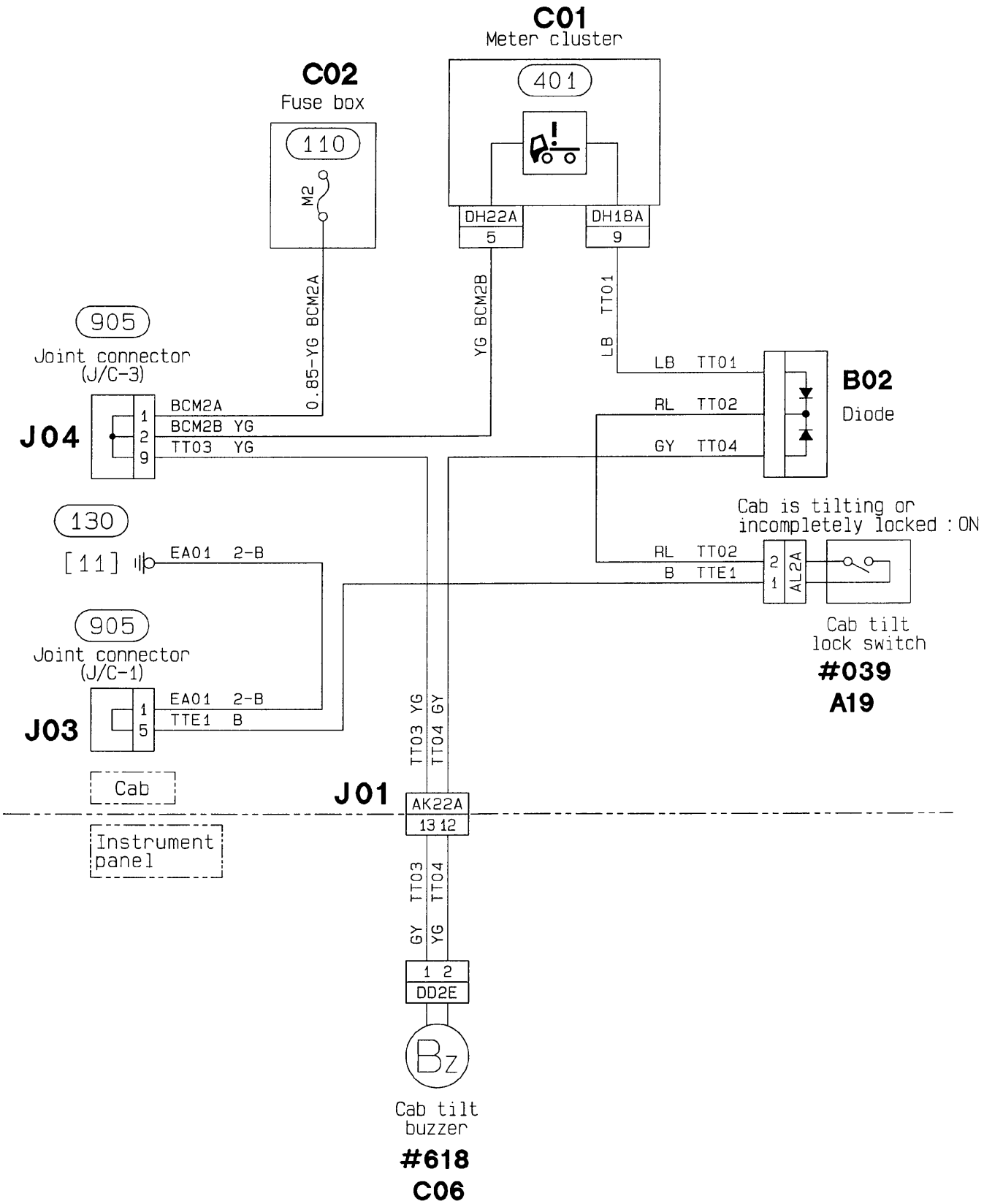


537-C00515

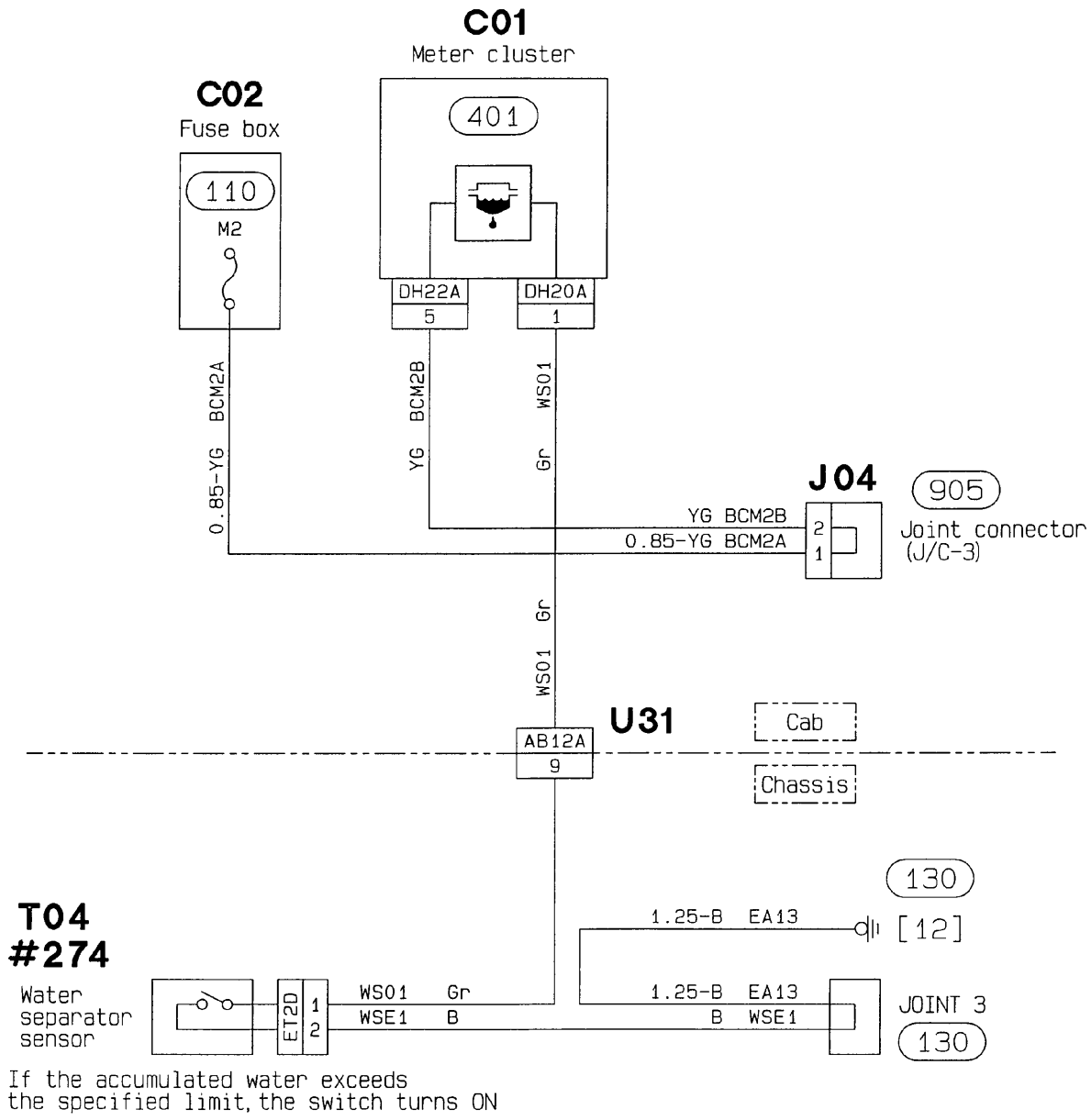

Joint connector
(J/C-3)
J04
905
1 2
C02
Fuse box
110
M2
BCM2A 0.85-YG
BCM2A
BCM2B
YG BCM2B
C01
Meter cluster
401
5
DH22A
DISC
BRAKE
Joint connector
(J/C-1)
J03
905
13
12
EA05 B
EA02 2-B
B EA05
B EA04
7
6
130
[11]
EA02 2-B
EA04 B
GO DP01
12
DH20A
CPU
DP01 GO
AB12A
12
Cab
U31
Chassis
DP01
Front brake pad wear
indicator, RH
GO DP01
GR DP02
1
2
GA2A
T02
#759
GR DP02
GO DP03
T12
#759
Front brake pad wear
indicator, LH
[12]
130
EA14 2-B
DP03
Chassis
AB16A
8 7
U22
Rear chassis
Rear brake pad wear
indicator, LH
1.25-B EA14L
GO DP03
B DPE1
GR DP04
2
1
T09
#759
GO DP03
GR DP04
T06
#759
Rear brake pad wear
indicator, RH

C00516

550 CAB TILT WARNING CIRCUIT

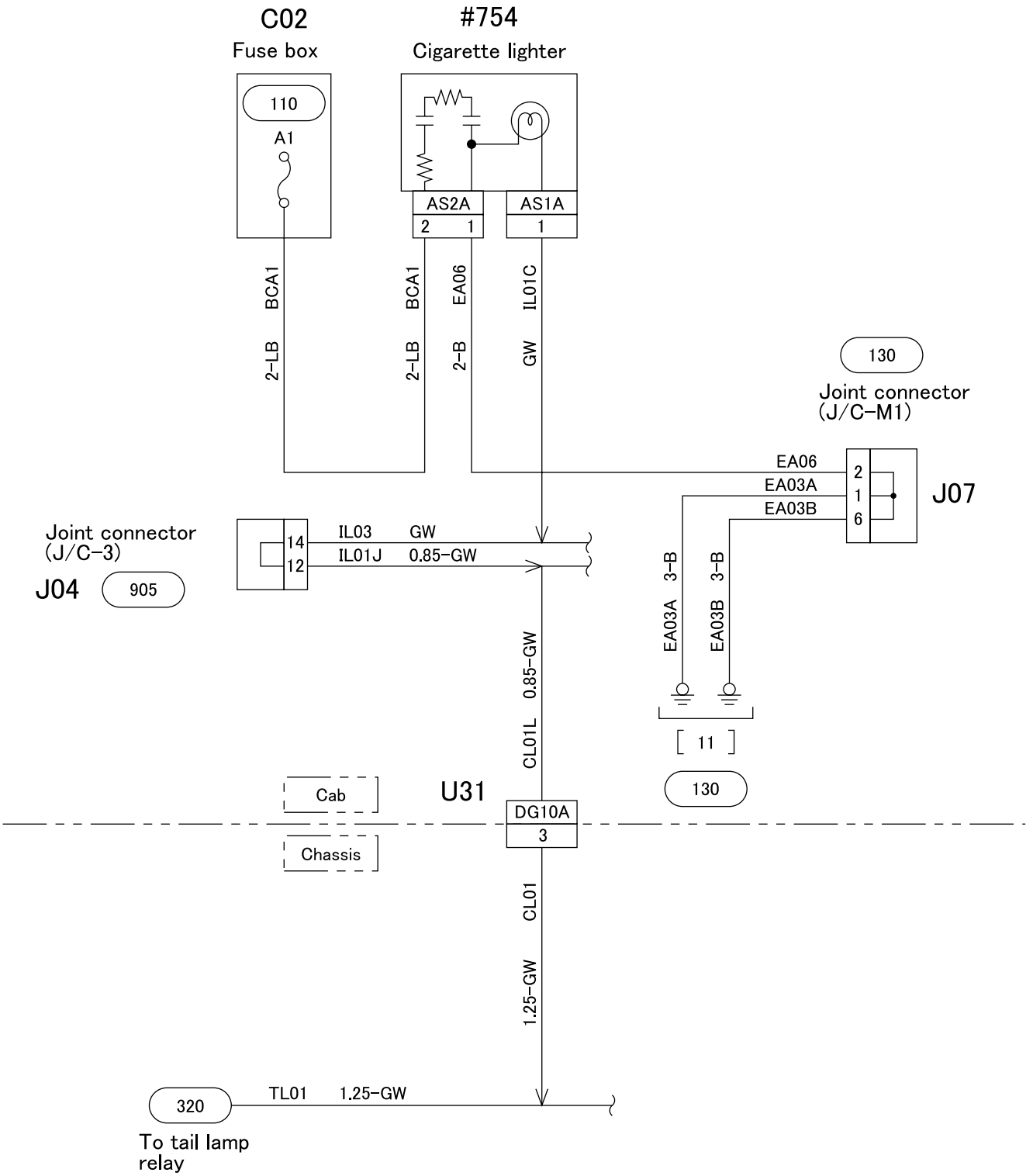


C00517

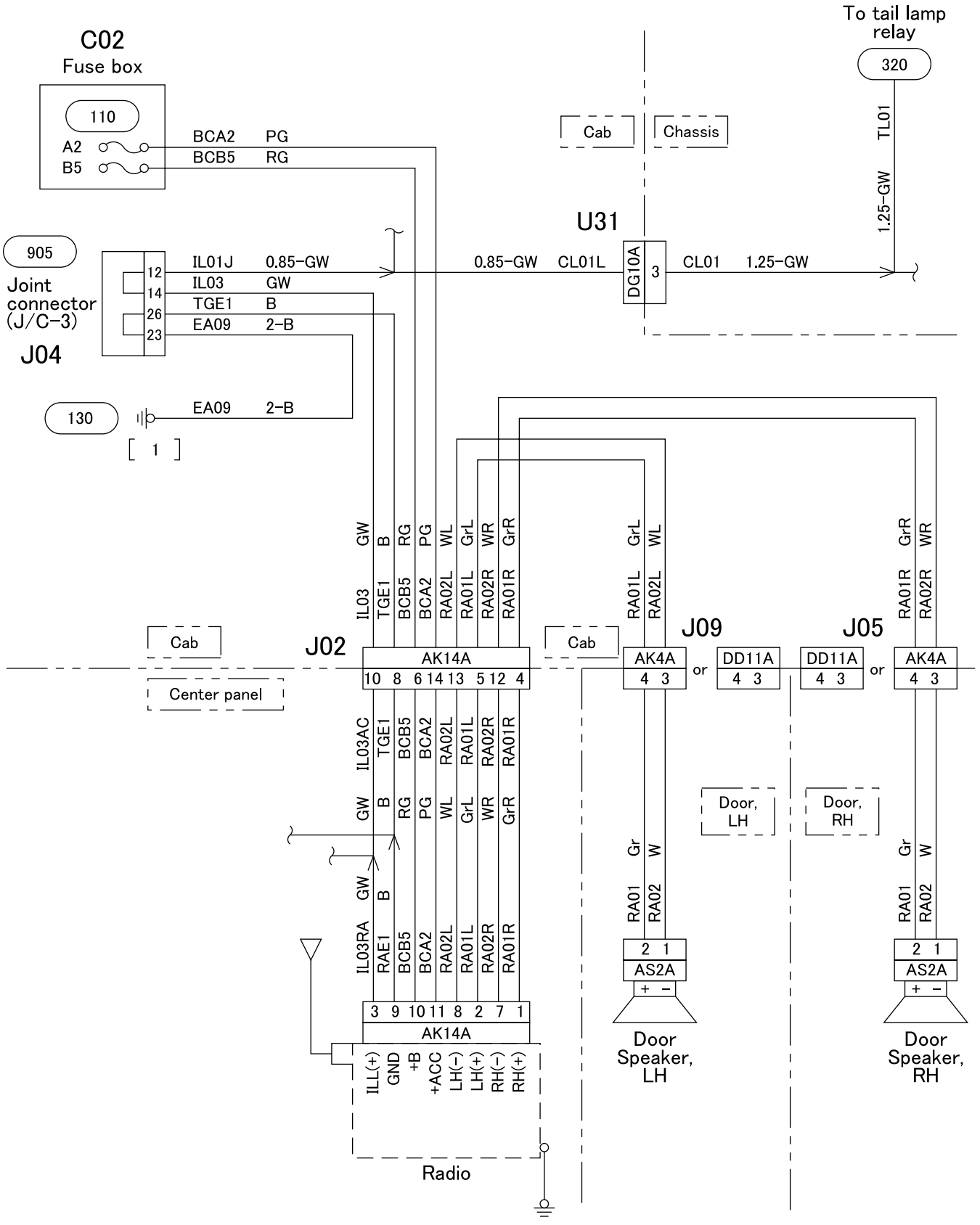

C01
Meter cluster
401
C02
Fuse box
110
M2
DH22A
5
DH20A
1
0.85-YG BCM2A
YG BCM2B
WS01 Gr
J04
905
YG BCM2B
0.85-YG BCM2A
2
1
Joint connector
(J/C-3)
WS01 Gr
U31
AB12A
9
Cab
Chassis
130
1.25-B EA13
[12]
T04
#274
Water
separator
sensor
ET2D
1
2
WS01 Gr
WSE1 B
1.25-B EA13
B WSE1
JOINT 3
130
If the accumulated water exceeds
the specified limit, the switch turns ON

C00518

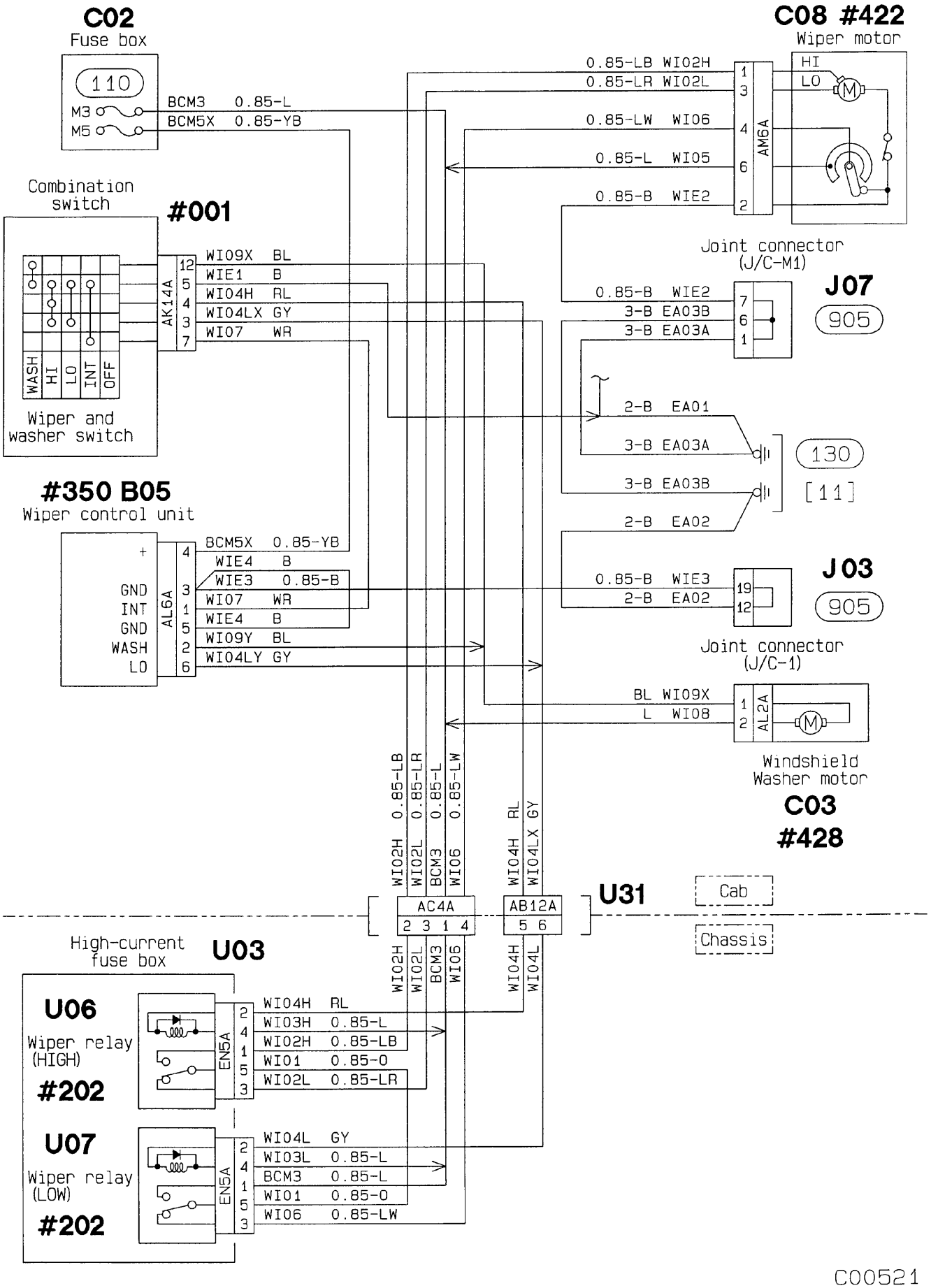
54-06 CAB SIDE ELECTRICAL CIRCUIT


C02
Fuse box
#754
Cigarette lighter
110
A1
AS2A
2 1
AS1A
1
BCA1
2-LB
BCA1
2-LB
EA06
2-B
IL01C
GW
130
Joint connector
(J/C-M1)
EA06
EA03A
EA03B
2
1
6
J07
Joint connector
(J/C-3)
J04
905
14
12
IL03 GW
IL01J 0.85-GW
EA03A 3-B
EA03B 3-B
CL01L 0.85-GW
11
130
Cab
Chassis
U31
DG10A
3
CL01
1.25-GW
320
TL01 1.25-GW
To tail lamp
relay

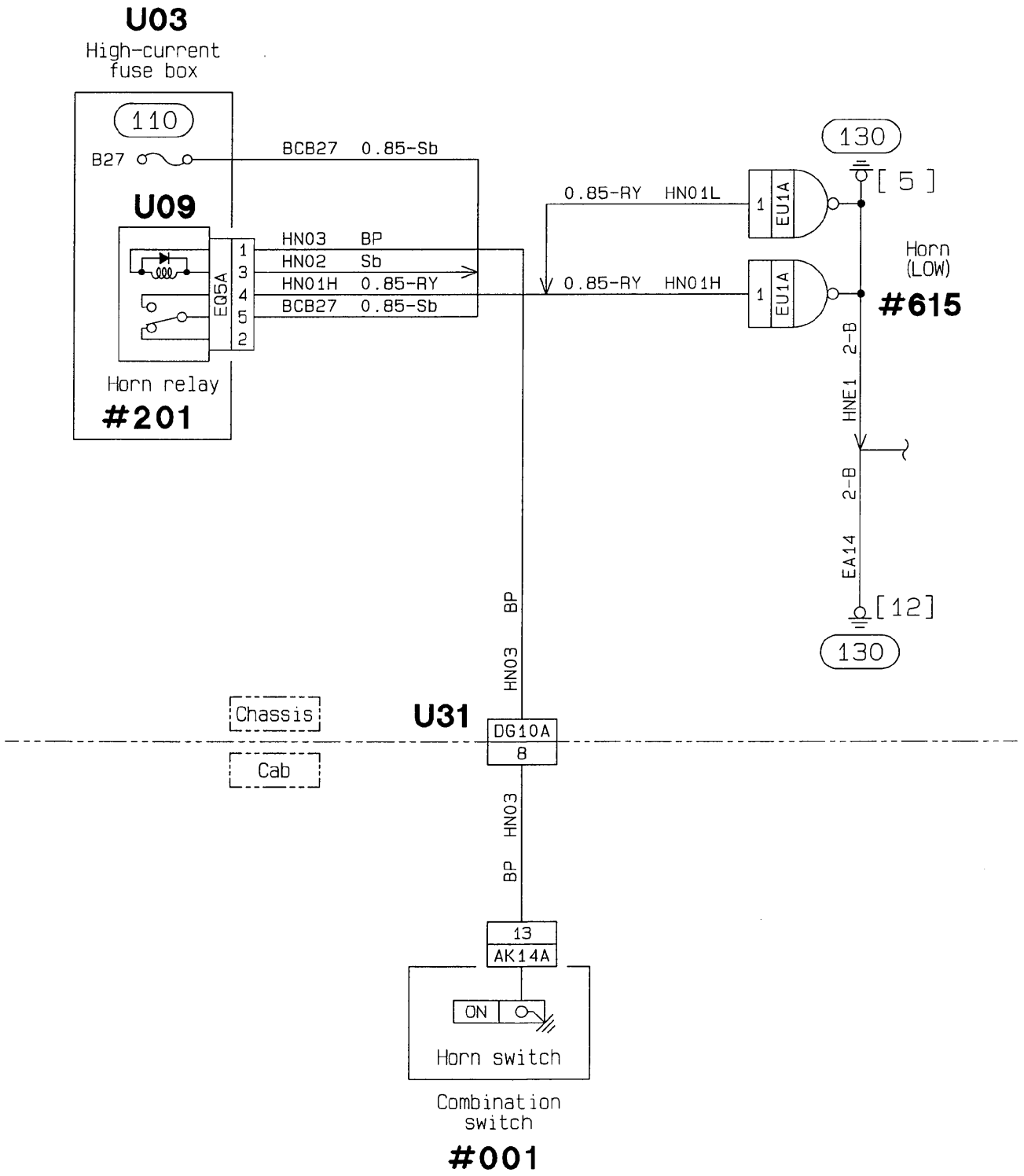
610-C00519


C02
Fuse box
110
A2
B5
BCA2 PG
BCB5 RG
Cab
Chassis
To tail lamp relay
320
TL01
1.25-GW
U31
905
Joint connector (J/C-3)
J04
12
14
26
23
IL01J 0.85-GW
IL03 GW
TGE1 B
EA09 2-B
0.85-GW CL01L
DG10A
3
CL01 1.25-GW
130
EA09 2-B
1
Cab
J02
AK14A
10 8 6 14 13 5 12 4
Center panel
IL03 GW
TGE1 B
BCB5 RG
BCA2 PG
RA02L WL
RA01L GrL
RA02R WR
RA01R GrR
IL03AC
IL03RA
RAE1
GW
B
Cab
J09
AK4A
4 3
or
DD11A
4 3
J05
DD11A
4 3
or
AK4A
4 3
RA01L GrL
RA02L WL
RA01R GrR
RA02R WR
Door, LH
Door, RH
Gr
W
RA01
RA02
2 1
AS2A
+ −
Door Speaker, LH
Door Speaker, RH
3 9 10 11 8 2 7 1
AK14A
ILL(+)
GND
+B
+ACC
LH(−)
LH(+)
RH(−)
RH(+)
Radio

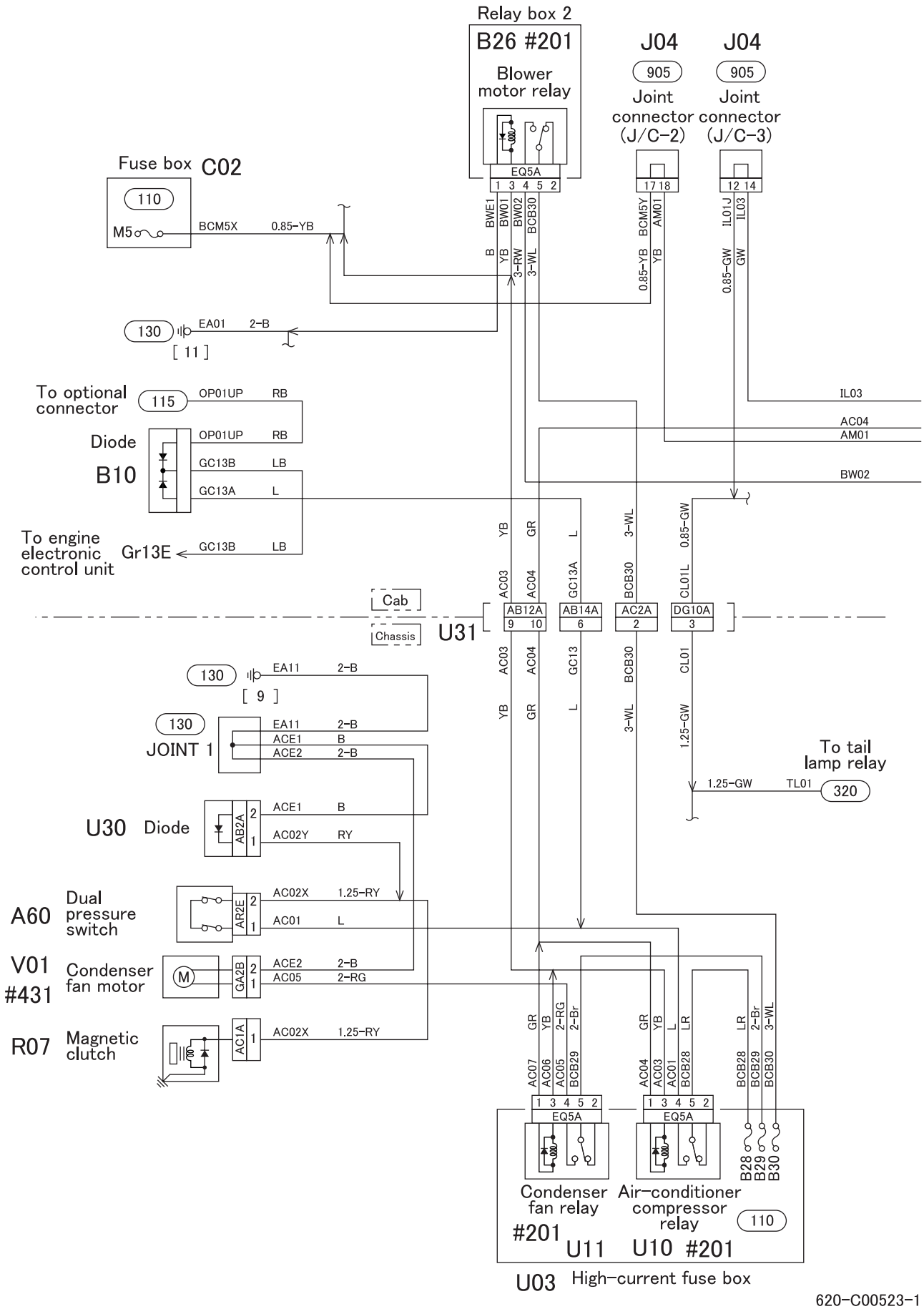
612-C00520


C02
Fuse box
110
M3
M5
BCM3 0.85-L
BCM5X 0.85-YB
C08 #422
Wiper motor
HI
LO
AM6A
0.85-LB WI02H
0.85-LR WI02L
0.85-LW WI06
0.85-L WI05
0.85-B WIE2
Combination switch
#001
AK14A
WI09X BL
WIE1 B
WI04H RL
WI04LX GY
WI07 WR
WASH
HI
LO
INT
OFF
Wiper and washer switch
Joint connector (J/C-M1)
J07
905
0.85-B WIE2
3-B EA03B
3-B EA03A
2-B EA01
3-B EA03A
3-B EA03B
2-B EA02
130
[11]
#350 B05
Wiper control unit
AL6A
+
GND
INT
GND
WASH
LO
BCM5X 0.85-YB
WIE4 B
WIE3 0.85-B
WI07 WR
WIE4 B
WI09Y BL
WI04LY GY
J03
905
0.85-B WIE3
2-B EA02
Joint connector (J/C-1)
BL WI09X
L WI08
AL2A
Windshield Washer motor
C03
#428
WI02H 0.85-LB
WI02L 0.85-LR
BCM3 0.85-L
WI06 0.85-LW
WI04H RL
WI04LX GY
AC4A
AB12A
U31
Cab
Chassis
High-current fuse box
U03
U06
Wiper relay (HIGH)
#202
EN5A
WI04H RL
WI03H 0.85-L
WI02H 0.85-LB
WI01 0.85-O
WI02L 0.85-LR
U07
Wiper relay (LOW)
#202
WI04L GY
WI03L 0.85-L
BCM3 0.85-L
WI01 0.85-O
WI06 0.85-LW

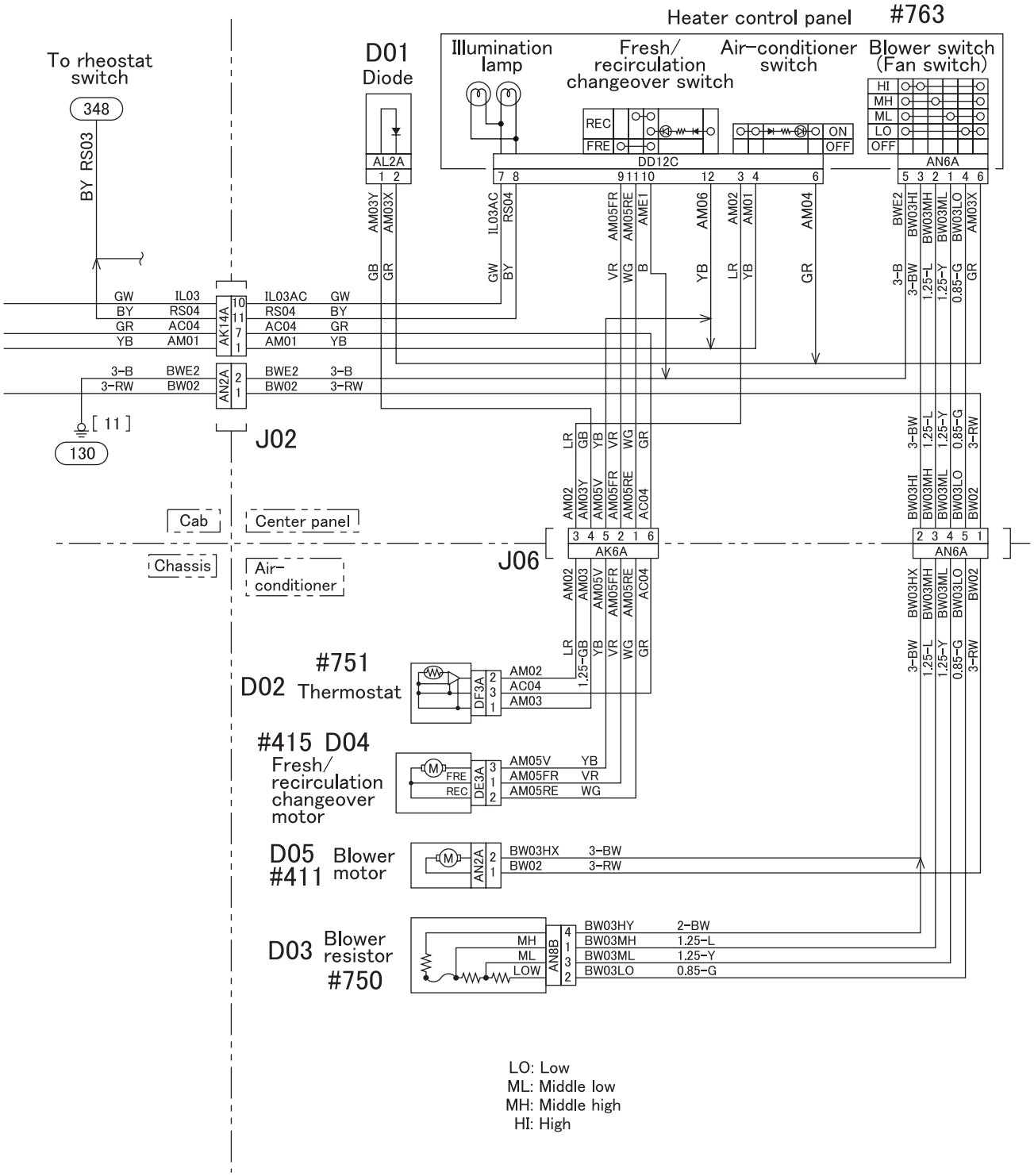
C00521

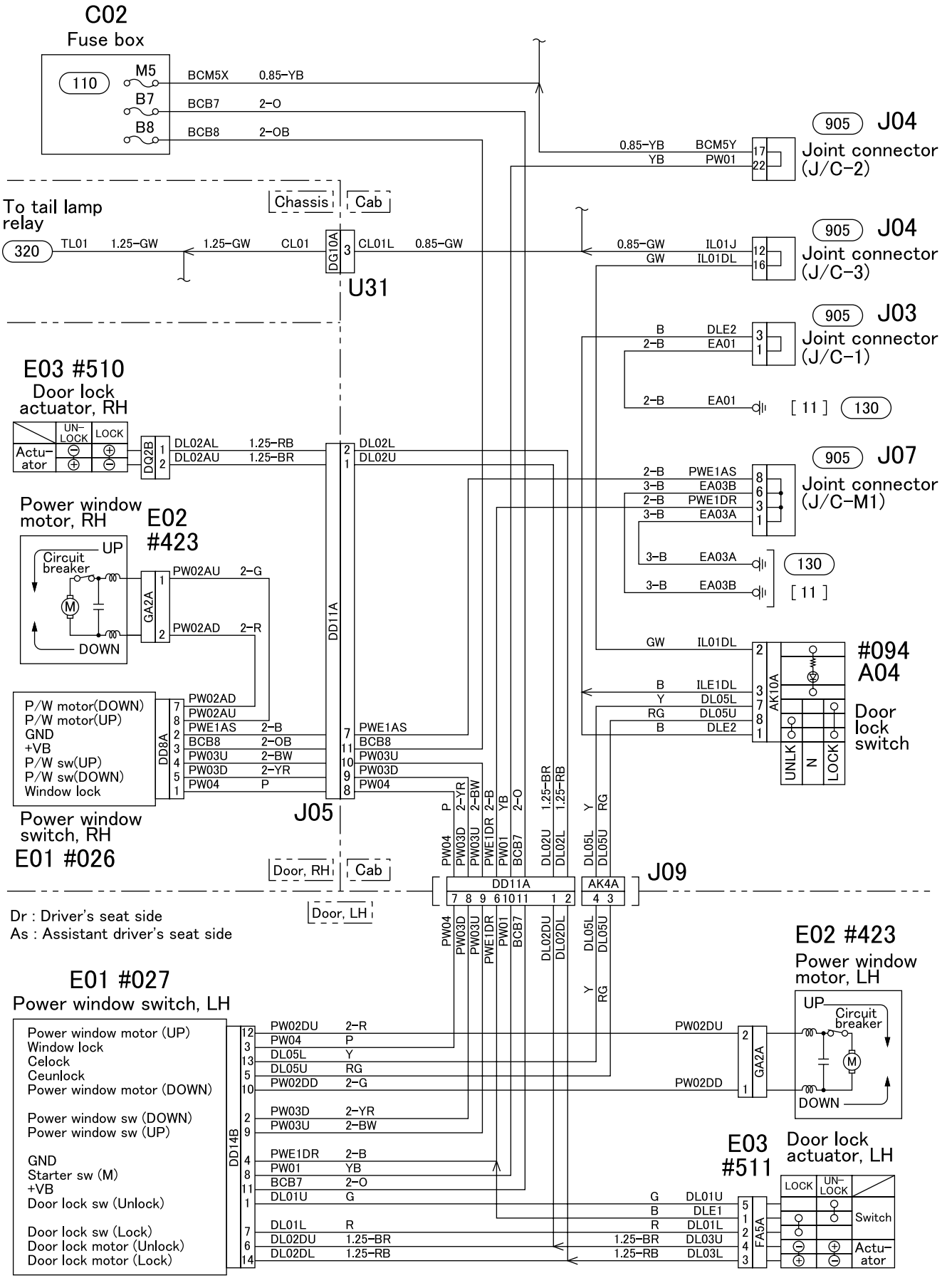

U03
High-current fuse box
110
B27
BCB27 0.85-Sb
U09
EQ5A
1
3
4
5
2
HN03 BP
HN02 Sb
HN01H 0.85-RY
BCB27 0.85-Sb
Horn relay
#201
130
[5]
0.85-RY HN01L
0.85-RY HN01H
1
EU1A
Horn (LOW)
#615
2-B
HNE1
2-B
EA14
[12]
130
BP
HN03
Chassis
Cab
U31
DG10A
8
BP HN03
13
AK14A
ON
Horn switch
Combination switch
#001

C00522

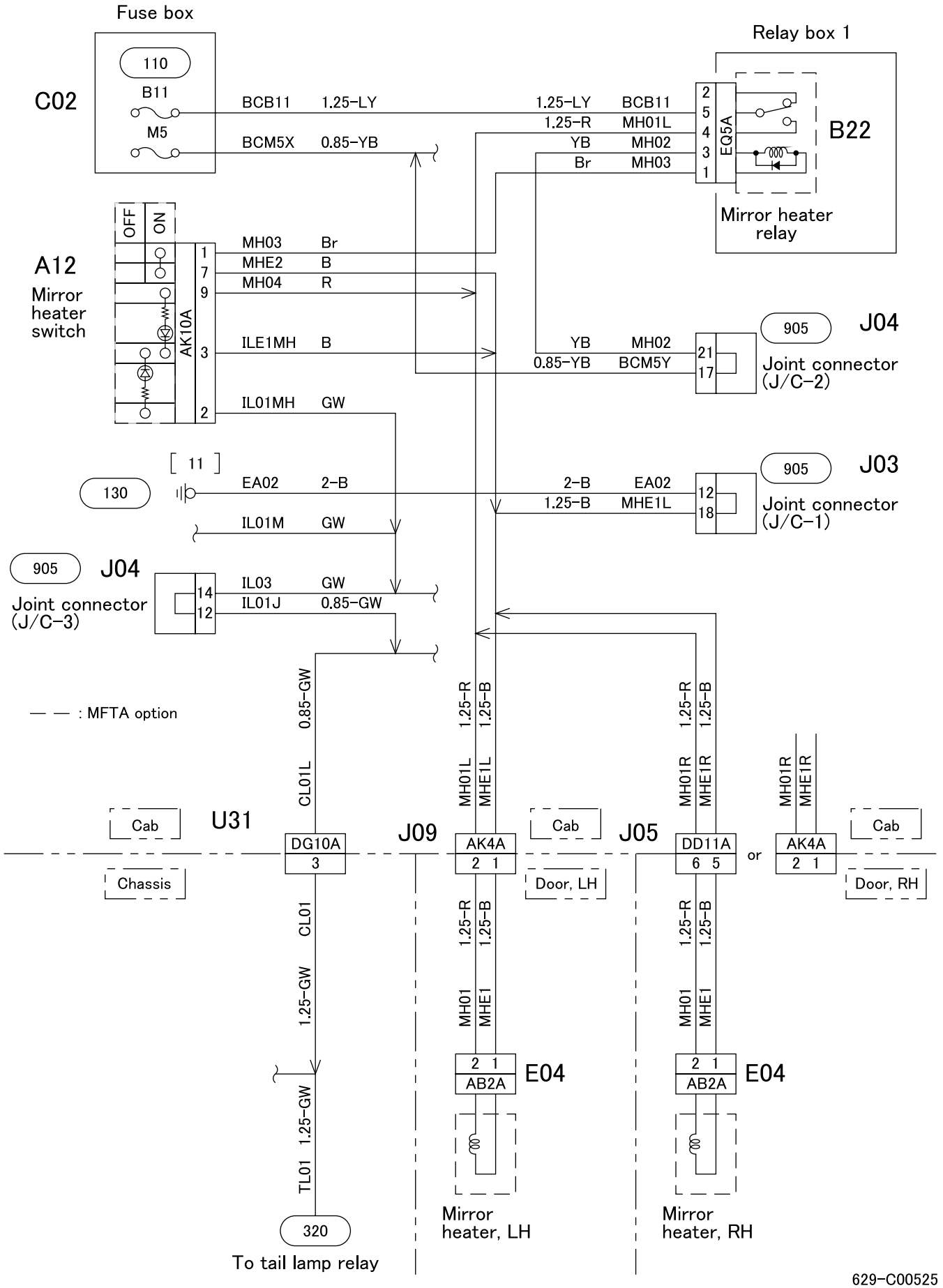

Relay box 2
B26 #201
Blower motor relay
EQ5A
1 3 4 5 2
J04
905
Joint connector (J/C-2)
17 18
J04
905
Joint connector (J/C-3)
12 14
Fuse box C02
110
M5
BCM5X
0.85-YB
BWE1
BW01
BW02
BCB30
B
YB
3-RW
3-WL
BCM5Y
AM01
0.85-YB
YB
IL01J
IL03
0.85-GW
GW
130
EA01
2-B
[11]
To optional connector
115
OP01UP
RB
Diode
B10
OP01UP
RB
GC13B
LB
GC13A
L
To engine electronic control unit
Gr13E
GC13B
LB
IL03
AC04
AM01
BW02
YB
GR
L
3-WL
0.85-GW
AC03
AC04
GC13A
BCB30
CL01L
Cab
Chassis
U31
AB12A
9 10
AB14A
6
AC2A
2
DG10A
3
130
EA11
2-B
[9]
130
JOINT 1
EA11
2-B
ACE1
B
ACE2
2-B
AC03
AC04
GC13
BCB30
CL01
YB
GR
L
3-WL
1.25-GW
To tail lamp relay
1.25-GW
TL01
320
U30
Diode
AB2A
2
1
ACE1
B
AC02Y
RY
A60
Dual pressure switch
AR2E
2
1
AC02X
1.25-RY
AC01
L
V01
#431
Condenser fan motor
M
GA2B
2
1
ACE2
2-B
AC05
2-RG
R07
Magnetic clutch
AC1A
1
AC02X
1.25-RY
GR
YB
2-RG
2-Br
AC07
AC06
AC05
BCB29
GR
YB
L
LR
AC04
AC03
AC01
BCB28
LR
2-Br
3-WL
BCB28
BCB29
BCB30
1 3 4 5 2
EQ5A
1 3 4 5 2
EQ5A
B28
B29
B30
Condenser fan relay
#201
Air-conditioner compressor relay
110
U11
U10 #201
U03
High-current fuse box

620-C00523-1


Heater control panel #763
To rheostat switch
348
BY RS03
D01 Diode
AL2A
Illumination lamp
Fresh/ recirculation changeover switch
REC
FRE
Air-conditioner switch
ON
OFF
Blower switch (Fan switch)
HI
MH
ML
LO
OFF
DD12C
AN6A
AM03Y AM03X IL03AC RS04 AM05FR AM05RE AME1 AM06 AM02 AM01 AM04 BWE2 BW03HI BW03MH BW03ML BW03LO AM03X
GB GR GW BY VR WG B YB LR YB GR 3-B 3-BW 1.25-L 1.25-Y 0.85-G GR
GW IL03 IL03AC GW
BY RS04 RS04 BY
GR AC04 AC04 GR
YB AM01 AM01 YB
AK14A
3-B BWE2 BWE2 3-B
3-RW BW02 BW02 3-RW
AN2A
[11]
130
J02
Cab
Center panel
Chassis
Air-conditioner
J06
AK6A
AN6A
AM02 AM03Y AM05V AM05FR AM05RE AC04
LR GB YB VR WG GR
BW03HI BW03MH BW03ML BW03LO BW02
3-BW 1.25-L 1.25-Y 0.85-G 3-RW
AM02 AM03 AM05V AM05FR AM05RE AC04
LR 1.25-GB YB VR WG GR
BW03HX BW03MH BW03ML BW03LO BW02
3-BW 1.25-L 1.25-Y 0.85-G 3-RW
#751
D02 Thermostat
DF3A
AM02
AC04
AM03
#415 D04
Fresh/ recirculation changeover motor
FRE
REC
DE3A
AM05V YB
AM05FR VR
AM05RE WG
D05 #411 Blower motor
AN2A
BW03HX 3-BW
BW02 3-RW
D03 Blower resistor #750
AN8B
MH
ML
LOW
BW03HY 2-BW
BW03MH 1.25-L
BW03ML 1.25-Y
BW03LO 0.85-G
LO: Low
ML: Middle low
MH: High
HI: High


C02
Fuse box
110
M5
B7
B8
BCM5X 0.85-YB
BCB7 2-O
BCB8 2-OB
905 J04
Joint connector (J/C-2)
0.85-YB BCM5Y
YB PW01
To tail lamp relay
320
TL01 1.25-GW
1.25-GW CL01
DG10A
CL01L 0.85-GW
Chassis
Cab
U31
905 J04
Joint connector (J/C-3)
0.85-GW IL01J
GW IL01DL
905 J03
Joint connector (J/C-1)
B DLE2
2-B EA01
2-B EA01
[11] 130
E03 #510
Door lock actuator, RH
UN-LOCK
LOCK
Actu-ator
DQ2B
DL02AL 1.25-RB
DL02AU 1.25-BR
DL02L
DL02U
905 J07
Joint connector (J/C-M1)
2-B PWE1AS
3-B EA03B
2-B PWE1DR
3-B EA03A
3-B EA03A
130
3-B EA03B
[11]
Power window motor, RH
E02 #423
UP
Circuit breaker
DOWN
GA2A
PW02AU 2-G
PW02AD 2-R
DD11A
GW IL01DL
#094
A04
Door lock switch
B ILE1DL
Y DL05L
RG DL05U
B DLE2
AK10A
UNLK
N
LOCK
P/W motor(DOWN)
P/W motor(UP)
GND
+VB
P/W sw(UP)
P/W sw(DOWN)
Window lock
DD8A
PW02AD
PW02AU
PWE1AS 2-B
BCB8 2-OB
PW03U 2-BW
PW03D 2-YR
PW04 P
PWE1AS
BCB8
PW03U
PW03D
PW04
Power window switch, RH
E01 #026
J05
Door, RH
Cab
Door, LH
J09
DD11A
AK4A
Dr : Driver's seat side
As : Assistant driver's seat side
E01 #027
Power window switch, LH
Power window motor (UP)
Window lock
Celock
Ceunlock
Power window motor (DOWN)
Power window sw (DOWN)
Power window sw (UP)
GND
Starter sw (M)
+VB
Door lock sw (Unlock)
Door lock sw (Lock)
Door lock motor (Unlock)
Door lock motor (Lock)
DD14B
PW02DU 2-R
PW04 P
DL05L Y
DL05U RG
PW02DD 2-G
PW03D 2-YR
PW03U 2-BW
PWE1DR 2-B
PW01 YB
BCB7 2-O
DL01U G
DL01L R
DL02DU 1.25-BR
DL02DL 1.25-RB
E02 #423
Power window motor, LH
UP
Circuit breaker
DOWN
GA2A
PW02DU
PW02DD
E03 #511
Door lock actuator, LH
LOCK
UN-LOCK
Switch
Actu-ator
FA5A
G DL01U
B DLE1
R DL01L
1.25-BR DL03U
1.25-RB DL03L

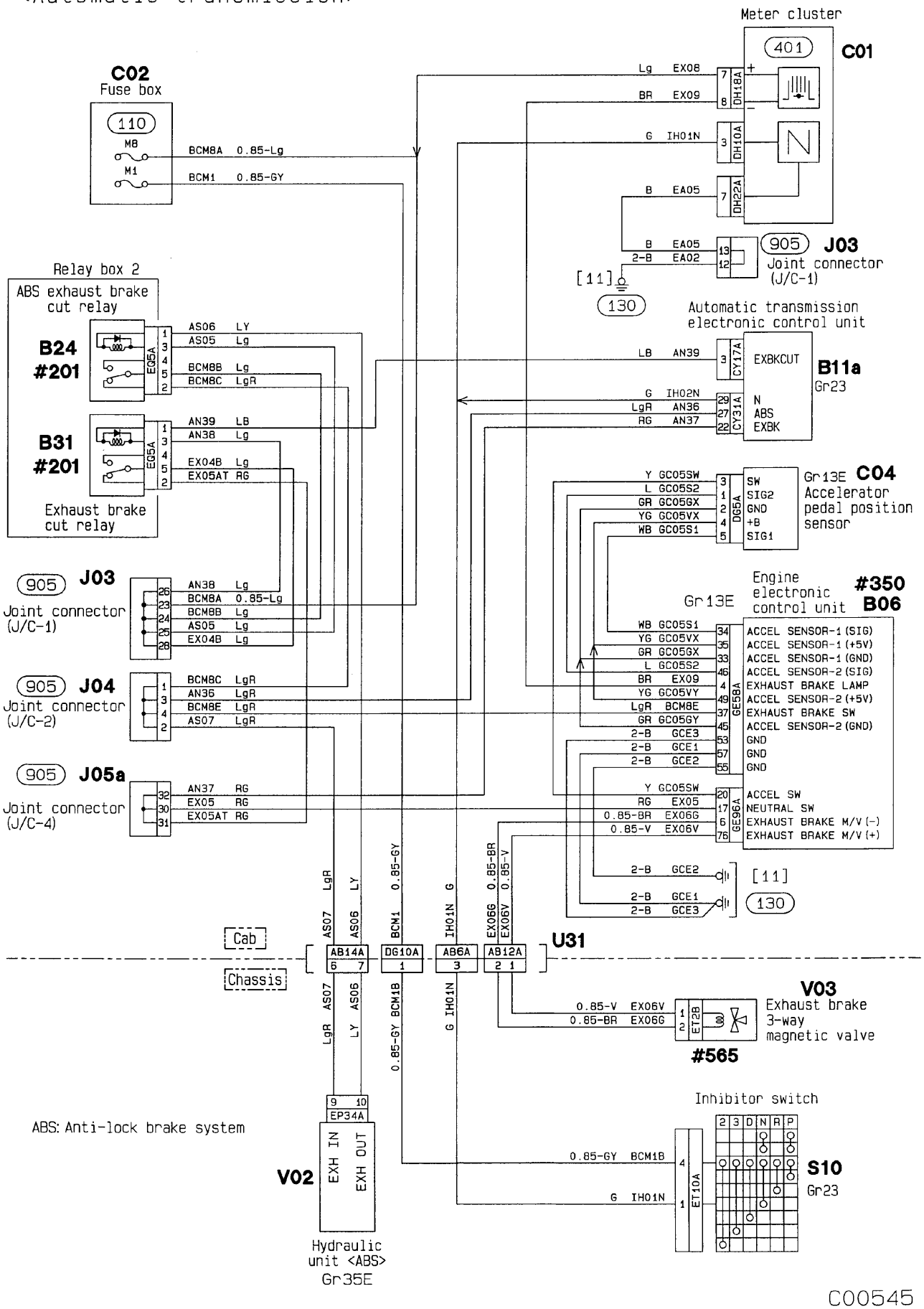
622-C00524


Fuse box
110
B11
M5
C02
BCB11 1.25-LY
BCM5X 0.85-YB
Relay box 1
2
5
4
3
1
EQ5A
B22
1.25-LY BCB11
1.25-R MH01L
YB MH02
Br MH03
Mirror heater relay
OFF
ON
A12
Mirror heater switch
AK10A
1
7
9
3
2
MH03 Br
MHE2 B
MH04 R
ILE1MH B
IL01MH GW
905
J04
Joint connector (J/C-2)
21
17
YB MH02
0.85-YB BCM5Y
905
J03
Joint connector (J/C-1)
12
18
2-B EA02
1.25-B MHE1L
[11]
130
EA02 2-B
IL01M GW
905
J04
Joint connector (J/C-3)
14
12
IL03 GW
IL01J 0.85-GW
— — : MFTA option
CL01L 0.85-GW
MH01L 1.25-R
MHE1L 1.25-B
MH01R 1.25-R
MHE1R 1.25-B
Cab
U31
Chassis
DG10A
3
J09
AK4A
2 1
Door, LH
J05
DD11A
6 5
or
AK4A
2 1
Door, RH
CL01 1.25-GW
TL01 1.25-GW
MH01 1.25-R
MHE1 1.25-B
2 1
AB2A
E04
Mirror heater, LH
Mirror heater, RH
320
To tail lamp relay

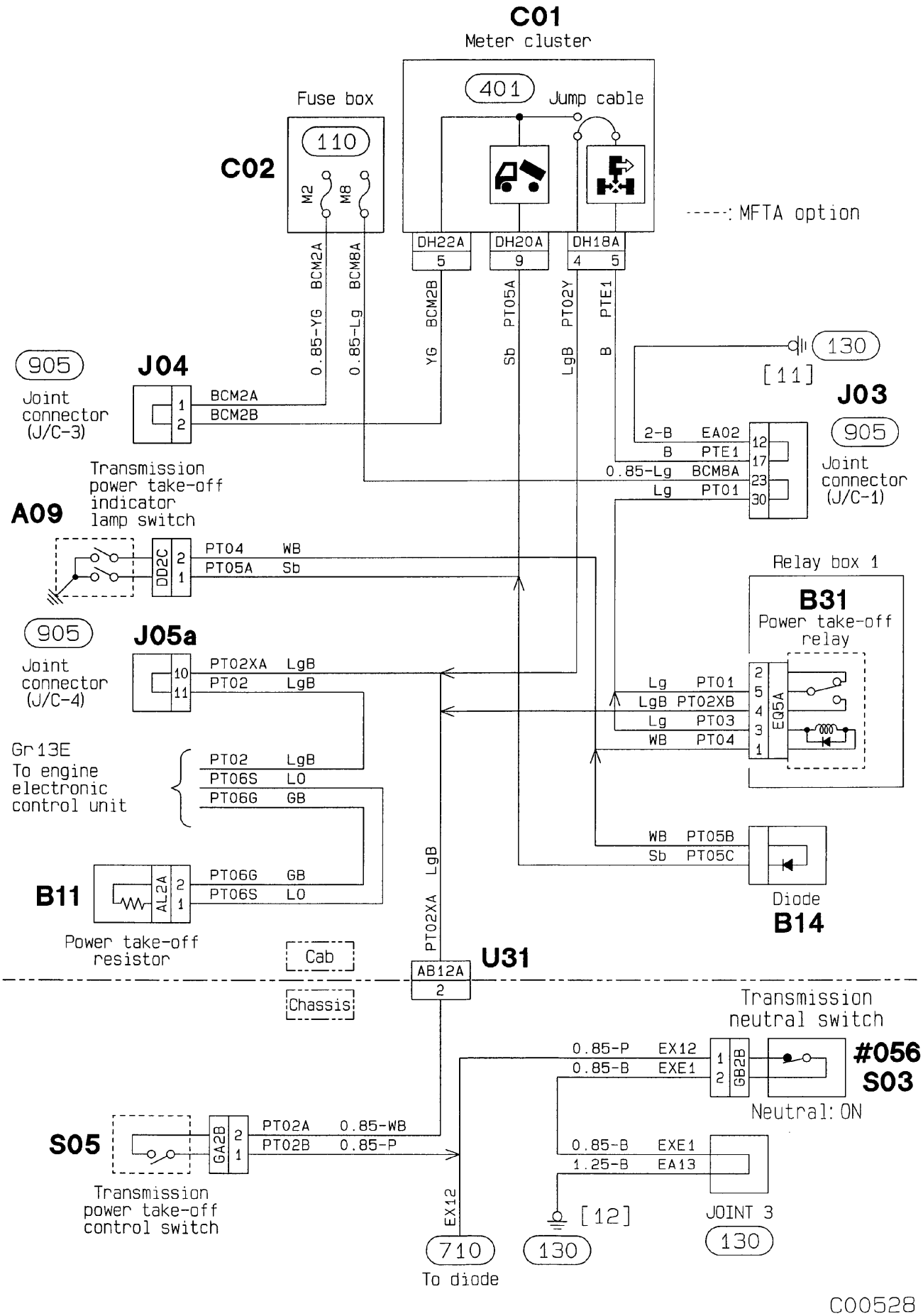
629-C00525

54-07 CHASSIS SIDE ELECTRICAL CIRCUIT

<Automatic transmission>



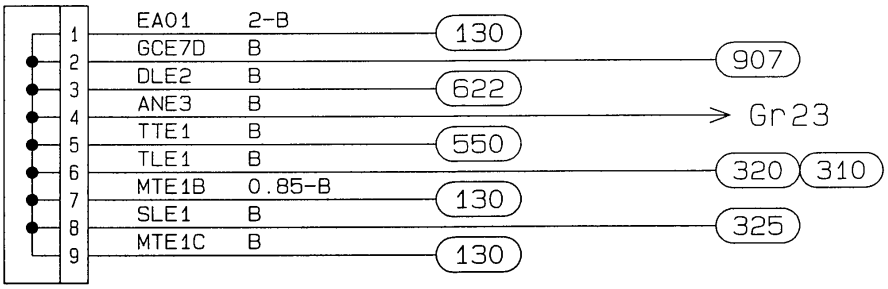
54-08 ENGINE AND TRANSMISSION SIDE ELECTRICAL CIRCUIT

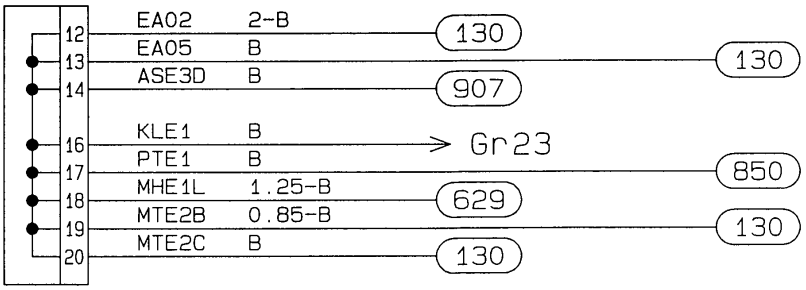

C01
Meter cluster
401
Jump cable
Fuse box
110
C02
M2
M8
-----: MFTA option
DH22A 5
DH20A 9
DH18A 4 5
0.85-YG BCM2A
0.85-Lg BCM8A
YG BCM2B
Sb PT05A
LgB PT02Y
B PTE1
130
[11]
J03
905
Joint connector (J/C-3)
J04
BCM2A
BCM2B
Transmission power take-off indicator lamp switch
A09
DD2C
PT04 WB
PT05A Sb
2-B EA02
B PTE1
0.85-Lg BCM8A
Lg PT01
Joint connector (J/C-1)
Relay box 1
B31
Power take-off relay
EQ5A
Lg PT01
LgB PT02XB
Lg PT03
WB PT04
905
Joint connector (J/C-4)
J05a
PT02XA LgB
PT02 LgB
Gr13E
To engine electronic control unit
PT02 LgB
PT06S LO
PT06G GB
WB PT05B
Sb PT05C
Diode
B14
B11
AL2A
PT06G GB
PT06S LO
Power take-off resistor
Cab
Chassis
PT02XA LgB
U31
AB12A 2
Transmission neutral switch
0.85-P EX12
0.85-B EXE1
GB2B
#056
S03
Neutral: ON
S05
GA2B
PT02A 0.85-WB
PT02B 0.85-P
Transmission power take-off control switch
0.85-B EXE1
1.25-B EA13
JOINT 3
130
EX12
[12]
710
To diode
130
C00528

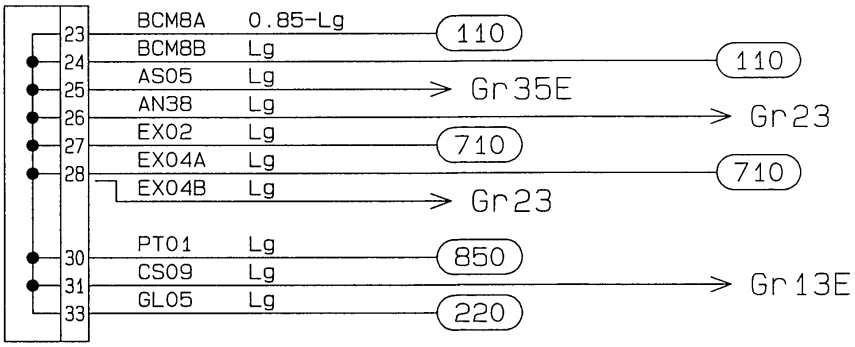
54-09 OTHER CIRCUIT

(J/C-1)

1	2	3	4	5	6	7	8	9	10	11
EA01	GCE7D	DLE2	ANE3	TTE1	TLE1	MTE1B	SLE1	MTE1C		—
12	13	14	15	16	17	18	19	20	21	22
EA02	EA05	ASE3D	—	KLE1	PTE1	MHE1L	MTE2B	MTE2C		—
23	24	25	26	27	28	29	30	31	32	33
BCM8A	BCM8B	AS05	AN38	EX02	EX04A EX04B	—	PT01	CS09		GL05



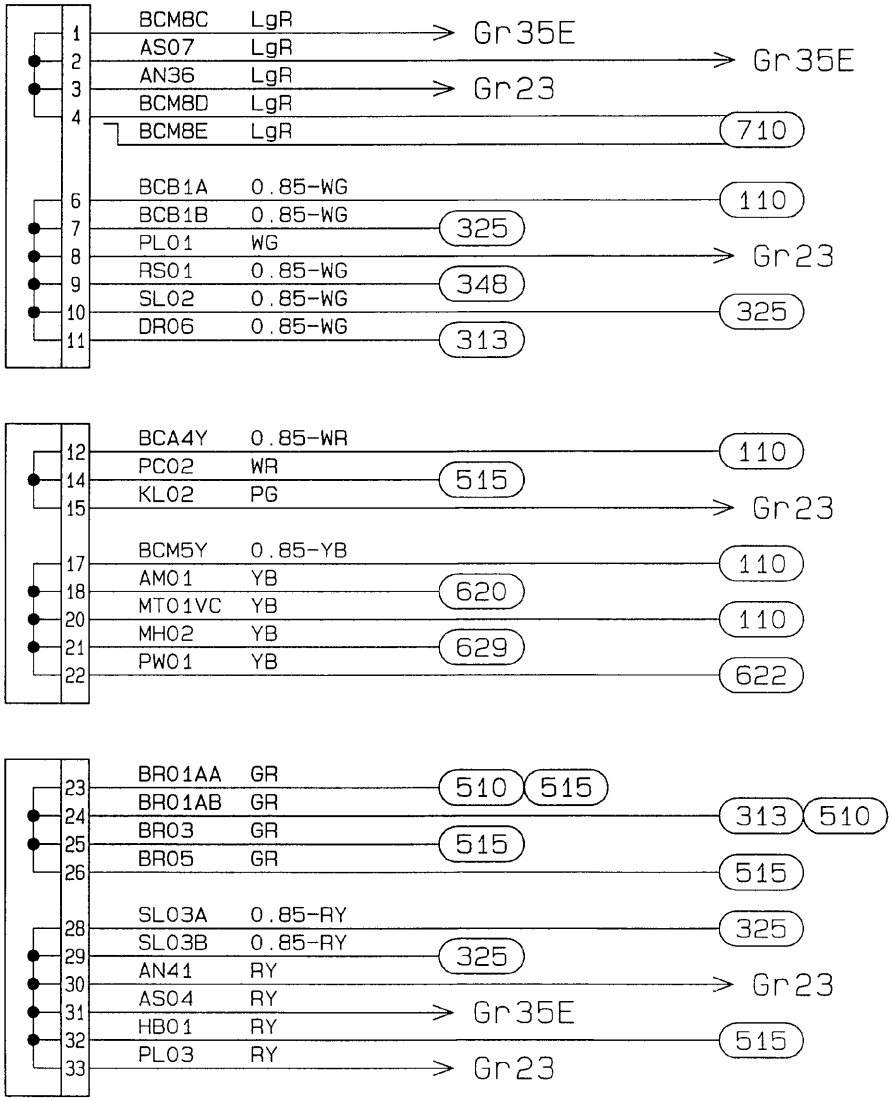




C02280

(J/C-2)

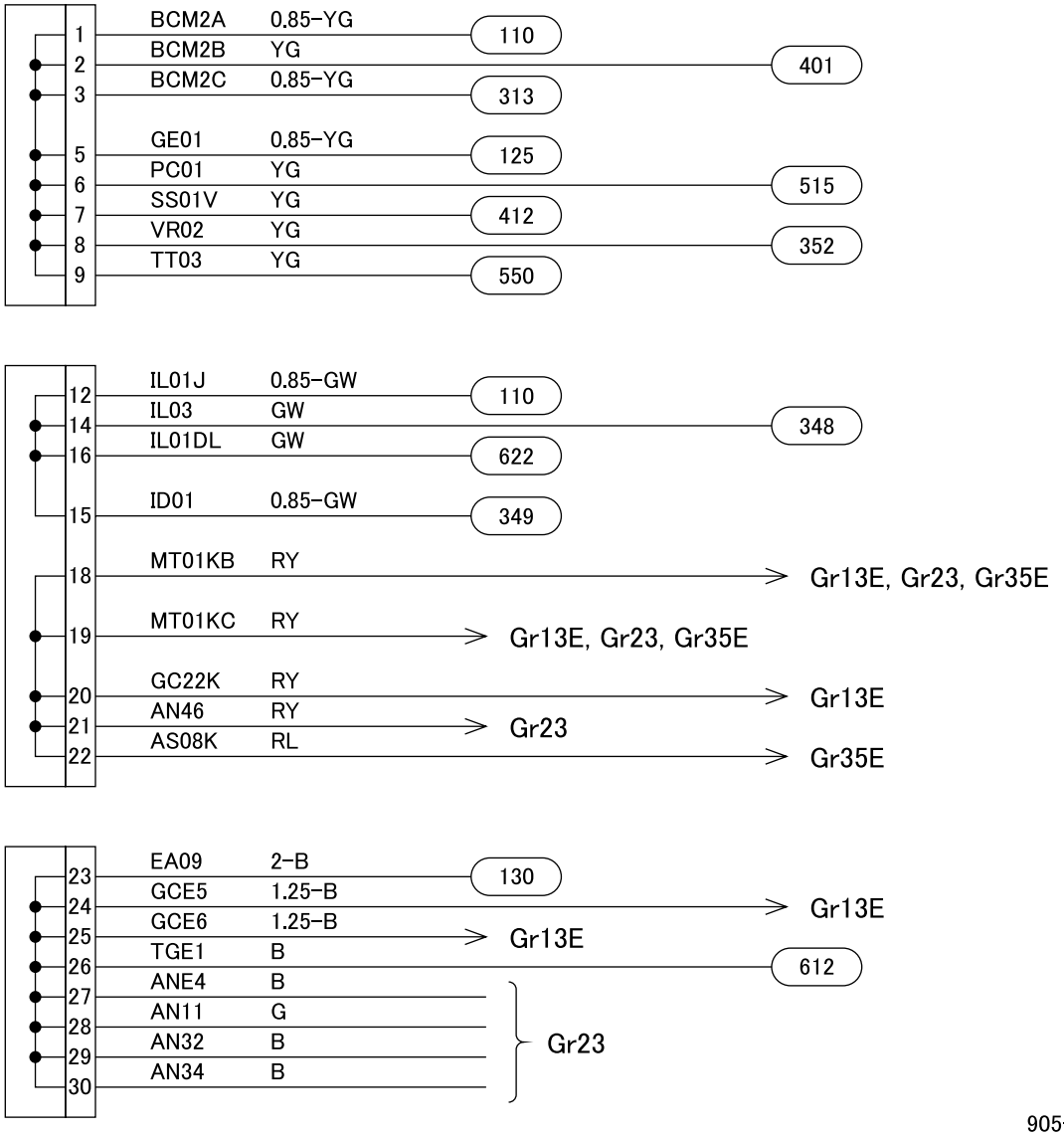
1	2	3	4	5	6	7	8	9	10	11
BCM8C	AS07	AN36	BCM8D BCM8E		BCB1A	BCB1B	PL01	RS01	SL02	DR06
12	13	14	15	16	17	18	19	20	21	22
BCA4Y	—	PC02	KL02		BCM5Y	AM01	—	MT01VC	MH02	PW01
23	24	25	26	27	28	29	30	31	32	33
BR01AA	BR01AB	BR03	BR05		SL03A	SL03B	AN41	AS04	HB01	PL03



C00530

(J/C-3)

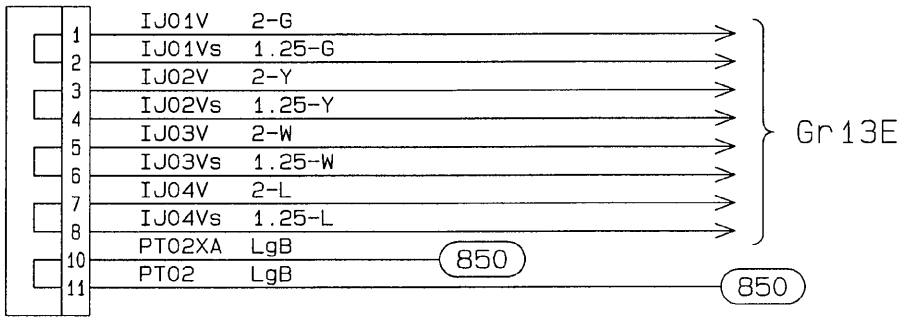
1	2	3	4	5	6	7	8	9	10	11
BCM2A	BCM2B	BCM2C	—	GE01	PC01	SS01V	VR02	TT03		—
12	13	14	15	16	17	18	19	20	21	22
IL01J		IL03	ID01	IL01DL	—	MT01KB	MT01KC	GC22K	AN46	AS08K
23	24	25	26	27	28	29	30	31	32	33
EA09	GCE5	GCE6	TGE1	ANE4	AN11	AN32	AN34	—		—

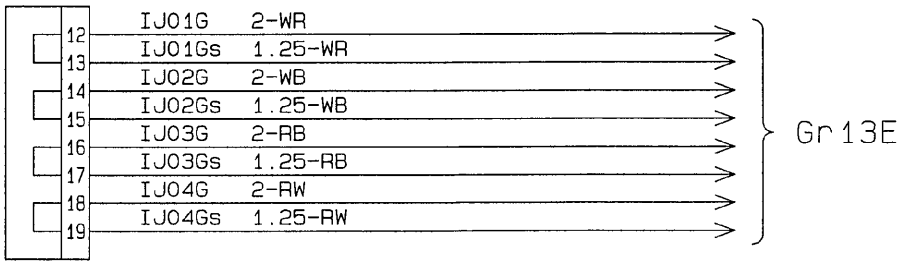


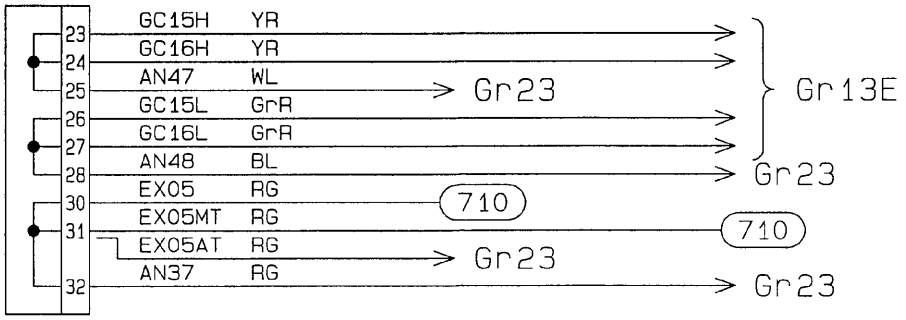
905-C02281

(J/C-4)

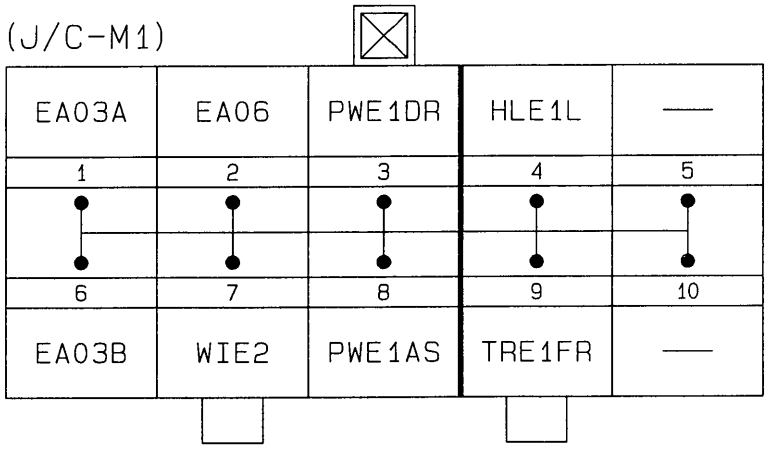
1	2	3	4	5	6	7	8	9	10	11
IJ01V	IJ01Vs	IJ02V	IJ02Vs	IJ03V	IJ03Vs	IJ04V	IJ04Vs		PT02XA	PT02
12	13	14	15	16	17	18	19	20	21	22
IJ01G	IJ01Gs	IJ02G	IJ02Gs	IJ03G	IJ03Gs	IJ04G	IJ04Gs		—	—
23	24	25	26	27	28	29	30	31	32	33
GC15H	GC16H	AN47	GC15L	GC16L	AN48		EX05	EX05AT EX05MT	AN37	—

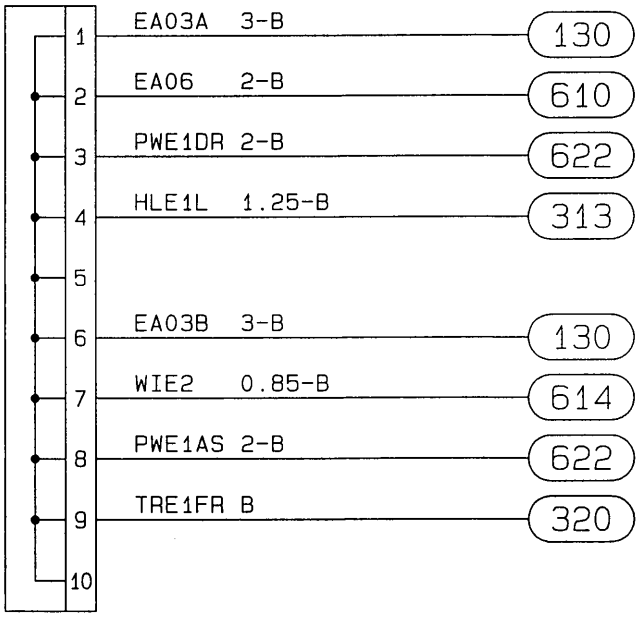




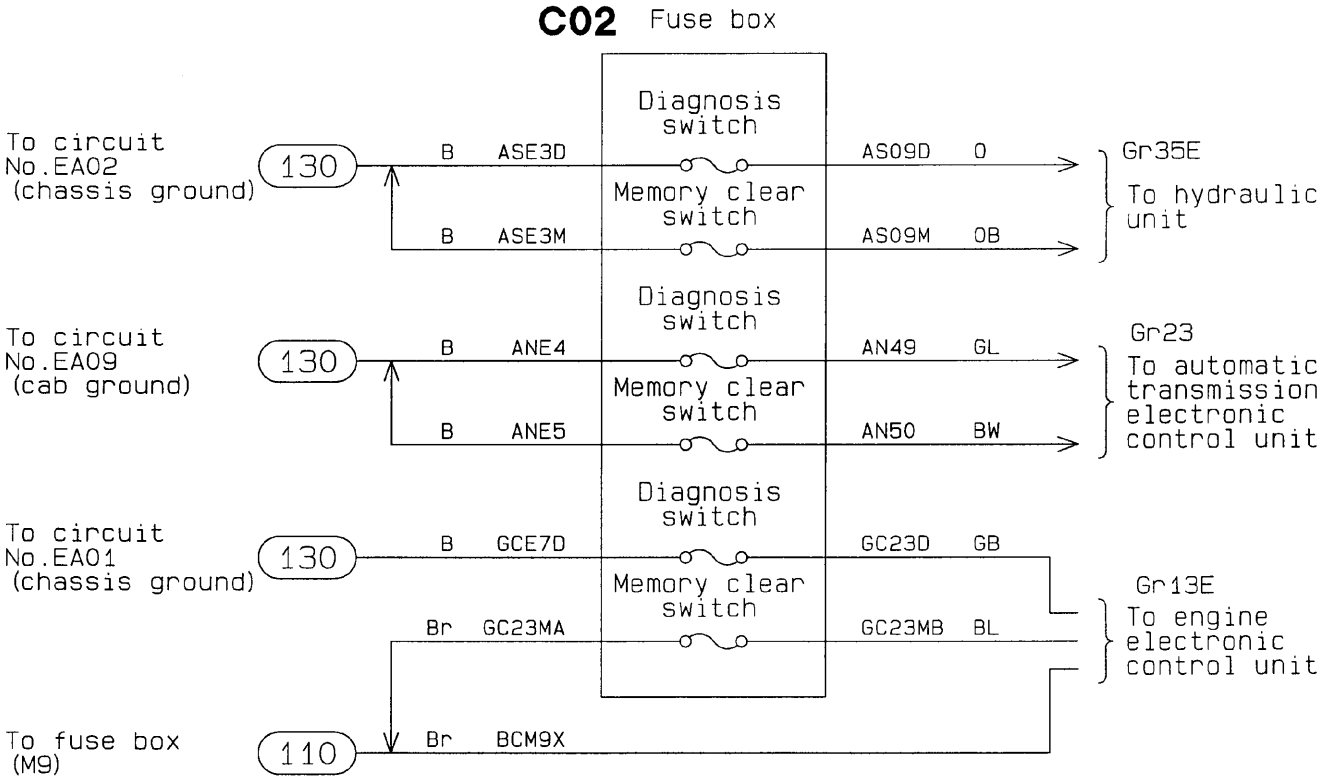


C00532


(J/C-M1)
EA03A
EA06
PWE1DR
HLE1L
—
1
2
3
4
5
6
7
8
9
10
EA03B
WIE2
PWE1AS
TRE1FR
—


1
2
3
4
5
6
7
8
9
10
EA03A 3-B
130
EA06 2-B
610
PWE1DR 2-B
622
HLE1L 1.25-B
313
EA03B 3-B
130
WIE2 0.85-B
614
PWE1AS 2-B
622
TRE1FR B
320

C00533

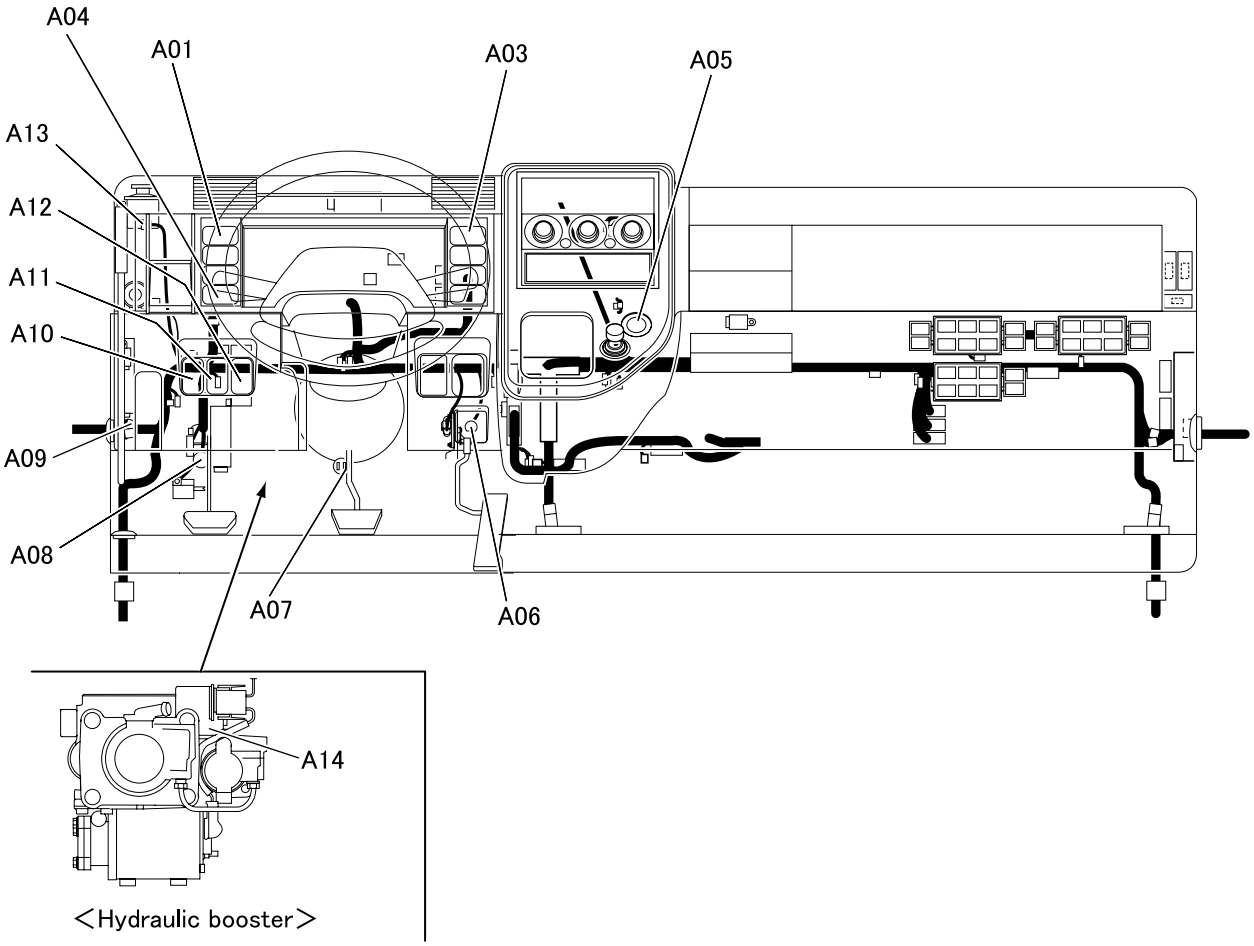


The fuse is substituted for diagnosis switch and the memory clear switch.

C00534

54-10 ELECTRICAL EQUIPMENT INSTALLATION POSITIONS

A01 to 14



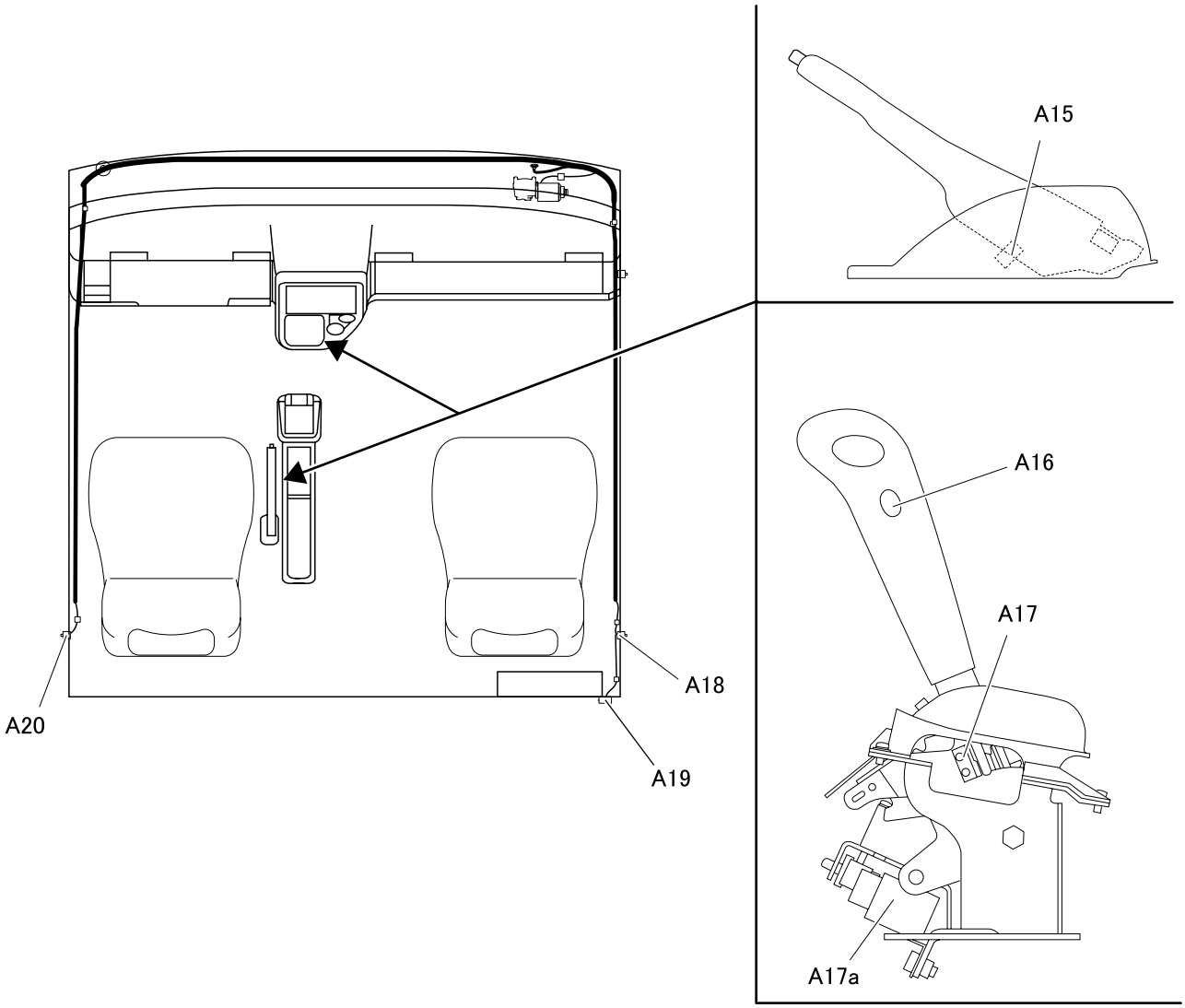
No relevant parts in a missing number

A01 Engine oil level check switch
A03 Warming switch
A04 Door lock switch
A05 Hazard switch
A06 Idling speed adjustment potentiometer
A07 Stop lamp switch
A08 Clutch switch
A09 T/M PTO indicator lamp switch
A10 Van body dome light switch
A11 Rheostat switch
A12 Mirror heater switch
A13 Brake fluid level switch
A14 Flow switch <With hydraulic booster>

PTO : Power take-off
T/M : Transmission

L01265

A15 to 22



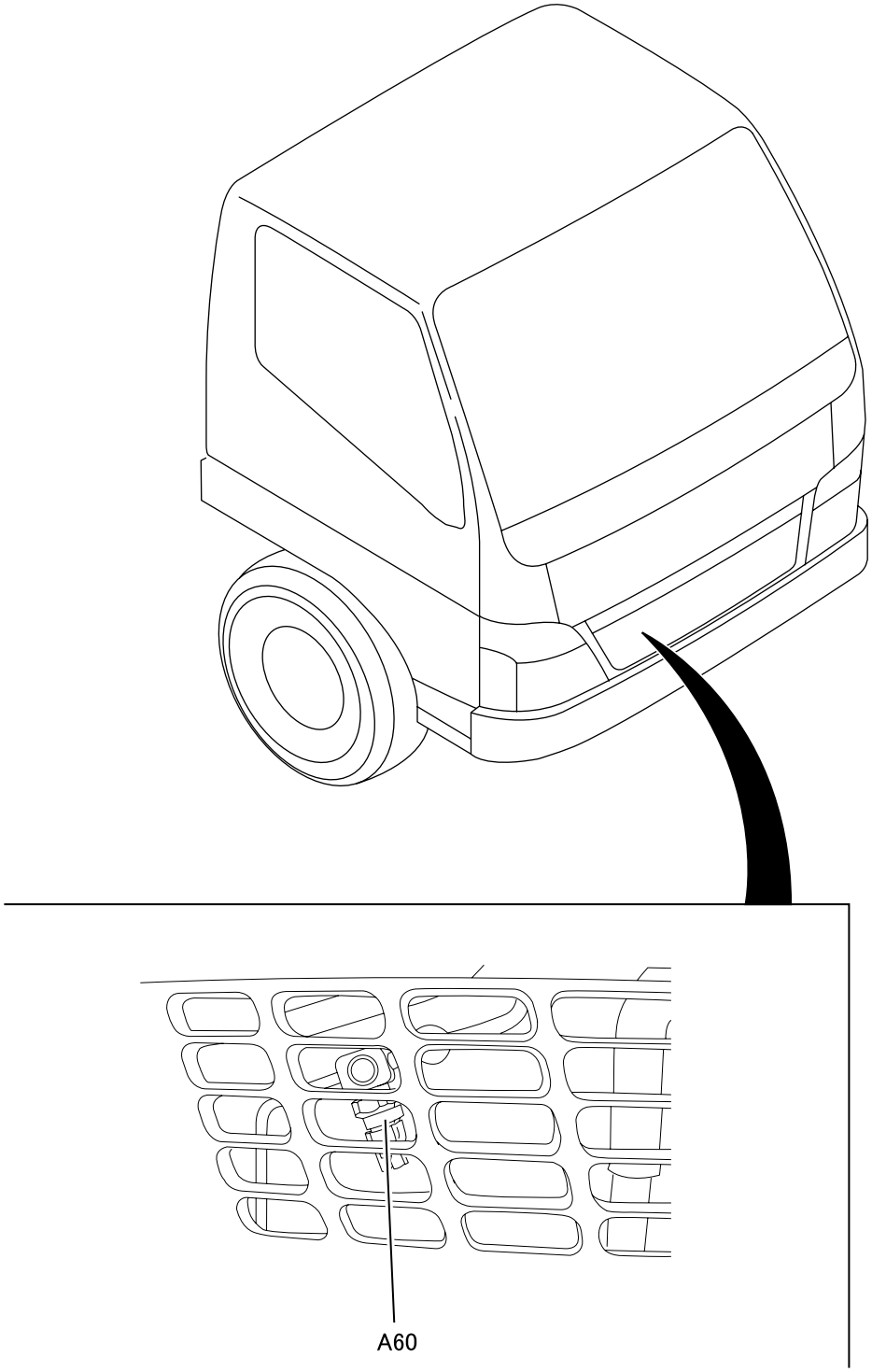
No relevant parts in a missing number

A15 Parking brake switch
A16 O/D switch <A/T>
A17 P range switch <A/T>
A17a Shift lock actuator <A/T>
A18 Front door switch, RH
A19 Cab tilt lock switch
A20 Front door switch, LH

A/T : Automatic transmission
O/D : Over drive

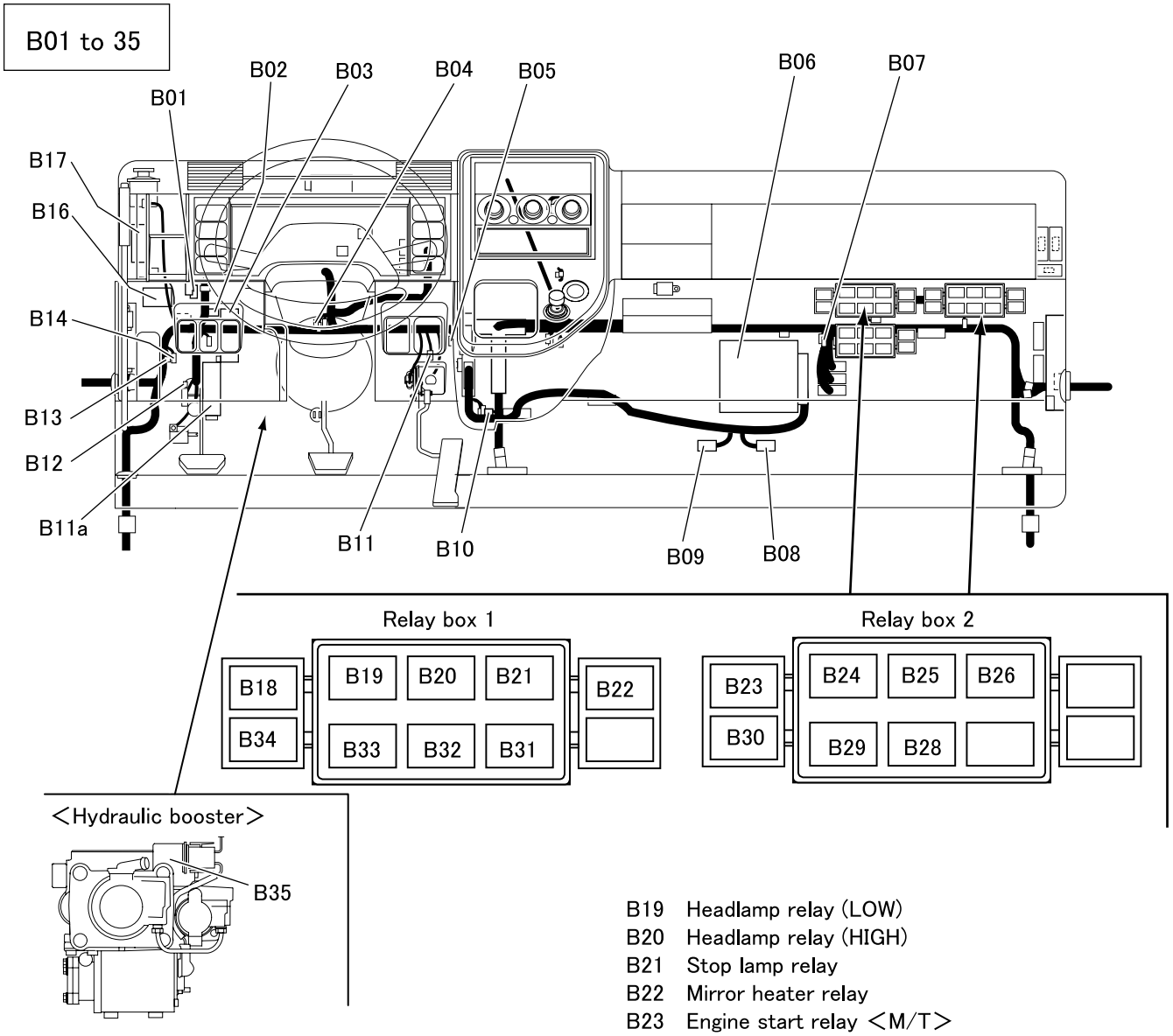
L01266

A60



A60 Dual pressure switch ＜With air-conditioner＞

L00160



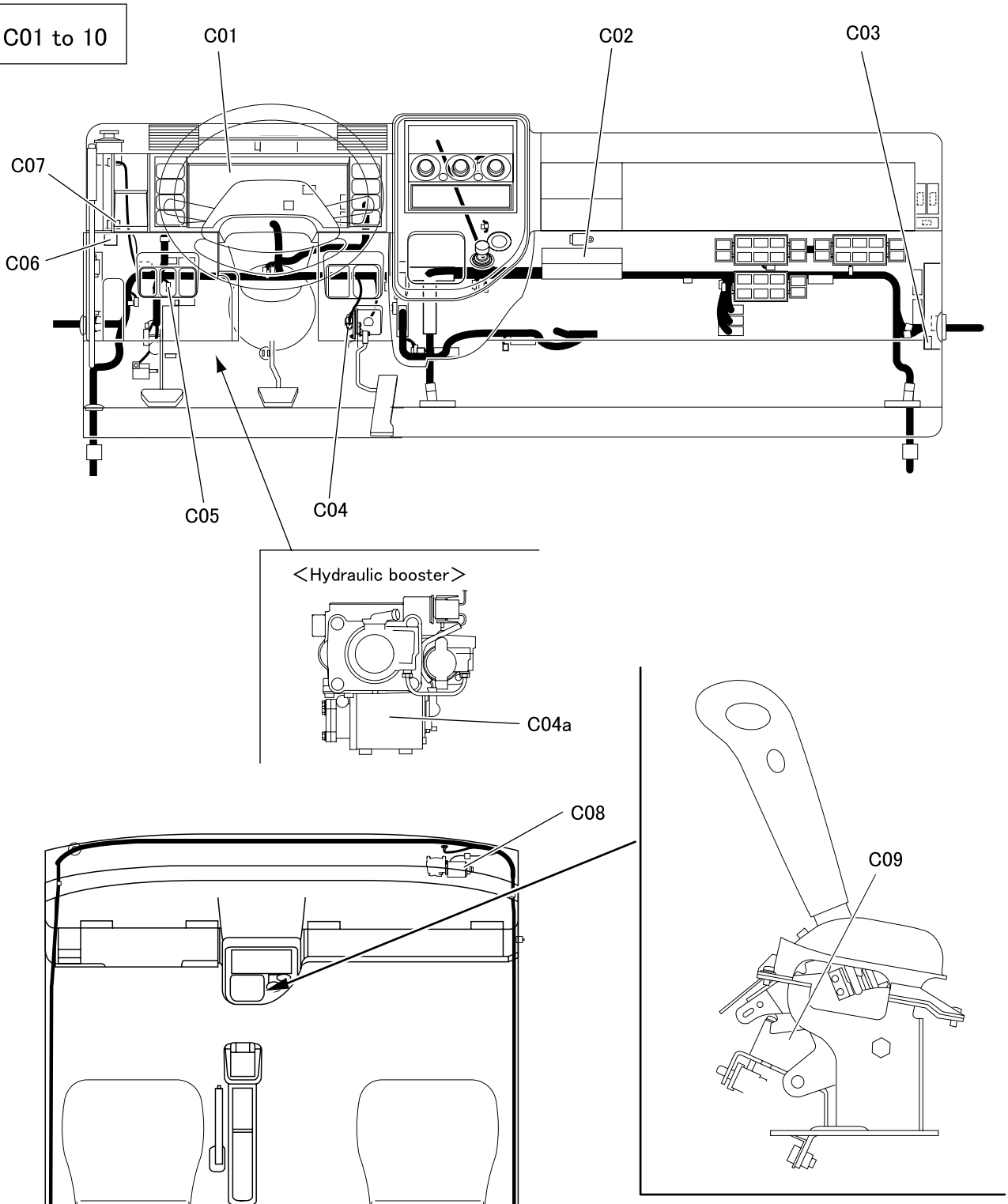
No relevant parts in a missing number

B01 Diode
B02 Diode
B03 Flasher unit
B04 Diode
B05 Wiper electronic control unit
B06 Engine ECU
B07 Diode
B08 Resistor unit
B09 Resistor unit
B10 Diode
B11 PTO resistor
B11a A/T ECU
B12 Diode
B13 Fuel injection rate adjustment unit
B14 Diode
B16 Daytime running light ECU
B17 Key interlock control unit
B18 Turn signal lamp relay
B19 Headlamp relay (LOW)
B20 Headlamp relay (HIGH)
B21 Stop lamp relay
B22 Mirror heater relay
B23 Engine start relay <M/T>
B24 ABS exhaust brake cut relay
B25 Glow drive relay
B26 Blower motor relay
B28 Overheating relay
B29 Daytime running light relay
B30 T/M neutral relay <M/T>
B31 Exhaust brake cut relay <A/T>
PTO relay <M/T>
B32 Parking brake relay <With hydraulic booster>
B33 Safety relay
B34 Engine oil level relay
B35 Emergency pump motor relay
<With hydraulic booster>

A/T : Automatic transmission
ABS : Anti-lock brake system
ECU : Electronic control unit
M/T : Manual transmission
PTO : Power take-off
T/M : Transmission

L01267

C01 to 10



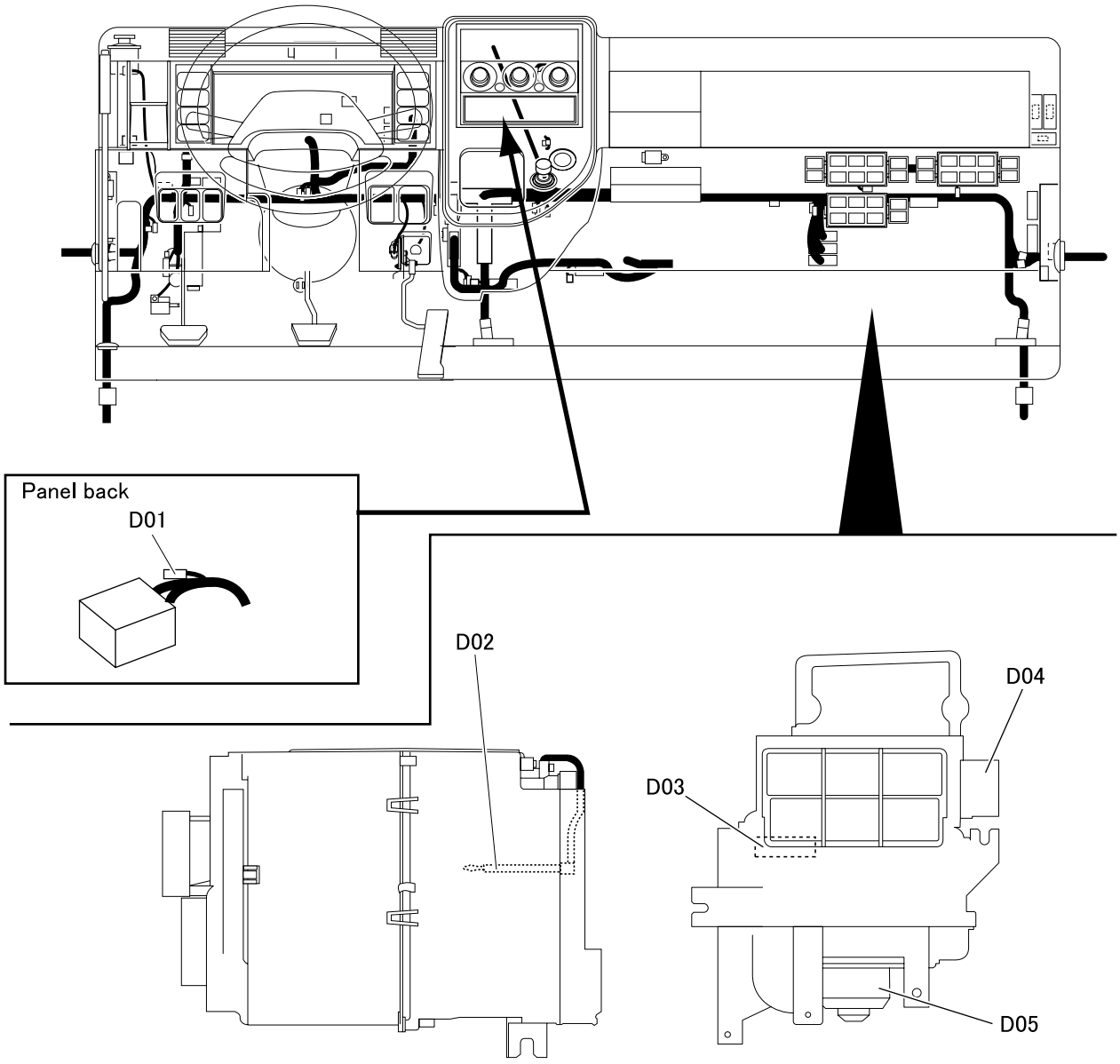
No relevant parts in a missing number

C01 Meter cluster
C02 Fuse box
C03 Windshield washer motor
C04 Accelerator pedal position sensor
C04a Motor <With hydraulic booster>
C05 G sensor <ABS>
C06 Cab tilt buzzer
C07 Warning buzzer
C08 Wiper motor
C09 Shift lock actuator <A/T>

ABS: Anti-lock brake system
A/T: Automatic transmission

L00161

D01 to 05

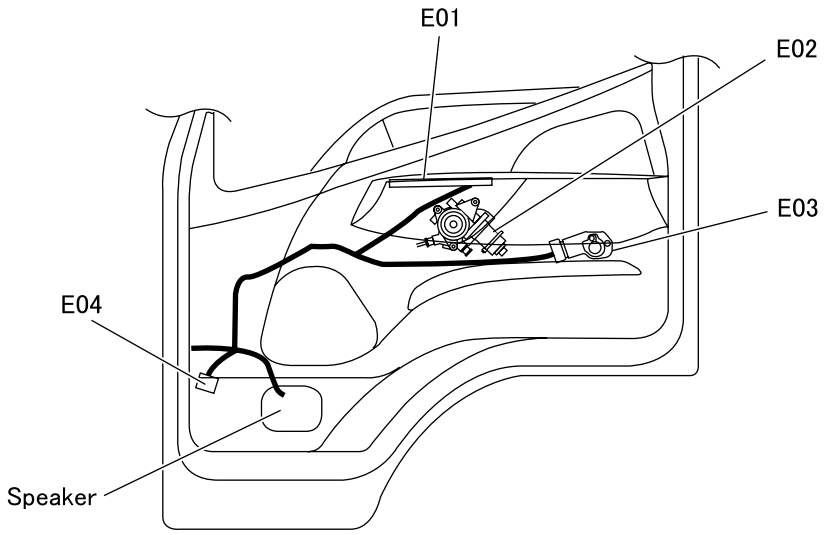


No relevant parts in a missing number

D01 Diode
D02 Thermostat
D03 Blower resistor
D04 Fresh/recirculation changeover motor
D05 Blower motor

L00162

E01 to 04



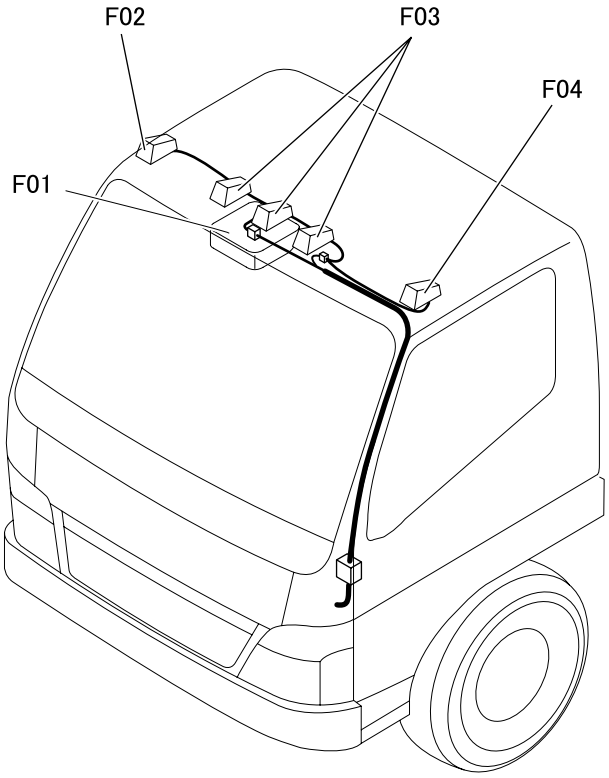
This illustrations show the right side door, the left side door is symmetrical.

No relevant parts in a missing number

E01 Power window switch
E02 Power window motor
E03 Door lock actuator
E04 Mirror heater connector

L00163

F01 to 05



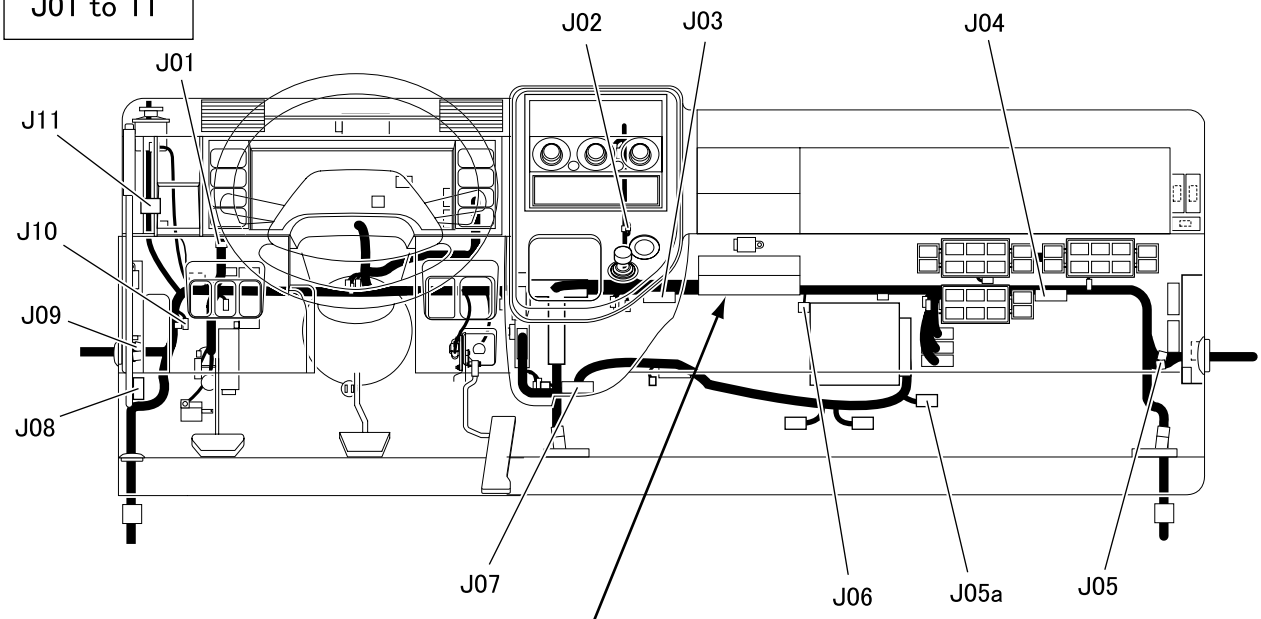
No relevant parts in a missing number

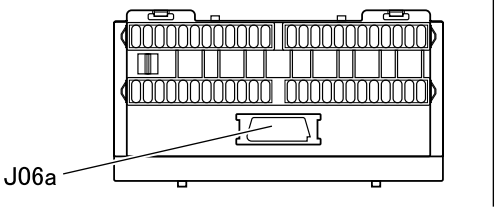
F01 Cab lamp
F02 Clearance and side marker lamp, RH
F03 Identification lamp
F04 Clearance and side marker lamp, LH

L01268

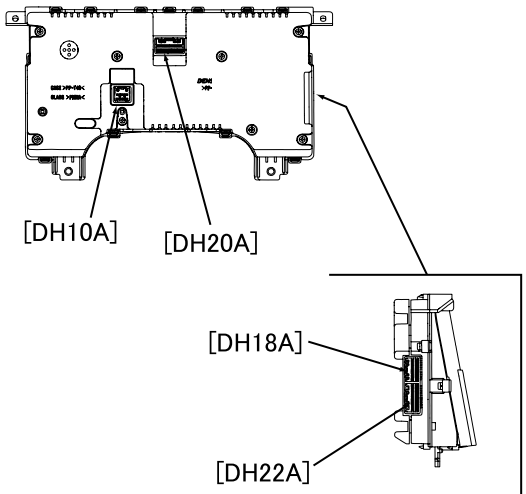
J JOINTS OF MAIN HARNESS CONNECTORS

J01 to 11





Meter cluster backward view



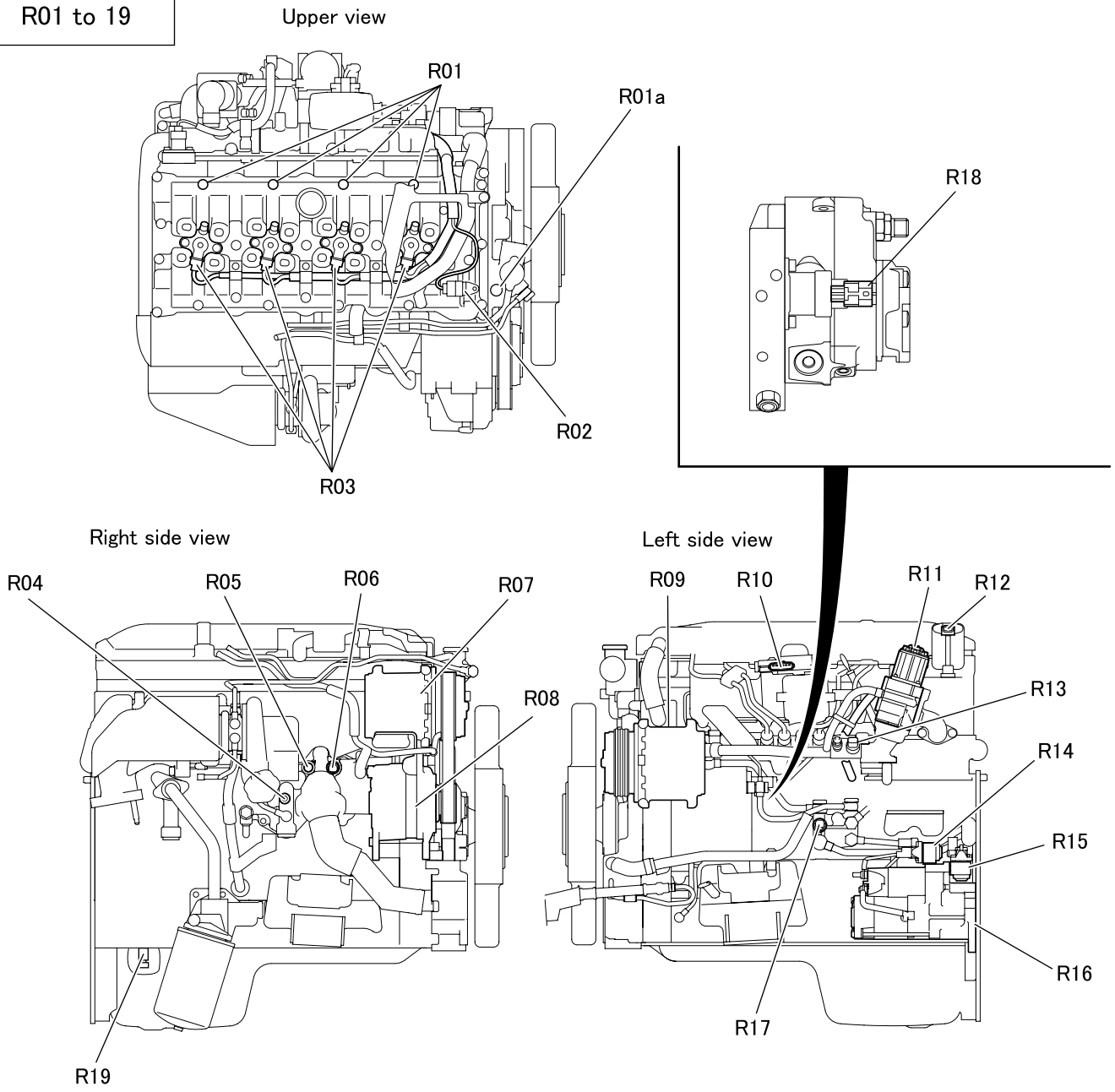
No relevant parts in a missing number

J01 Connection of cab harness and instrument panel harness
J02 Connection of cab harness and center panel harness
J03 Joint connector (J/C-1)
J04 Joint connector (J/C-2, 3)
J05 Connection of cab harness and door harness, RH
J05a Joint connector (J/C-4)
J06 Connection of center panel harness and air-conditioner harness
J06a Multi-Use Tester-Ⅲ connector (for recorder)
J07 Joint connector (J/C-M1)
J08 Multi-Use Tester-Ⅲ connector (for inspection)
J09 Connection of cab harness and door harness, LH
J10 Optional connector
J11 Connection of cab harness and roof harness

Indicate by connector type [ ]. [connector type]

L00165

R01 to 19



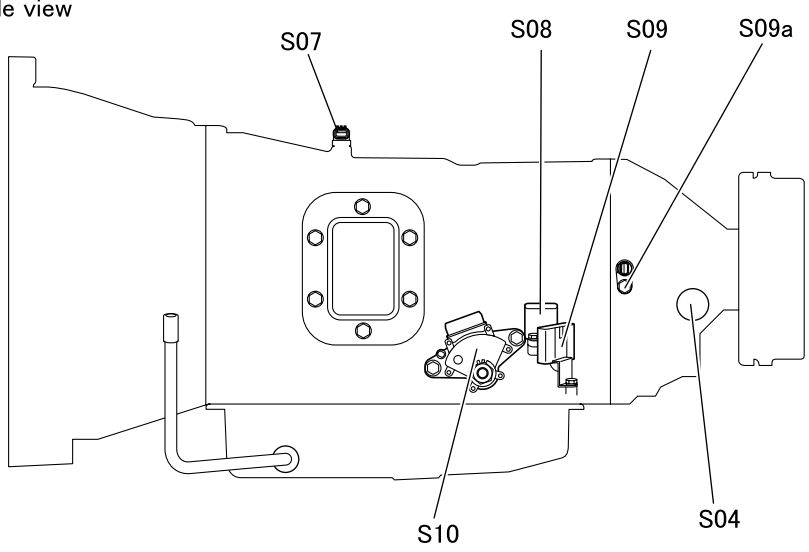
No relevant parts in a missing number

R01	Glow plug	R11	EGR valve (building into motor, position sensor)
R01a	Overheating switch		
R02	Cylinder recognition sensor	R12	Boost pressure sensor
R03	Injectors	R13	Common rail pressure sensor
R04	Engine oil pressure switch	R14	Glow relay
R05	Water temperature sensor (connects to water temperature gauge)	R15	Starter relay
		R16	Starter
R06	Water temperature sensor (connects to engine ECU)	R17	Fuel temperature sensor
		R18	MPROP (rail pressure control valve)
R07	Magnetic clutch	R19	Engine oil level sensor
R08	Alternator		
R09	Magnetic clutch <Freezer>	ECU : Electronic control unit	
R10	Intake throttle (building into motor, position sensor)	EGR : Exhaust gas recirculation	

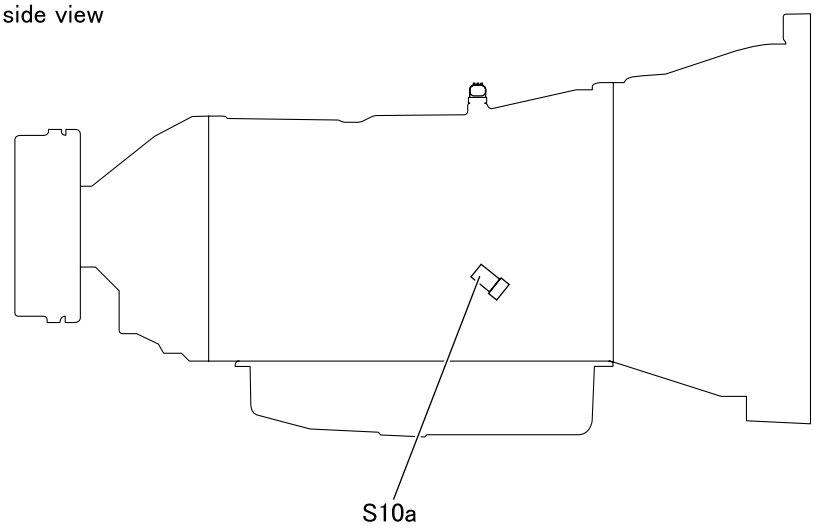
L00154

S01 to 12 <Automatic transmission>

Left side view



Right side view

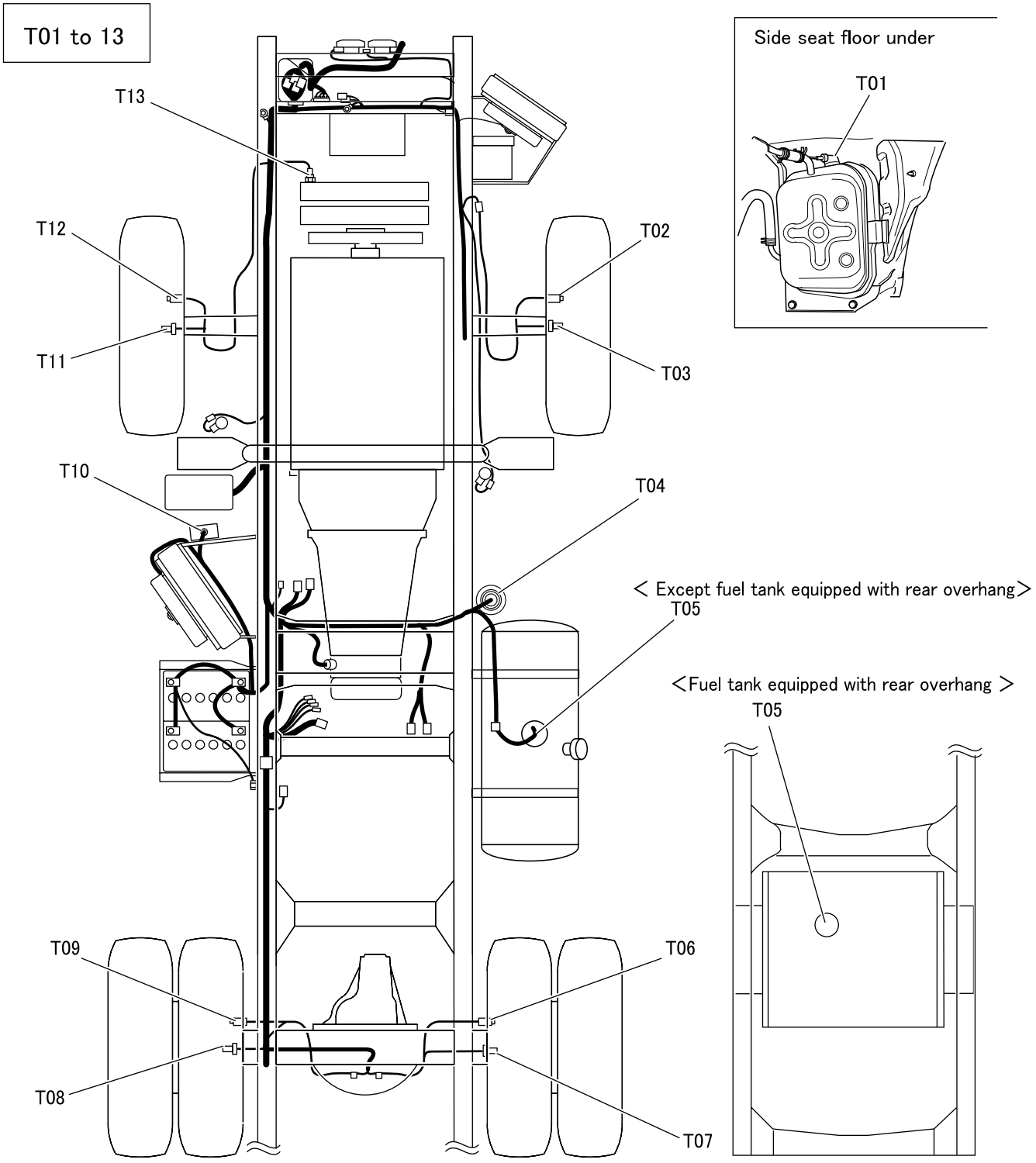


No relevant parts in a missing number

S04 Vehicle speed sensor
S07 Turbine revolution sensor
S08 A/T solenoid connector
S09 A/T solenoid connector
S09a Output speed sensor
S10 Inhibitor switch
S10a A/T fluid temperature sensor

A/T : Automatic transmission

L00156

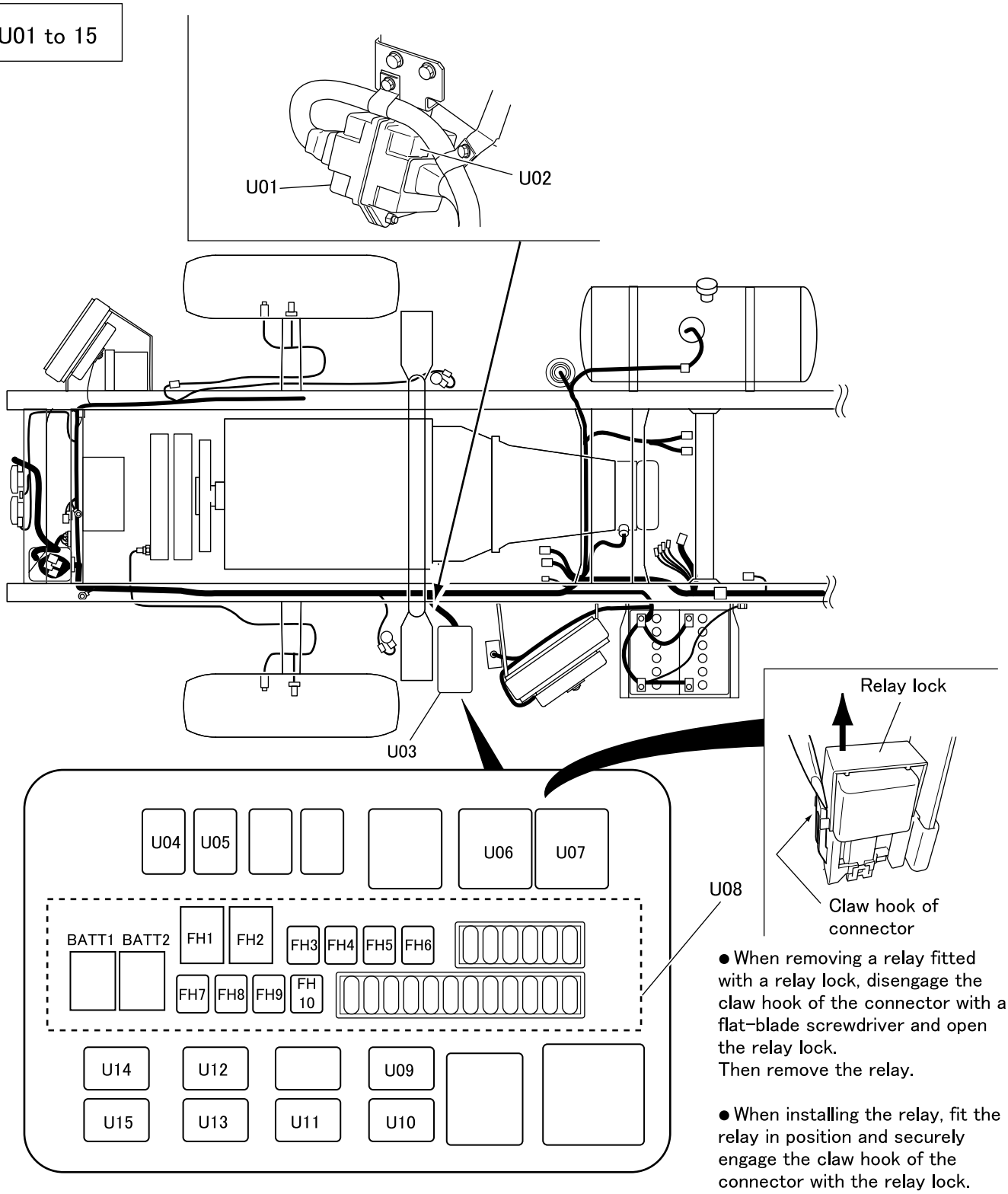


No relevant parts in a missing number

T01	Vacuum switch	T08	Rear wheel speed sensor, LH
T02	Front brake pad wear indicator, RH	T09	Rear brake pad wear indicator, LH
T03	Front wheel speed sensor, RH	T10	Automatic transmission fluid cooler fan thermo switch
T04	Water separator sensor	T11	Front wheel speed sensor, LH
T05	Fuel level sensor	T12	Front brake pad wear indicator, LH
T06	Rear brake pad wear indicator, RH	T13	Boost air temperature sensor
T07	Rear wheel speed sensor, RH		

L00170

U01 to 15



● When removing a relay fitted with a relay lock, disengage the claw hook of the connector with a flat-blade screwdriver and open the relay lock.
Then remove the relay.

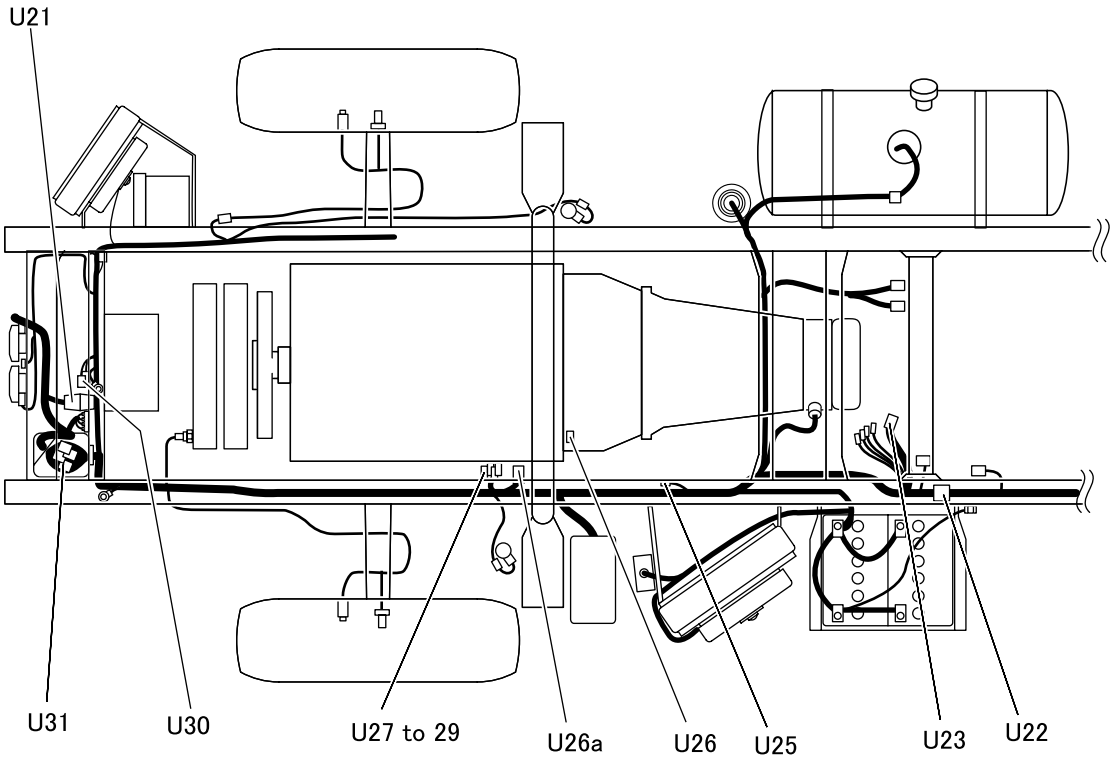
● When installing the relay, fit the relay in position and securely engage the claw hook of the connector with the relay lock.

U01 Throttle EDU
U02 EGR EDU
U03 High-current fuse box
U04 ATF cooler fan motor relay
U05 Backup lamp relay <A/T>
U06 Wiper relay (HIGH)
U07 Wiper relay (LOW)
U08 High-current fuse
U09 Horn relay
U10 Air-conditioner compressor relay
U11 Condenser fan relay
U12 Tail lamp relay
U13 EDU relay
U14 Van body dome light relay
U15 Neutral start relay <A/T>

ATF : Automatic transmission fluid
A/T : Automatic transmission
EDU : Electronic drive unit
EGR : Exhaust gas recirculation

L01269

U21 to 31



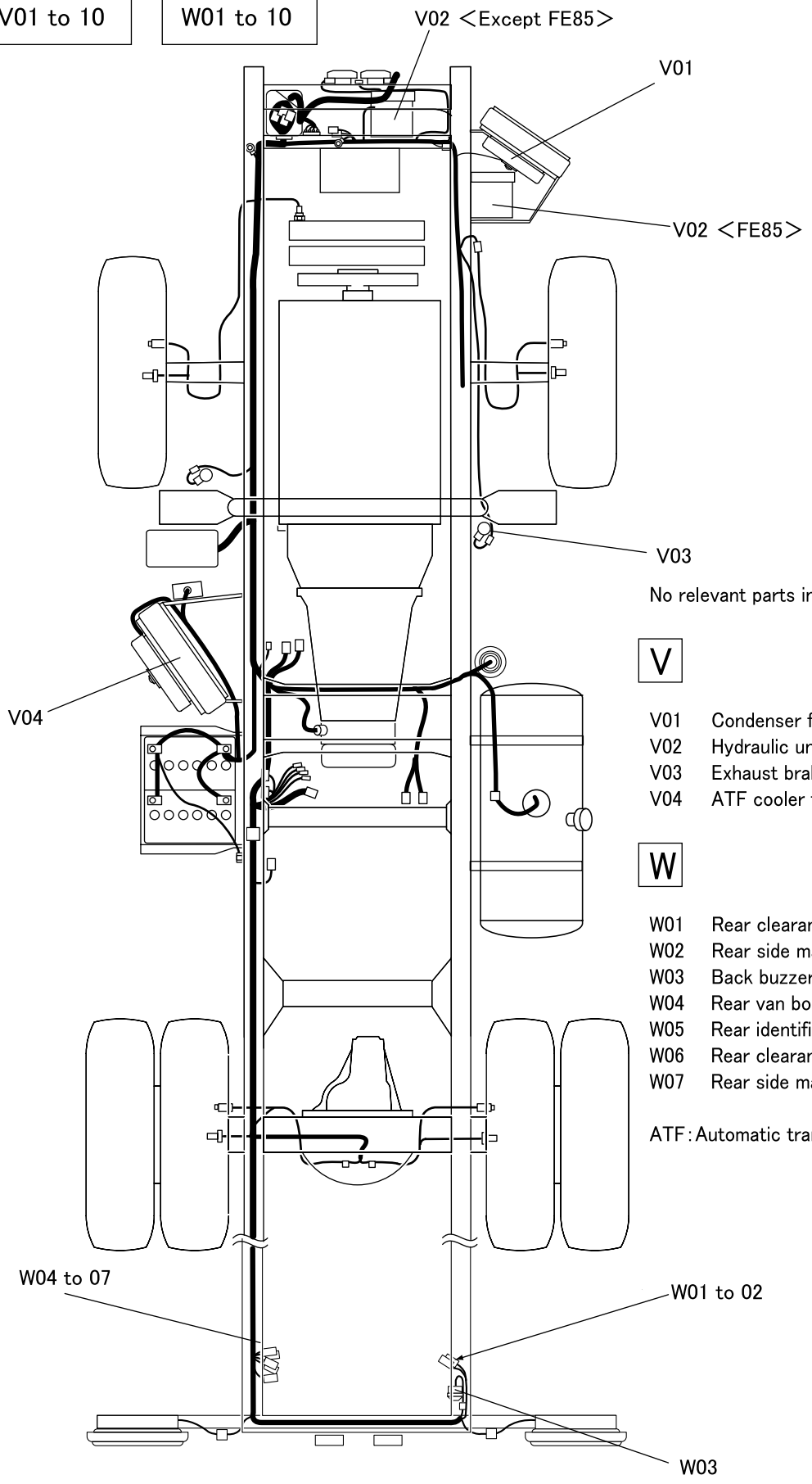
No relevant parts in a missing number

U21 Connection of cab harness and engine harness
U22 Connection of chassis harness and rear chassis harness
U23 Connection of chassis harness and transfer control harness
U25 Diode
U26 Connection of chassis harness and starter harness
U26a Joint connector
U27 Front van body dome light connector
U28 Front identification lamp connector
U29 Front clearance lamp connector
U30 Diode
U31 Connection of chassis harness and cab harness or engine harness

V MAGNETIC VALVE AND MOTOR W BUZZER AND CONNECTORS

V01 to 10

W01 to 10



No relevant parts in a missing number

V

V01 Condenser fan motor
V02 Hydraulic unit
V03 Exhaust brake 3-way magnetic valve
V04 ATF cooler fan motor

W

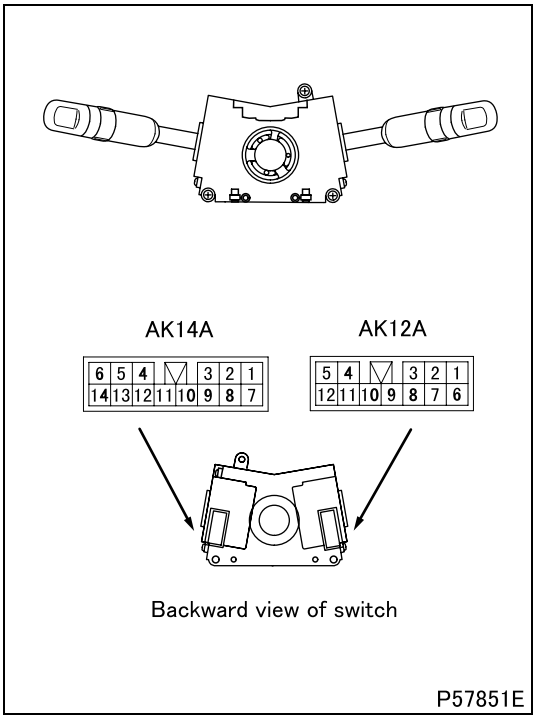
W01 Rear clearance lamp, RH connector
W02 Rear side marker lamp, RH connector
W03 Back buzzer
W04 Rear van body dome light connector
W05 Rear identification lamp connector
W06 Rear clearance lamp, LH connector
W07 Rear side marker lamp, LH connector

ATF : Automatic transmission fluid

L01271

54-11 INSPECTION OF ELECTRICAL EQUIPMENT

#001 to #179 SWITCH



#001 Inspection of combination switch

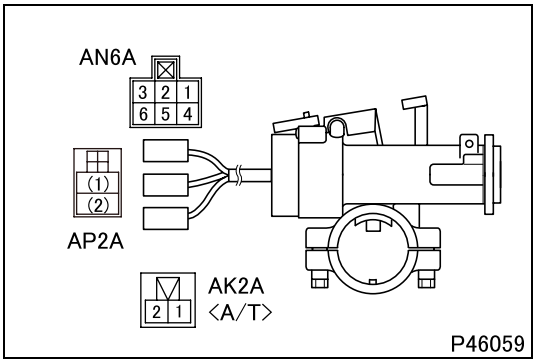
AK12A connector connection table

Switch position			Continuity terminal
Lighting switch	OFF		–
	I		1–2
	II	Dimmer	1–9
		Main	1–9–12
Dimmer switch	Passing		11–12
Turn signal lamp switch	LH		6–8
	N (neutral)		–
	RH		7–8

AK14A connector connection table

Switch position		Continuity terminal
Wiper and washer switch	OFF	–
	INT (interval)	5–7
	LO (low)	3–5
	HI (high)	3–4–5
	WASH (washer)	5–12
Horn switch	OFF	–
	ON	13-body ground
Exhaust brake switch	ON	8–9
	OFF	–

- If any fault is found, replace the switch. (See Gr37.)



#002 Inspection of starter switch

AP2A, AN6A connector connection table

Switch position	Continuity terminal
LOCK	–
ACC	(2)–3
ON	(1)–(2)–3–4
START	(1)–(2)–2–3–4

- Terminal numbers within parentheses ( ) show terminals of AP2A.

AK2A connector connection table

<Key interlock solenoid (A/T)>

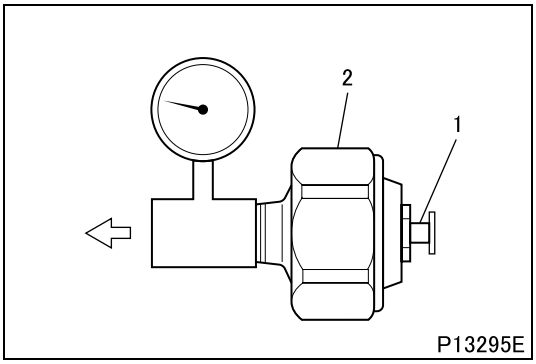
Shift position	Continuity terminal	Remarks
P range: OFF	–	The key must be turned to the lock direction
Without P range: ON	(+) 2–1 (–)	The key must not be turned to the lock direction

A/T: Automatic transmission

- If any fault is found, replace the switch. (See Gr37.)

#011 Inspection of rheostat switch

- The rheostat switch contains a control circuit, because of this it is difficult to inspect the rheostat switch independently, therefore you should inspect the rheostat switch indirectly by inspecting the system harness and the related parts.
- If no fault is found in the related parts but the system is faulty, replace the switch.



#023 Inspection of vacuum switch

- Perform the following checks, and if any fault is found, replace the switch. (See Gr35A.)

(1) Inspection without applying negative pressure

- Make sure that there is no continuity between terminals 1 and 2 (body).

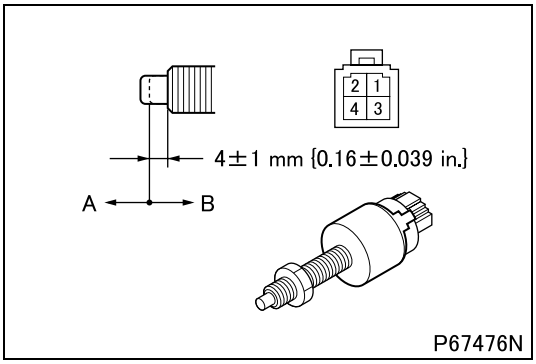
(2) Inspection by applying negative pressure

- Gradually apply negative pressure to the switch starting from 0 kPa {0 psi, 0 kgf/cm^2}.
- Measure the degree of air pressure at the moment when continuity is detected between terminals 1 and 2 (body), and make sure to confirm if the value meets the standard.

Standard value	$-(47\ ^{+3.3}_{-4.0})$ kPa {$-(13.8\ ^{+0.98}_{-1.18})$ in.Hg, $-(350\ ^{+25}_{-30})$ mmHg}

#026, #027 Inspection of power window switch

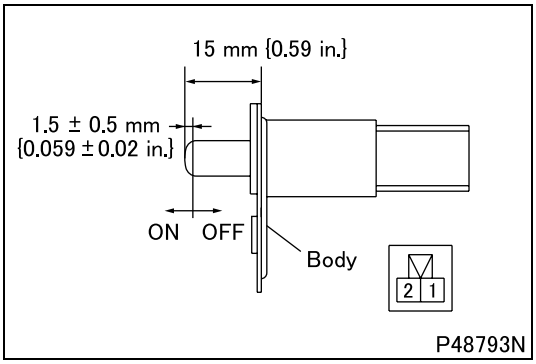
- Because it is not easy to check these swtches individually, determine quality of the switches indirectly by checking related parts, such as harnesses, power window motor, etc. in the system.
- If there is nothing abnormal in related parts, but still something wrong with the system, then replace the switches. (See Gr43.)



#031 Inspection of clutch switch

Switch position	Continuity terminal
A	1–4
B	2–3

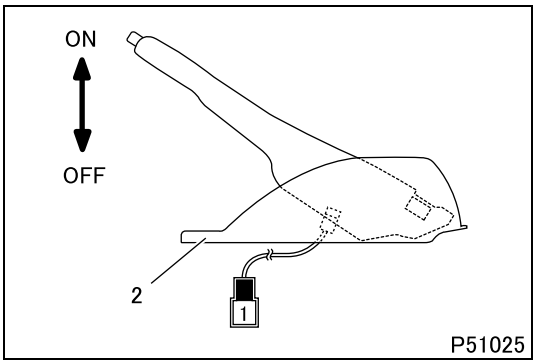
- If any fault is found, replace the switch. (See Gr21.)



#035 Inspection of door switch

Switch position	Continuity terminal
OFF	–
ON	1-body, 2-body

- If any fault is found, replace the switch. (See Gr43.)

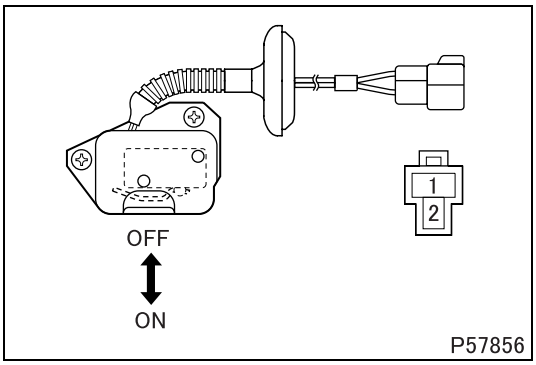


#038 Inspection of parking brake switch

- Measure continuity between terminals 1 and 2 (body) ground.

Pull the parking brake lever	Continuity exists
Release the parking brake lever	Continuity does not exist

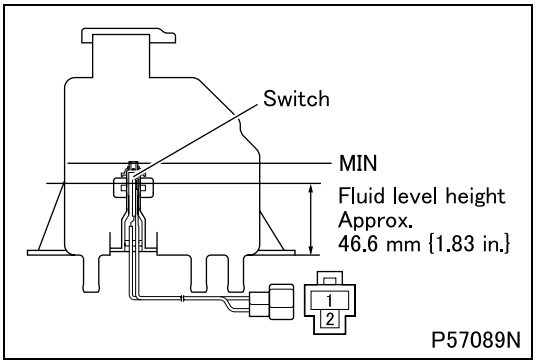
- If any fault is found, replace the switch. (See Gr36.)



#039 Inspection of cab tilt lock switch

Switch position	Continuity terminal
OFF	–
ON	1–2

- If any fault is found, replace the switch. (See Gr42.)



#041 Inspection of brake fluid level switch

- Gradually drain brake fluid from the brake fluid tank.

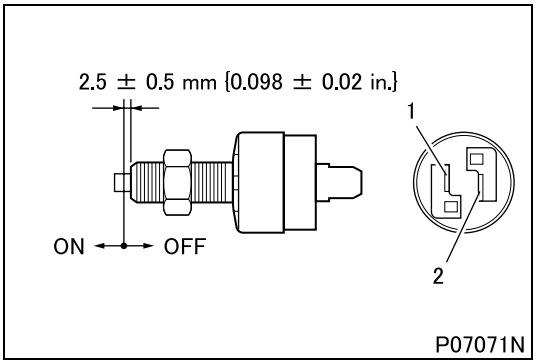
CAUTION ⚠

- **Brake fluid contains ingredients that dissolve paint on the bodywork of a vehicle. Quickly wipe off brake fluid when it is spilled.**

- Measure height of the switch when continuity is detected between terminals 1 and 2.

Standard value	46.6 mm {1.83 in.}

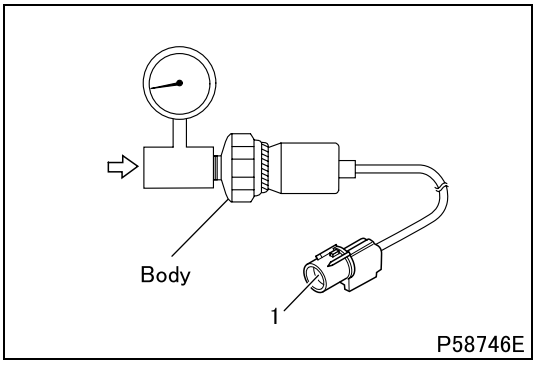
- If the measured value deviates from the standard value, replace the brake fluid tank. (See Gr52.)



#042 Inspection of stop lamp switch

Switch position	Continuity terminal
OFF	–
ON	1–2

- If any fault is found, replace the switch. (See Gr35A.)



#044 Inspection of engine oil pressure switch

- Perform the following checks, and if any fault is found, replace the switch. (See Gr12.)

(1) Inspection without applying air pressure

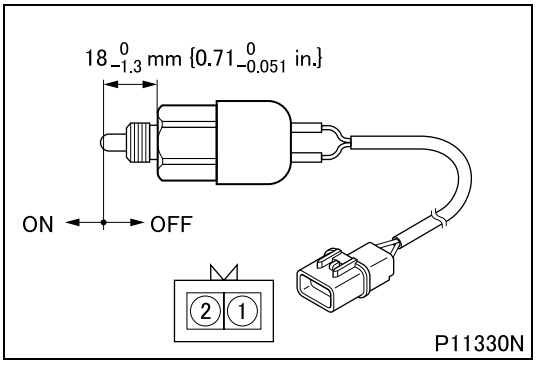
- Make sure that there is continuity between terminals 1 and body.

(2) Inspection by applying air pressure

- Gradually apply air pressure to the switch starting from 0 kPa {0 psi, 0 kgf/cm^2}.

- Measure the degree of air pressure at the moment when continuity is not detected between terminals 1 and body, and make sure to confirm if the value meets the standard.

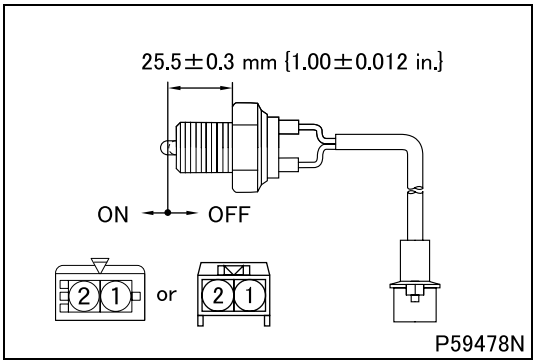
Standard value (operating pressure)	50 ± 10 kPa {7.1 ± 1.4 psi, 0.5 ± 0.1 kgf/cm^2}



#054 Inspection of switch

Switch position	Continuity terminal
OFF	–
ON	1–2

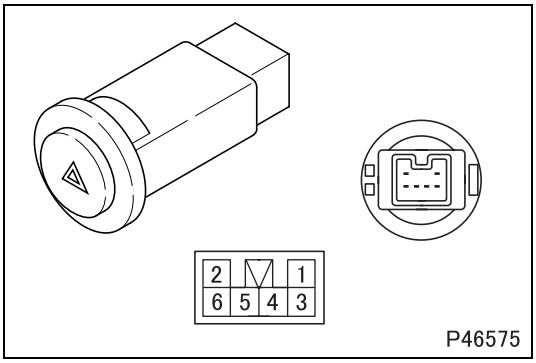
- If any fault is found, replace the switch.
  - Backup lamp switch. (See Gr22.)



#056 Inspection of transmission neutral switch

Switch position	Continuity terminal
OFF	–
ON	1–2

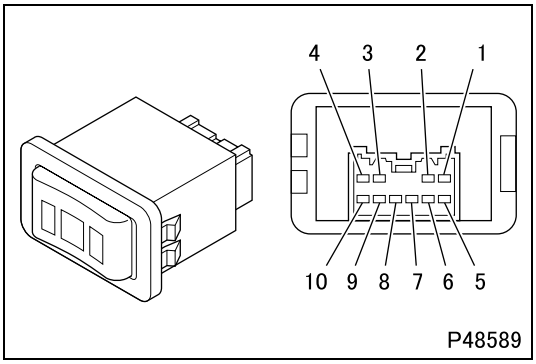
- If any fault is found, replace the switch. (See Gr22.)



#081 Inspection of hazard switch

Switch position	Continuity terminal	Night illumination
OFF	–	(+) 2-1 (–)
ON	4–5–6	

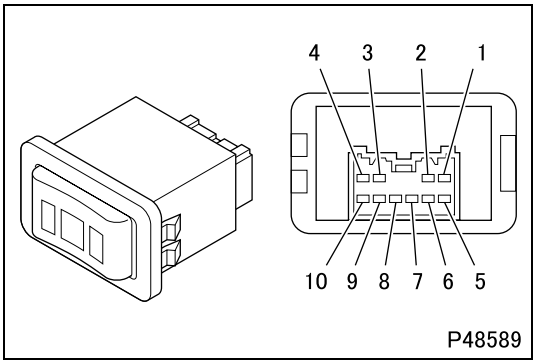
- If any fault is found, replace the switch. (See Gr52.)



#087 Inspection of van body dome light switch

Switch position	Continuity terminal	Operation illumination	Night illumination
OFF	1–8	–	(+) 2-3 (–)
ON	1–7	(–) 3–9 (+)	

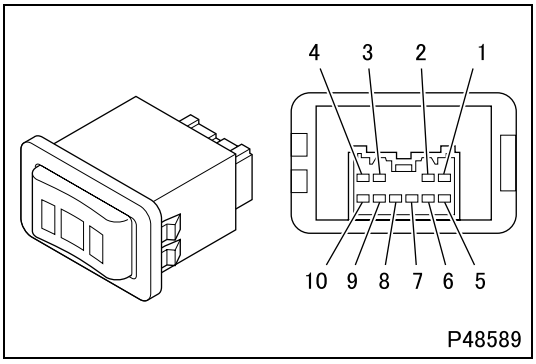
- If any fault is found, replace the switch.



#089 Inspection of switch

Switch position	Continuity terminal	Night illumination
OFF	1–8	(+) 2-3 (–)
ON	1–7	

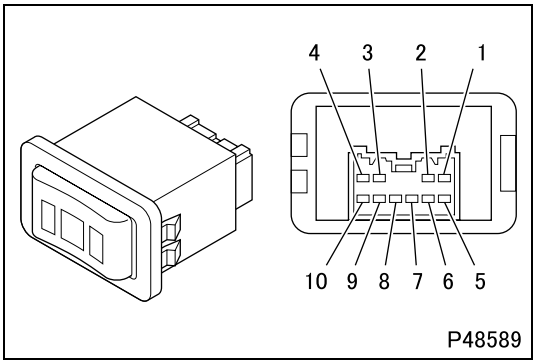
- If any fault is found, replace the switch. (See Gr52.)
  - Warm-up switch



#092 Inspection of engine oil level check switch

Switch position	Continuity terminal
–	–
CHK	1–7, 5–6

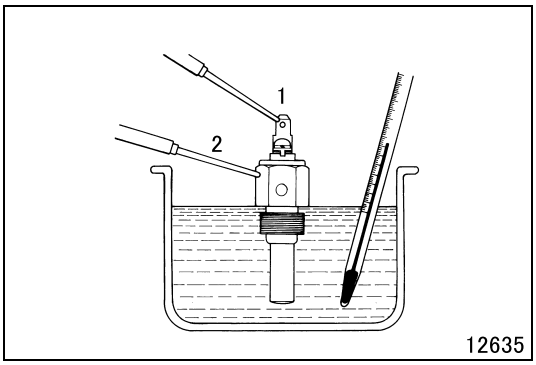
- If any fault is found, replace the switch. (See Gr52.)



#094 Inspection of door lock switch

Switch position	Continuity terminal	Night illumination
LOCK	1–7	(+) 2-3 (–)
Neutral	–	
UNLK	1–8	

- If any fault is found, replace the switch. (See Gr43.)

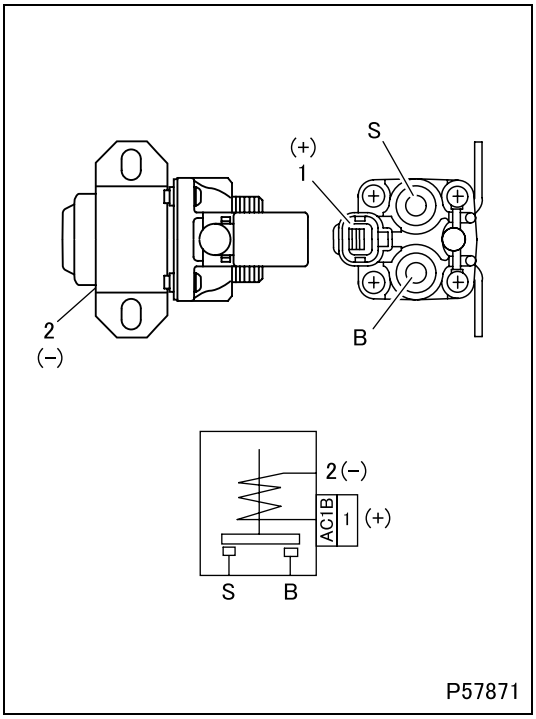


#160 Inspection of overheating switch

- Place the switch in engine oil in a container.
- Raise the oil temperature to the specified values and stir the oil.
- Measure the operating temperature between terminals 1 and 2 (body) respectively.

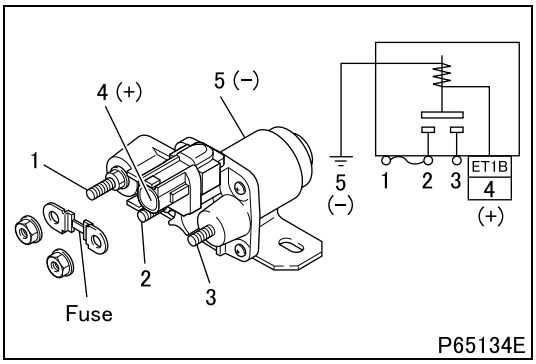
Standard Value	When temperature increase (OFF→ON)	110 ± 2°C {230 ± 36°F}
	When temperature decrease (ON→OFF)	110 ± 4°C {230 ± 39°F}

- If the measured value deviates from the standard value, replace the switch. (See Gr14.)



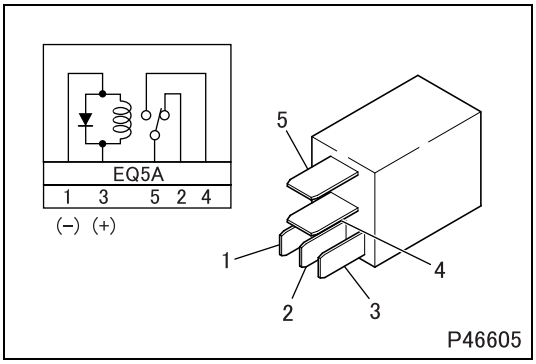
#187 Inspection of starter relay

- Perform continuity check and operation check, and if any fault is found, replace the relay.



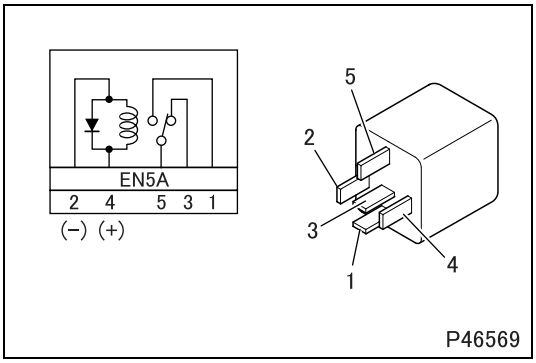
#195 Inspection of glow relay

- Perform continuity check and operation check, and if any fault is found, replace the relay.



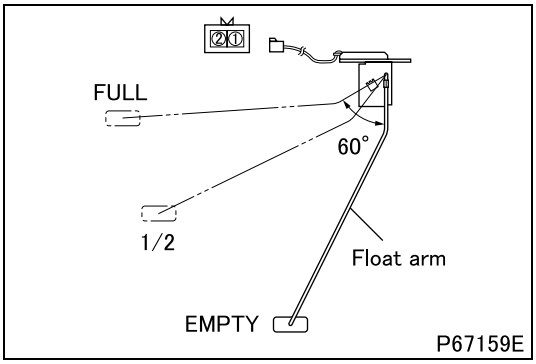
#201 Inspection of relay (normally open type 5 pin)

- Perform continuity check and operation check, and if any fault is found, replace the relay.



#202 Inspection of relay (normally open type 5 pin)

- Perform continuity check and operation check, and if any fault is found, replace the relay.

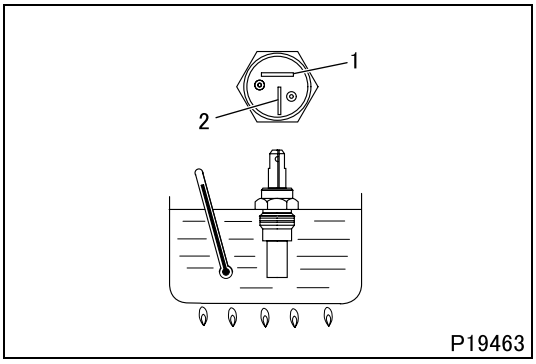


#258 Inspection of fuel level sensor

- Measure resistance values between terminals 1 and 2 when bringing the float arm into contact with stoppers (at EMPTY and FULL positions) and placing it at the midpoint position.

Standard value	at FULL position	0^{+2}_{0} Ω
	at 1/2 position	50 ± 3 Ω
	at EMPTY position	150 ± 10 Ω

- If the measured value deviates from the standard value, replace the sensor. (See Gr13A.)



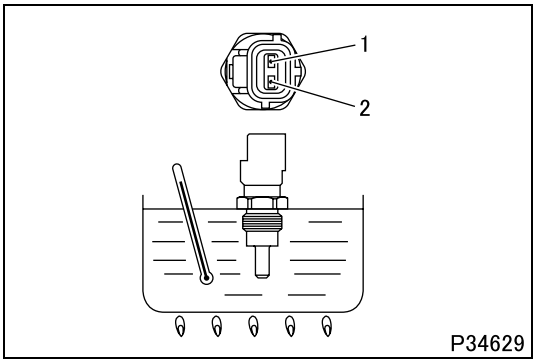
#262 Inspection of water temperature sensor

<For water temperature gauge>

- Dip the sensor in a container filled with engine oil.
- Raise the oil temperature to the specified one while stirring oil.
- Measure resistance values between terminals 1 and 2 and body.
  Terminal 1: water temperature gauge connected side
  Terminal 2: Is not use

Standard value	1 and body (water temperature gauge connected side)	50°C {122°F}	153.9 Ω (reference value)
		80°C {176°F}	$51.9^{+4.9}_{-4.4}$ Ω
		100°C {212°F}	$27.4^{+1.9}_{-1.2}$ Ω

- If the measured value deviates from the standard value, replace the sensor. (See Gr14.)

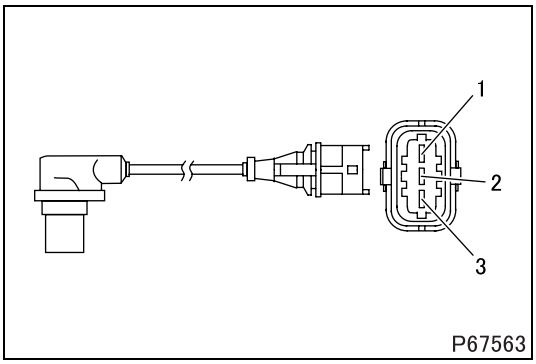


<For engine control>

- Place the sensor in engine oil in a container.
- Raise the oil temperature to the specified values and stir the oil.
- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	2.45 ± 0.14 kΩ
	80°C {176°F}	322.2 Ω (reference value)
	110°C {230°F}	147.1 ± 2 Ω

- If the measured value deviates from the standard value, replace the sensor. (See Gr14.)

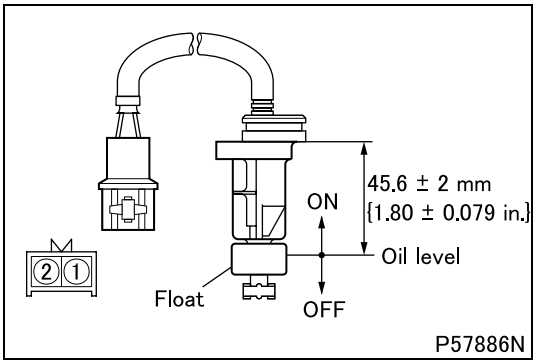


#263 Inspection of engine speed sensor

- Measure the resistance between terminals 1 and 2.

Standard value (at 20°C {68°F})	860 ± 86 Ω

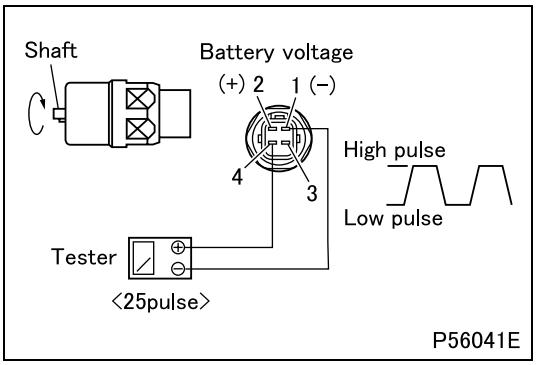
- If the measured value deviates from the standard value, replace the sensor. (See Gr13E.)



#264 Inspection of engine oil level sensor

Switch position	Continuity terminal
OFF	–
ON	1–2

- If any fault is found, replace the sensor. (See Gr12.)

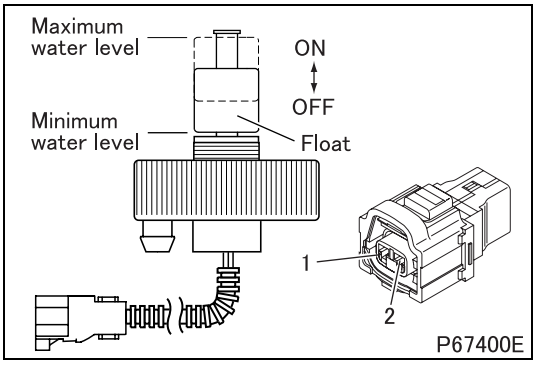


#265 Inspection of vehicle speed sensor

- Rotate the sensor shaft with the battery voltage applied between terminals 1 and 2.
- Measure the maximum value (high pulse voltage) and the minimum value (low pulse voltage) of the voltage generated at each terminal.

Standard value	Between 25 pulse output terminals 1 and 4	Low pulse voltage	0.5 V or less
		High pulse voltage	8 ± 1 V

- If the measurement is not within the range of the standard value, replace the sensor. (See Gr22.)



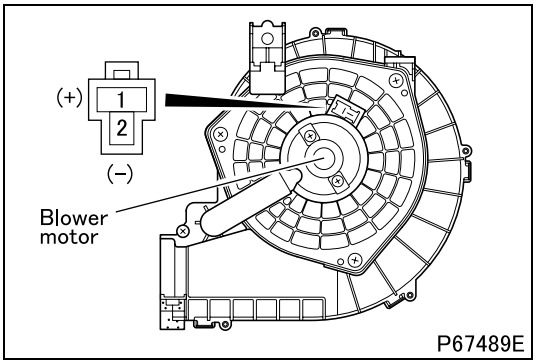
#274 Inspection of water separator sensor

Condition	Continuity terminal
ON (when coolant quantity is approx. 100 cm^3 {6.10 cu.in.})	1–2
OFF	–

- If any fault is found, replace the sensor (See Gr13A.)

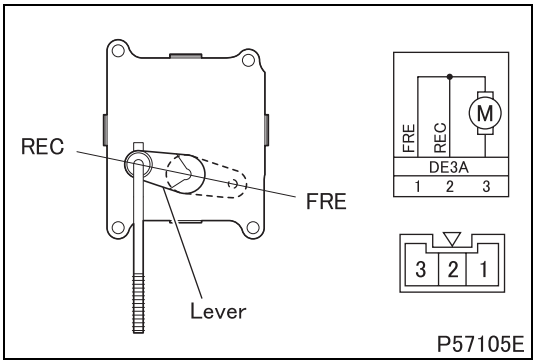
#350 Inspection of control unit and other units

- Since the units alone cannot be readily checked in the off-vehicle state, check the harness, switch and other related parts in each system.
- If any fault is not found in the related parts, and the problem still remains in the system, replace the control units or other units.



#411 Inspection of blower motor

- Make sure that the motor operates when battery voltage is applied between terminals 1 and 2.
- If any fault is found, replace the motor. (See Gr55.)



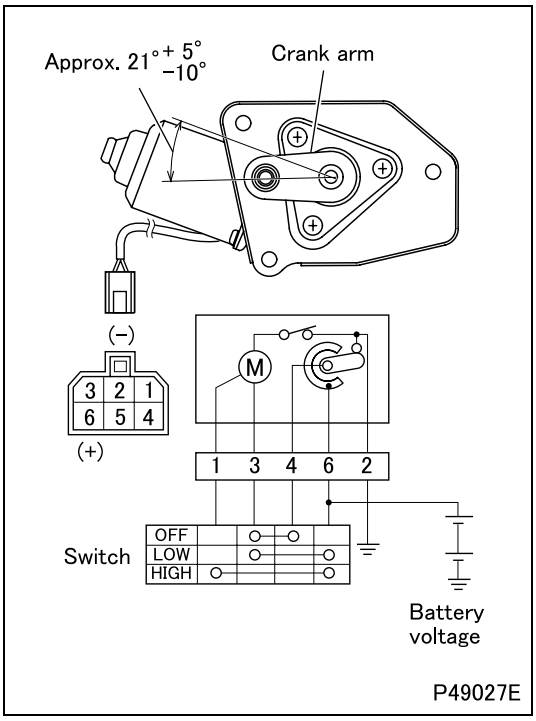
#415 Inspection of fresh/recirculation changeover motor

- Perform the following checks, and if any fault is found, replace the motor. (See Gr55.)
- Make sure that the motor operates when battery voltage is applied between each terminal.

Lever position	Terminal
REC (inside air)	(+) 3–2 (–)
FRE (outside air)	(+) 3–1 (–)

CAUTION ⚠

- **Stop applying battery voltage if the lever stops spontaneously at the REC or FRE position.**



#422 Inspection of wiper motor

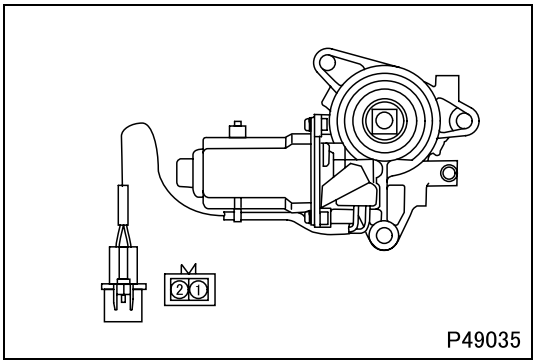
- Connect a switch to wiper motor as shown.
- Check the motor for correct operation as follows. If any fault is found, replace the motor. (See Gr51.)

(1) Inspection of motor operation

- Set switch to HIGH position to check that the motor rotates at high speed.
- Set switch to LOW position to check that the motor rotates at low speed.

(2) Inspection of automatic stop position

- Set switch to LOW position to let the motor rotate at low speed.
- When the crank arm is in a position other than automatic stop position (outside the angles shown), set switch to OFF position.
- Check to see that the crank arm stops at the automatic stop position (within the angles range shown).

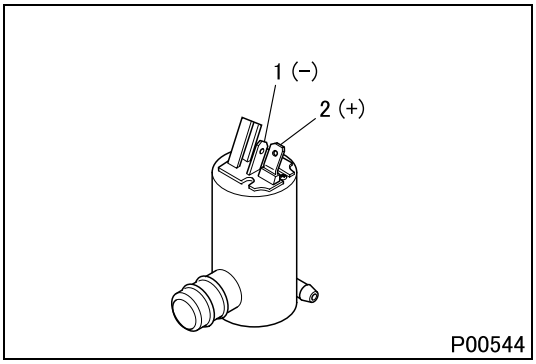


#423 Inspection of power window motor

- Make sure that the motor operates when battery voltage is applied between terminals 1 and 2.

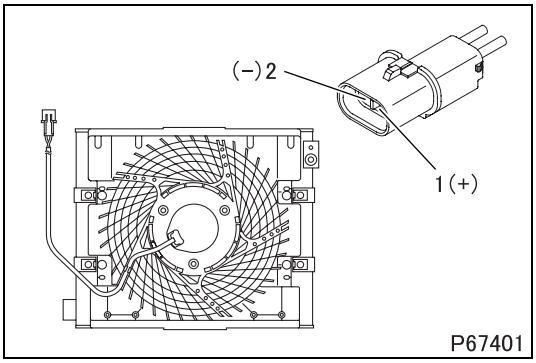
Rotation direction	Terminal
Left	(+) 2–1 (–)
Right	(+) 1–2 (–)

- If any fault is found, replace the motor and the regulator as a set. (See Gr43.)



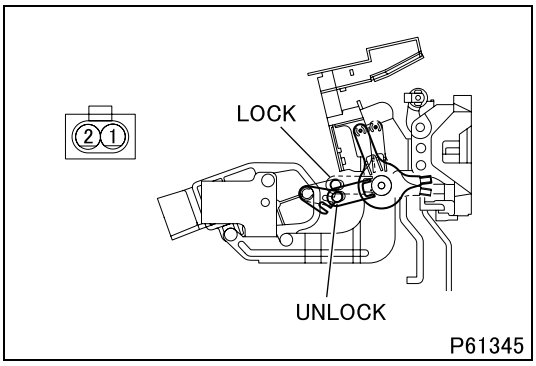
#428 Inspection of windshield washer motor

- Make sure that the motor operates when battery voltage is applied between terminals 1 and 2.
- If any fault is found, replace the motor. (See Gr51.)



#431 Inspection of condenser fan motor

- Make sure that the motor operates when battery voltage is applied between terminals 1 and 2.
- If any fault is found, replace the motor. (See Gr55.)

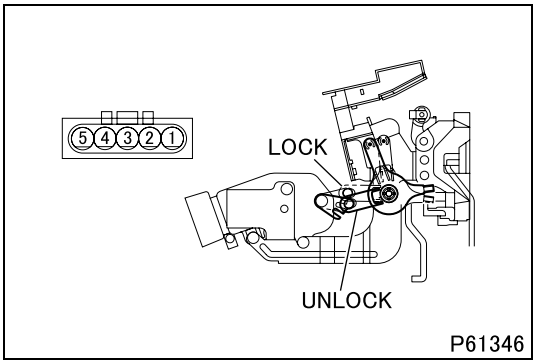


#510 Inspection of door lock actuator (on assistant driver's side)

- Apply battery voltage between each terminals confirm that the actuator operates.

Switch position	Terminal
LOCK	(+) 1–2 (–)
UNLOCK	(+) 2–1 (–)

- If any fault is found, replace the actuator. (See Gr43.)

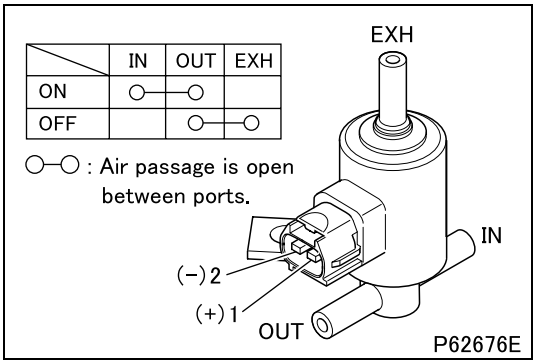


#511 Inspection of door lock actuator (on driver's side)

- Apply battery voltage between each terminals confirm that the actuator operates.

Switch position	Continuity terminal	Terminal
LOCK	1–2	(+) 3–4 (–)
UNLOCK	1–5	(+) 4–3 (–)

- If any fault is found, replace the actuator. (See Gr43.)



#565 Inspection of 3-way magnetic valve

- Perform the following checks, and if any fault is found, replace the 3-way magnetic valve.

(1) Operation check

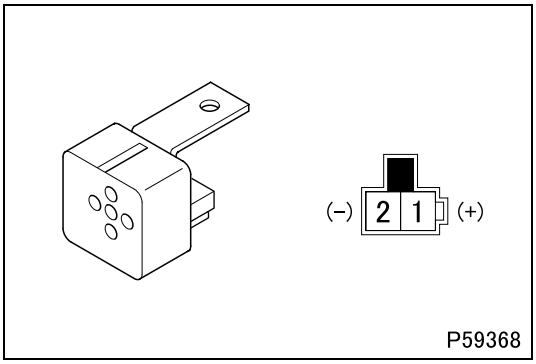
- Gradually apply DC current between terminals 1 and 2 starting from 0 V.

Measure the voltage at which the 3-way magnetic valve operates. (Determine ON/OFF of the magnetic valve by operating noises.)

Standard value (minimum operating voltage)	11 V or less

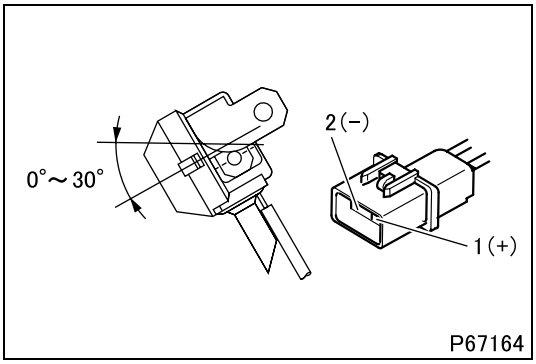
(2) Inspection of continuity and air tightness

- Negative pressure when inspected: –100 kPa {–29.5 in.Hg, –750 mmHg}



#611 Inspection of warning buzzer

- Make sure that the buzzer sounds when battery voltage is applied between terminals 1 and 2.
- If any fault is found, replace the buzzer.



#614 Inspection of back buzzer

[Inspection]

- Make sure to confirm if the buzzer intermittently sounds by applying the battery voltage between terminals 1 and 2.
- If any fault is found, replace the buzzer.

[Installation]

- Install the back buzzer to the frame in the range of angles as illustrated.

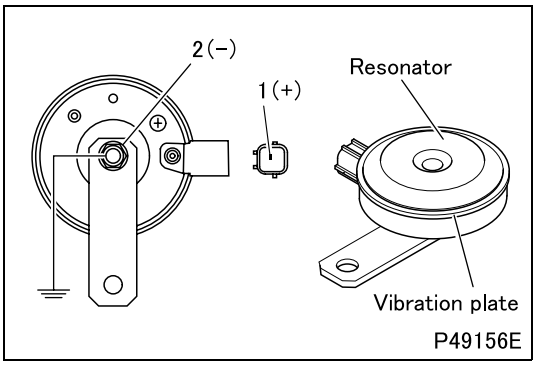
CAUTION ⚠

- **Beware that if the installed angle of the buzzer is out of the range as illustrated, water in the buzzer will not be drained normally.**

#615 Inspection of electric horn

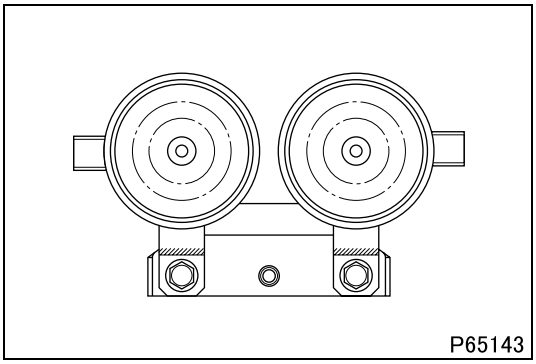
CAUTION ⚠

- **Bending the stay changes the sound quality of the horn, degrading the horn performance.**
- **Never bend or damage the stay.**



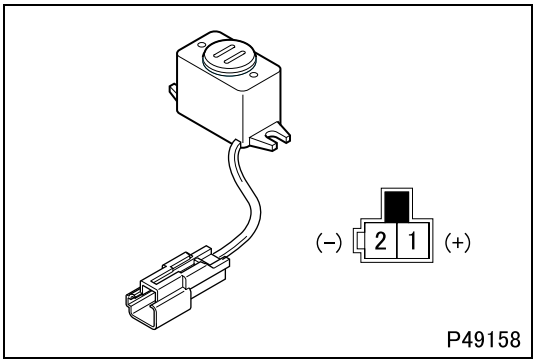
[Inspection]

- Make sure to confirm whether the horn sounds by applying the battery voltage between terminals 1 and 2 (body).
- Remove foreign substances adhered to the resonator and diaphragm.
- If any fault is found, replace the horn.



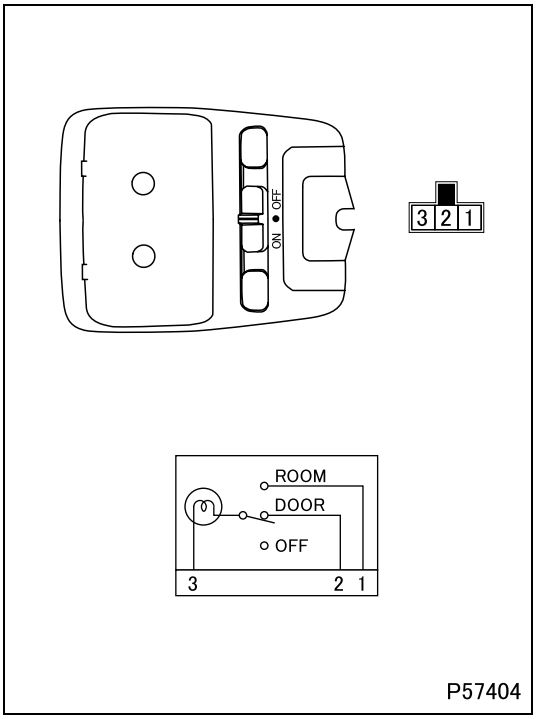
[Installation]

- Install in the direction as illustrated.



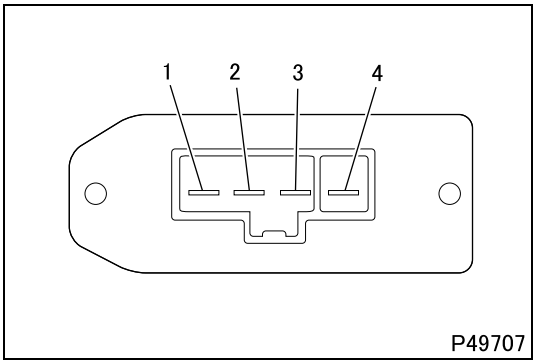
#618 Inspection of cab tilt buzzer

- Make sure that the buzzer sounds when battery voltage is applied between terminals 1 and 2.
- If any fault is found, replace the buzzer.



#656 Inspection of cab lamp

- If any fault is found, replace the lamp.

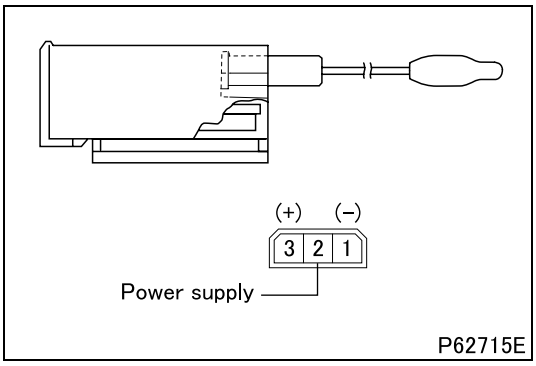


#750 Inspection of blower resistor

- Measure resistance values between each terminals.

Position	Terminal	Standard value
MEDIUM HIGH	1–4	0.24 Ω
MEDIUM LOW	3–4	0.93 Ω
LOW	2–4	1.5 Ω

- If the measured value deviates from the standard value, replace the blower resistor. (See Gr55.)

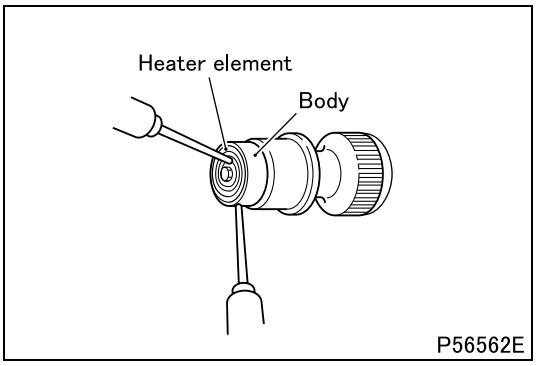


#751 Inspection of thermostat

- Measure resistance values between each terminals 1 and 3 at the specified temperature.

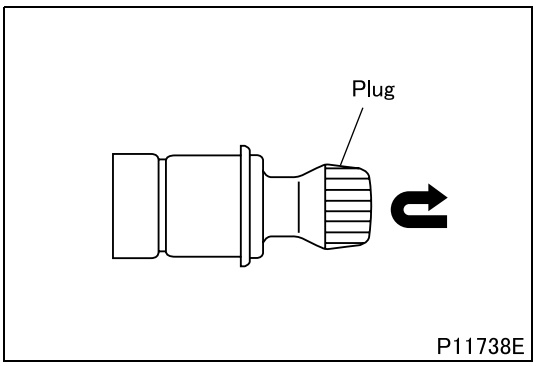
Switch position	Continuity terminal
OFF (4.2°C)	–
ON (5.2°C)	1–3

- If any fault is found, replace the thermostat. (See Gr55.)



#754 Inspection of cigarette lighter

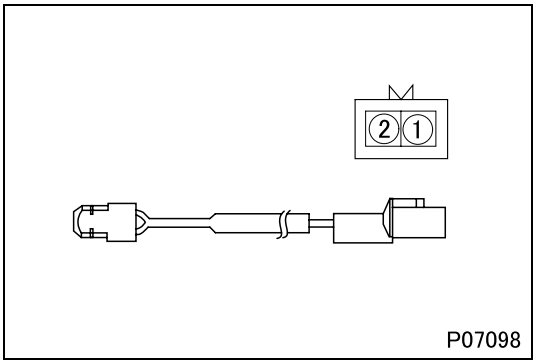
- Perform the following checks, and if any fault is found, replace the cigarette lighter. (See Gr52.)
- Make sure that there is continuity between heater element and body.



- Make sure that when plug is pushed in by hand, it immediately returns to its original position.
- Place the starter switch at ACC or ON position.
- Push plug into the socket in the cab.
- Measure the time required for plug to automatically return.

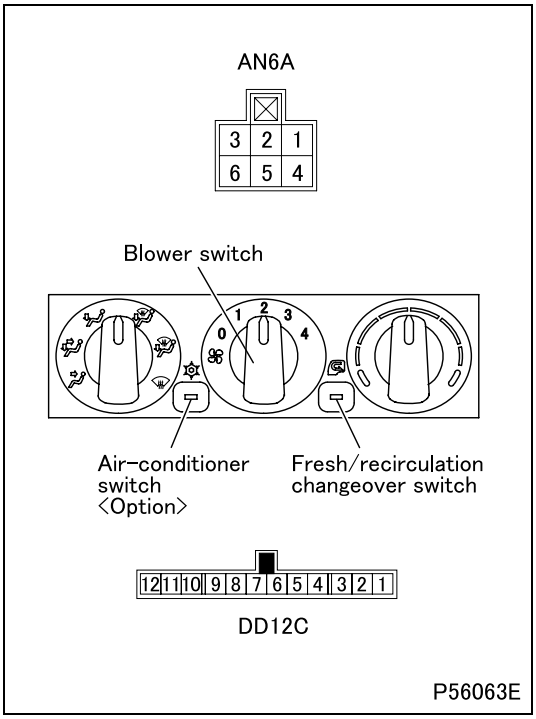
Standard value	15 ± 5 seconds

- Check to see that heater element is red-hot.



#759 Inspection of brake pad wear indicator

- Make sure that there is continuity between terminals 1 and 2.
- If any fault is found, replace the brake pad wear indicator. (See Gr35A.)



#763 Inspection of heater control panel

- Perform the following checks, and if any fault is found, replace the heater control panel. (See Gr52.)

(1) Blower switch <AN6A connector>

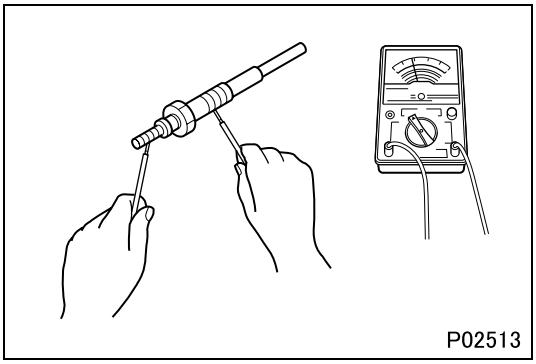
Switch position	Continuity terminal
0 : OFF	–
1 : LO (LOW)	4–5–6
2 : ML (MEDIUM LOW)	1–5–6
3 : MH (MEDIUM HIGH)	2–5–6
4 : HI (HIGH)	3–5–6

(2) Fresh/recirculation changeover switch <DD12C connector>

Switch position	Continuity terminal	Operation illumination	Night illumination
OFF : Fresh air	9–10	–	(+) 7–8 (–)
ON : recirculation air	10–11	(+) 12–10 (–)	

(3) Air-conditioner switch <DD12C connector>

Switch position	Continuity terminal	Operation illumination	Night illumination
OFF	–	–	(+) 7–8 (–)
ON	3–4–6	(+) 3–6 (–) (+) 4–6 (–)	



#764 Inspection of glow plug

- Measure resistance value of glow plug as shown.

Standard value (cold resistance of glow plug)	Approx. 1.0 Ω

- If the measured value deviates from the standard value, replace the glow plug. (See Gr11.)

#860 BATTERY

DANGER ⚠

- **Since flammable hydrogen gas is generated by the battery be sure to obey the following warnings:**
  - **Do not short-circuit the (+) and (–) terminals on the battery.**
  - **Keep sparks and lit cigarettes away from the battery.**
  - **Do not wear metal objects on your arms and lean over battery.**
- **Because the battery electrolyte is made of diluted sulfuric acid and is corrosive, when handling battery wear safety glasses and rubber gloves to protect the eyes and hands.**

WARNING ⚠

- **Make sure that you disconnect battery cable (–) first when you disconnect battery cables.**

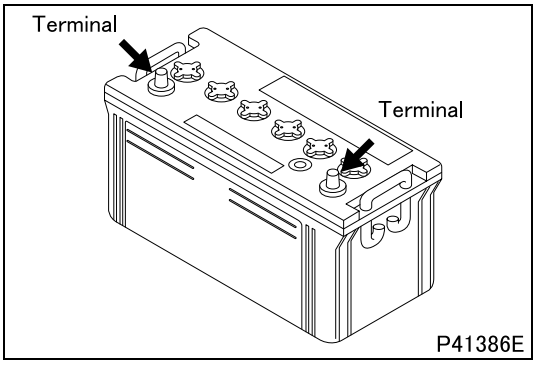
CAUTION ⚠

- **Make sure that all electrical switches of the vehicle are OFF before connecting battery cables.**
- **Make sure that you connect battery cable (+) before you connect battery cable (–).**
- **To prevent a short-circuit be sure that disconnected battery cables do not accidentally touch the battery terminals.**

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Specific gravity of battery electrolyte (20°C {68°F})	1.280	1.220	Charge or replace

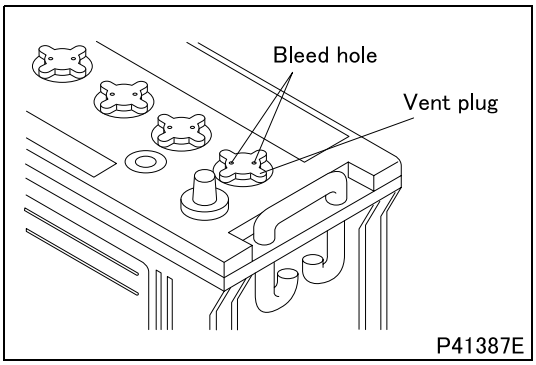
◆Service procedure◆



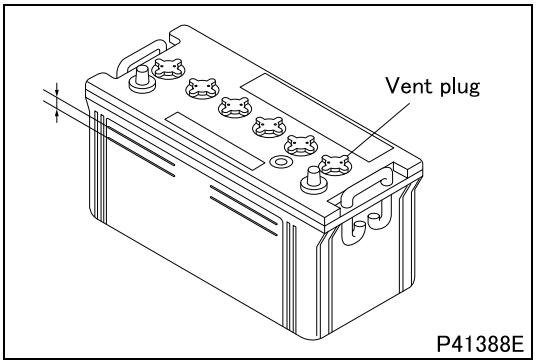
Inspection of battery

(1) Visual inspection

- If terminal is corroded, scrub off the corrosion from it using a wire brush.
- If cracks or defects are found on battery, replace it since the cracks or defects can cause liquid spills.

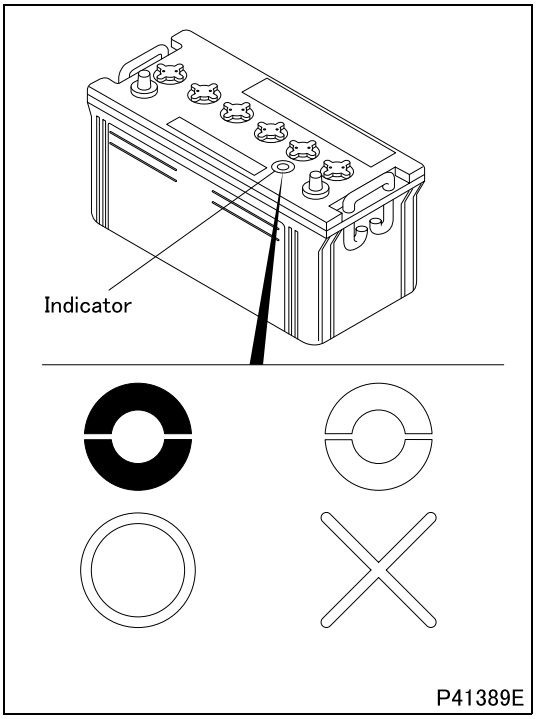


- If bleed hole of vent plug is clogged, clean the hole.



(2) Inspection of fluid level

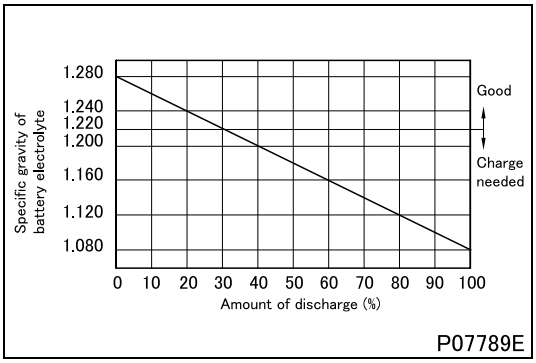
- Make sure that the battery electrolyte level is between UPPER and LOWER.
- If the level is below LOWER, remove vent plug and fill the battery with distilled water or battery replenisher to UPPER.



(3) Measurement of specific gravity

You can tell the specific gravity of the battery electrolyte by the color shown in indicator.

Blue : Good
White : Charge or replace



(4) Charging

- Although, as a rule, battery charging should be done with the battery removed from the vehicle, if you have to charge the battery while it is on the vehicle, make sure that you stop the engine and disconnect battery cable (–).
- Remove vent plug before charging the battery.
- For the recommended charge time and current, see the following table to avoid overcharging.

	Charge current (A)	Charge time (H)	Upper limit of fluid temperature (°C {°F})
Normal charge	Value of 5-hour rating capacity / 10	*Amount of discharge (Ah) / Charge current (A) ×1.2 (to 1.5)	45 {113}
Quick charge	Value of 5-hour rating capacity / 1.5	0.5	55 {131}

* Amount of discharge (Ah) =

$$\text{5-hour rating capacity (Ah)} \times \frac{\text{Amount of discharge (\%)}}{100}$$

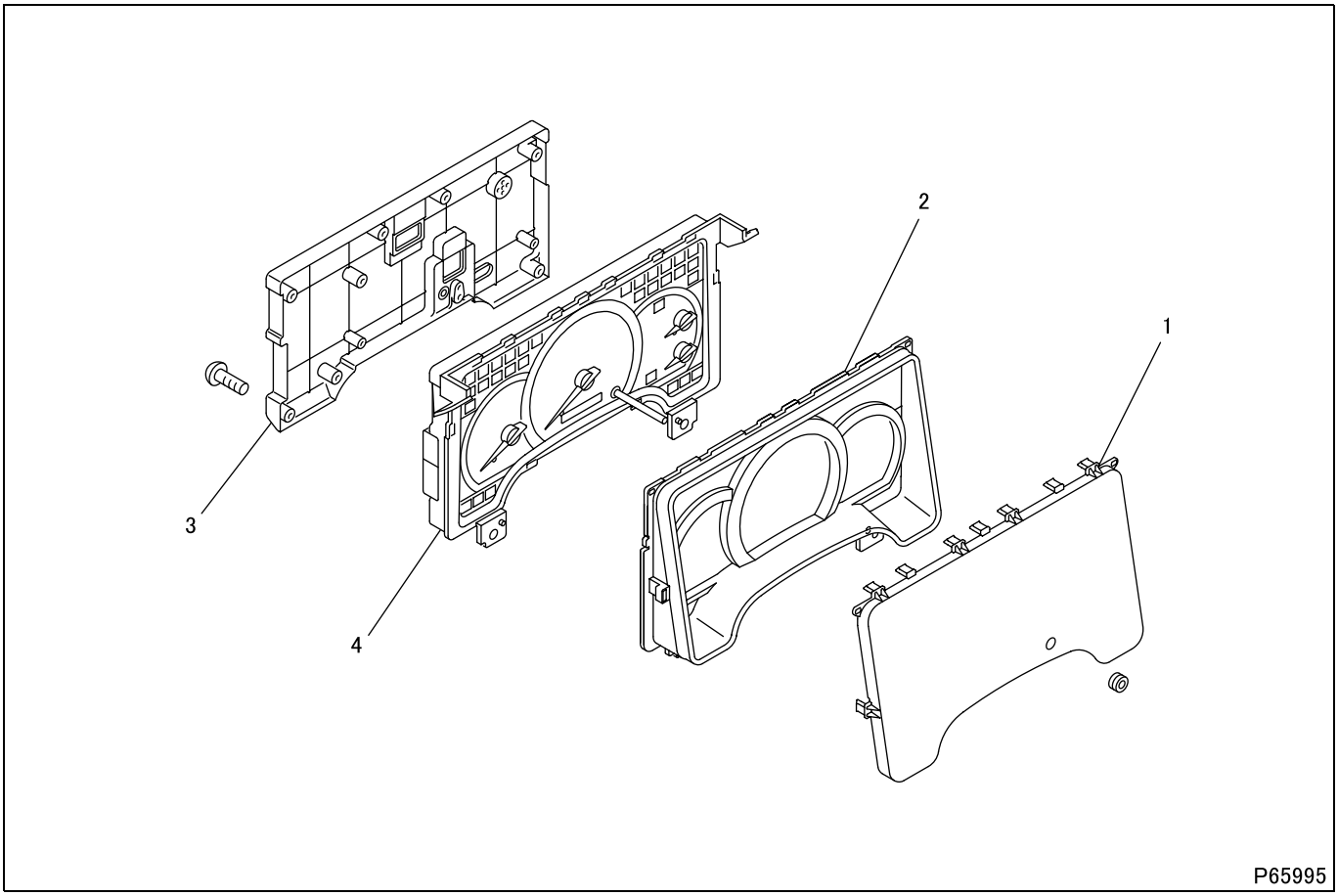
- Use the graph shown on the left to calculate the amount of discharge (%).
- Use diluted sulfuric acid, made up of sulfuric acid and refined or distilled water, as the battery electrolyte.

DANGER ⚠

- **Keep naked light away from the battery while charging to prevent explosion.**
- **It is dangerous to generate sparks while charging the battery.**
- **Do not charge battery if the electrolyte level is below LOWER LEVEL, since it can cause early deterioration, heating, or explosion. Make sure to add the fluid to the specified level before charging.**

WARNING ⚠

- **Do not let the battery electrolyte level rise and overflow while charging the battery.**
- **After charging the battery, tighten vent plug, wash away sulfuric acid from the battery using water, and dry the surface.**



● Disassembly sequence

1 Meter glass
2 Plate
3 Cover
4 Body

● Assembly sequence

Follow the disassembly sequence in reverse.

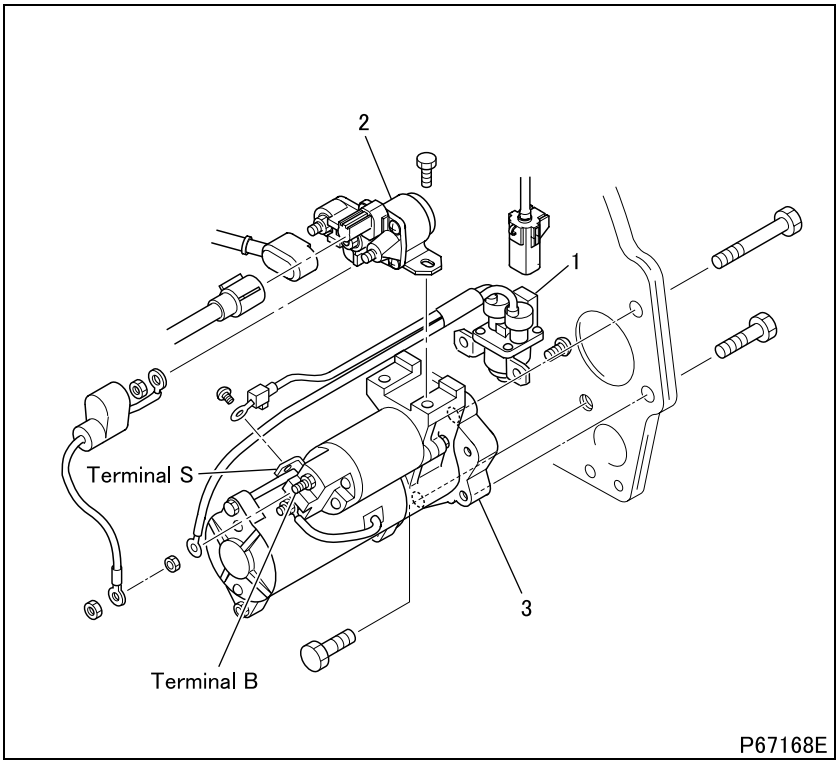
◆Inspection procedure◆

■ Inspection: Meters

- Each sensor signal is converted into digital signal in the meter cluster and then the value is indicated by the corresponding meter on the cluster. Therefore, a single meter inspection cannot be performed.
  Each meter should be checked indirectly by checking its related harnesses and parts.
- If the related harnesses and parts are normal but the meter indication is faulty, replace the meter cluster.

54-12 STARTER AND ALTERNATOR

#930 STARTER



● Removal sequence

1 Starter relay
2 Glow relay
3 Starter

WARNING ⚠

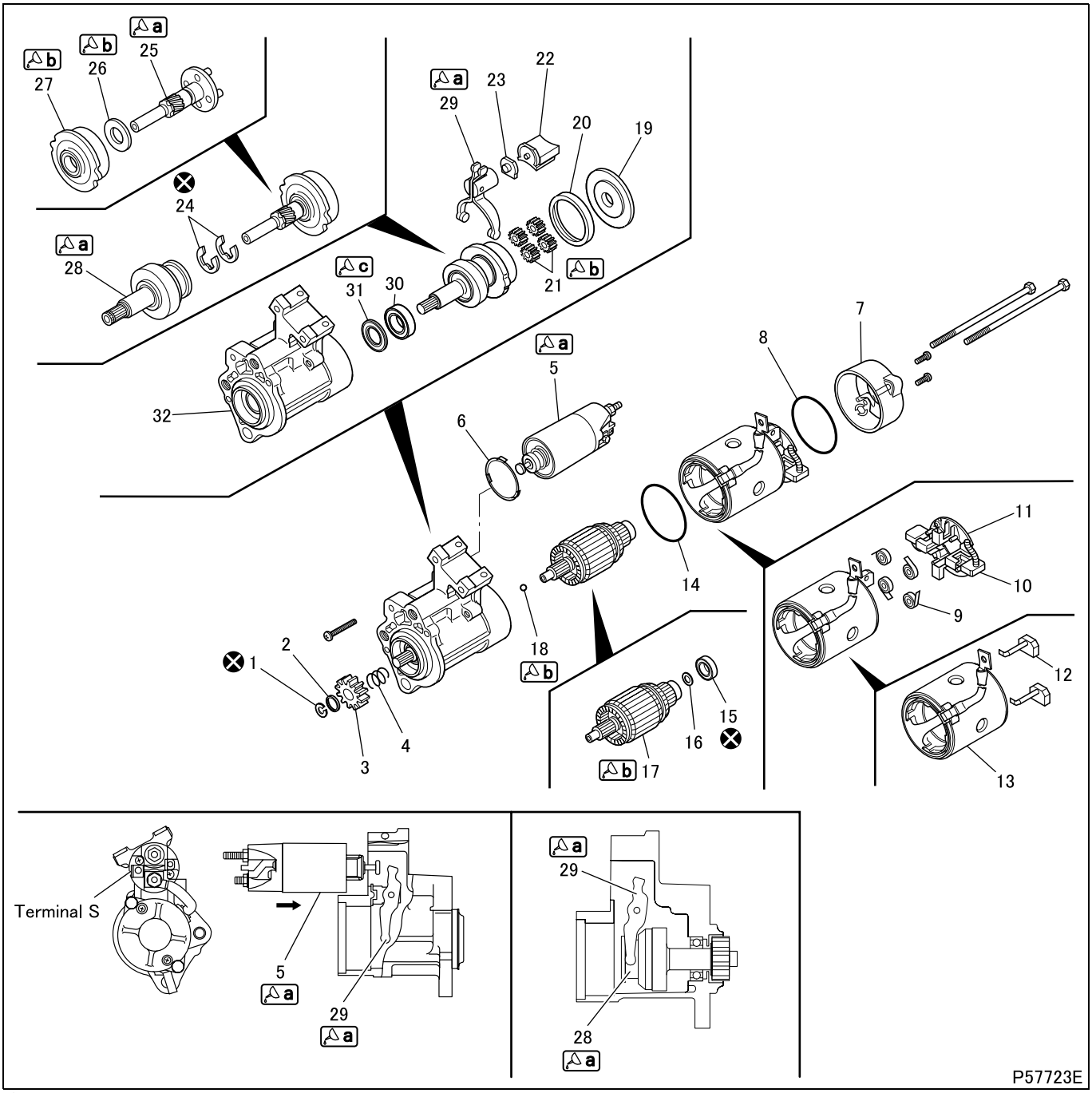
- **Before removing the starter, disconnect the (–) battery cable and insulate the cable and the (–) battery terminal with tape.**
- **It is dangerous to leave the (–) battery cable connected since the battery cable voltage is always present at terminal B.**

● Installation sequence

Follow the removal sequence in reverse.

M E M O

#930 STARTER



● **Disassembly sequence**

1 Stopper ring
2 Pinion stopper
3 Pinion
4 Spring
5 Magnetic switch
6 Shim
7 Rear bracket
8 Packing
9 Brush spring
10 Brush (–)
11 Brush holder
12 Brush (+)
13 Yoke
14 Packing
15 Rear bearing
16 Washer
17 Armature
18 Ball
19 Cover
20 Rubber packing
21 Planetary gear
22 Rubber packing
23 Plate
24 E-ring
25 Gear shaft
26 Washer
27 Internal gear
28 Overrunning clutch
29 Lever
30 Front bearing
31 Oil seal
32 Front bracket

⊗: Non-reusable parts

CAUTION ⚠

- **Do not remove the rear bearing unless defects are evident.**
- **When the armature is removed, the ball may come out with it. Take care not to lose the ball.**
- **It is not necessary to remove the pinion when only the motor section needs to be disassembled for inspection, like when inspecting brushes and related parts.**
- **Be sure to remove the pinion before disassembling any other parts.**

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **Whenever the magnetic switch is replaced, the pinion gap must be adjusted.**

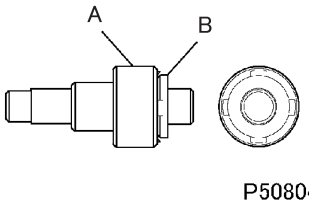
Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
–	Pinion gap			0.5 to 2.0 {0.02 to 0.079}	–	Adjust
–	No-load characteristics	With 11 V applied	Current	180 A or less	–	Inspect
			Rotation speed	3800 rpm or higher	–	
9	Brush spring pressure			29.2 to 39.4 N {6.6 to 8.9 lbs, 3 to 4 kgf}	13.7 N {3.1 lbs, 1.4 kgf}	Replace
10, 12	Brush length			18 {0.71}	11 {0.43}	Replace
17	Commutator outside diameter			32 {1.26}	31.4 {1.24}	Replace
	Runout of commutator periphery			–	0.1 {0.0039} or higher	
	Mold depth between segments			–	0.2 {0.0079} or less	Correct or replace

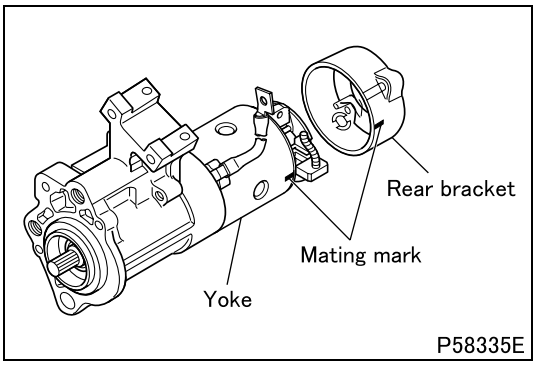
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Lever contact surface of magnetic switch	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
	Sliding surfaces of gear shaft and overrunning clutch		
	Splines of overrunning clutch		
	Sliding surfaces of lever and overrunning clutch		
b	Sliding surfaces of armature and gear shaft	Molykote AG650	As required
	Ball		
	Teeth of planetary gear and internal gear		
	Washer		
c	Oil seal	Multipurpose grease [NLGI No.2 (Li soap)] or grease attached to oil seal	As required

Special tools

Mark	Tool name and shape	Part No.	Application
ⓒa	Bearing remover and installer **A**: Bearing remover and installer **B**: Bearing installer  P50804	MH063596 **A**: MH063614 **B**: MH063618	Removal and installation of front bearing

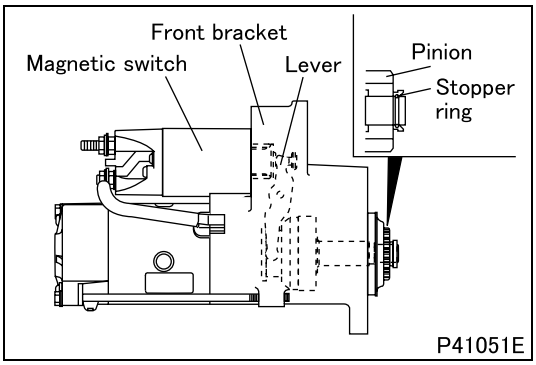
◆Work before disassembly◆



P58335E

■ **Mating mark: Rear bracket and yoke**

◆Disassembly procedure◆



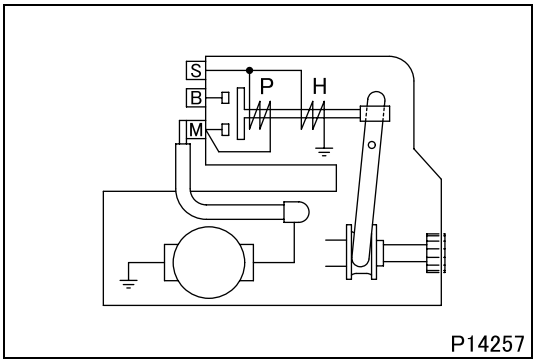
P41051E

■ **Disassembly: Pinion**

- For removal of the pinion, current must be supplied to the starter such that the pinion springs out.

WARNING ⚠

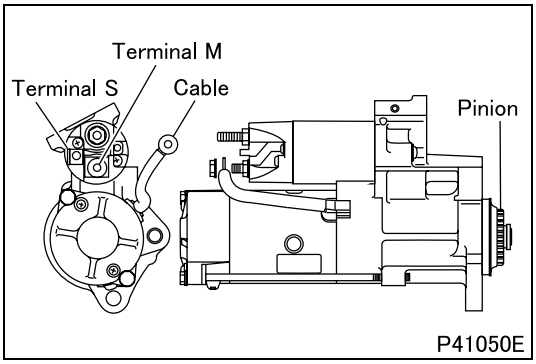
- **When the starter is energized, the pinion will spring out and rotate. Be careful not to touch it with your hands.**
- **The magnetic switch may become very hot during inspections. Be careful when touching it.**



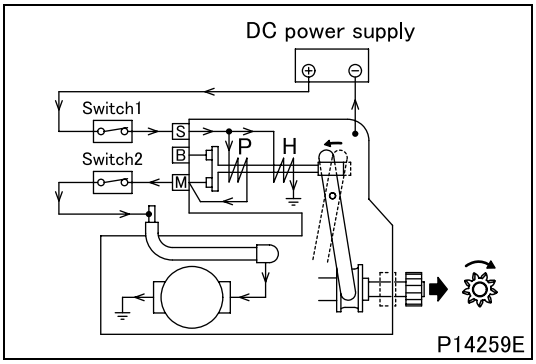
P14257

CAUTION ⚠

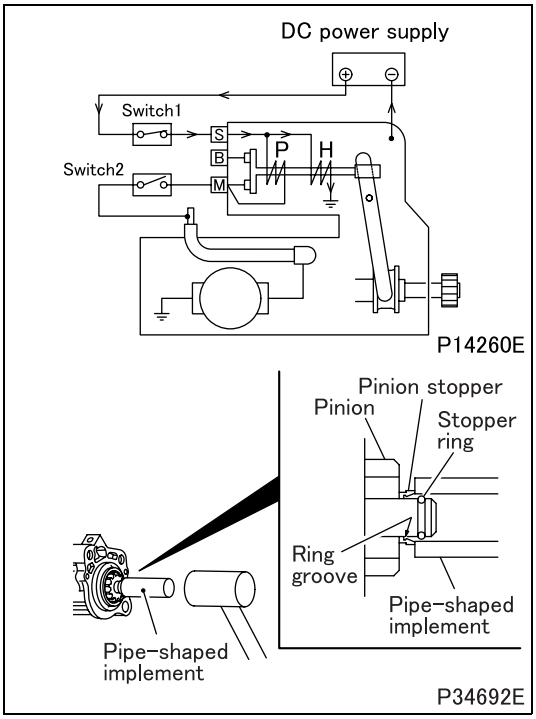
- **Do not energize the pull-in coil P for longer than 10 seconds, and do not energize the holding coil H for longer than 30 seconds. If these periods are exceeded, the coils may overheat and burn out.**
- **To make the pinion spring out, be sure to energize the starter such that its parts are positioned correctly. If the starter is not energized and the lever is pulled to make the pinion come out, the front bracket and/or lever may be damaged by the shock inflicted upon them when the stopper ring is removed.**
- **When current is supplied to the starter, a large current (100 A or higher) will flow. For inspection purposes, use booster cables or similarly thick cables. It is also important to ensure that all connections are secure.**



- Connect the starter as illustrated.



- The following operations are performed with current supplied to the starter. Thus, the entire procedure for removal of the pinion must be completed within 30 seconds.
  - Turn ON switches 1 and 2 to supply current to the starter. The pinion will spring out and rotate.



- After the pinion starts to rotate, quickly (within five seconds) turn OFF switch 2 to stop the pinion's rotation.

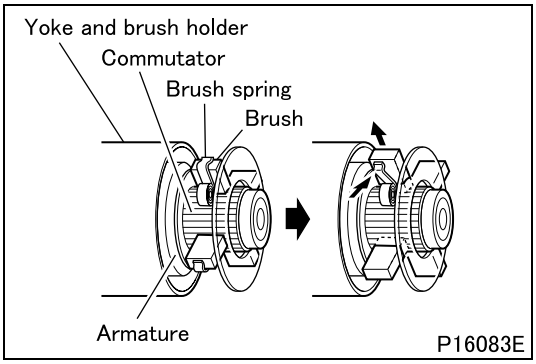
CAUTION ⚠

- **When switches 1 and 2 are turned ON, the pull-in coil P and holding coil H are both energized. The circuit is connected such that no voltage is applied to starter terminal B, so current flows to the pull-in coil while the pinion rotates. To prevent the pull-in coil from burning out, it is essential to turn OFF switch 2 quickly (within five seconds) after the pinion starts to rotate.**

- Apply a pipe-shaped implement to the pinion stopper.
- Using a hammer, lightly tap the pipe-shaped implement to remove the stopper ring from the ring groove of the pinion stopper.
- Remove the stopper ring and pinion.
- Turn OFF switch 1 to de-energize the starter.

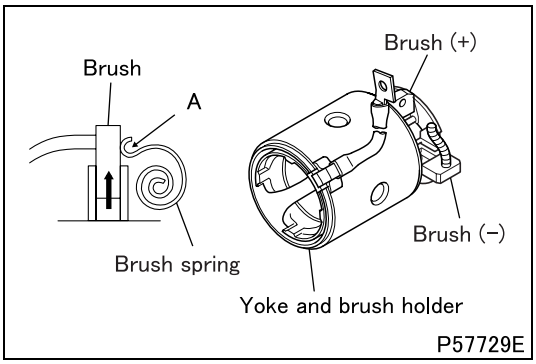
CAUTION ⚠

- **When the starter is de-energized, the mechanism will attempt to pull in the pinion. Thus, the stopper ring may slip back into the ring groove of the pinion stopper. If this happens, energize the starter and go through the pinion removal procedure again.**



■ **Disassembly: Yoke and brush holder**

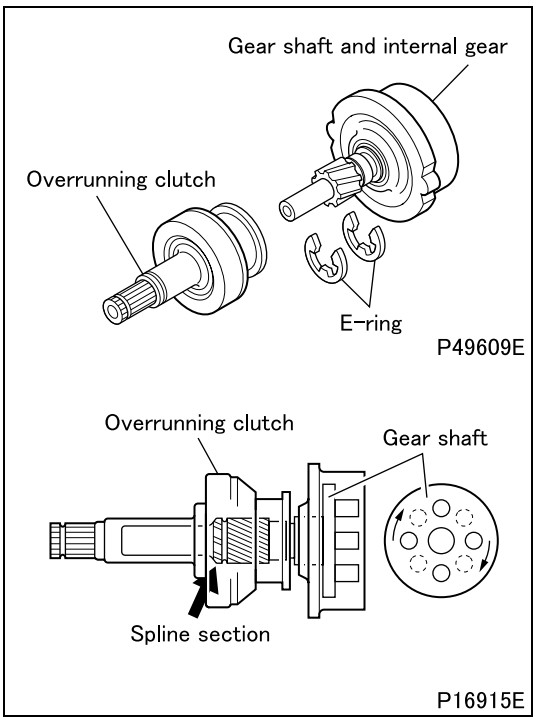
- Use the following method to remove the yoke and brush holder in order to prevent the commutator of the armature from being damaged by the brushes.
  - Lift the brushes away from the commutator and hold them lifted by applying the brush springs against the sides of the brush springs.



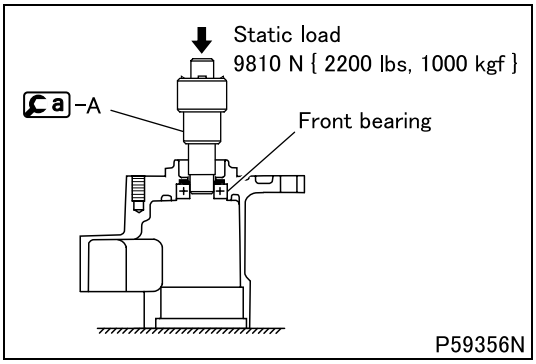
- Pull part A of each brush spring and pull up the brushes.
- Hold the brushes in position with the brush springs as illustrated.
- Remove the yoke and brush holder.

■ **Disassembly: Gear shaft and internal gear**

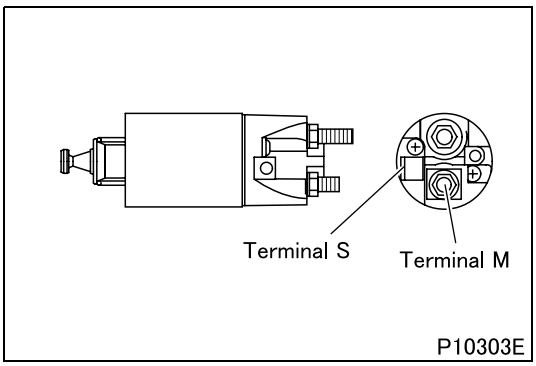
- Remove the E-rings and then the gear shaft and internal gear from the overrunning clutch.
  Proceed as follows if the gear shaft cannot be removed due to interference of the splined section of gear shaft with internal parts of the overrunning clutch.
  - Press the gear shaft against the overrunning clutch.
  - Turn the gear shaft approx. 1/8 of a turn to change the position of splined section.



■ **Disassembly: Front bearing**



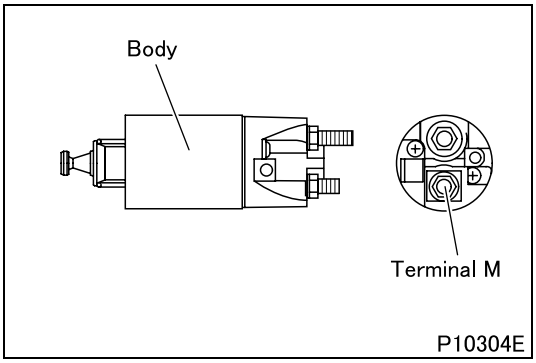
◆Inspection procedure◆



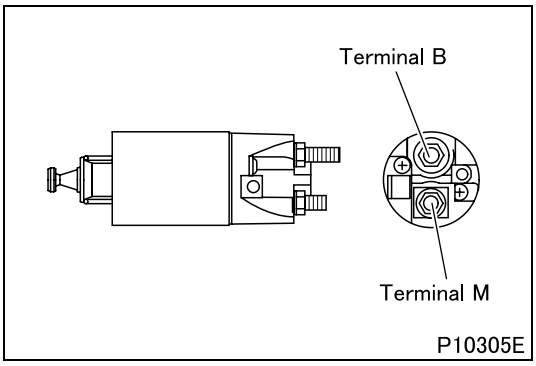
■**Inspection: Magnetic switch**

(1) Test for coil open circuit

- Check that continuity exists between terminals S and M.

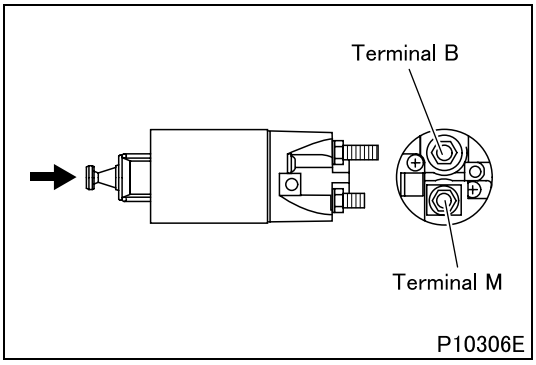


- Check that continuity exists between terminal M and the body.



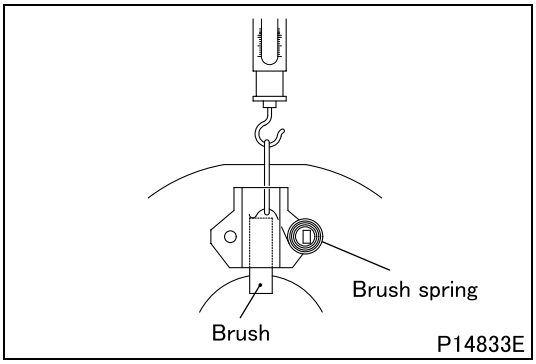
(2) Test for fused-together contacts

- Check that continuity does not exist between terminals B and M.



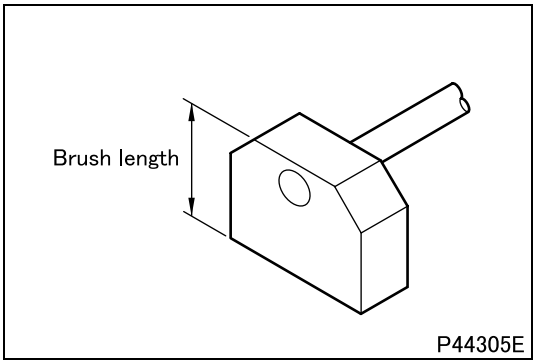
(3) Test for contact-to-contact continuity

- Push in the end of the magnetic switch to close the internal contacts. Then, check that continuity exists between terminals B and M.



■ **Inspection: Brush spring**

- Using new brushes, measure the load required to separate each brush spring from its brush.
- If either measurement is lower than the specified limit, replace the brush springs.



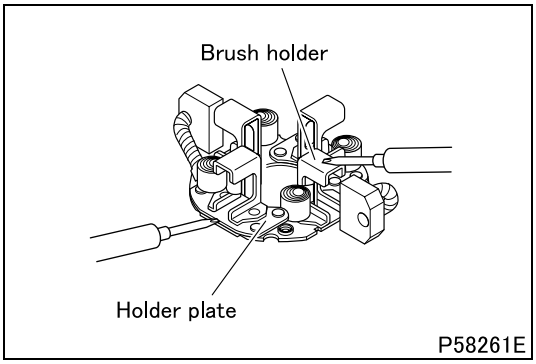
■ **Inspection: Brush (–)**

(1) Brush length

- If either brush (–) is shorter than the limit, it must be replaced.

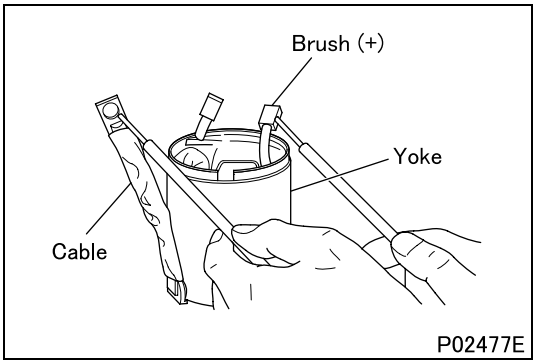
(2) Commutator contact surface of brush

- If the commutator contact surface of either brush is rough or unevenly worn, rectify it with emery paper (#300 to 500).



■ **Inspection: Brush holder**

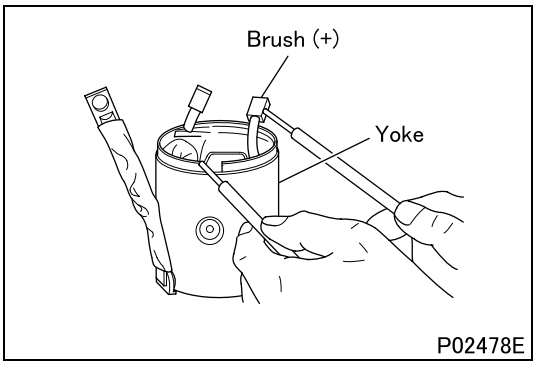
- Thoroughly clean the (+) brush holder and the (–) holder plate, then, check that continuity does not exist between them.
- If continuity exists, there is a short circuit and the brush holder must be replaced.



■ **Inspection: Yoke**

(1) Test for coil open circuit

- Check that continuity exists between the cable and the (+) brush.
- If there is no continuity, there is an open circuit and the yoke or (+) brush must be replaced.

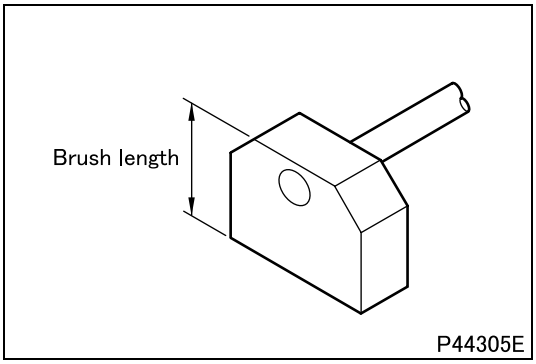


(2) Test for coil grounding

- Check that continuity does not exist between the yoke and the (+) brush.
- If continuity exists, the coil is grounded. Inspect the insulation, and replace the yoke and the (+) brush if the insulation cannot be rectified.

CAUTION ⚠

- **The coil may be grounded to the yoke due to the accumulation of worn-off metal particles from the brushes and/or armature.**



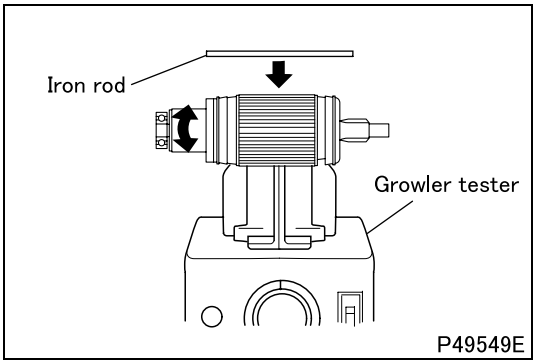
■**Inspection: Brush (+)**

(1) Brush length

- If either brush (+) is shorter than the limit, it must be replaced.

(2) Commutator contact surface of brush

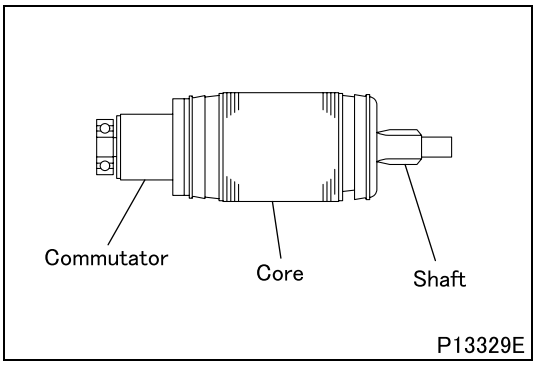
- If the commutator contact surface of either brush is rough or unevenly worn, rectify it with emery paper (#300 to 500).



■ **Inspection: Armature**

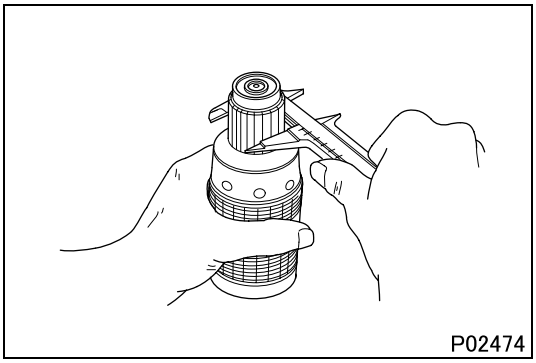
(1) Test for coil short circuit

- Hold an iron rod parallel with the armature.
- Slowly rotate the armature by hand.
- If the iron rod vibrates or is pulled toward the armature, the coil is short-circuited and the armature must be replaced.



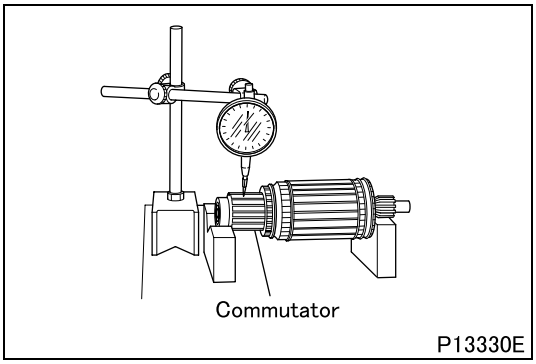
(2) Test for coil grounding

- Check that continuity does not exist between the commutator and the core (or shaft).
- If continuity exists, the coil is grounded and the armature must be replaced.



(3) Commutator outside diameter

- If the measurement is out of specification, replace the armature.

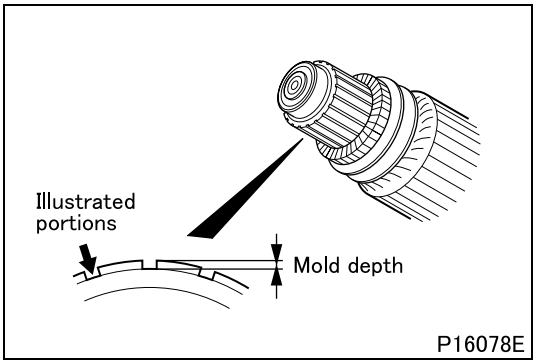


(4) Runout of commutator periphery

- If the reading exceeds the specified limit, rectify the commutator of the armature, making sure the outside diameter stays within specification.

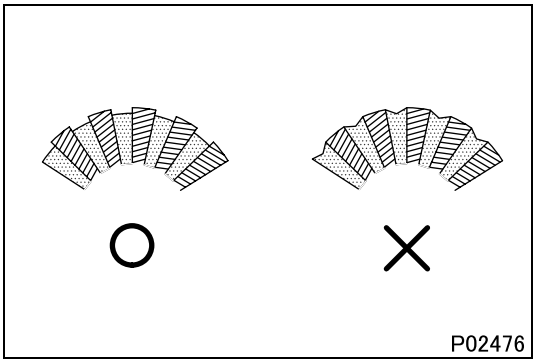
(5) Condition of commutator surface

- If the surface is rough or has stepped wear, rectify it with emery paper (#300 to 500).
- After rectifying the surface, check the extent of commutator runout.



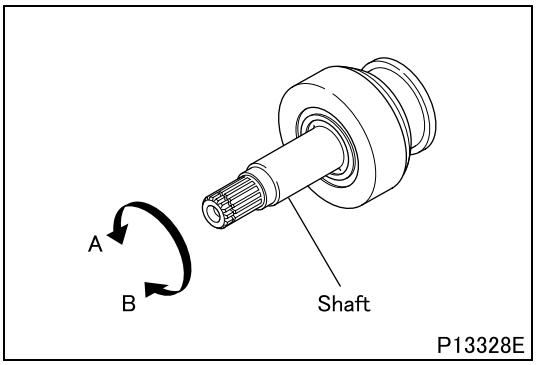
(6) Mold depth between segments

- If the measurement is lower than the specified limit, rectify or replace the armature.
- To rectify the armature, grind the illustrated portions.



- If the mold is worn as illustrated, rectify or replace the armature.

○: Acceptable
×: Unacceptable

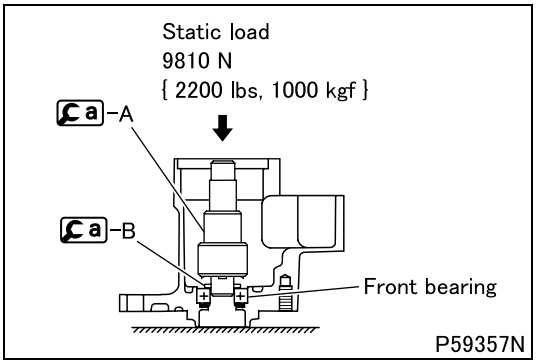


■ Inspection: Overrunning clutch

If the following inspections reveal any abnormality, replace the overrunning clutch.

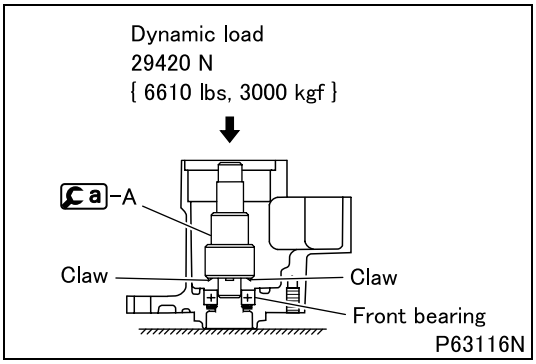
- Turn the shaft in direction B and check that it rotates smoothly.
- Turn the shaft in direction A and check that it locks.

◆Assembly procedure◆



■ Assembly: Front bearing

- Press-fit the front bearing using Ca-A and Ca-B.



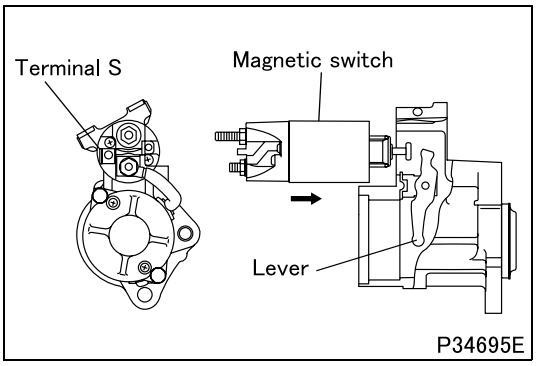
- After the press fitting, caulk the front bearing using the claw on a -A.

CAUTION ⚠

- **Avoid re-caulking previously caulked points.**

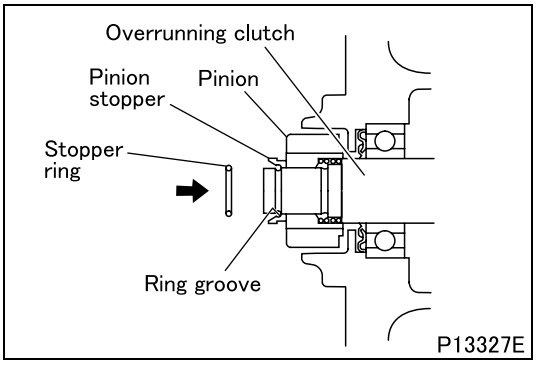
■ Assembly: Yoke and brush holder

- To install the yoke and brush holder, follow the removal sequence in reverse.
  (See "**■ Disassembly: Yoke and brush holder**".)



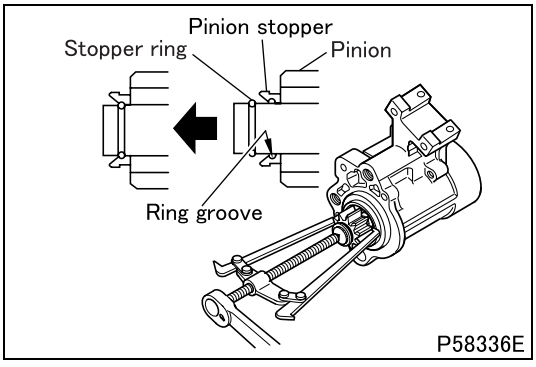
■ Assembly: Magnetic switch

- Fit the magnetic switch onto the lever with terminal S aligned as illustrated.



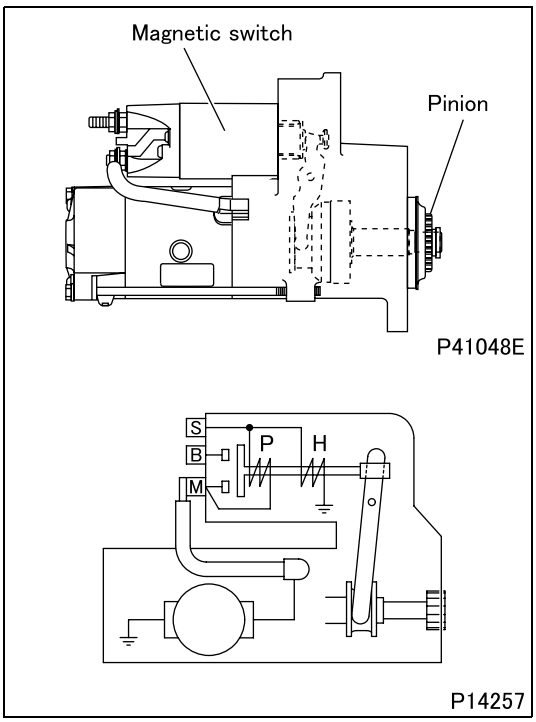
■ Assembly: Pinion

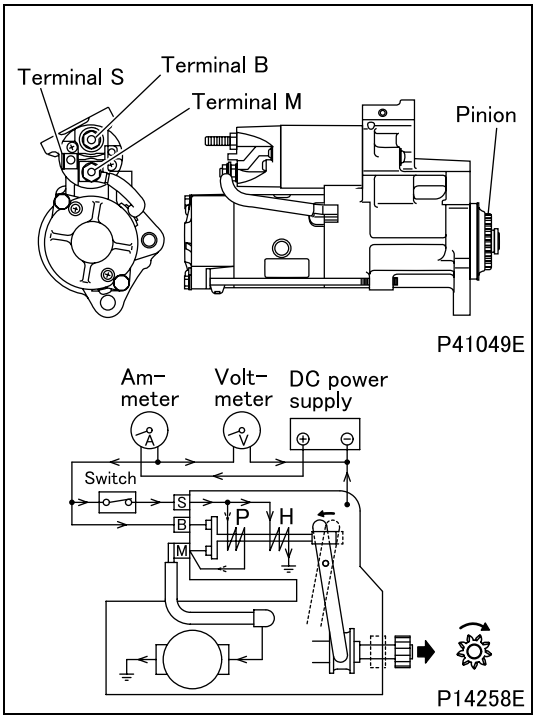
- For installation of the pinion, it is not necessary to supply current to the starter.
  - Fit the pinion stopper and pinion onto the overrunning clutch, making sure they are oriented as illustrated.
  - Fit the stopper ring into the ring groove of the overrunning clutch.



- Pull the pinion hard and securely fit the stopper ring into the ring groove of the pinion stopper.

◆Inspection after assembly◆





■ Inspection: Performance and pinion gap

- After assembling the starter, perform inspections with current supplied to it.

WARNING ⚠

- **When the starter is energized, the pinion will spring out and rotate. Be careful not to touch it with your hands.**
- **The magnetic switch may become very hot during inspections. Be careful when touching it.**

CAUTION ⚠

- **Do not energize the pull-in coil P for longer than 10 seconds, and do not energize the holding coil H for longer than 30 seconds. If these periods are exceeded, the coils may overheat and burn out.**
- **When current is supplied to the starter, a large current (100 A or higher) will flow. For inspection purposes, booster cables or similarly thick cables must therefore be used. It is also important to ensure that all connections are secure.**

(1) Performance test

- Connect the starter as illustrated.
- Set the voltage to 11 volts DC.

CAUTION ⚠

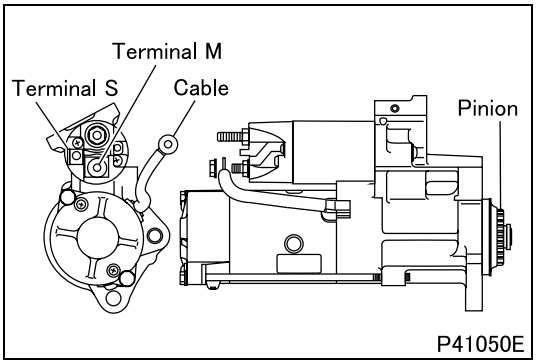
- **The voltage applied must not exceed 12 V.**

- The following operations are performed with current supplied to the starter. Thus, the entire test (consisting of measurement of the current flowing through the starter and measurement of the starter's rotational speed) must be completed within 30 seconds.
  - Turn ON the switch to supply current to the starter. The pinion will spring out and rotate.

CAUTION ⚠

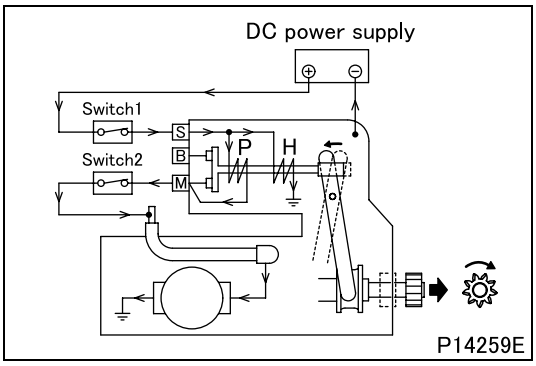
- **When the switch is turned ON, the pull-in coil P and holding coil H are both energized. When the large current from the DC power supply flows from terminal B to terminal M, the supply of current to the pull-in coil P is cut; only the holding coil H remains energized. To prevent the holding coil from burning out, it is essential to complete all operations within 30 seconds.**

  - Measure the current and the starter's rotational speed. To measure the rotational speed, shine a stroboscope on the pinion.
  - Turn OFF the switch to de-energize the starter.
- If either measurement is out of specification, disassemble and inspect the starter again.

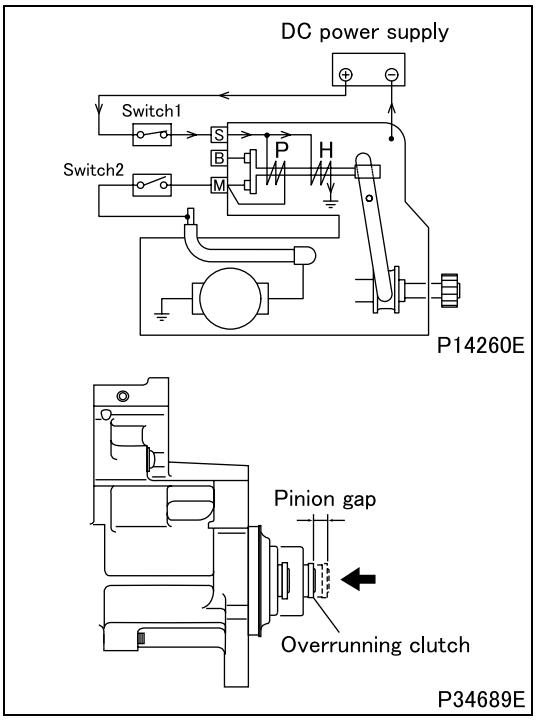


(2) Pinion gap

- Connect the starter as illustrated.



- The following operations are performed with current supplied to the starter. Thus, the entire procedure for measurement of the pinion gap must be completed within 30 seconds.
  - Turn ON switches 1 and 2 to supply current to the starter. The pinion will spring out and rotate.



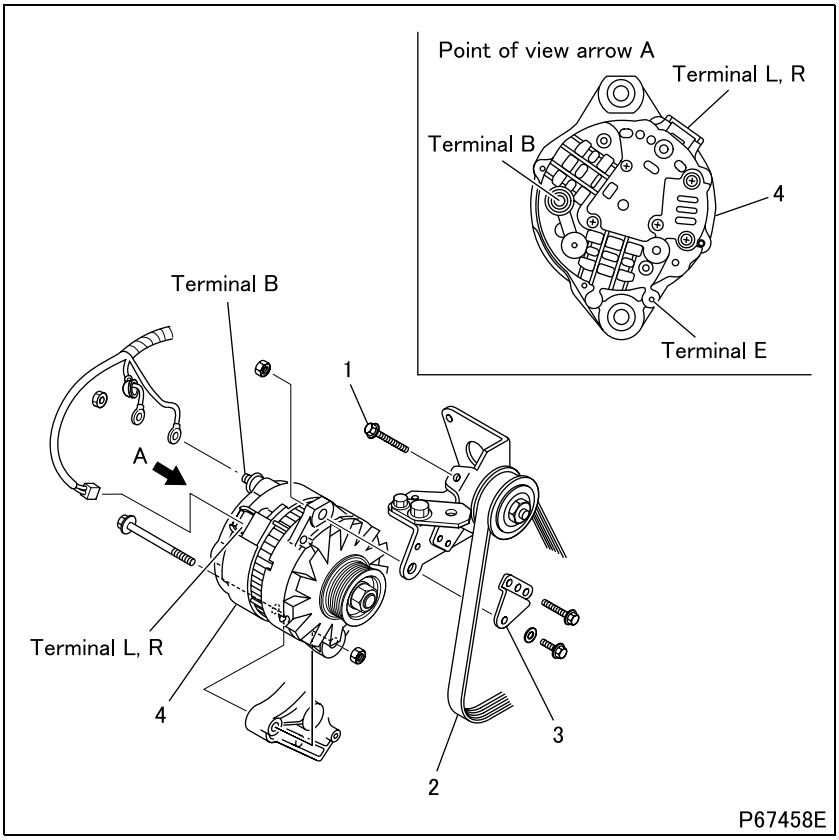
  - After the pinion starts to rotate, quickly (within five seconds) turn OFF switch 2 to stop the pinion's rotation.

CAUTION ⚠

- **When switches 1 and 2 are turned ON, the pull-in coil P and holding coil H are both energized. The circuit is connected such that no voltage is applied to starter terminal B, so current flows to the pull-in coil while the pinion rotates. To prevent the pull-in coil from burning out, it is essential to turn OFF switch 2 quickly (within five seconds) after the pinion starts to rotate.**

  - Pull out the end of the overrunning clutch and then lightly push in the end of the overrunning clutch and measure the amount of movement in the axial direction, i.e., the pinion gap.
  - Turn OFF switch 1 to de-energize the starter.
- If the measurement is out of specification, replace the lever.

#940 ALTERNATOR



● Removal sequence

1 Adjusting bolt
2 V-belt
3 Alternator stay
4 Alternator

WARNING ⚠

- **Before removing the alternator, disconnect the (–) battery cable and insulate the cable and the (–) battery terminal with tape.**
- **It is dangerous to leave the (–) battery cable connected since the battery cable voltage is always present at terminal B.**

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

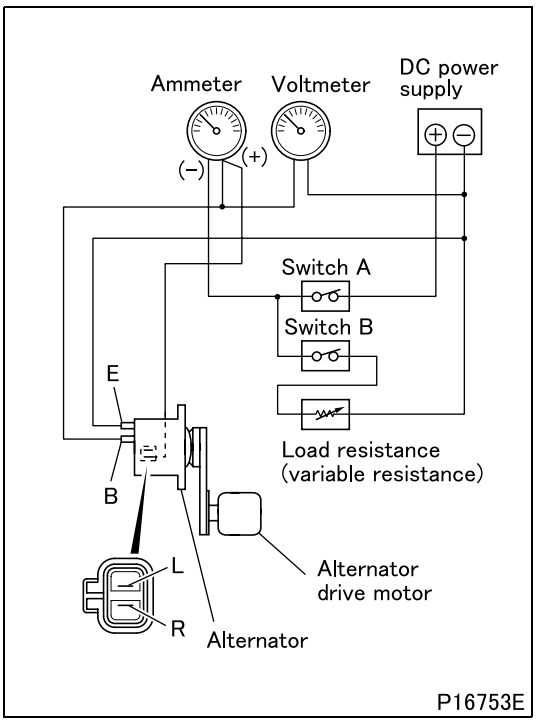
- **Be sure to adjust the V-belt tension. (See Gr14)**

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
4	Alternator output current (*when alternator is hot and producing 13.5 V)	At 1500 rpm	51.5 A or more	–	Inspect
		At 2500 rpm	82.5 A or more	–	
		At 5000 rpm	104 A or more	–	
	Adjustment voltage of regulator (at 5000 rpm, 5A is loaded)		14.7 ± 0.3 V	–	Replace

* The hot condition is that which occurs after the alternator has been running at normal ambient temperature with 5000 rpm and maximum output for 30 minutes.

◆Inspection procedure◆



■Inspection: Alternator

(1) Alternator output current (Bench test)

- Connect the alternator as illustrated.

CAUTION ⚠

- **Wires with sufficient thickness should be used for wiring and each connection should be securely fastened.**

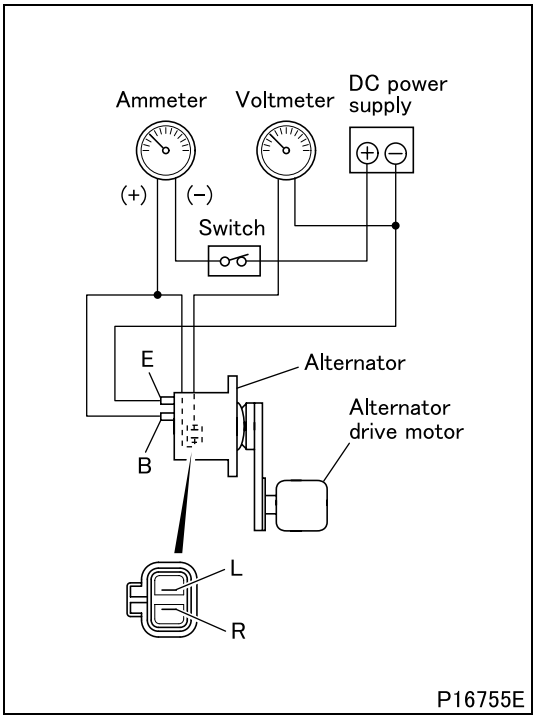
B: Terminal B
E: Terminal E
L: Terminal L
R: Terminal R

- Increase load resistance to the maximum (condition under which the load current hardly flows).
- Turn switch A and B ON.
- Run alternator at 5000 rpm for 30 minutes by adjusting load resistance so that electric current can conform to the specified standard.

  Alternator nominal current

Current
104 A or more

- Measure the current at each specified revolution of alternator.
- If the measured value is lower than the standard value, disassemble and check alternator.



(2) Adjustment voltage of regulator (Bench test)

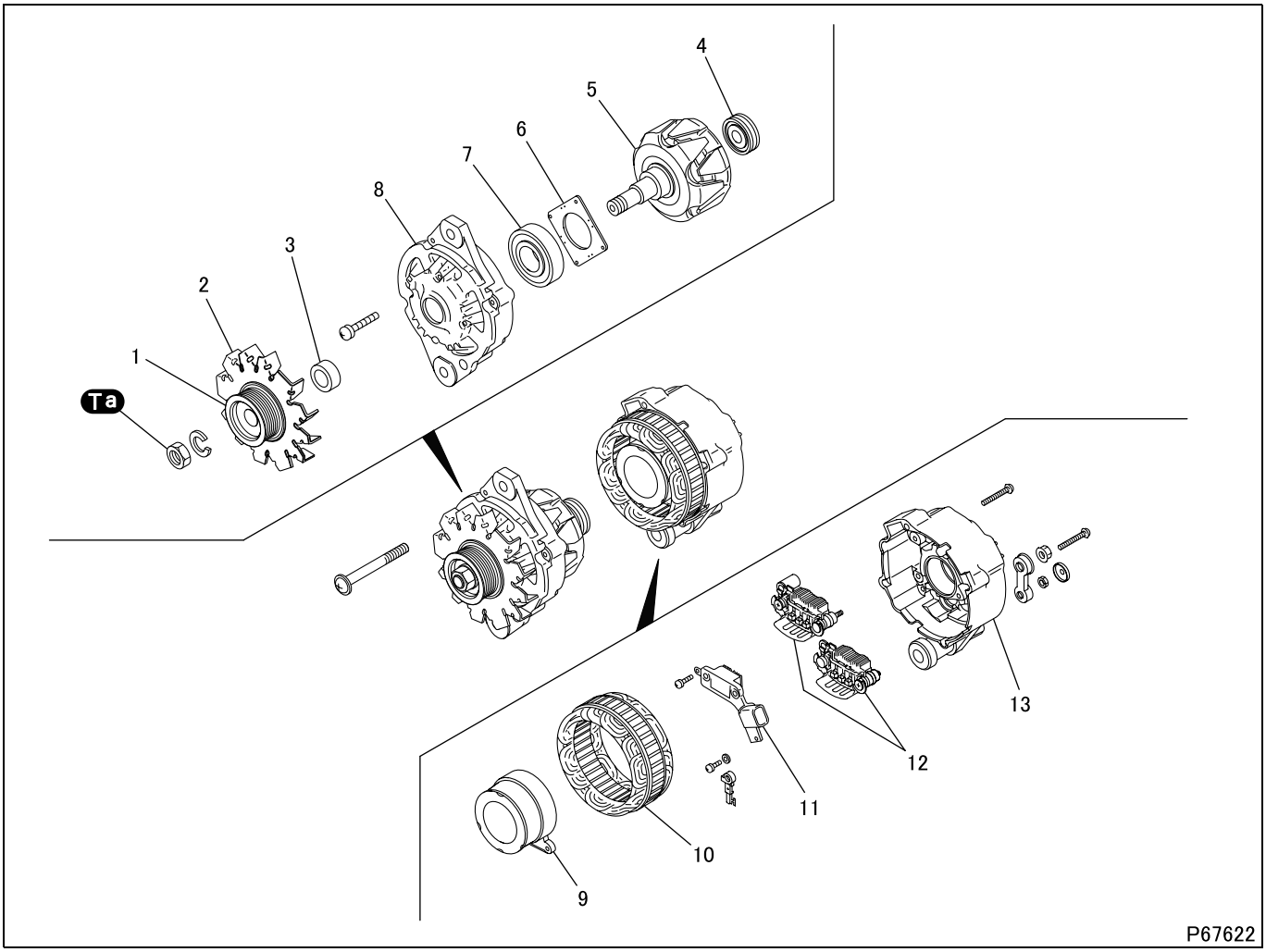
- Connect the alternator as illustrated.

B: Terminal B
E: Terminal E
L: Terminal L
R: Terminal R

- Turn switch ON.
- Run alternator at low speeds.
- Increase the speed of alternator to 5000 rpm and measure the voltage (adjustment voltage) at this speed. At the same time, make sure that the current is 10 amperes or less at 5000 rpm.
- If the measured value deviates from the standard value, do as follows:
  - If higher than the standard value: Replace the regulator.
  - If lower than the standard value: Inspect the alternator related parts before replacing the regulator.

M E M O

#940 ALTERNATOR



● **Disassembly sequence**

1 Pulley
2 Fan
3 Spacer
4 Rear bearing
5 Rotor
6 Cover
7 Front bearing
8 Front bracket
9 Field coil
10 Stator
11 Regulator
12 Rectifier
13 Rear bracket

NOTE

- **Do not remove the rear and front bearing, stator unless faulty.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

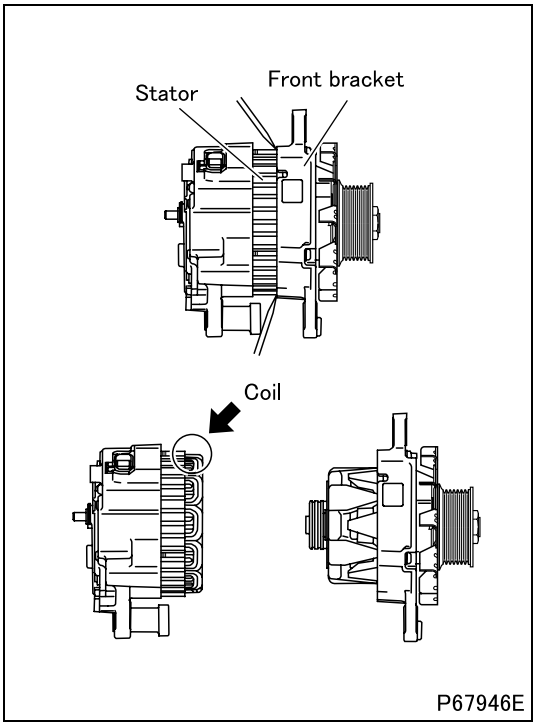
Tightening torque (Unit: N·m {ft. lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Pulley mounting)	132 to 162 {97 to 120, 13 to 17}	–

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
9	Field coil resistance (at 20°C {68°F})	1.9 to 2.3 Ω	–	Replace

◆Disassembly procedure◆

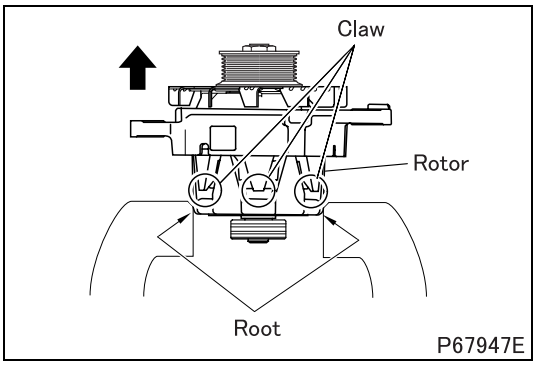


■ **Disassembly: Rotor and front bracket**

- Insert a screwdriver between front bracket and stator.
- Use the screwdriver to pry rotor and front bracket away from stator and rear bracket.

CAUTION ⚠

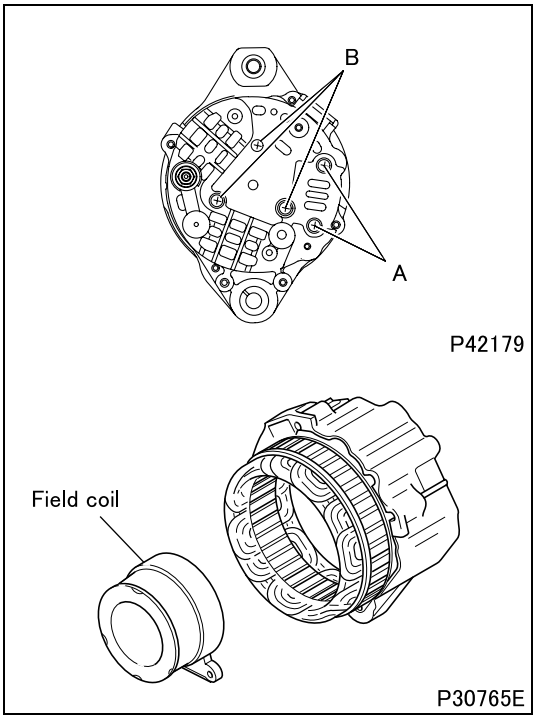
- **Be careful not to insert the screwdriver too deep or it will damage coil of stator and might cause a short-circuit.**



■ **Disassembly: Pulley**

CAUTION ⚠

- **Make sure to grip the root of the core claws when you hold the rotor in a vice. Gripping claws can damage them.**



■ **Disassembly: Field coil**

- Remove screw **A** (2 places).

CAUTION ⚠

- **If screw B are removed first, the weight of field coil may be placed on the joining portion with regulator which is fixed with screw A, causing break of the joining portion. To avoid this, remove screw A first.**

- Remove screw **B** (3 places).

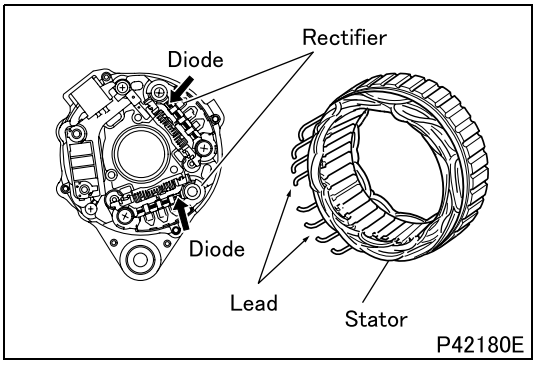
CAUTION ⚠

- **If screw B are removed, the field coil will fall under its own weight. Keep the field coil supported by your hand.**

- Remove field coil.

CAUTION ⚠

- **Do not remove the field coil forcibly. Otherwise the portion that joins with the regulator may be caught by the stator coil.**



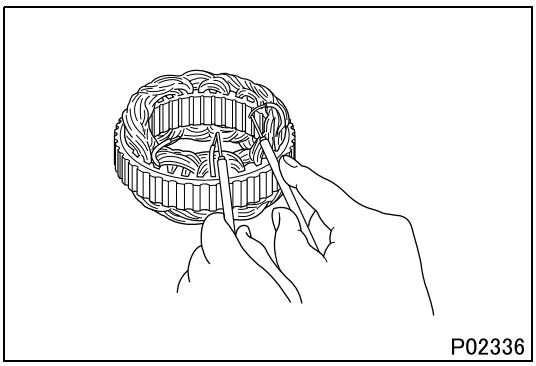
■ **Disassembly: Stator**

- Disconnect lead of stator from rectifier. The lead is soldered to diode of the rectifier at 8 places. (Each of the 2 rectifiers has 4 soldered sections.)

CAUTION ⚠

- **Unsolder within as short a time period as possible (within 5 seconds), otherwise diode can be easily damaged by heat.**

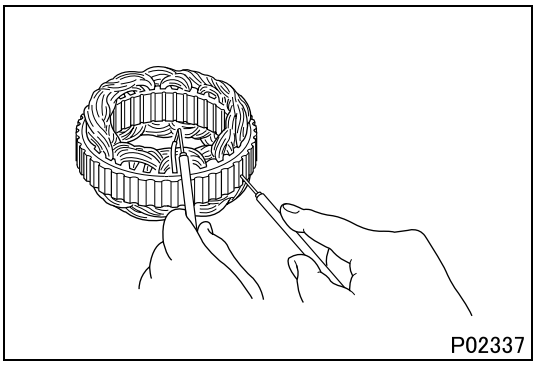
◆Inspection procedure◆



■Inspection: Stator

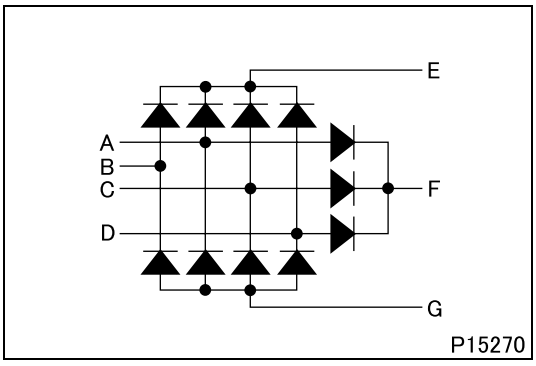
(1) Continuity between each lead wire

- Check that there is continuity between each stator lead.
- If there is no continuity, the lead has broken.



(2) Continuity between each lead wires and the core

- Check that there is no continuity between lead wires and the core.
- If there is continuity, the lead wire has short-circuited.

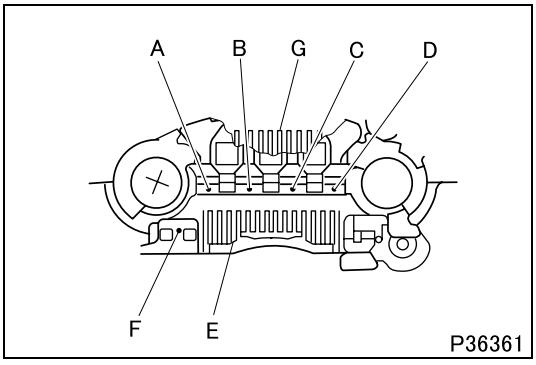


■Inspection: Rectifier

- Check the function of diodes within rectifier properly. If any fault is found, replace the rectifier.

  If resistance is infinite in both cases, the diode is open.
  If resistance is close to 0 Ω in both cases, the diode has shorted.

  A, B, C, D: Lead connecting area of stator coil
  E, G: Heat sink area
  F: Regulator connecting area



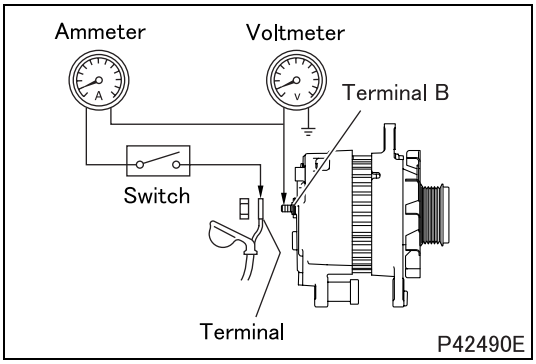
- Inspection should be conducted twice, changing over the positive probe and the negative probe of the tester.

CAUTION ⚠

- **When inspecting using a tester, the current flowing through the rectifier is smaller than usual. Therefore, an incorrect resistance value may be indicated on the tester.**
  Additionally, incorrect indications become larger as the range of the tester gets smaller. Set the tester to a largest possible scale.

54-13 ON-VEHICLE INSPECTION AND ADJUSTMENT

#950 INSPECTION OF ALTERNATOR



Performance test

- Connect the meters to the alternator as shown.

WARNING ⚠

- **To prevent possible injury, be sure to disconnect the negative battery cable and insulate the cable and the negative battery terminal with tape before working on the wiring. With the negative (–) battery cable connected, battery voltage is always applied to terminal B.**
- **To connect to switch, use a lead wire with the same or larger diameter than that of the chassis harness connected to terminal B.**

- Turn on switch and make sure that voltmeter indicates battery voltage.
- Start the engine.
- Immediately turn on the switches for all lamps on the vehicle.
- Immediately accelerate the engine to the speed indicated below and measure the alternator's output current.
  Approx. 2400 rpm
- The alternator is considered to be good if the measured value is 70% or more of the nominal output current.
  Alternator nominal output

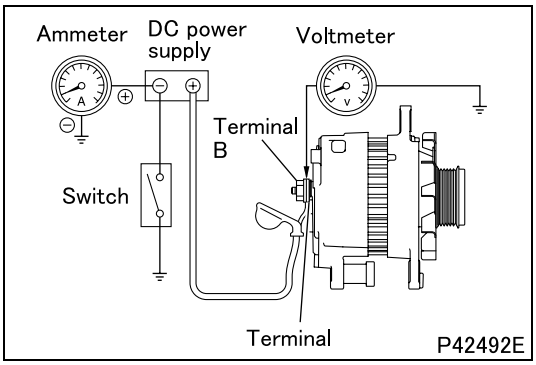
Voltage	Output current
12 V	100 A

NOTE

- **The on-vehicle inspection is only a simplified check. Use a test bench for accurate checking.**

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Adjusting voltage	14.7 ± 0.3 V	–	Replace



- Connect the meters to the alternator as shown.

WARNING ⚠

- **To prevent possible injury, be sure to disconnect the negative battery cable and insulate the cable and the negative battery terminal with tape before working on the wiring. With the negative (–) battery cable connected, battery voltage is always applied to terminal B.**
- **To connect to switch, use a lead wire with the same or larger diameter than that of the chassis harness connected to terminal B.**

- Turn off the switches for lamps, heater, etc. so that electric loads may not be applied during the inspection.
- Turn on switch and then start the engine.
- If the output current is 5 amperes or less when the engine speed is raised to the appropriate speed indicated below, then measure the voltage at terminal B.
  Approx. 2400 rpm

CAUTION ⚠

- **If the output current is in the range from 5 to 10 amperes, the measured value (regulated voltage) will be slightly lower.**
  14.4 V ± 0.3 V

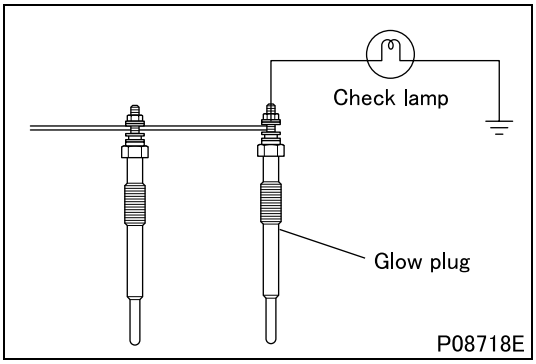
- If the output current is 5 amperes or more, do one of the following:
  - Run the engine for a while to charge the battery.
  - Replace the battery with a fully-charged one.
- If the measured value deviates from the standard value, conduct checking again on the test bench.

#955 INSPECTION OF PREHEATING SYSTEM

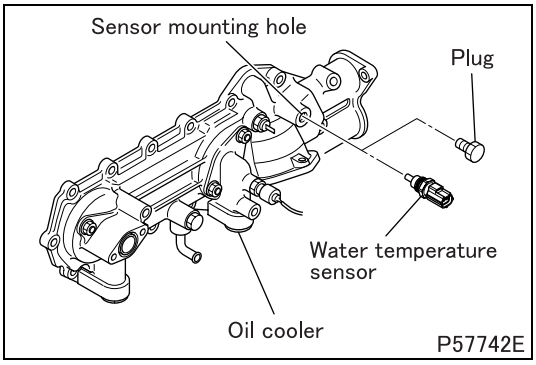
1. Preparation for inspection

Service standards

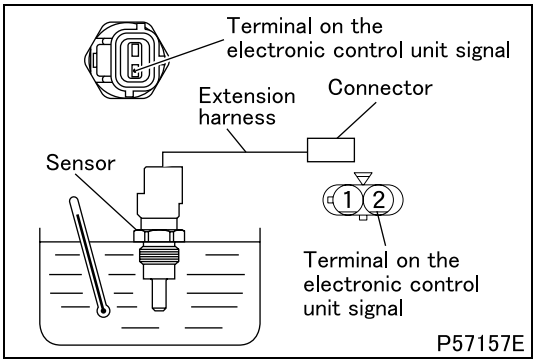
Location	Maintenance item			Standard value	Limit	Remedy
–	Coolant temperature	Pre-glow time	60°C {140°F} or higher	No pre-glow operation	–	Inspect
			0 to 60°C {32 to 140°F}	About 12 seconds	–	
			0°C {32°F} or below	About 12 seconds	–	
		After-glow time	60°C {140°F} or higher	No after-glow operation	–	
			0 to 60°C {32 to 140°F}	No after-glow operation	–	
			0°C {32°F} or below	About 20 seconds	–	
		Indicator lamp ON time	60°C {140°F} or higher	No illumination	–	
			0 to 60°C {32 to 140°F}	No illumination	–	
			0°C {32°F} or below	About 8 seconds	–	



- Turn the starter switch to OFF.
- Connect a check lamp to the glow plug.



- Remove the water temperature sensor from the engine, and close the sensor mounting hole with the plug (M16 × 1.5 mm).



- Connect the extension harness between the water temperature sensor and connector.
- Place the water temperature sensor in a container of water.
- Conduct the following test while changing the temperature of water in the container. If anything abnormal is found, check relevant components.

(1) Pre-glow time and indicator lamp ON time checking

- Turn the starter switch to ON (without starting the engine), and confirm that the pre-glow time and indicator lamp ON time at each water temperature conform with standard values.
- Measure the illuminating time of the check lamp to measure the pre-glow time.
- Measure the meter cluster glow lamp illuminating time to measure the indicator lamp ON time.

(2) After-glow time checking

- Start the engine, and measure how long the illumination of check lamp lasts after the glow lamp on the meter cluster goes out to ensure that the after-glow time conforms with the standard value.

2. Inspection Based on Diagnosis Codes

2.1 Diagnosis code list

NOTE

- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

Code	Message	Flashes
P0380	Relay for Glow Relay	26
P0381	Glow Lamp	89

2.2 Diagnosis code generation conditions and inspection items

P0380 : Relay for Glow Relay (Warning lamp flashes : 26)

Generation conditions		Glow drive relay short or open circuit, or overload
Recoverability		System recovers if signal becomes with starter switch ON position.
Control effected by electronic control unit		• Suspend glow control
Inspection	Service data	8D : Glow Relay
	Actuator test	AF : Relay for Glow Relay
	Electronic control unit connector	01 : Glow drive relay
	Electrical equipment	#201 : Glow drive relay #350 : Engine electronic control unit
	Electronic circuit diagram	Glow drive relay system (See 220)

P0381 : Glow Lamp (Warning lamp flashes : 89)

Generation conditions		Glow indicator lamp short or open circuit, or overload
Recoverability		System recovers if signal becomes with starter switch ON position.
Control effected by electronic control unit		• Normal control
Inspection	Service data	8E : Glow Relay Indicator Lamp
	Actuator test	B0 : Glow Indicator Lamp
	Electronic control unit connector	02 : Glow indicator lamp
	Electrical equipment	Meter cluster #350 : Engine electronic control unit
	Electronic circuit diagram	Glow drive relay system (See 220)

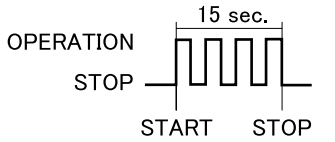
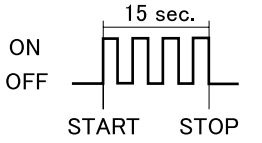
3. Multi-Use Tester Service Data

CAUTION ⚠

- **It is possible to see service data and actuator tests simultaneously.**

No.	Item	Data	Inspection condition	Requirement
8D	Glow Relay	ON/OFF	With engine coolant temperature at or below 60°C {140 °F}, turn starter switch OFF and ON. Inspect immediately after turning ON starter switch.	ON
			With engine coolant temperature at or above 60°C {140 °F} or water temperature at or below 60°C {140 °F}, turn starter switch OFF and ON. Inspect 40 seconds after turning starter switch ON.	OFF
			[Actuator test] AF: Relay for glow relay	
8E	Glow Relay Indicator Lamp	ON/OFF	With engine coolant temperature at or below 60°C {140 °F}, turn starter switch OFF and ON. Inspect immediately after turning ON starter switch.	ON
			With engine coolant temperature at or above 60°C {140 °F} or water temperature at or below 60°C {140 °F}, turn starter switch OFF and ON. Inspect 40 seconds after turning starter switch ON.	OFF
			[Actuator test] B0: Glow indicator lamp	

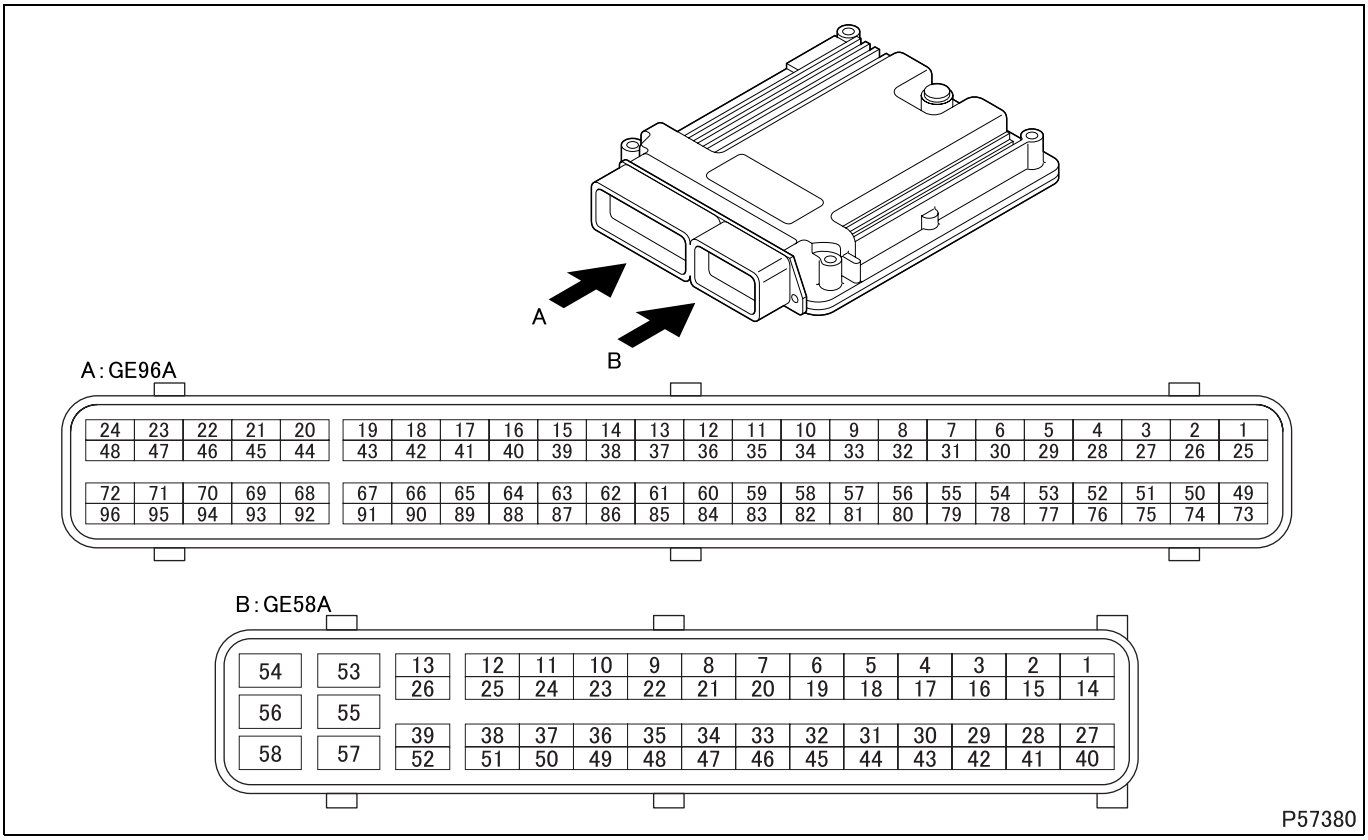
4. Actuator Tests Pertormed Using Multi-Use Tester

No.	Item	Explanation	Confirmation method
AF	Relay for Glow Relay	Glow drive relay drive signal  P57740E	Actuation noise should be heard. [Service data] 8D: Glow relay
B0	Glow Indicator Lamp	Glow indicator lamp illumination signal  P57725E	Actuation noise should be heard. [Service data] 8E: Glow indicator lamp

5. Inspection Performed at Electronic Control Unit Connectors

- The following inspection should assist troubleshooting by enabling you to verify whether or not electronic control unit signals are correctly transmitted via the vehicle harnesses and connectors.
  The numbers in the table ⓫, ⓬, etc. cross-refers you to the corresponding numbers in the table in "**2. Inspection Based on Diagnosis Codes**".

5.1 Electronic control unit connector terminal layout



5.2 Inspection instructions

CAUTION ⚠

- **Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following caution:**
- **Do not touch any terminal other than those specified for the inspection. Be particularly careful not to cause short circuits between terminals using the tester probes.**

Check item	Measurement method
⓫ Glow drive relay voltage	[Conditions] • Keep the vehicle harnesses connected to the electronic control unit connector halves. (Inspection is made at the back of the vehicle connectors.) • Carry out the actuator test "AF - Relay for Glow Relay" using Multi-Use Tester. [Normal status] Terminals (+) - (–) : A73 - A7 • Battery voltage
⓬ Glow indicator lamp illumination	[Conditions] • Keep the vehicle harnesses connected to the electronic control unit connector halves. (Inspection is made at the back of the vehicle connectors.) • Carry out the actuator test "B0 - Glow Indicator Lamp" using Multi-Use Tester. [Normal status] Short the terminal A51 to ground. • The glow indicator lamp should illuminate.

1. Inspection Based on Diagnosis Codes

1.1 Diagnosis code list

NOTE

- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

Code	Message	Flashes
P0615	Starter Safety Relay	48
P0616		
P0617		

1.2 Diagnosis code generation conditions and inspection items

P0615 : Starter Safety Relay (Warning lamp flashes : 48)

Generation conditions		Safety relay overload
Recoverability		System recovers if signal becomes with starter switch ON position.
Control effected by electronic control unit		• Normal control
Inspection	Service data	8F : Starter safety relay
	Actuator test	B1 : Starter safety relay
	Electronic control unit connector	01 : Safety relay
	Electrical equipment	#201 : Safety relay #350 : Engine electronic control unit
	Electronic circuit diagram	Safety relay system (See 210)

P0616 : Starter Safety Relay (Warning lamp flashes : 48)

Generation conditions		Safety relay ground short or open circuit
Recoverability		System recovers if signal becomes with starter switch ON position.
Control effected by electronic control unit		• Normal control
Inspection	Service data	8F : Starter safety relay
	Actuator test	B1 : Starter safety relay
	Electronic control unit connector	01 : Safety relay
	Electrical equipment	#201 : Safety relay #350 : Engine electronic control unit
	Electronic circuit diagram	Glow drive relay system (See 210)

P0617 : Starter Safety Relay (Warning lamp flashes : 48)

Generation conditions		Safety relay Battery short or open circuit
Recoverability		System recovers if signal becomes with starter switch ON position.
Control effected by electronic control unit		• Normal control
Inspection	Service data	8F : Starter safety relay
	Actuator test	B1 : Starter safety relay
	Electronic control unit connector	01 : Safety relay
	Electrical equipment	#201 : Safety relay #350 : Engine electronic control unit
	Electronic circuit diagram	Glow drive relay system (See 210)

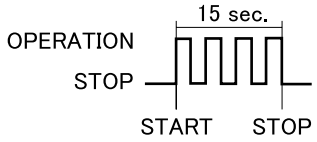
2. Multi-Use Tester Service Data

CAUTION ⚠

- **It is possible to see service data and actuator tests simultaneously.**

No.	Item	Data	Inspection condition	Requirement
8F	Starter Safety Relay	ON/OFF	Carry out the actuator test “B1 - Starter safety relay” using Multi-Use Tester. The relay should be ON.	ON
			When not testing	OFF
			[Actuator test] B1: Starter safety relay	

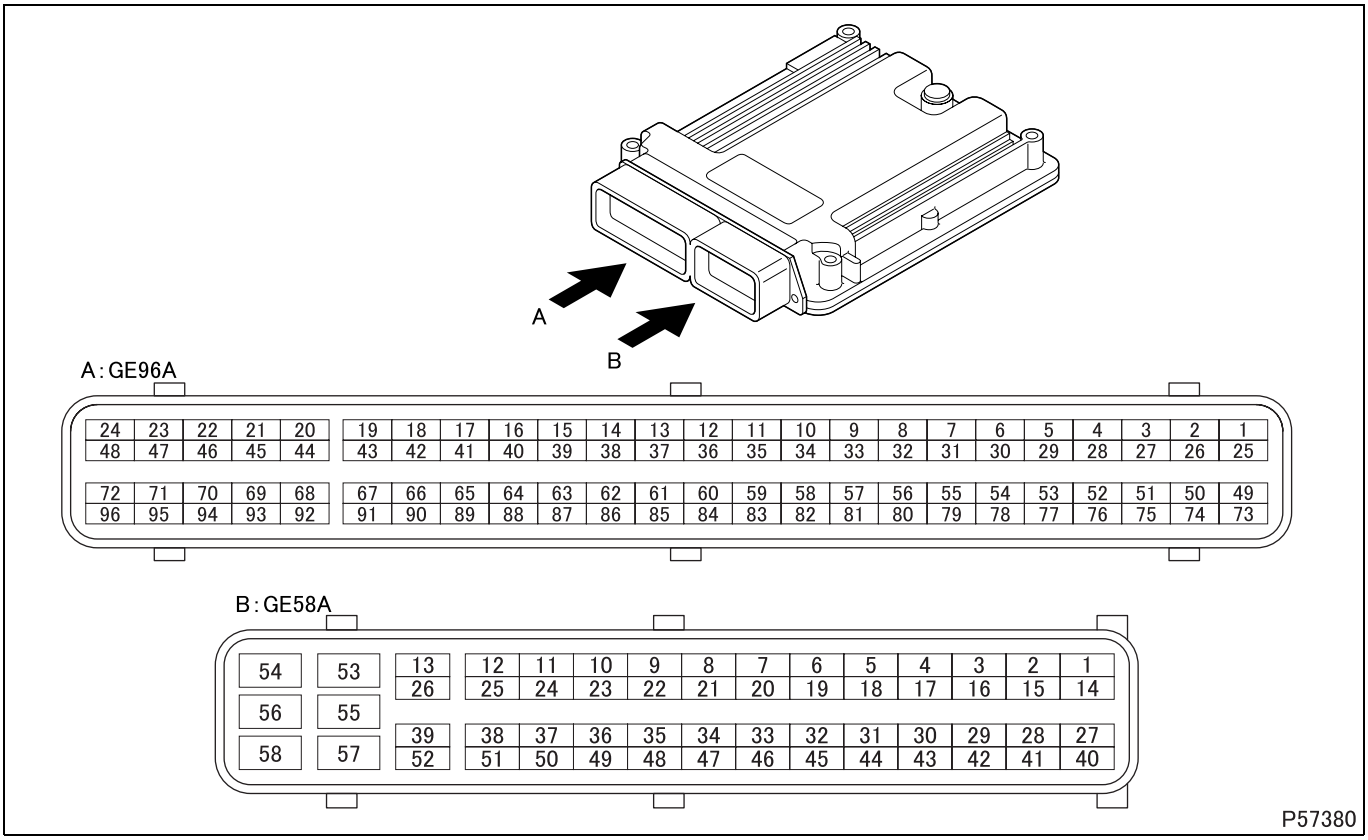
3. Actuator Tests Performed Using Multi-Use Tester

No.	Item	Explanation	Confirmation method
B1	Starter Safety Relay	Starter safety relay drive signal  P57740E	Actuation noise should be heard. [Service data] 8F: Starter safety relay

4. Inspection Performed at Electronic Control Unit Connectors

- The following inspection should assist troubleshooting by enabling you to verify whether or not electronic control unit signals are correctly transmitted via the vehicle harnesses and connectors.
  The numbers in the table **01**, **02**, etc. cross-refers you to the corresponding numbers in the table in "**1. Inspection Based on Diagnosis Codes**".

4.1 Electronic control unit connector terminal layout



4.2 Inspection instructions

CAUTION ⚠

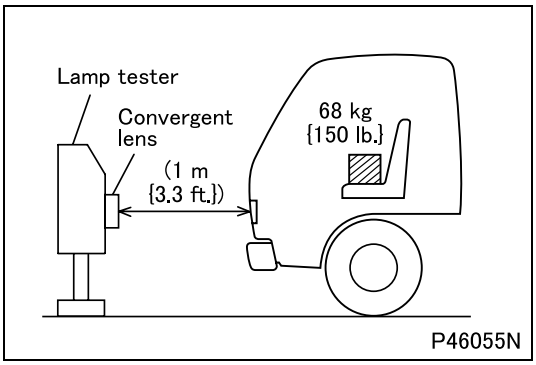
- **Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following caution:**
- **Do not touch any terminal other than those specified for the inspection. Be particularly careful not to cause short circuits between terminals using the tester probes.**

Inspection item	Procedures
01 Safety relay voltage	[Conditions] • Keep the vehicle harnesses connected to the electronic control unit connector halves. (Inspection is made at the back of the vehicle connectors.) [Normal status] Terminals (+) - (–) : A81 - A49 • Relay ON: 12 V • Relay OFF: 0 V

M E M O

#960 HEADLAMP AIMING

1. Preparation before Adjustment

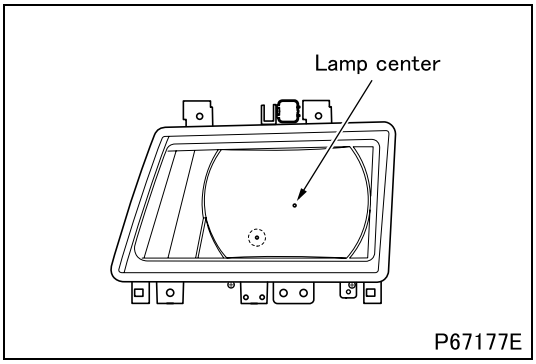


- Park the vehicle on a level place.

WARNING ⚠

- **Be sure to put tire chocks securely in place.**

- Unload the vehicle and make sure no one is in it.
- Inflate the tires to the specified pressure. (See Gr31.)
- Seat one person of an equivalent mass (68 kg {150 lb.}) in the vehicle.
- Start the engine and check that the battery is being charged.
- Place convergent lamp tester and the vehicle facing each other as shown in the drawing.
- Align the center of headlamp bulb and the center of convergent lens of convergent lamp tester. (The drawing shows the left-hand headlamp.)

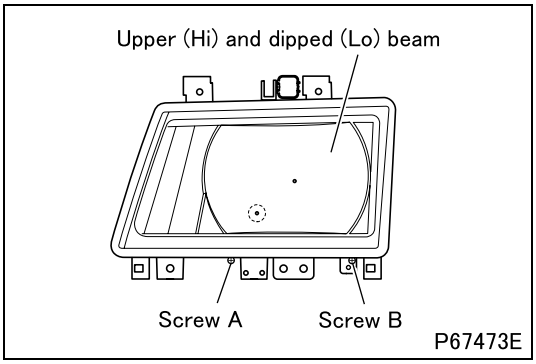


2. Adjustment

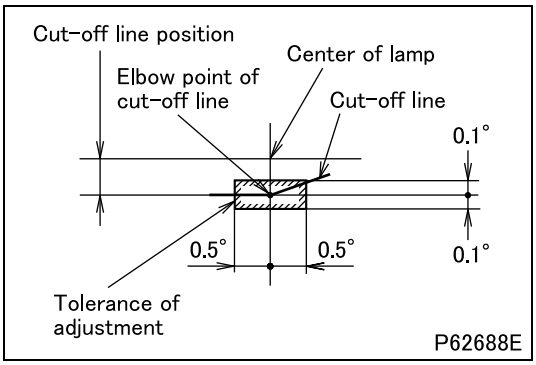
WARNING ⚠

- **Do not mask a lit headlamp for more than 10 minutes or the heat generated might cause a fire.**

2.1 Adjustment of Dipped Beam



- Turn on dipped beam.
- Make adjustment by the following procedure so that the elbow point of dipped beam cut-off line is in the illustrated position.
- Vertical adjustment: Adjust by turning screws A and B in this order by the same amount.



- Horizontal adjustment: Turn screw B. Adjust the optical axes of both the right- and left-hand dipped beams to the illustrated position.
  Cut-off line position: 0.7°

Adjusting direction for optical axis

<Left-hand headlamp>

	Upward	Downward	Leftward	Rightward
Screw A	Counter-clockwise	Clockwise	–	–
Screw B	–	–	Clockwise	Counter-clockwise

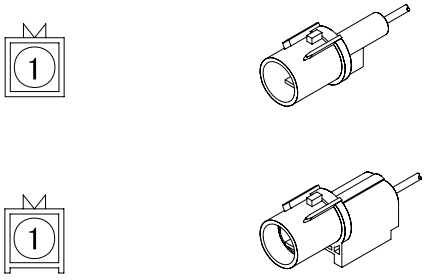
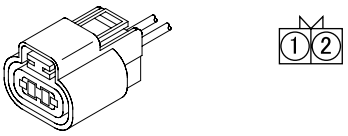
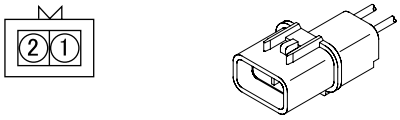
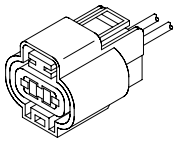
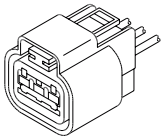
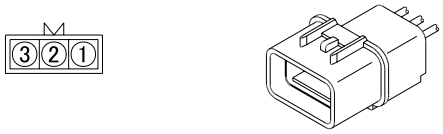
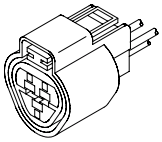
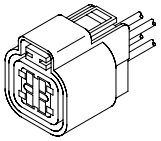
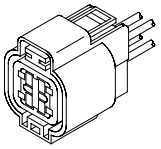
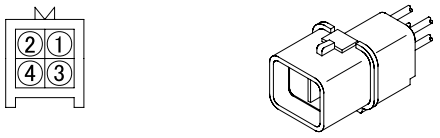
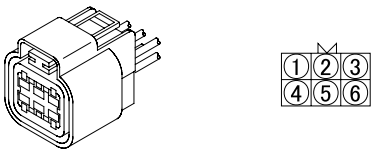
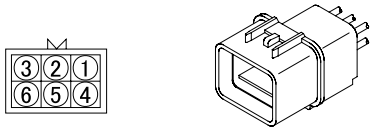
<Right-hand headlamp>

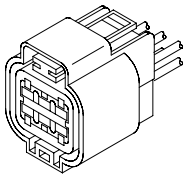
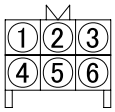
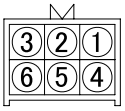
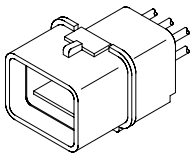
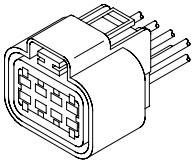
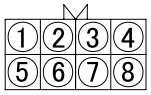
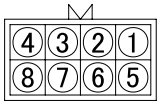
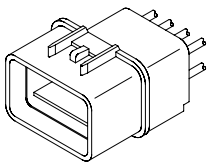
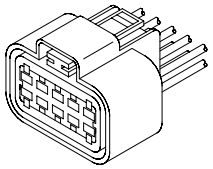
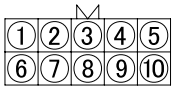
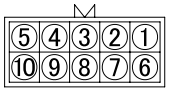
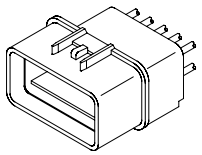
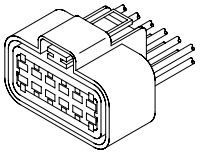
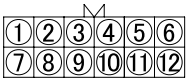
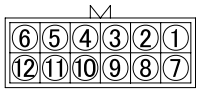
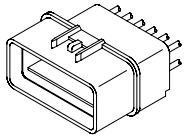
	Upward	Downward	Leftward	Rightward
Screw A	Counter-clockwise	Clockwise	–	–
Screw B	–	–	Counter-clockwise	Clockwise

54-14 CONNECTOR CONFIGURATION CHART

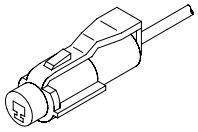
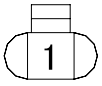
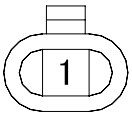
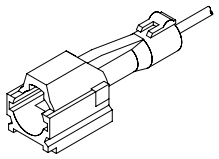
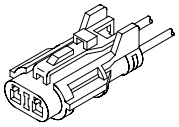
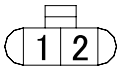
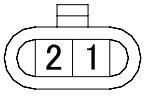
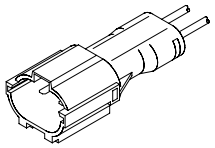
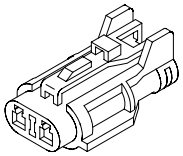
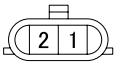
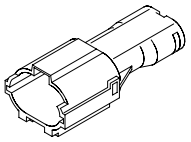
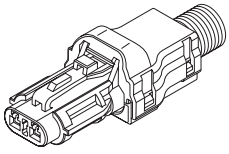
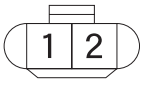
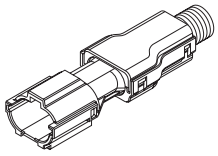
CONNECTOR CONFIGURATION CHART

AA type

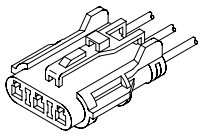
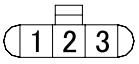
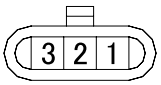
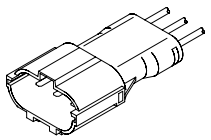
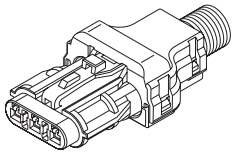
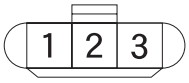
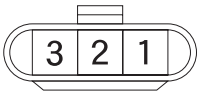
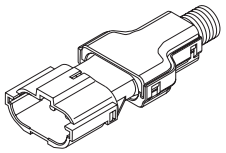
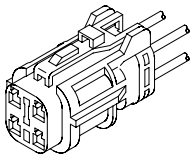
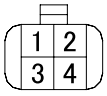
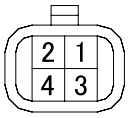
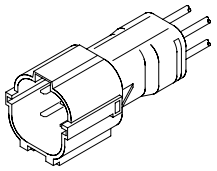
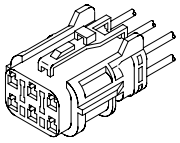
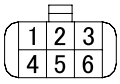
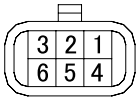
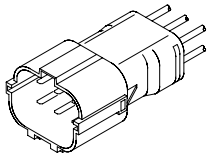
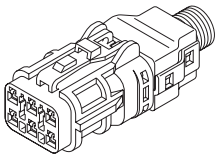
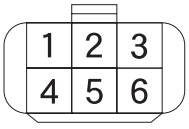
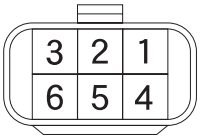
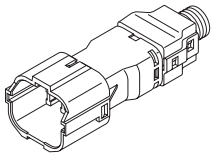
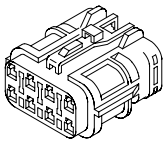
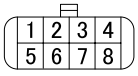
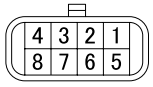
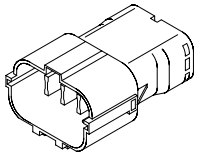
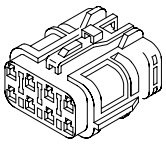
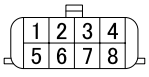
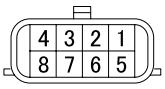
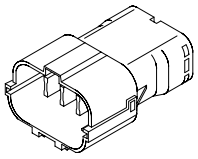
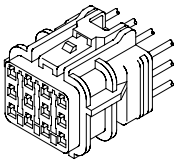
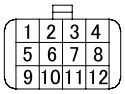
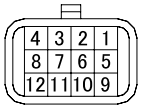
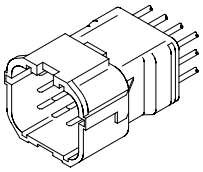
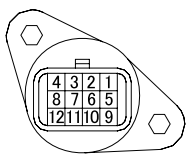
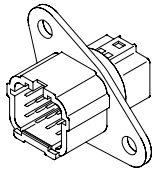
Number shows number of pins	Female connector	Male connector
AA1A		
AA2A		
AA2B		
AA3A		
AA3B		
AA4A		
AA4B		
AA6A		

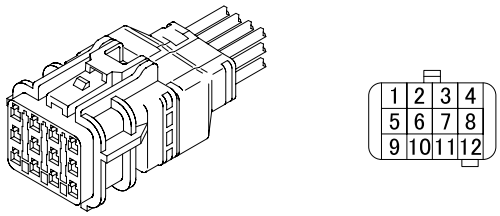
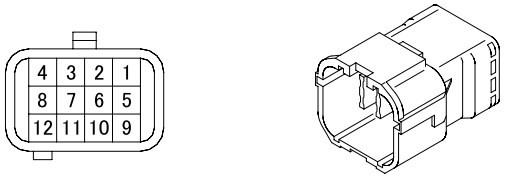
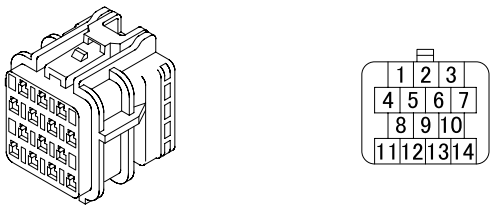
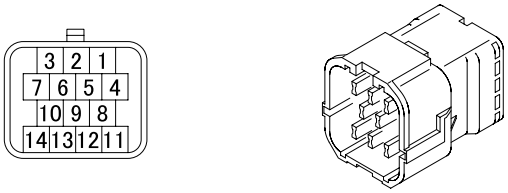
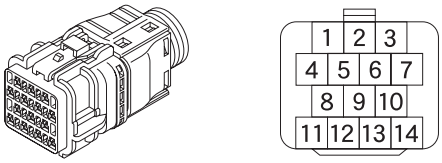
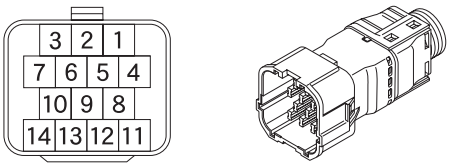
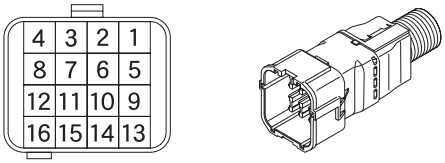
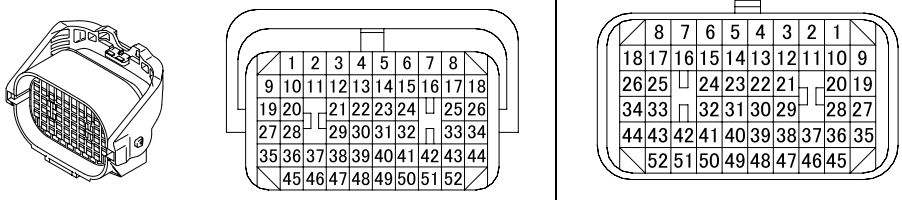
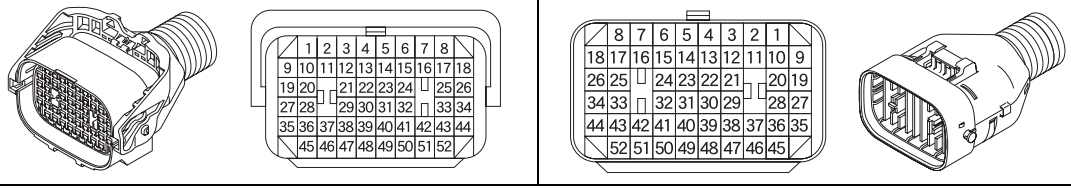
Number shows number of pins	Female connector	Male connector
AA6B	 	 
AA8A	 	 
AA10A	 	 
AA12A	 	 

AB type

Number shows number of pins	Female connector	Male connector
AB1A	 	 
AB2A	 	 
AB2B		 
AB2C	 	

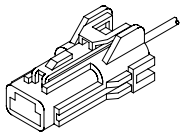
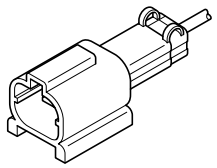
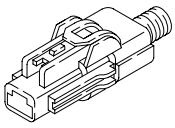
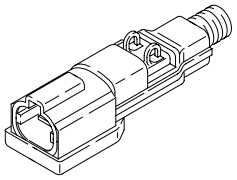
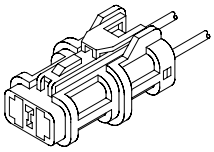
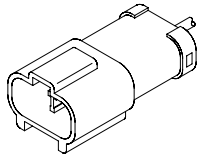
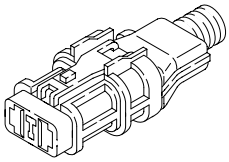
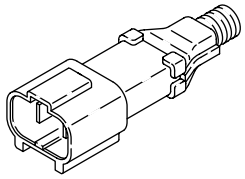
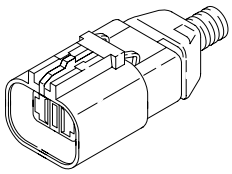
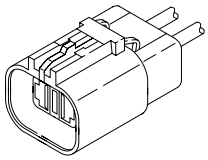
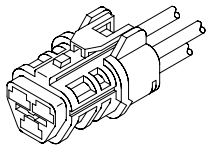
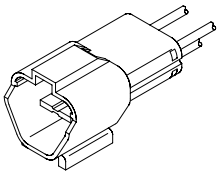
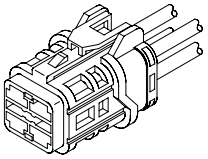
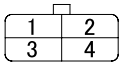
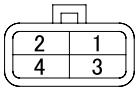
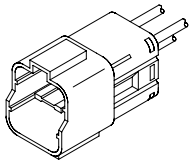
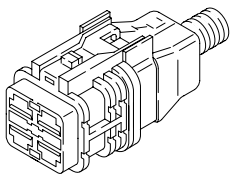
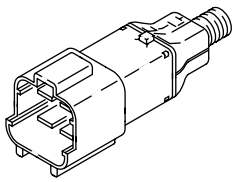
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
AB3A	 	 
AB3B	 	 
AB4A	 	 
AB6A	 	 
AB6B	 	 
AB8A	 	 
AB8B	 	 
AB12A	 	   

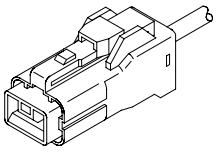
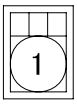
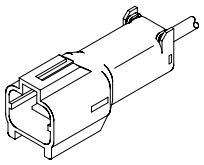
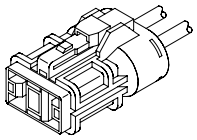
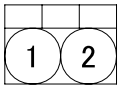
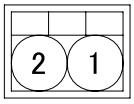
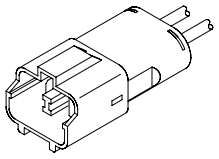
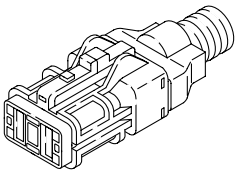
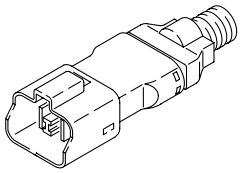
Number shows number of pins	Female connector	Male connector
AB12B		
AB14A		
AB14B		
AB16A		
AB16B		
AB52A		
AB52B		

CONNECTOR CONFIGURATION CHART

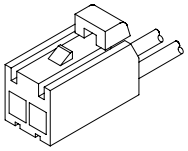
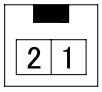
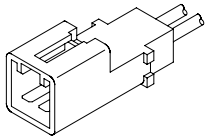
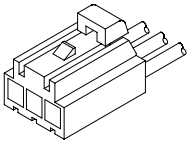
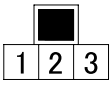
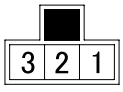
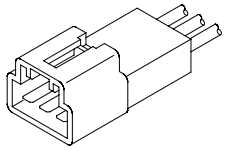
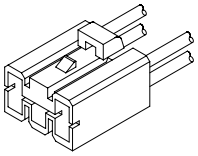
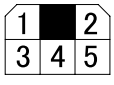
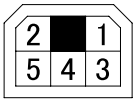
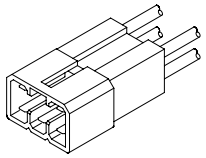
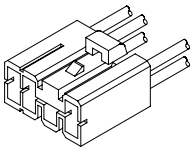
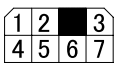
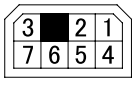
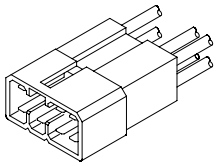
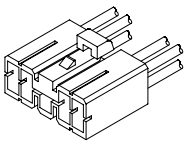
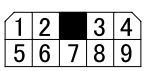
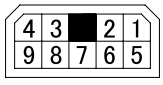
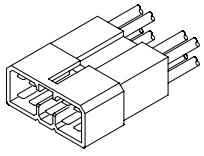
AC type

Number shows number of pins	Female connector	Male connector
AC1A		
AC1B		
AC2A		
AC2B		
AC2C		
AC2D		
AC3A		
AC4A	 	 
AC4B		

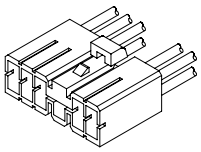
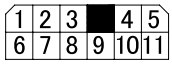
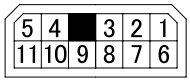
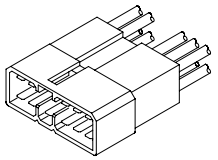
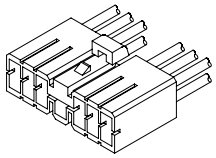
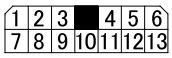
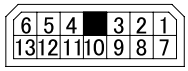
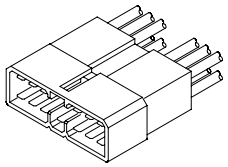
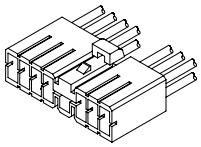
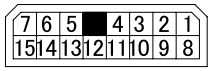
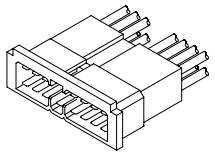
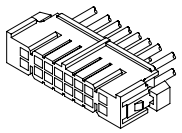
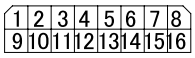
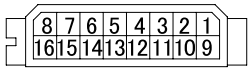
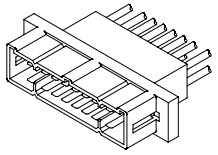
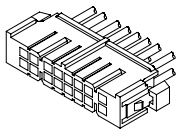
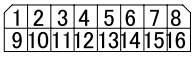
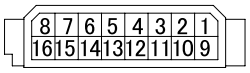
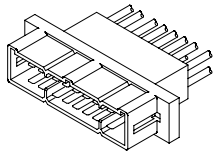
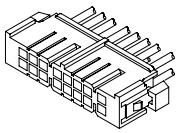
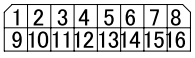
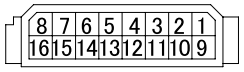
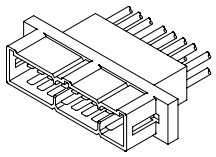
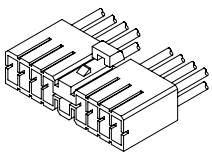
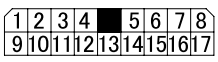
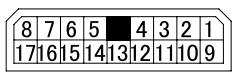
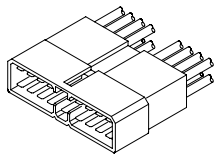
AD type

Number shows number of pins	Female connector	Male connector
AD1A		 
AD2A	 	 
AD2B		

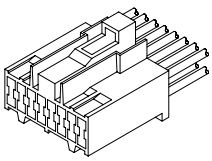
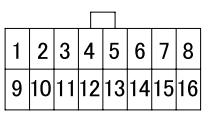
AE type

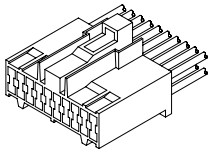
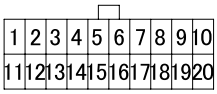
Number shows number of pins	Female connector	Male connector
AE2A		 
AE3A	 	 
AE5A	 	 
AE7A	 	 
AE9A	 	 

CONNECTOR CONFIGURATION CHART

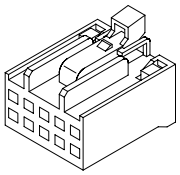
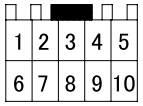
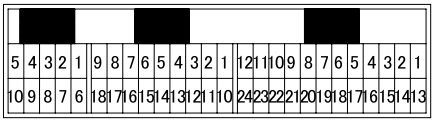
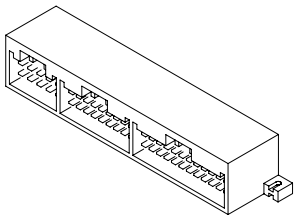
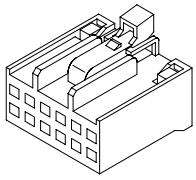
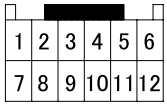
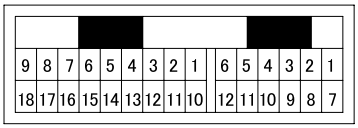
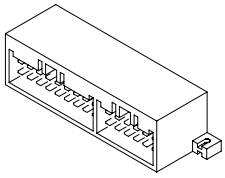
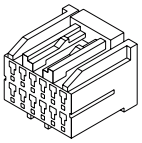
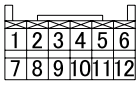
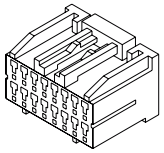
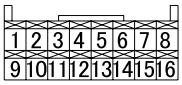
Number shows number of pins	Female connector	Male connector
AE11A	 	 
AE13A	 	 
AE15A		 
AE16A	 	 
AE16B	 	 
AE16C	 	 
AE17A	 	 

AG type

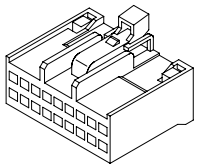
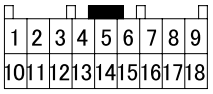
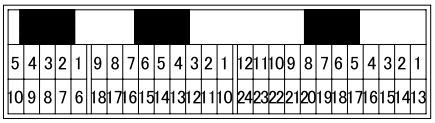
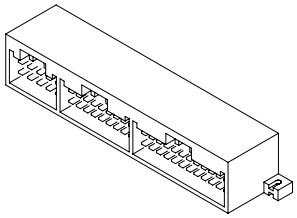
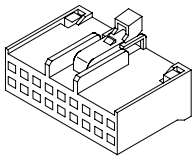
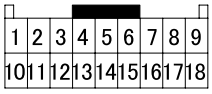
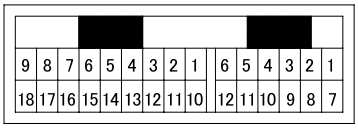
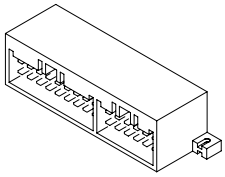
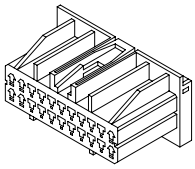
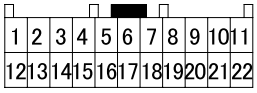
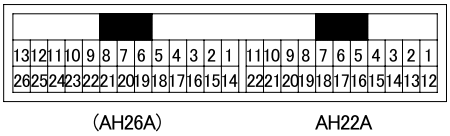
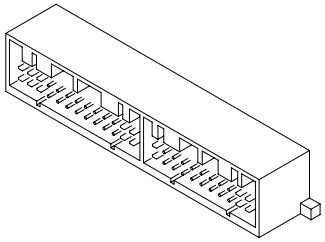
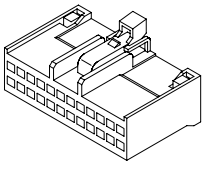
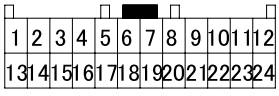
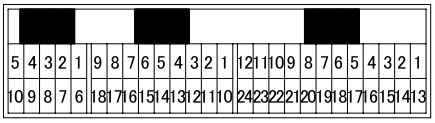
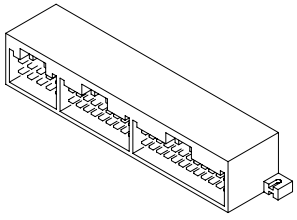
Number shows number of pins	Female connector	Male connector
AG16A	 	

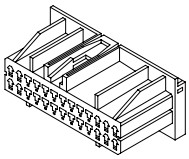
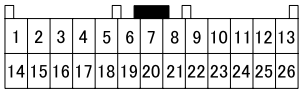
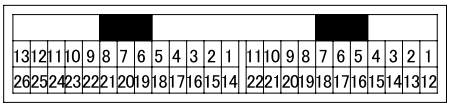
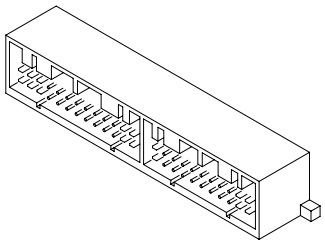
Number shows number of pins	Female connector	Male connector
AG20A	 	

AH type

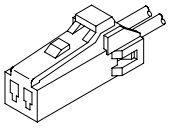
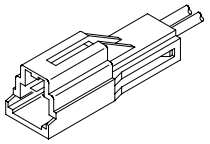
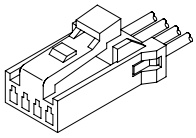
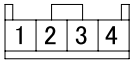
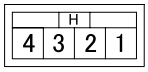
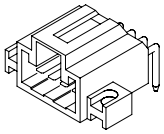
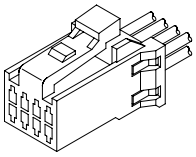
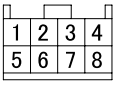
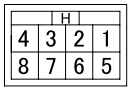
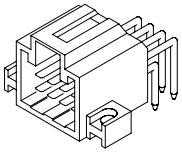
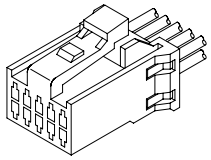
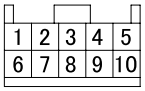
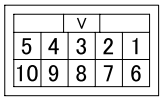
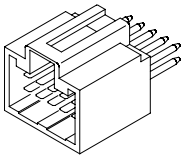
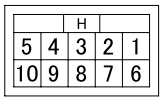
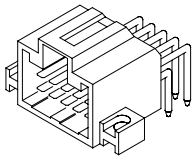
Number shows number of pins	Female connector	Male connector
AH10A	 	 AH10A （AH18A） （AH24A） 
AH12A	 	 （AH18B） AH12A 
AH12B	 	
AH16A	 	

CONNECTOR CONFIGURATION CHART

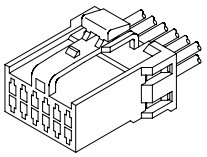
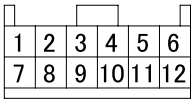
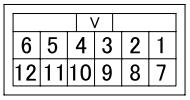
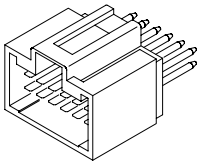
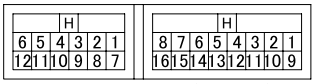
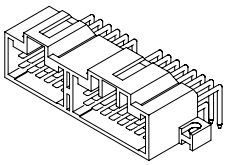
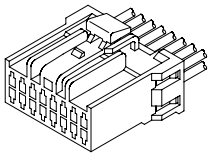
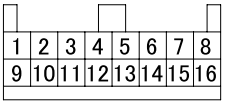
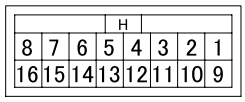
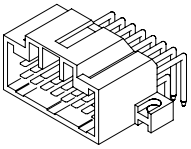
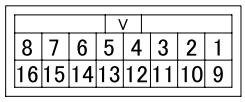
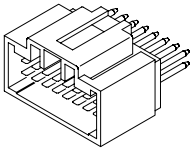
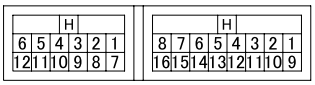
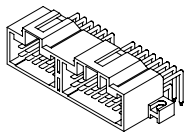
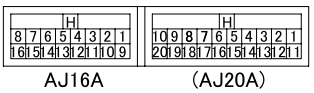
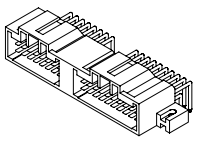
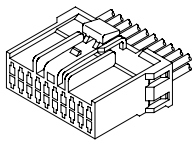
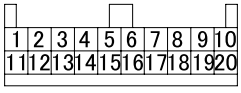
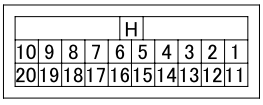
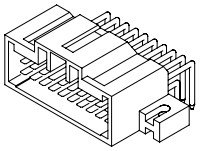
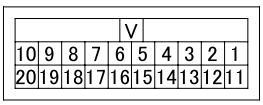
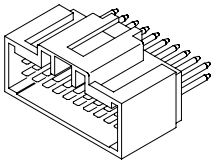
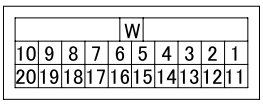
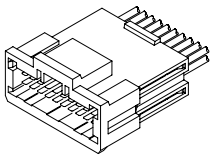
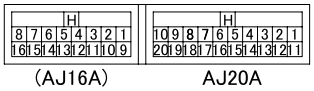
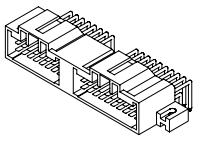
Number shows number of pins	Female connector	Male connector
AH18A	  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	 5 4 3 2 1 9 8 7 6 5 4 3 2 1 12 11 10 9 8 7 6 5 4 3 2 1 10 9 8 7 6 18 17 16 15 14 13 12 11 10 24 23 22 21 20 19 18 17 16 15 14 13 (AH10A) AH18A (AH24A) 
AH18B	  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	 9 8 7 6 5 4 3 2 1 6 5 4 3 2 1 18 17 16 15 14 13 12 11 10 12 11 10 9 8 7 AH18B (AH12A) 
AH22A	  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	 13 12 11 10 9 8 7 6 5 4 3 2 1 11 10 9 8 7 6 5 4 3 2 1 26 25 24 23 22 21 20 19 18 17 16 15 14 22 21 20 19 18 17 16 15 14 13 12 (AH26A) AH22A 
AH24A	  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	 5 4 3 2 1 9 8 7 6 5 4 3 2 1 12 11 10 9 8 7 6 5 4 3 2 1 10 9 8 7 6 18 17 16 15 14 13 12 11 10 24 23 22 21 20 19 18 17 16 15 14 13 (AH10A) (AH18A) AH24A 

Number shows number of pins	Female connector	Male connector
AH26A	  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	 13 12 11 10 9 8 7 6 5 4 3 2 1 11 10 9 8 7 6 5 4 3 2 1 26 25 24 23 22 21 20 19 18 17 16 15 14 22 21 20 19 18 17 16 15 14 13 12 AH26A (AH22A) 

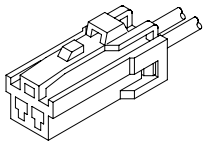
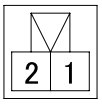
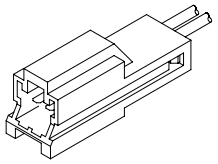
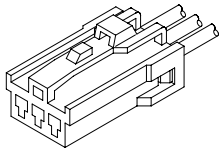
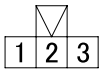
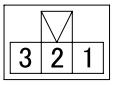
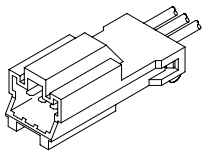
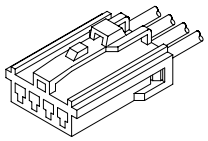
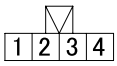
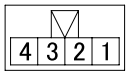
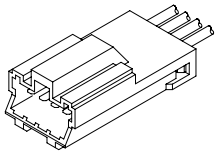
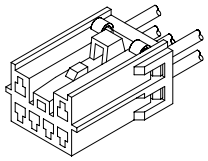
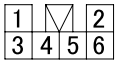
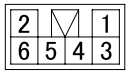
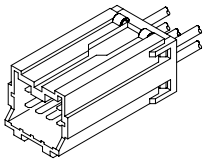
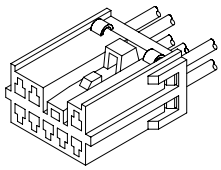
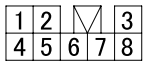
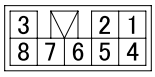
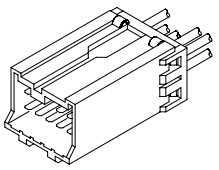
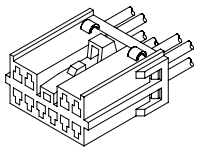
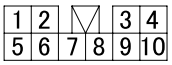
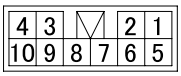
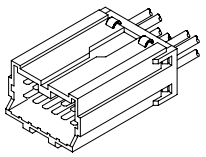
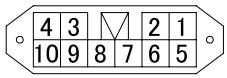
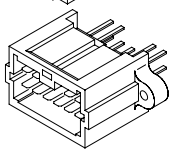
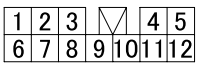
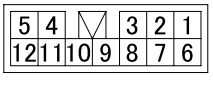
AJ type

Number shows number of pins	Female connector	Male connector
AJ2A	 1 2	 2 1 
AJ4A	  1 2 3 4	 H 4 3 2 1 
AJ8A	  1 2 3 4 5 6 7 8	 H 4 3 2 1 8 7 6 5 
AJ10A	  1 2 3 4 5 6 7 8 9 10	 V 5 4 3 2 1 10 9 8 7 6   H 5 4 3 2 1 10 9 8 7 6 

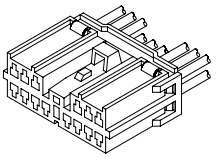
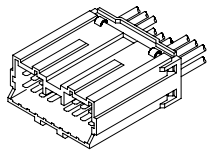
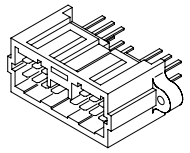
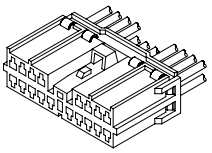
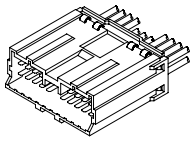
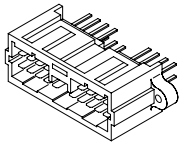
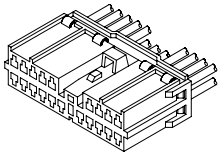
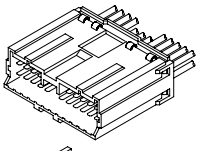
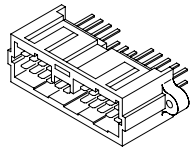
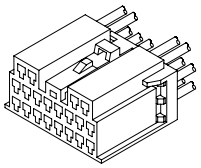
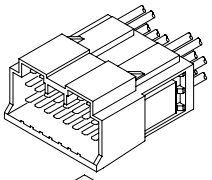
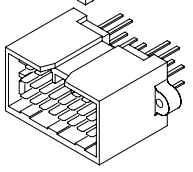
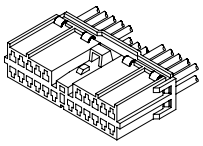
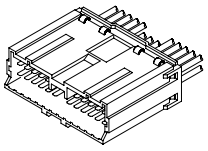
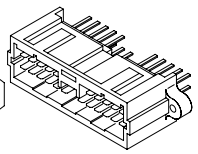
CONNECTOR CONFIGURATION CHART

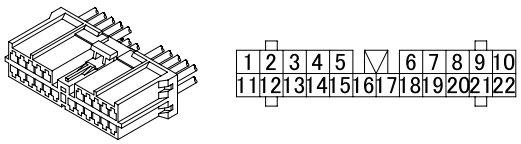
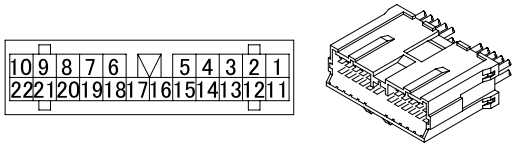
Number shows number of pins	Female connector	Male connector
AJ12A	  1 2 3 4 5 6 7 8 9 10 11 12	 V 6 5 4 3 2 1 12 11 10 9 8 7   H 6 5 4 3 2 1 12 11 10 9 8 7 AJ12A H 8 7 6 5 4 3 2 1 16 15 14 13 12 11 10 9 (AJ16A) 
AJ16A	  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	 H 8 7 6 5 4 3 2 1 16 15 14 13 12 11 10 9   V 8 7 6 5 4 3 2 1 16 15 14 13 12 11 10 9   H 6 5 4 3 2 1 12 11 10 9 8 7 (AJ12A) H 8 7 6 5 4 3 2 1 16 15 14 13 12 11 10 9 AJ16A   H 8 7 6 5 4 3 2 1 16 15 14 13 12 11 10 9 AJ16A H 10 9 8 7 6 5 4 3 2 1 20 19 18 17 16 15 14 13 12 11 (AJ20A) 
AJ20A	  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	 H 10 9 8 7 6 5 4 3 2 1 20 19 18 17 16 15 14 13 12 11   V 10 9 8 7 6 5 4 3 2 1 20 19 18 17 16 15 14 13 12 11   W 10 9 8 7 6 5 4 3 2 1 20 19 18 17 16 15 14 13 12 11   H 8 7 6 5 4 3 2 1 16 15 14 13 12 11 10 9 (AJ16A) H 10 9 8 7 6 5 4 3 2 1 20 19 18 17 16 15 14 13 12 11 AJ20A 

AK type

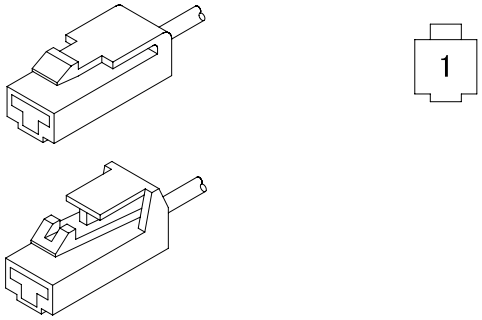
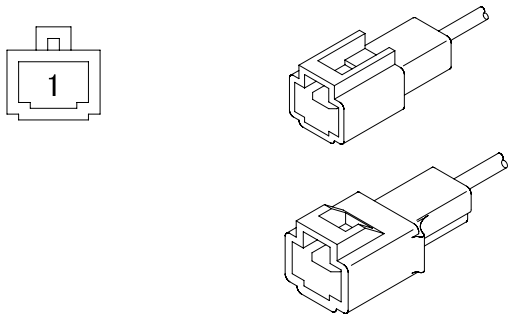
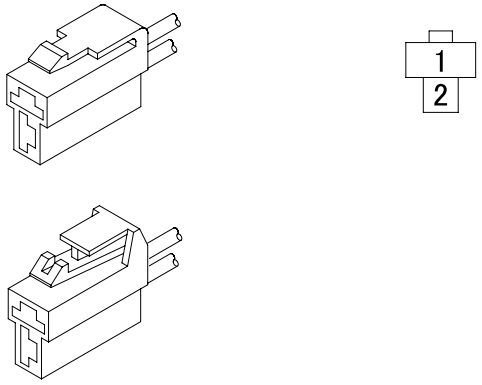
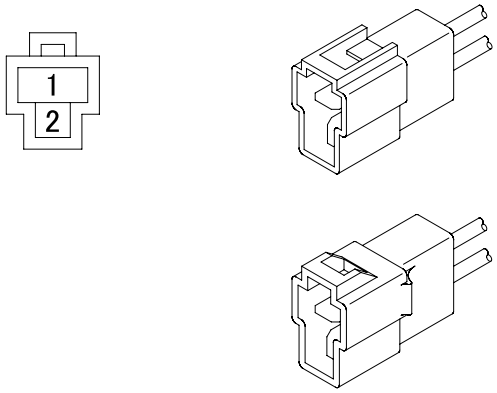
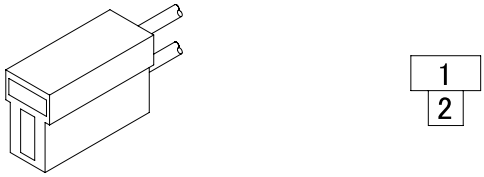
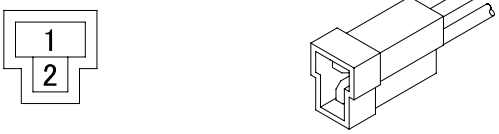
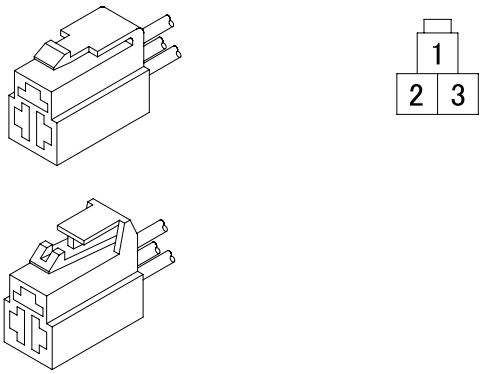
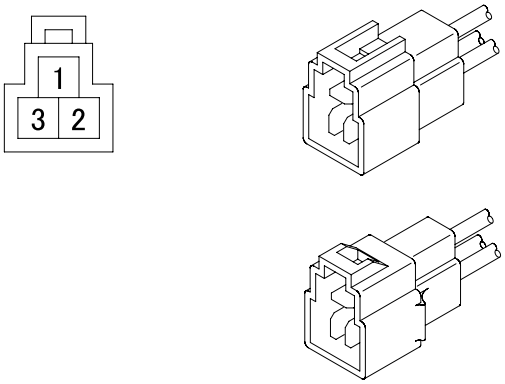
Number shows number of pins	Female connector	Male connector
AK2A		 
AK3A	 	 
AK4A	 	 
AK6A	 	 
AK8A	 	 
AK10A	 	   
AK12A		

CONNECTOR CONFIGURATION CHART

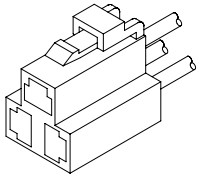
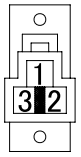
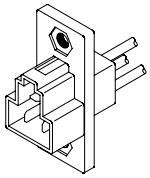
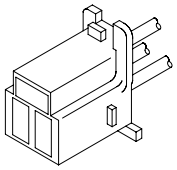
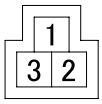
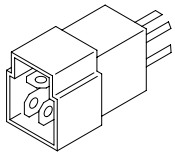
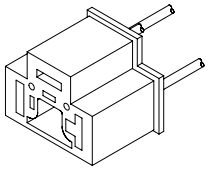
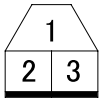
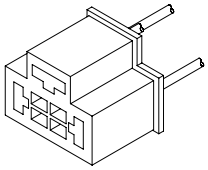
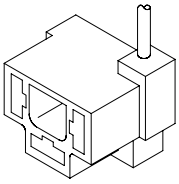
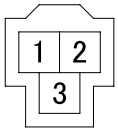
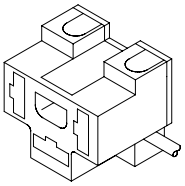
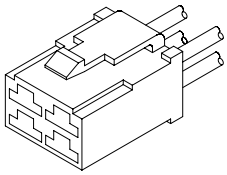
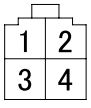
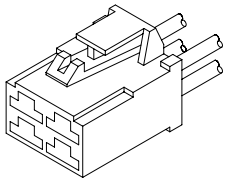
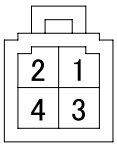
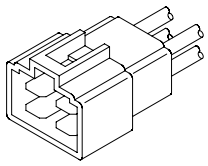
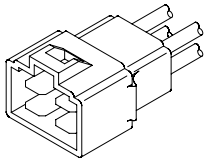
Number shows number of pins	Female connector	Male connector
AK14A	 1 2 3 ▽ 4 5 6 7 8 9 10 11 12 13 14	6 5 4 ▽ 3 2 1 14 13 12 11 10 9 8 7  6 5 4 ▽ 3 2 1 14 13 12 11 10 9 8 7 
AK18A	 1 2 3 4 ▽ 5 6 7 8 9 10 11 12 13 14 15 16 17 18	8 7 6 5 ▽ 4 3 2 1 18 17 16 15 14 13 12 11 10 9  8 7 6 5 ▽ 4 3 2 1 18 17 16 15 14 13 12 11 10 9 
AK20A	 1 2 3 4 5 ▽ 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	9 8 7 6 ▽ 5 4 3 2 1 20 19 18 17 16 15 14 13 12 11 10  9 8 7 6 ▽ 5 4 3 2 1 20 19 18 17 16 15 14 13 12 11 10 
AK20B	 1 2 ▽ 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	4 3 ▽ 2 1 12 11 10 9 8 7 6 5 20 19 18 17 16 15 14 13  4 3 ▽ 2 1 12 11 10 9 8 7 6 5 20 19 18 17 16 15 14 13 
AK22A	 1 2 3 4 5 ▽ 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	10 9 8 7 6 ▽ 5 4 3 2 1 22 21 20 19 18 17 16 15 14 13 12 11  10 9 8 7 6 ▽ 5 4 3 2 1 22 21 20 19 18 17 16 15 14 13 12 11 

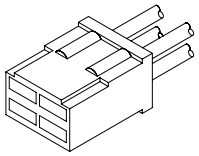
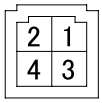
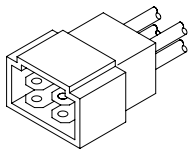
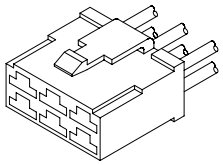
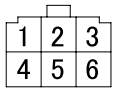
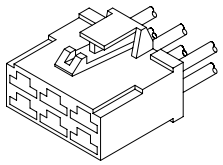
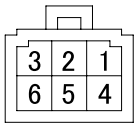
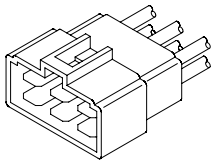
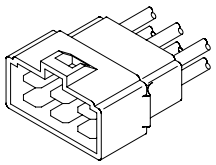
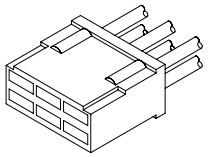
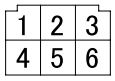
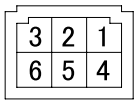
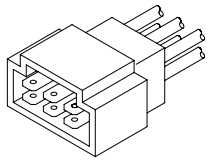
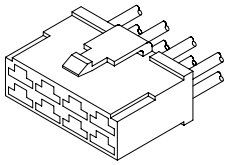
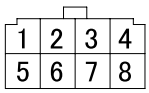
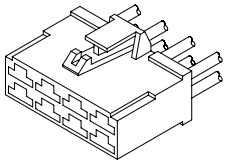
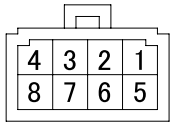
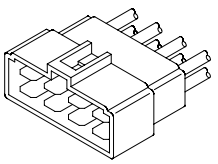
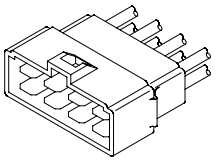
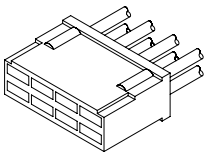
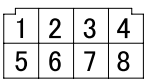
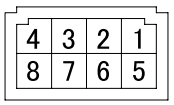
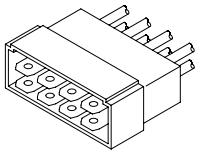
Number shows number of pins	Female connector	Male connector
AK22B		

AL type

Number shows number of pins	Female connector	Male connector
AL1A		
AL2A		
AL2B		
AL3A		

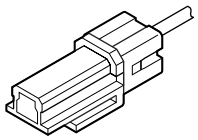
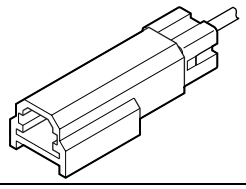
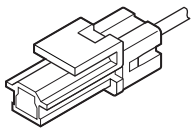
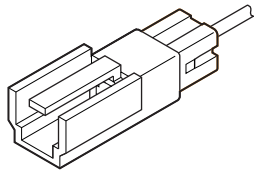
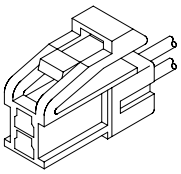
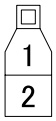
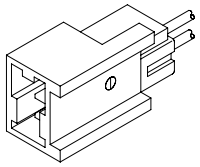
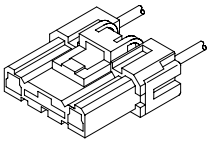
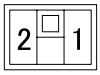
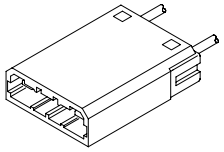
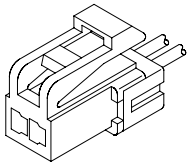
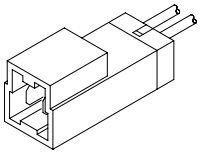
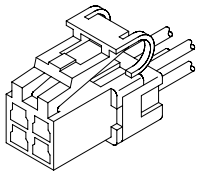
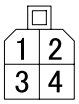
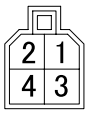
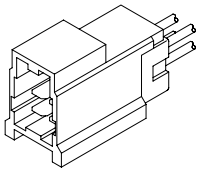
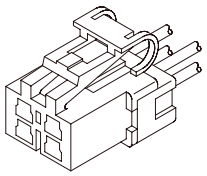
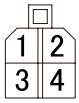
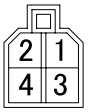
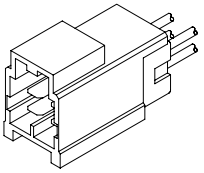
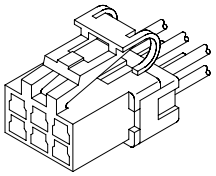
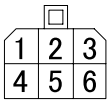
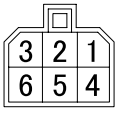
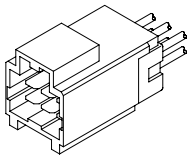
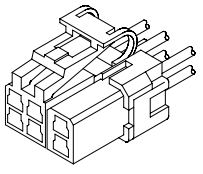
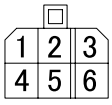
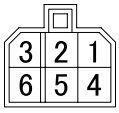
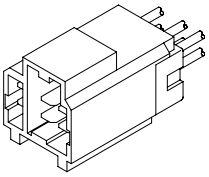
CONNECTOR CONFIGURATION CHART

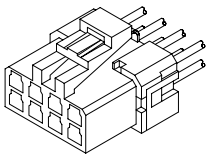
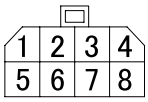
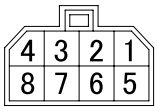
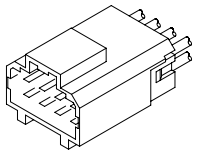
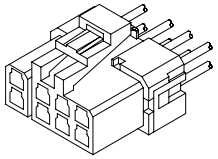
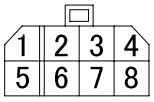
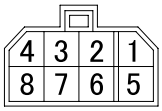
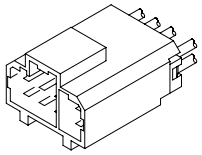
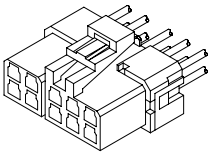
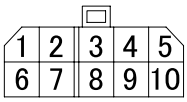
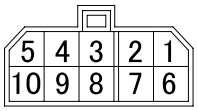
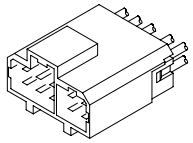
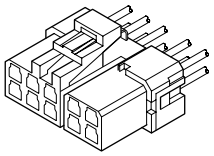
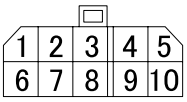
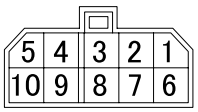
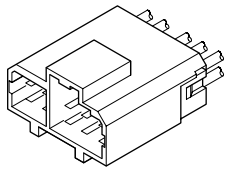
Number shows number of pins	Female connector	Male connector
AL3B		 
AL3C		 
AL3D	  	
AL3E	  	
AL4A	  	  

Number shows number of pins	Female connector	Male connector
AL4B		 
AL6A	  	  
AL6B	 	 
AL8A	  	  
AL8B	 	 

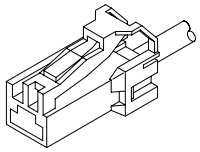
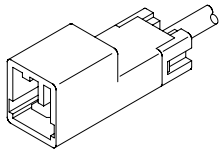
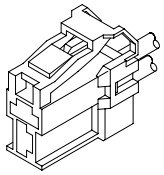
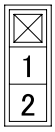
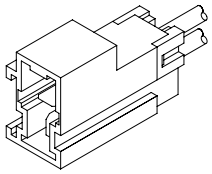
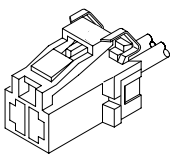
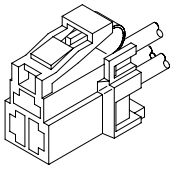
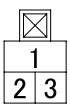
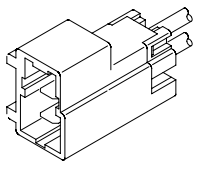
CONNECTOR CONFIGURATION CHART

AM type

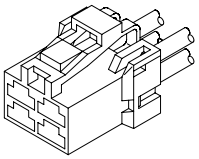
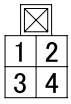
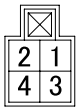
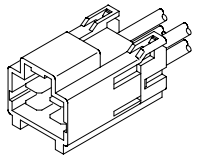
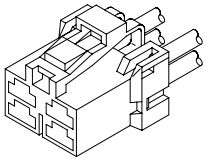
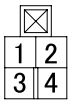
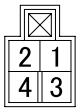
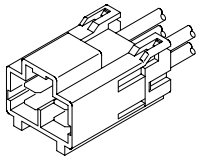
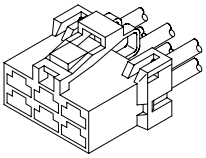
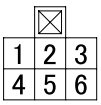
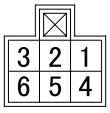
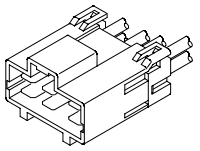
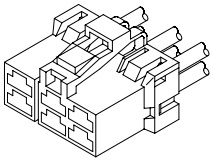
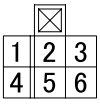
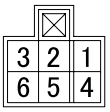
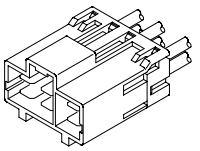
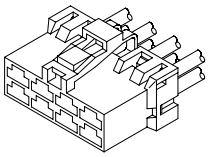
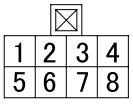
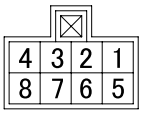
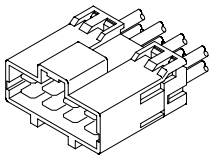
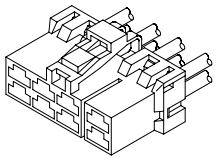
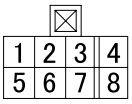
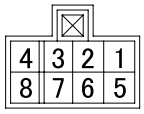
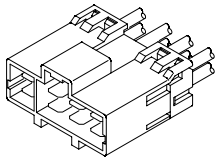
Number shows number of pins	Female connector	Male connector
AM1A		
AM1B		
AM2A	 	
AM2B		 
AM2C		
AM4A	 	 
AM4B	 	 
AM6A	 	 
AM6B	 	 

Number shows number of pins	Female connector	Male connector
AM8A	 	 
AM8B	 	 
AM10A	 	 
AM10B	 	 

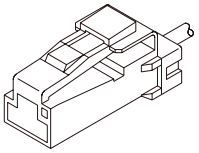
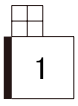
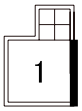
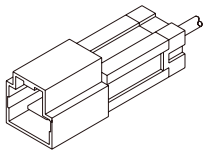
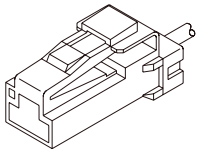
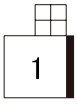
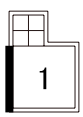
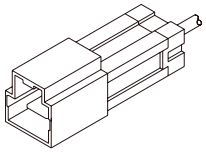
AN type

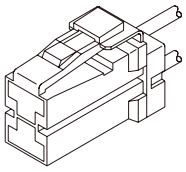
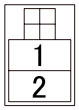
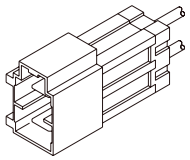
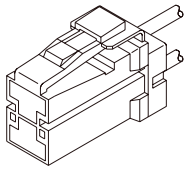
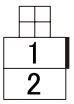
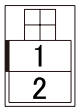
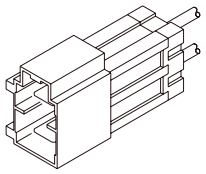
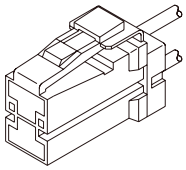
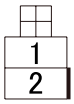
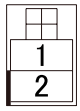
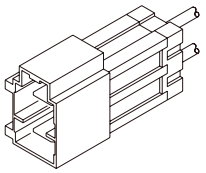
Number shows number of pins	Female connector	Male connector
AN1A		
AN2A		 
AN2B		
AN3A	 	

CONNECTOR CONFIGURATION CHART

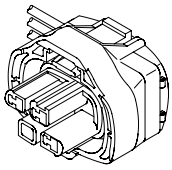
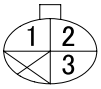
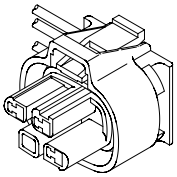
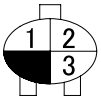
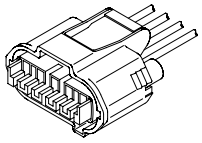
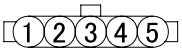
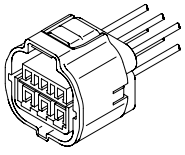
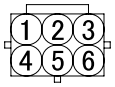
Number shows number of pins	Female connector	Male connector
AN4A	 	 
AN4B	 	 
AN6A	 	 
AN6B	 	 
AN8A	 	 
AN8B	 	 

AP type

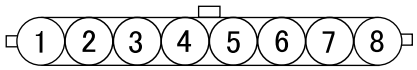
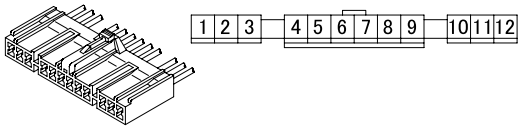
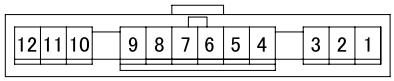
Number shows number of pins	Female connector	Male connector
AP1A	 	 
AP1B	 	 

Number shows number of pins	Female connector	Male connector
AP2A		 
AP2B	 	 
AP2C	 	 

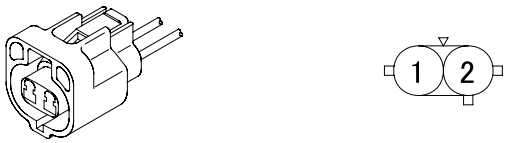
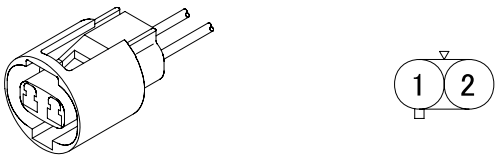
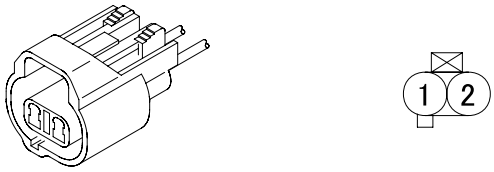
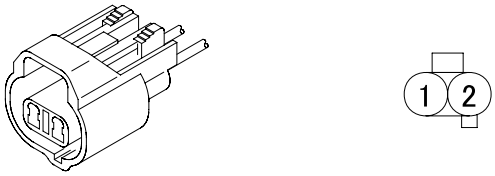
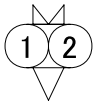
AQ type

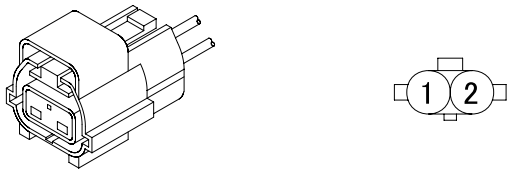
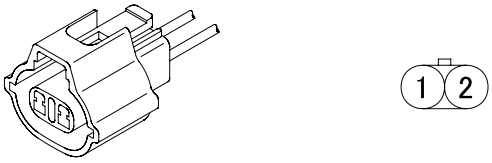
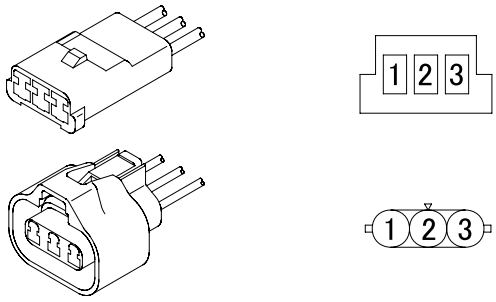
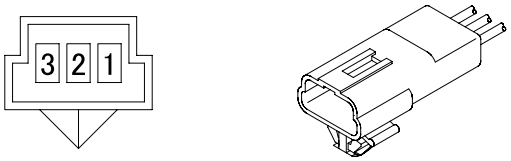
Number shows number of pins	Female connector	Male connector
AQ1A		
AQ3A	 	
AQ3B	 	
AQ5A	 	
AQ6A	 	

CONNECTOR CONFIGURATION CHART

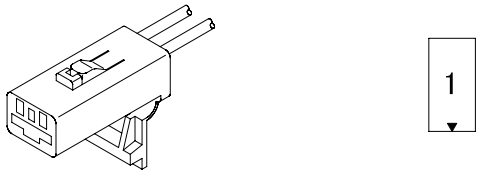
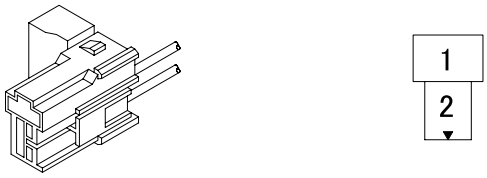
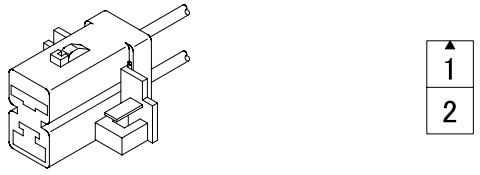
Number shows number of pins	Female connector	Male connector
AQ8A		
AQ12A		

AR type

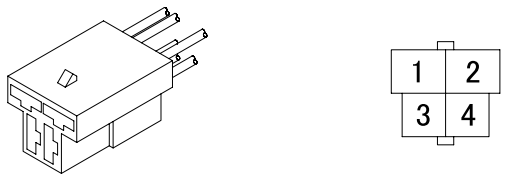
Number shows number of pins	Female connector	Male connector
AR2A		
AR2B		
AR2C		
AR2D		
AR2E		
AR2F		

Number shows number of pins	Female connector	Male connector
AR2G		
AR2H		
AR3A		

AS type

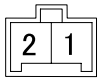
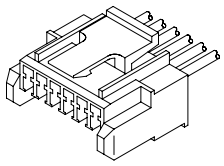
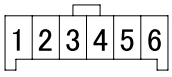
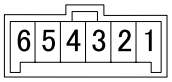
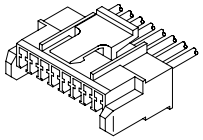
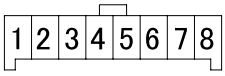
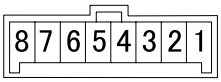
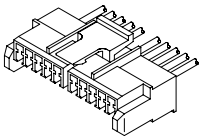
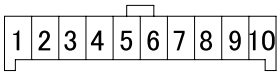
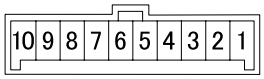
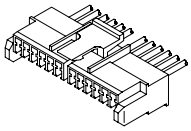
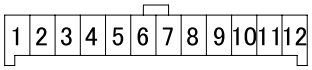
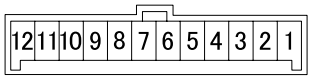
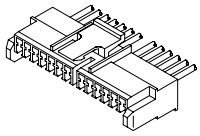
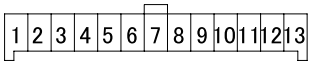
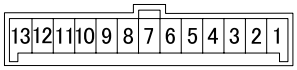
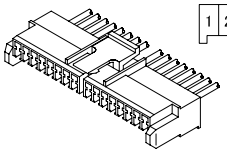
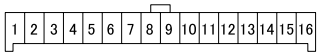
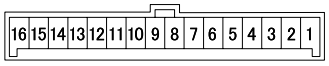
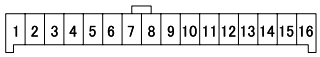
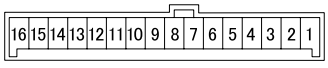
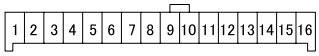
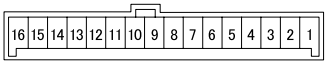
Number shows number of pins	Female connector	Male connector
AS1A		
AS2A		
AS2B		

AT type

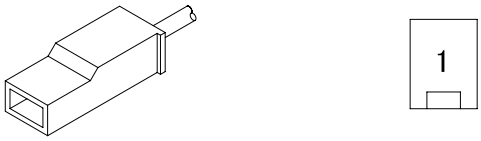
Number shows number of pins	Female connector	Male connector
AT4A		

CONNECTOR CONFIGURATION CHART

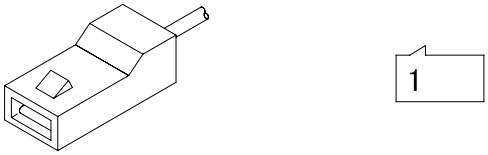
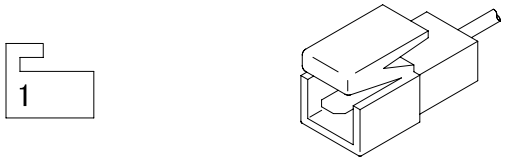
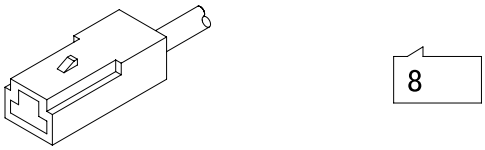
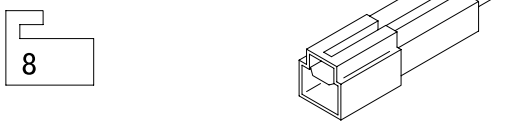
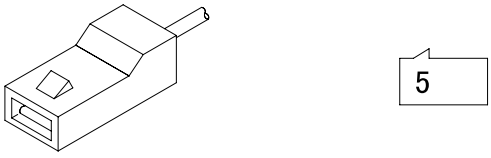
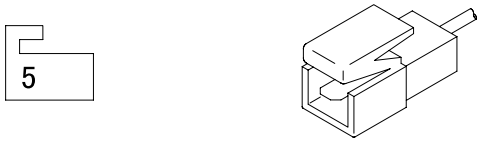
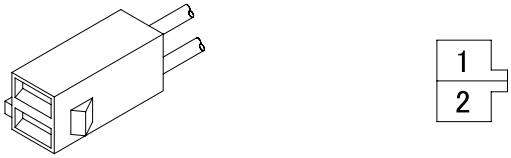
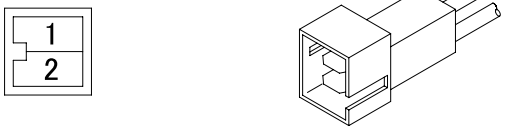
AU type

Number shows number of pins	Female connector	Male connector
AU2A		
AU6A	 	
AU8A	 	
AU10A	 	
AU12A	 	
AU13A	 	
AU16A	 	
AU16B		
AU16C		

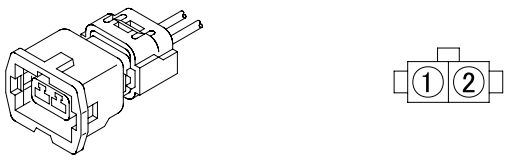
AV type

Number shows number of pins	Female connector	Male connector
AV1A		
AV2A		

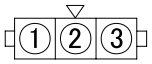
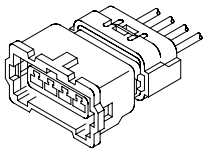
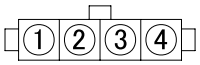
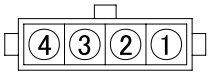
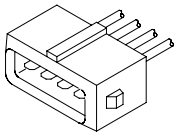
AW type

Number shows number of pins	Female connector	Male connector
AW1A		
AW1B		
AW1C		
AW2A		

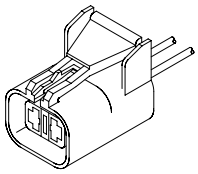
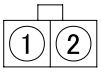
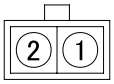
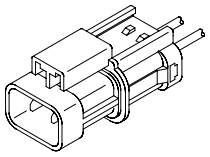
AX type

Number shows number of pins	Female connector	Male connector
AX2A		

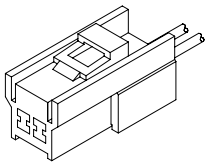
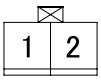
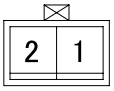
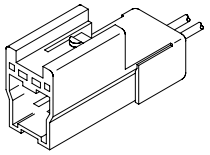
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
AX3A		
AX4A	 	 

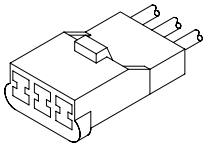
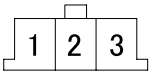
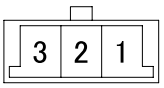
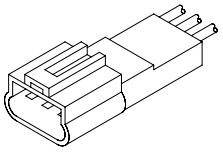
AY type

Number shows number of pins	Female connector	Male connector
AY2A	 	 

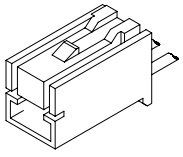
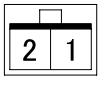
AZ type

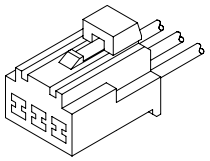
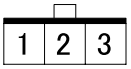
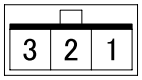
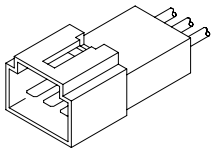
Number shows number of pins	Female connector	Male connector
AZ2A	 	 

BA type

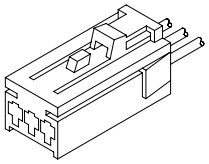
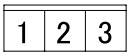
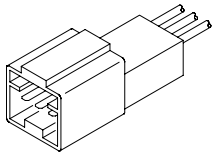
Number shows number of pins	Female connector	Male connector
BA3A	 	 

BB type

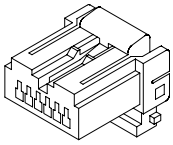
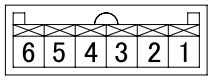
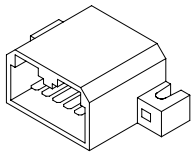
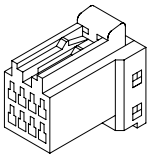
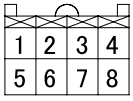
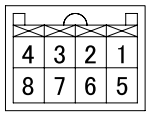
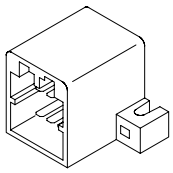
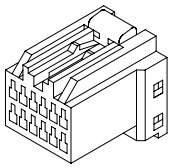
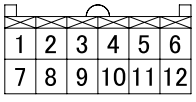
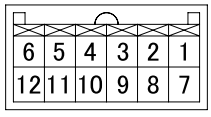
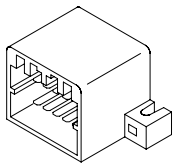
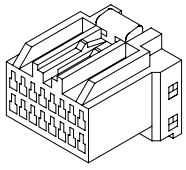
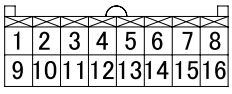
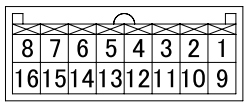
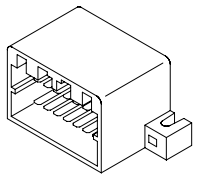
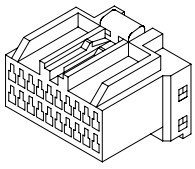
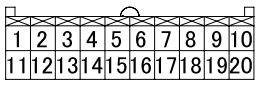
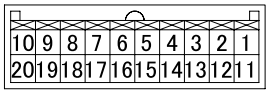
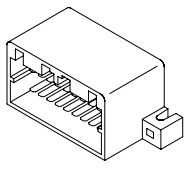
Number shows number of pins	Female connector	Male connector
BB2A		

Number shows number of pins	Female connector	Male connector
BB3A	 	 

BC type

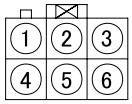
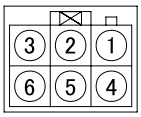
Number shows number of pins	Female connector	Male connector
BC3A	 	

BD type

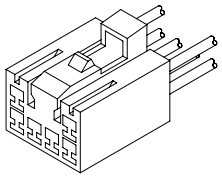
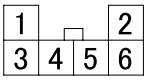
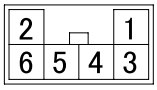
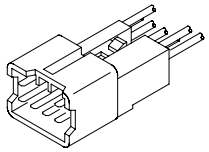
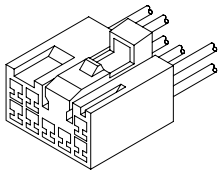
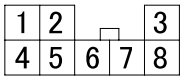
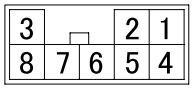
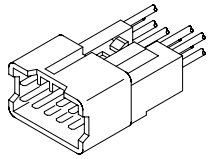
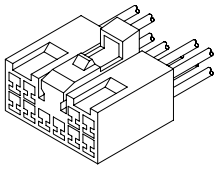
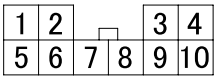
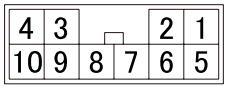
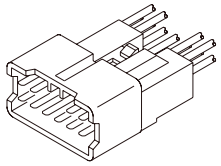
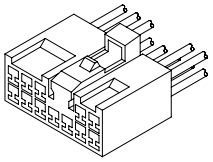
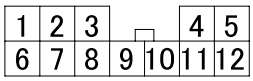
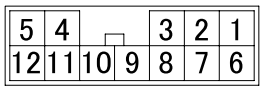
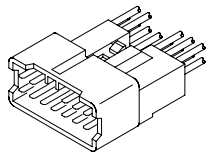
Number shows number of pins	Female connector	Male connector
BD6A		 
BD8A	 	 
BD12A	 	 
BD16A	 	 
BD20A	 	 

CONNECTOR CONFIGURATION CHART

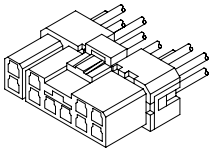
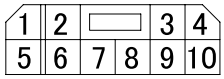
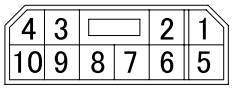
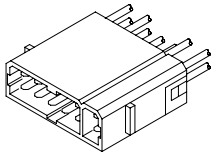
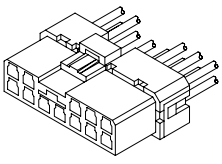
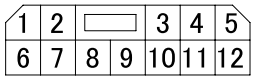
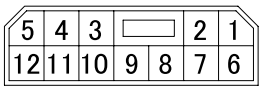
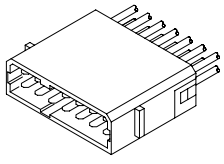
BE type

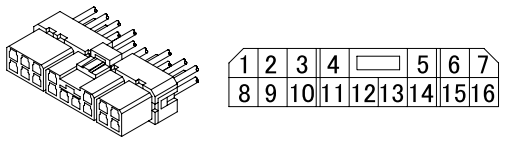
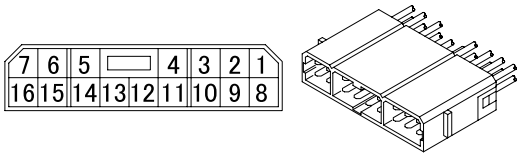
Number shows number of pins	Female connector	Male connector
BE6A		

BF type

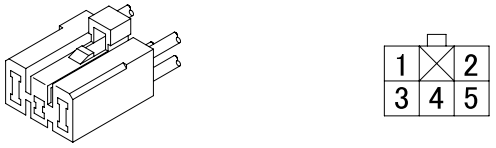
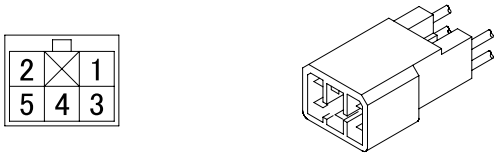
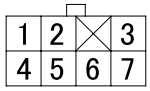
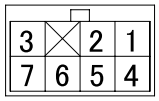
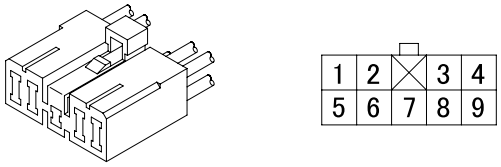
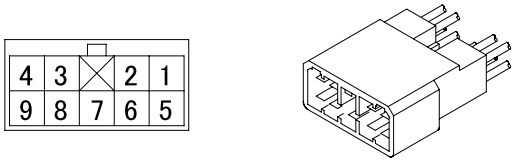
Number shows number of pins	Female connector	Male connector
BF6A	 	 
BF8A	 	 
BF10A	 	 
BF12A	 	 

BG type

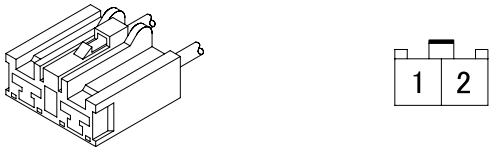
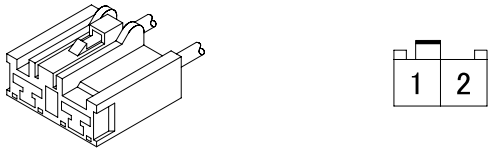
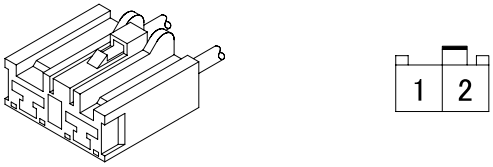
Number shows number of pins	Female connector	Male connector
BG10A	 	 
BG12A	 	 

Number shows number of pins	Female connector	Male connector
BG16A		

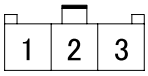
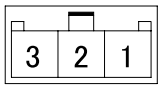
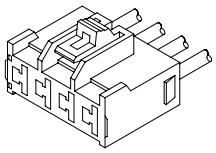
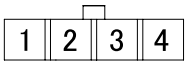
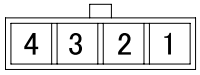
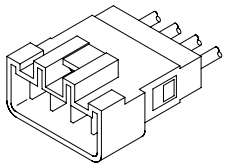
BJ type

Number shows number of pins	Female connector	Male connector
BJ5A		
BJ7A		
BJ9A		

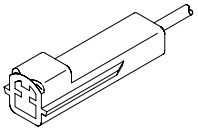
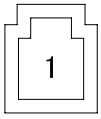
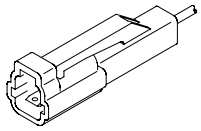
BM type

Number shows number of pins	Female connector	Male connector
BM2A		
BM2B		
BM2C		

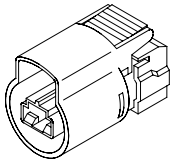
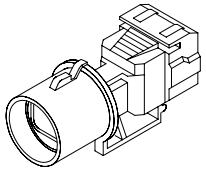
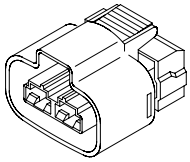
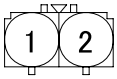
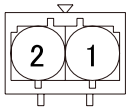
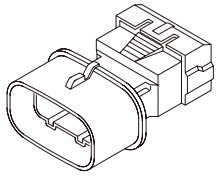
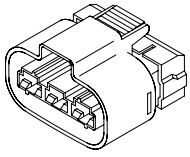
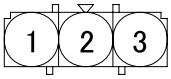
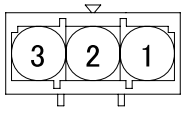
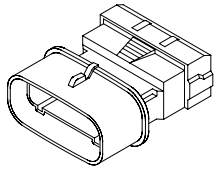
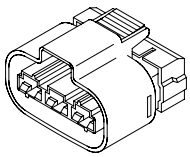
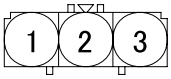
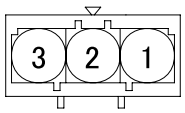
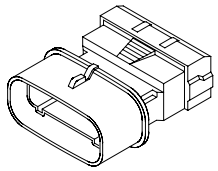
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
BM3A		
BM4A	 	 

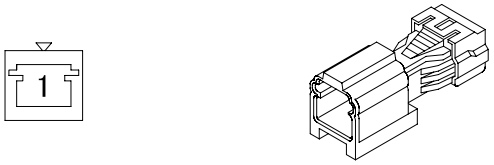
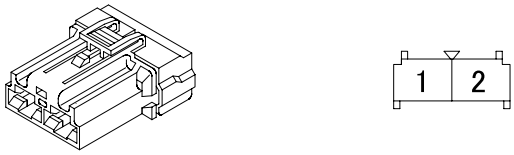
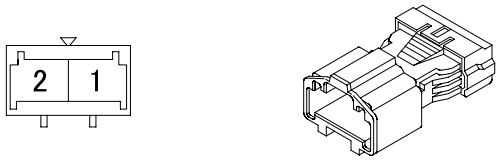
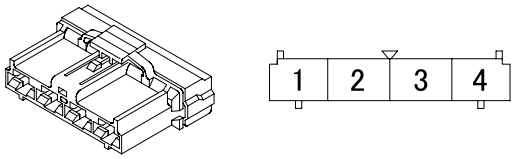
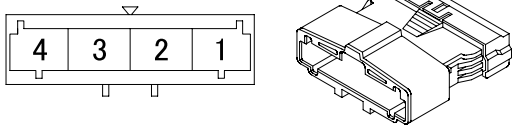
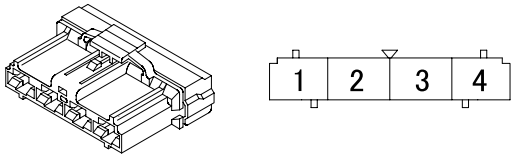
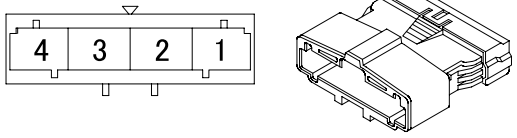
BN type

Number shows number of pins	Female connector	Male connector
BN1A		 

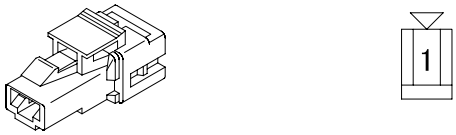
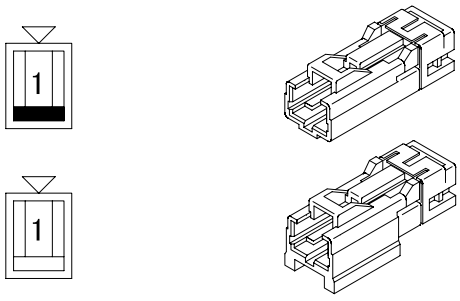
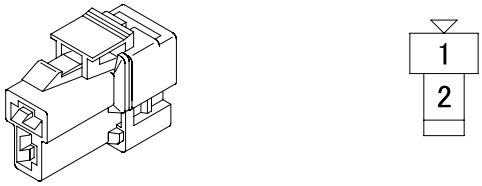
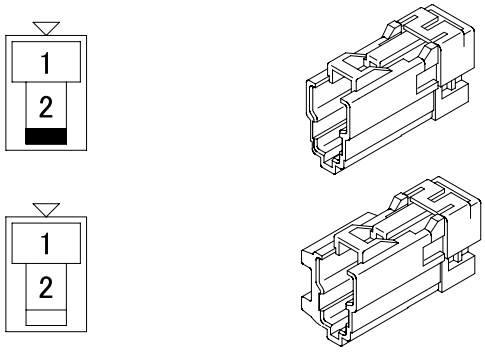
BQ type

Number shows number of pins	Female connector	Male connector
BQ1A		
BQ2A	 	 
BQ3A	 	 
BQ3B	 	 

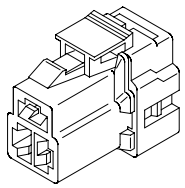
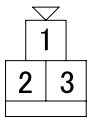
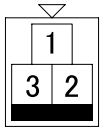
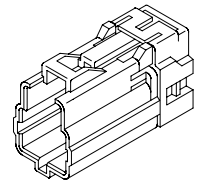
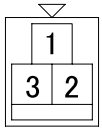
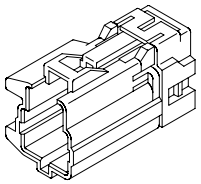
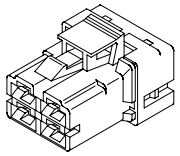
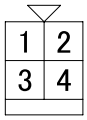
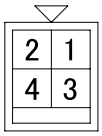
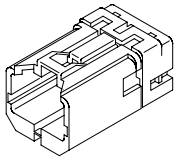
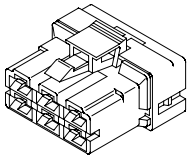
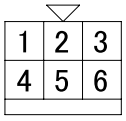
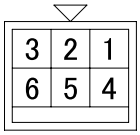
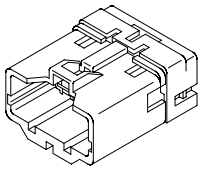
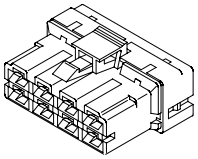
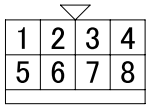
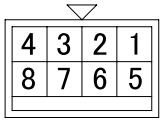
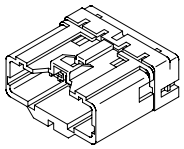
BR type

Number shows number of pins	Female connector	Male connector
BR1A		
BR2A		
BR4A		
BR4B		

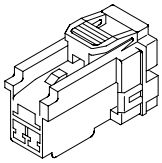
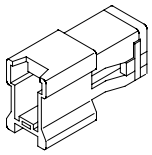
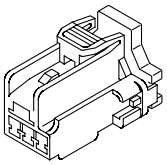
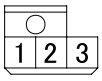
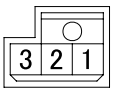
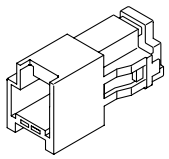
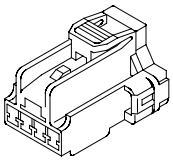
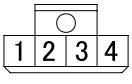
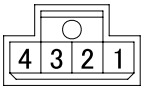
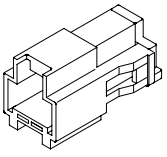
BS type

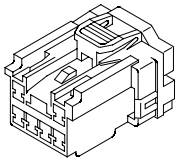
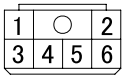
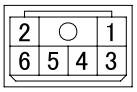
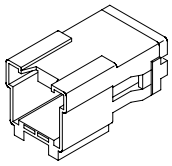
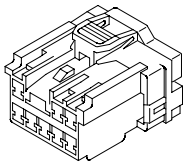
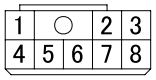
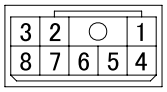
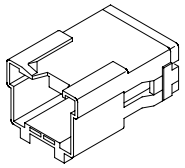
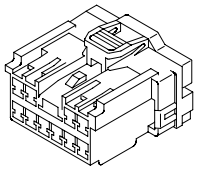
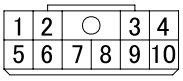
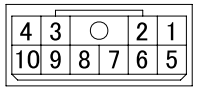
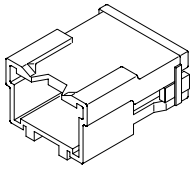
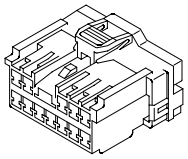
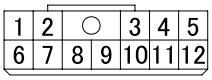
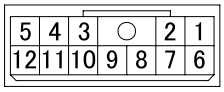
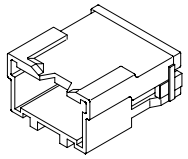
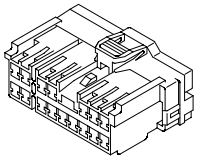
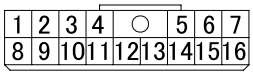
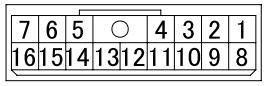
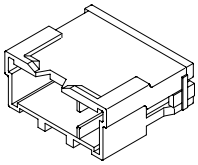
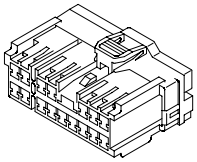
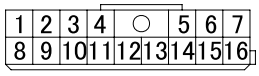
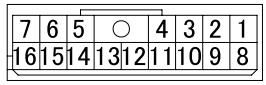
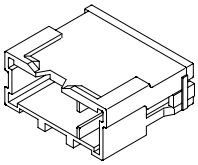
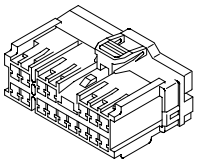
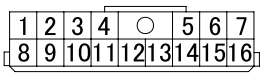
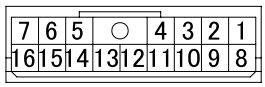
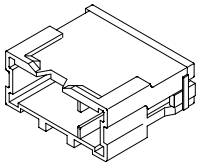
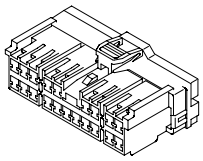
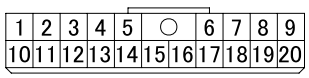
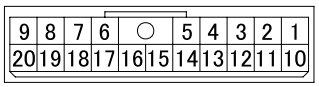
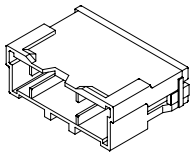
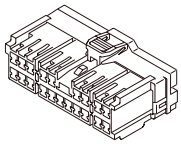
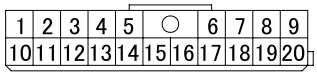
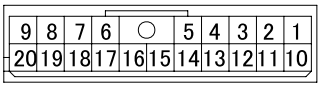
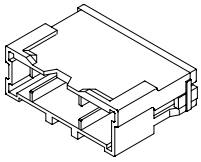
Number shows number of pins	Female connector	Male connector
BS1A		
BS2A		

CONNECTOR CONFIGURATION CHART

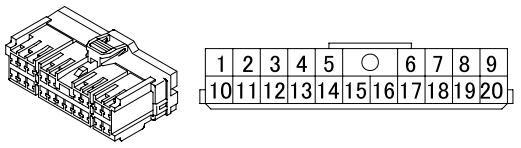
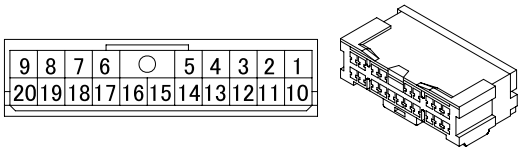
Number shows number of pins	Female connector	Male connector
BS3A	 	   
BS4A	 	 
BS6A	 	 
BS8A	 	 

BT type

Number shows number of pins	Female connector	Male connector
BT2A		
BT3A	 	 
BT4A	 	 

Number shows number of pins	Female connector	Male connector
BT6A	 	 
BT8A	 	 
BT10A	 	 
BT12A	 	 
BT16A	 	 
BT16B	 	 
BT16C	 	 
BT20A	 	 
BT20B	 	 

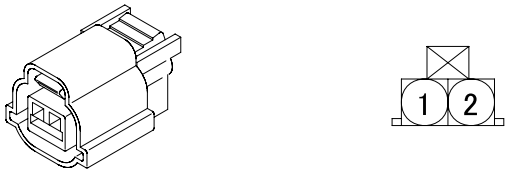
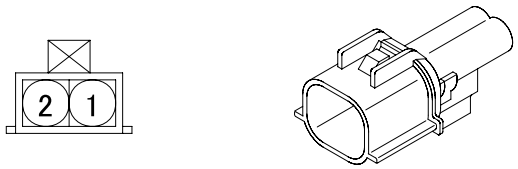
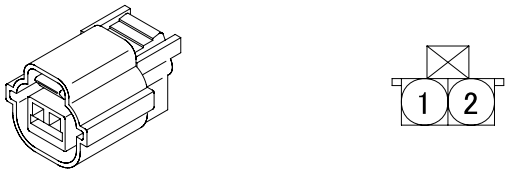
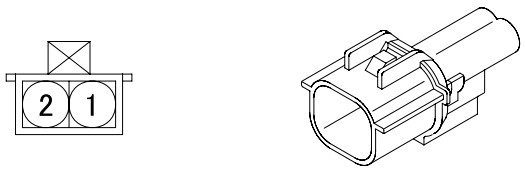
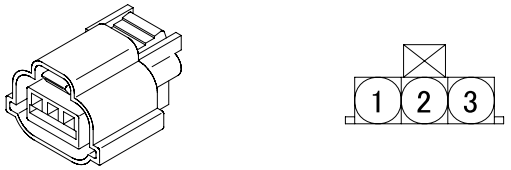
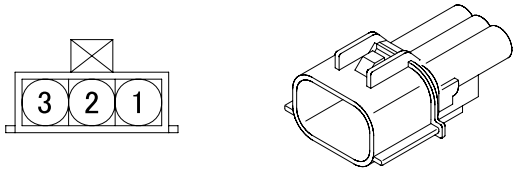
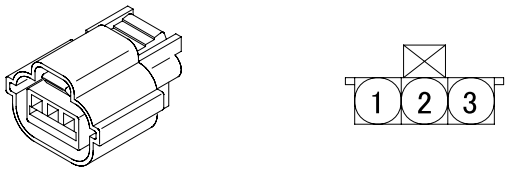
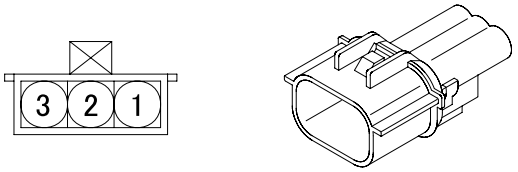
CONNECTOR CONFIGURATION CHART

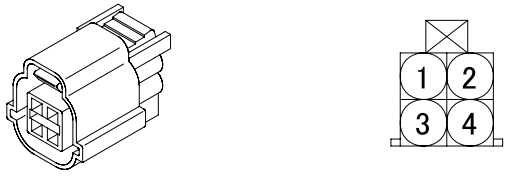
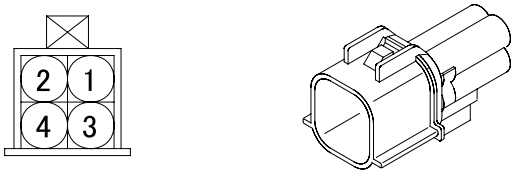
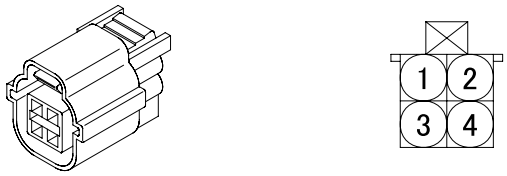
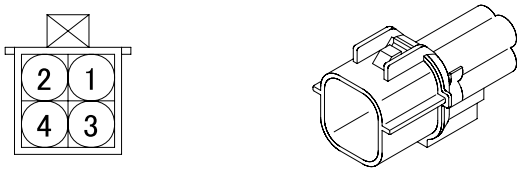
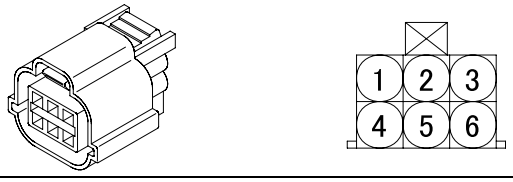
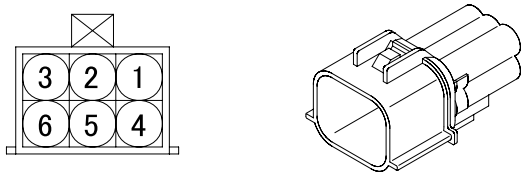
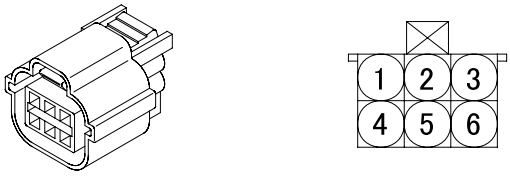
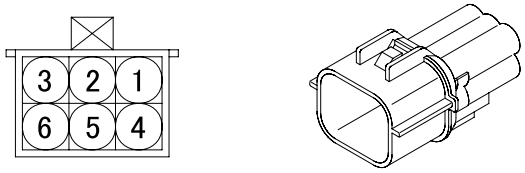
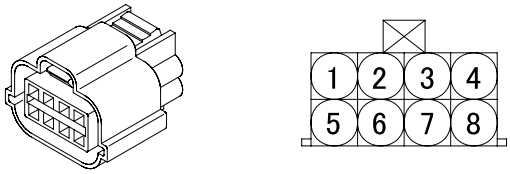
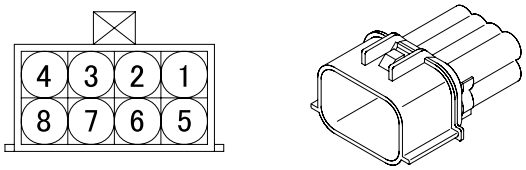
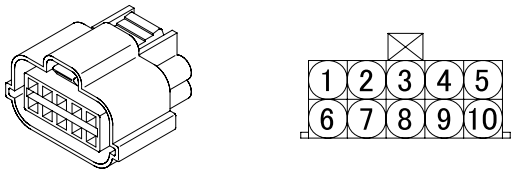
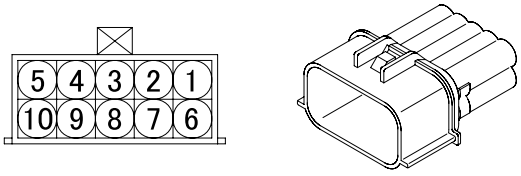
Number shows number of pins	Female connector	Male connector
BT20C		

BU type

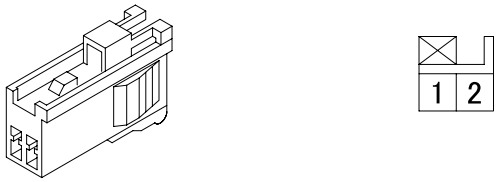
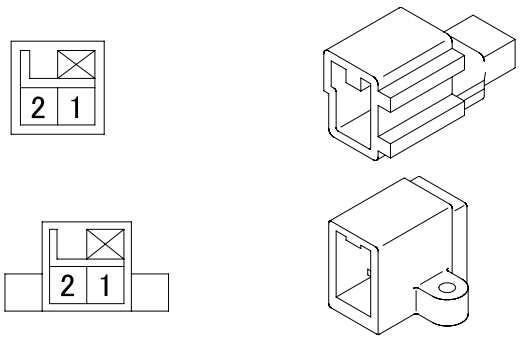
Number shows number of pins	Female connector	Male connector
BU4A		
BU6A		

BW type

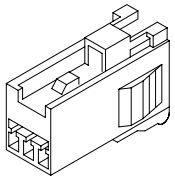
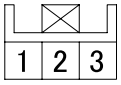
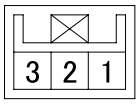
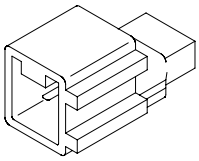
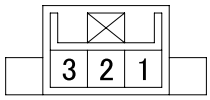
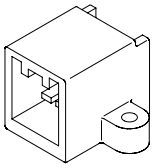
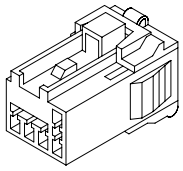
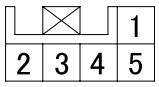
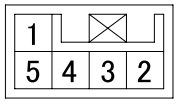
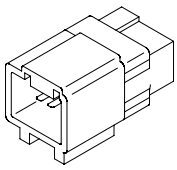
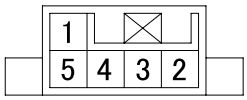
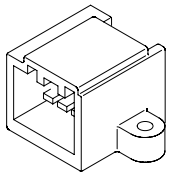
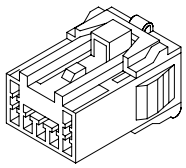
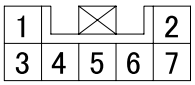
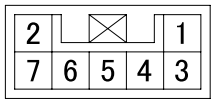
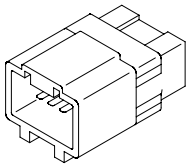
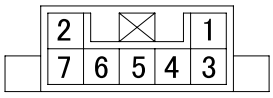
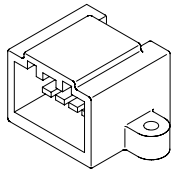
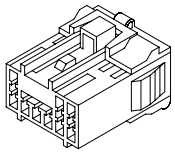
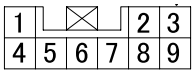
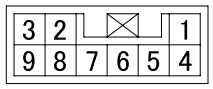
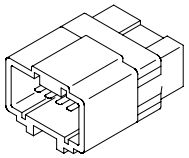
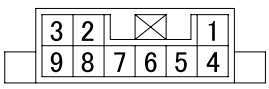
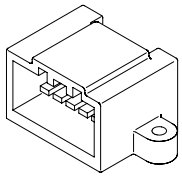
Number shows number of pins	Female connector	Male connector
BW2A		
BW2B		
BW3A		
BW3B		

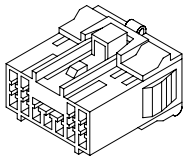
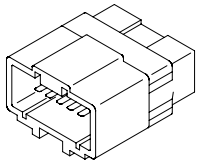
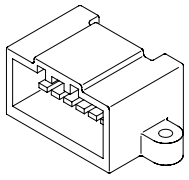
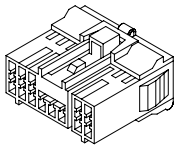
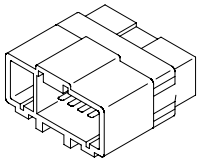
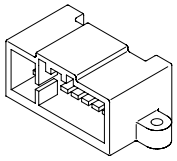
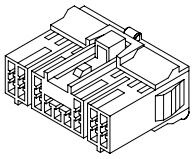
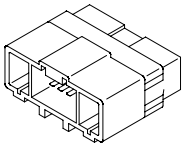
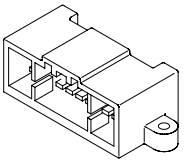
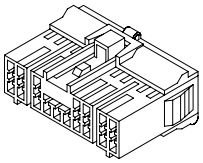
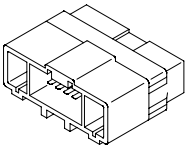
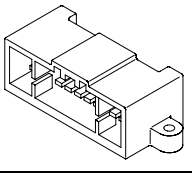
Number shows number of pins	Female connector	Male connector
BW4A		
BW4B		
BW6A		
BW6B		
BW8A		
BW10A		

BX type

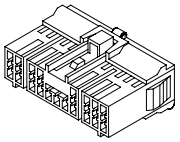
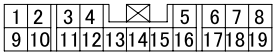
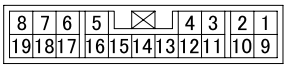
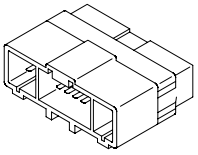
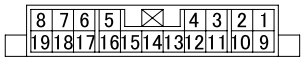
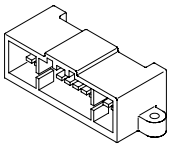
Number shows number of pins	Female connector	Male connector
BX2A		

CONNECTOR CONFIGURATION CHART

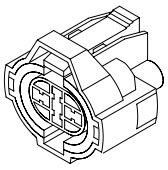
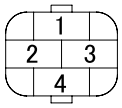
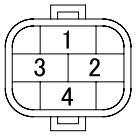
Number shows number of pins	Female connector	Male connector
BX3A	 	   
BX5A	 	   
BX7A	 	   
BX9A	 	   

Number shows number of pins	Female connector	Male connector
BX11A	 1 2 3 4 5 6 7 8 9 10 11	4 3 2 1 11 10 9 8 7 6 5  4 3 2 1 11 10 9 8 7 6 5 
BX13A	 1 2 3 4 5 6 7 8 9 10 11 12 13	5 4 3 2 1 13 12 11 10 9 8 7 6  5 4 3 2 1 13 12 11 10 9 8 7 6 
BX15A	 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	6 5 4 3 2 1 15 14 13 12 11 10 9 8 7  6 5 4 3 2 1 15 14 13 12 11 10 9 8 7 
BX17A	 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17	7 6 5 4 3 2 1 17 16 15 14 13 12 11 10 9 8  7 6 5 4 3 2 1 17 16 15 14 13 12 11 10 9 8 

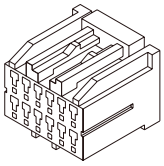
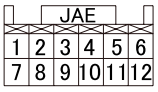
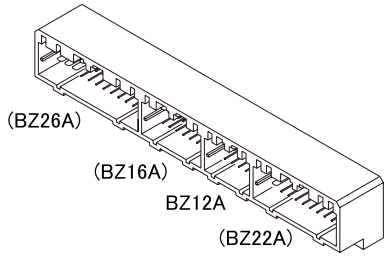
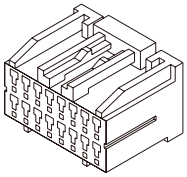
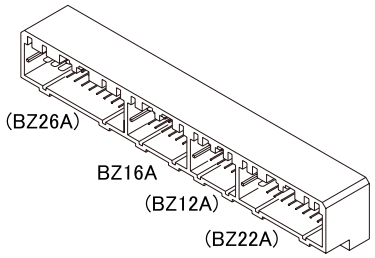
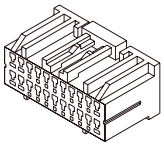
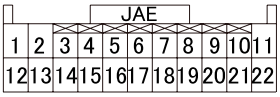
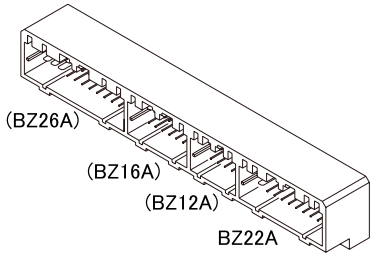
CONNECTOR CONFIGURATION CHART

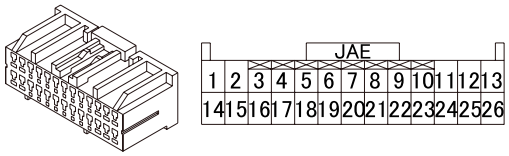
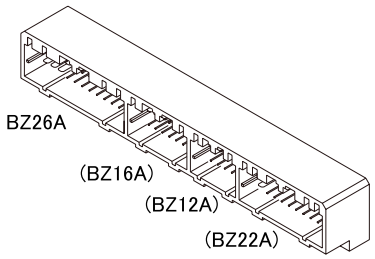
Number shows number of pins	Female connector	Male connector
BX19A	 	   

BY type

Number shows number of pins	Female connector	Male connector
BY4A	 	

BZ type

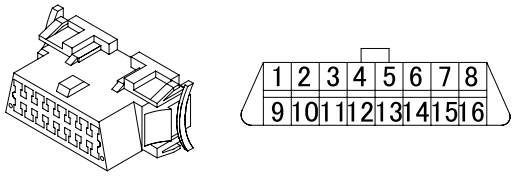
Number shows number of pins	Female connector	Male connector
BZ12A	 	
BZ16A		
BZ22A	 	

Number shows number of pins	Female connector	Male connector
BZ26A		

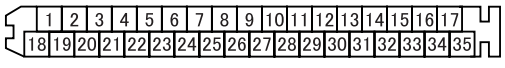
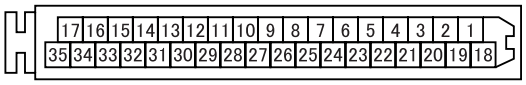
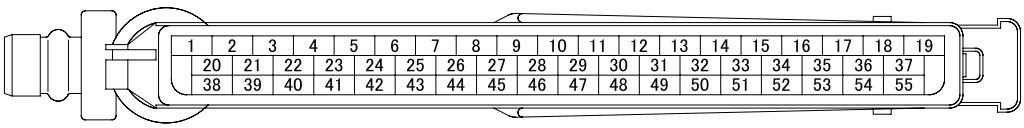
CA type

Number shows number of pins	Female connector	Male connector
CA2A		

CB type

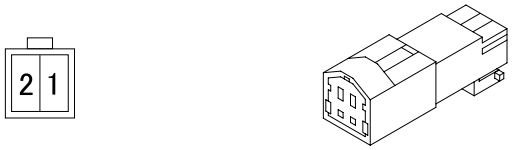
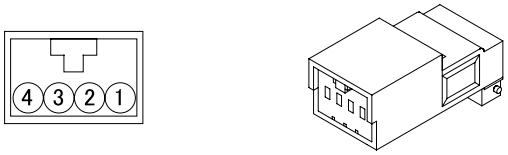
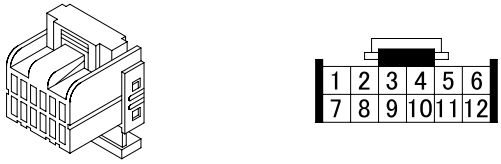
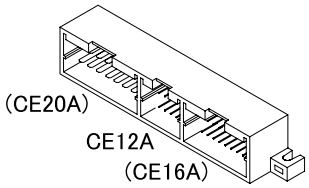
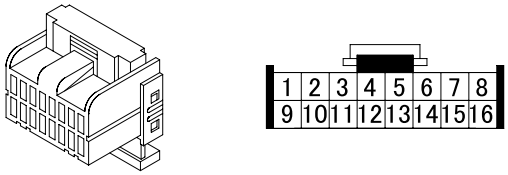
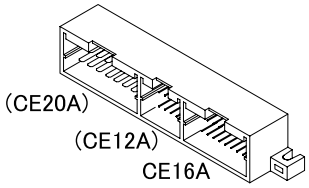
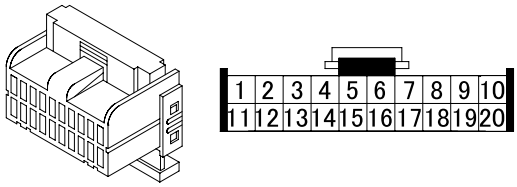
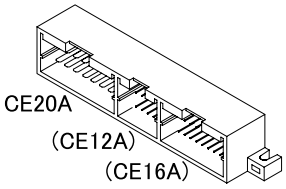
Number shows number of pins	Female connector	Male connector
CB16A		

CD type

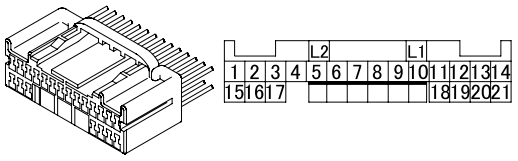
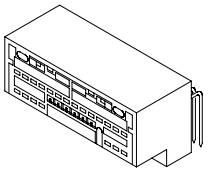
Number shows number of pins	Female connector	Male connector
CD35A		
CD55A		

CONNECTOR CONFIGURATION CHART

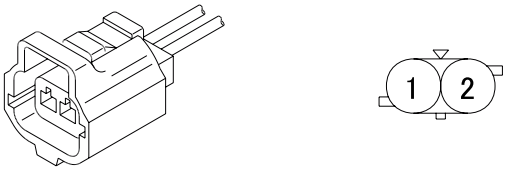
CE type

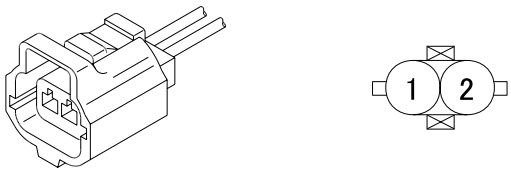
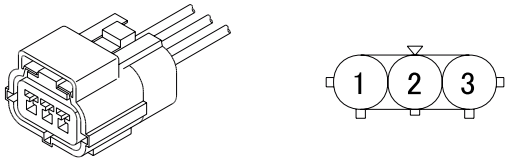
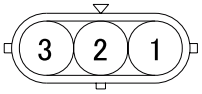
Number shows number of pins	Female connector	Male connector
CE2A		
CE4A		
CE12A		
CE16A		
CE20A		

CF type

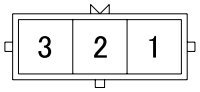
Number shows number of pins	Female connector	Male connector
CF21A		

CH type

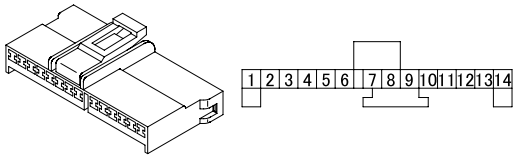
Number shows number of pins	Female connector	Male connector
CH2A		

Number shows number of pins	Female connector	Male connector
CH2B		
CH3A		

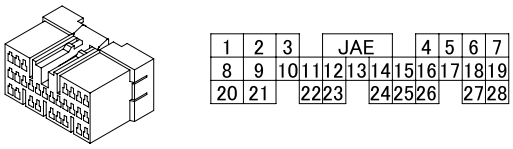
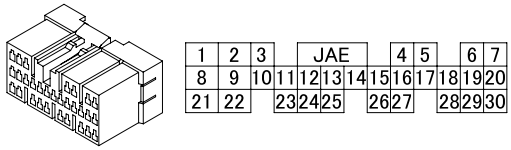
CK type

Number shows number of pins	Female connector	Male connector
CK3A		

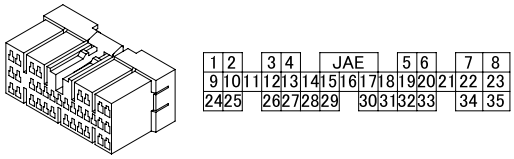
CL type

Number shows number of pins	Female connector	Male connector
CL14A		

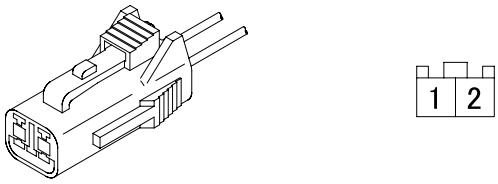
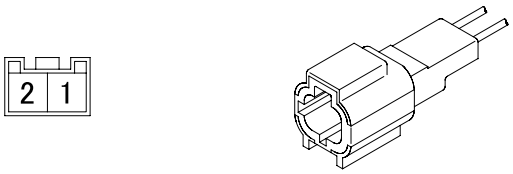
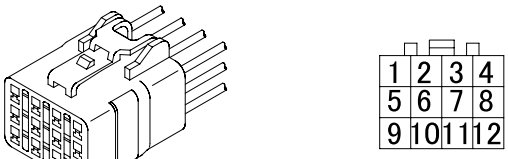
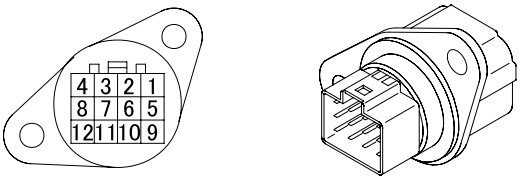
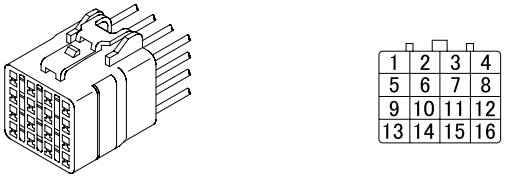
CM type

Number shows number of pins	Female connector	Male connector
CM28A		
CM30A		

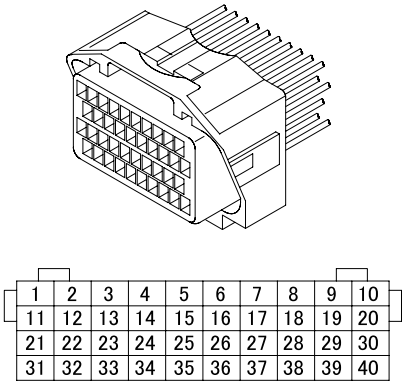
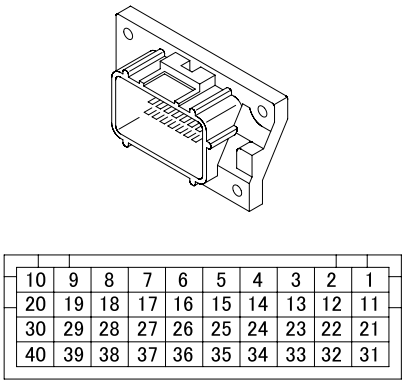
CONNECTOR CONFIGURATION CHART

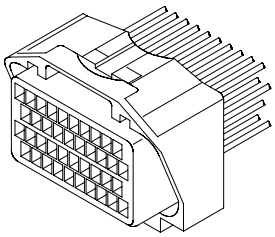
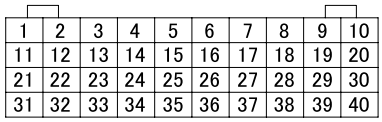
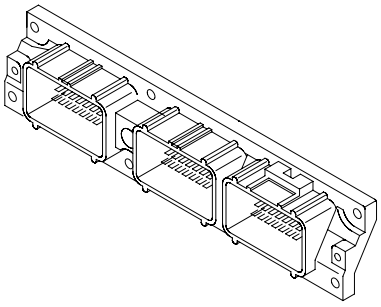
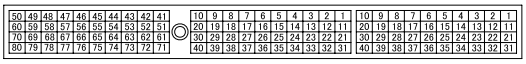
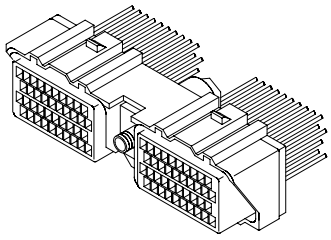
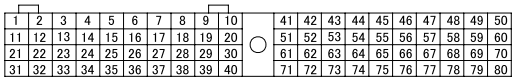
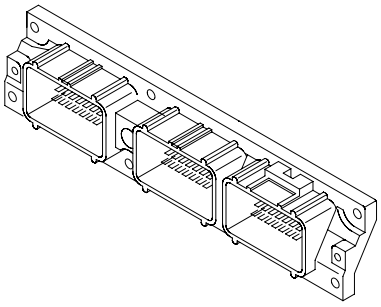
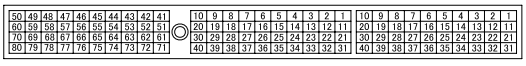
Number shows number of pins	Female connector	Male connector
CM35A		

CN type

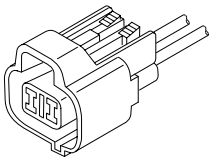
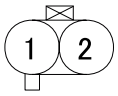
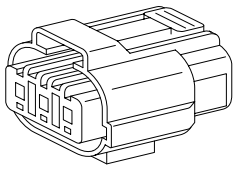
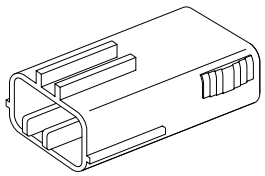
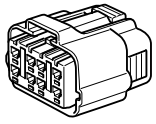
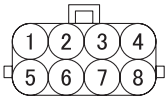
Number shows number of pins	Female connector	Male connector
CN2A		
CN12A		
CN16A		

CP type

Number shows number of pins	Female connector	Male connector
CP40A		

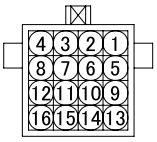
Number shows number of pins	Female connector	Male connector
CP40B	  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40	  (CP80A) CP40B
CP80A	  1 2 3 4 5 6 7 8 9 10 / 41 42 43 44 45 46 47 48 49 50 11 12 13 14 15 16 17 18 19 20 / 51 52 53 54 55 56 57 58 59 60 21 22 23 24 25 26 27 28 29 30 / 61 62 63 64 65 66 67 68 69 70 31 32 33 34 35 36 37 38 39 40 / 71 72 73 74 75 76 77 78 79 80	  CP80A (CP40B)

CQ type

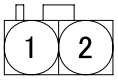
Number shows number of pins	Female connector	Male connector
CQ2B	  1 2	
CQ3A		
CQ8A	  1 2 3 4 5 6 7 8	

CONNECTOR CONFIGURATION CHART

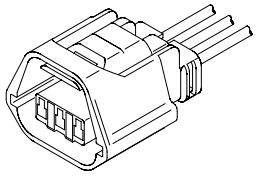
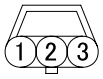
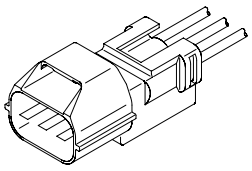
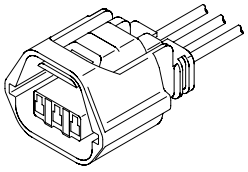
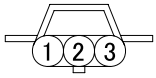
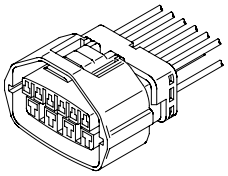
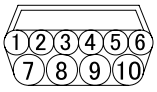
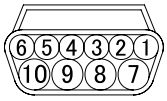
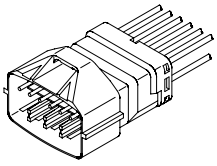
CR type

Number shows number of pins	Female connector	Male connector
CR16A		

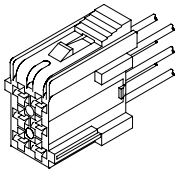
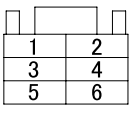
CS type

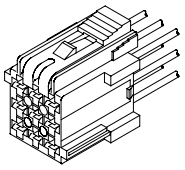
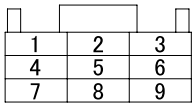
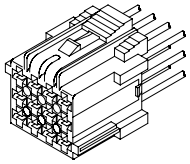
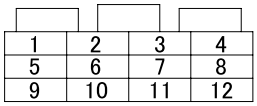
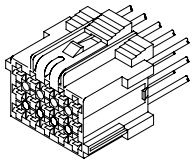
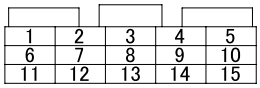
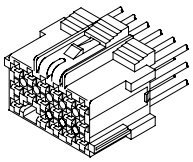
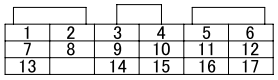
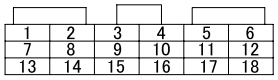
Number shows number of pins	Female connector	Male connector
CS2A		

CT type

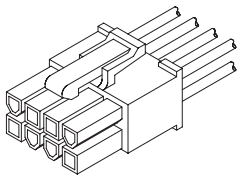
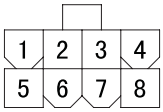
Number shows number of pins	Female connector	Male connector
CT3A	 	
CT3B	 	
CT10A	 	 

CU type

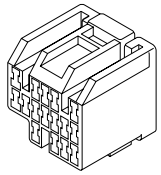
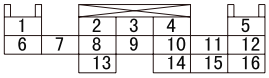
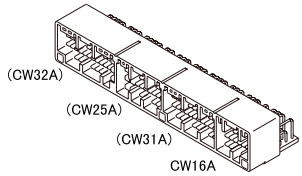
Number shows number of pins	Female connector	Male connector
CU6A	 	

Number shows number of pins	Female connector	Male connector
CU9A	 	
CU12A	 	
CU15A	 	
CU17A	 	
CU18A		

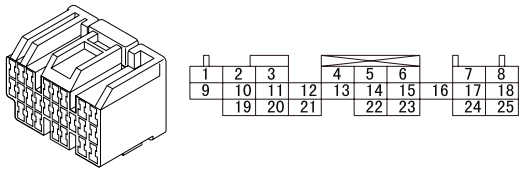
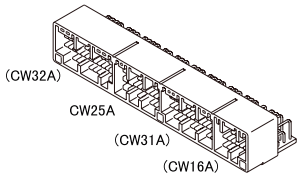
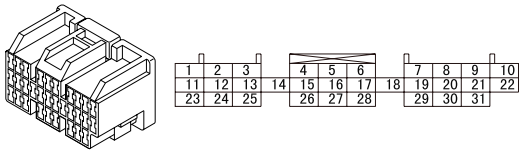
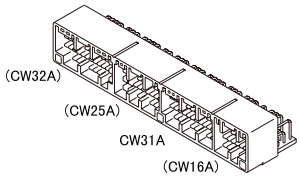
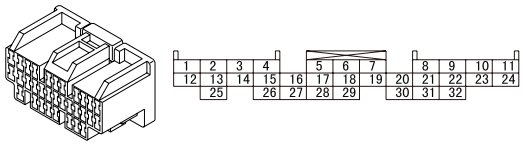
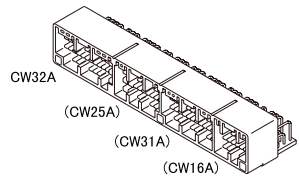
CV type

Number shows number of pins	Female connector	Male connector
CV8A	 	

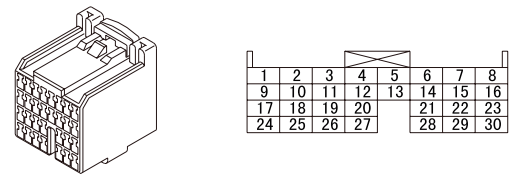
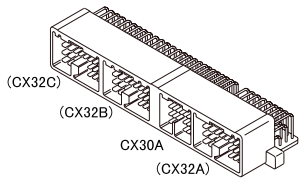
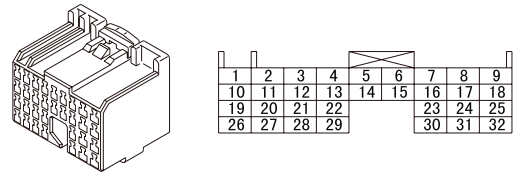
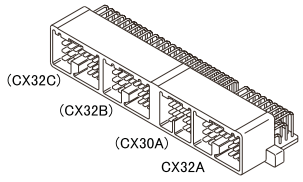
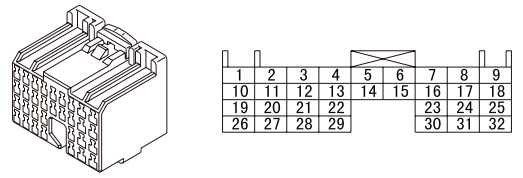
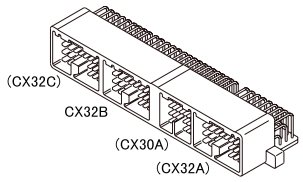
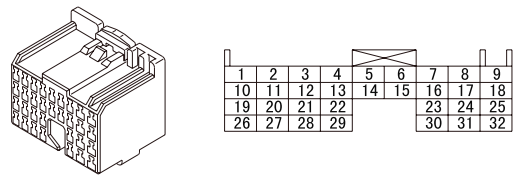
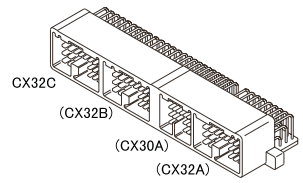
CW type

Number shows number of pins	Female connector	Male connector
CW16A	 	

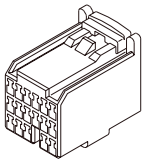
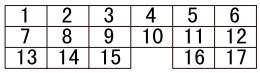
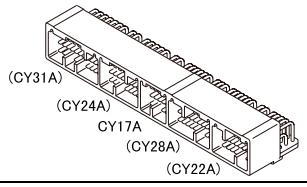
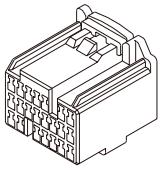
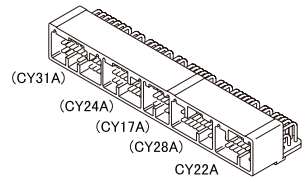
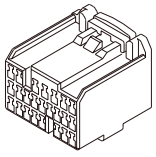
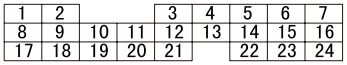
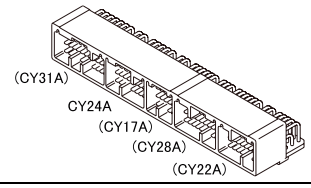
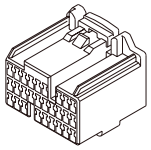
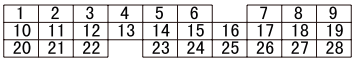
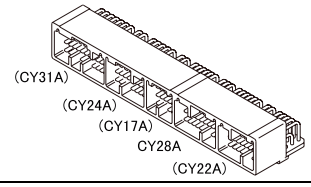
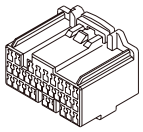
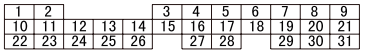
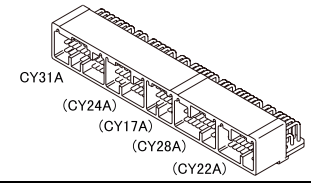
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
CW25A		
CW31A		
CW32A		

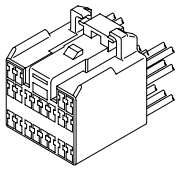
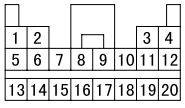
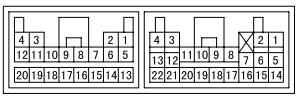
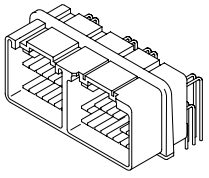
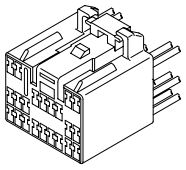
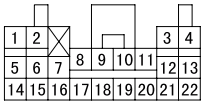
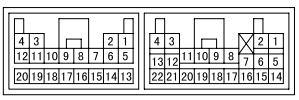
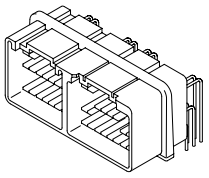
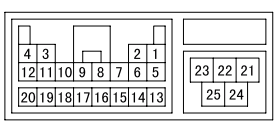
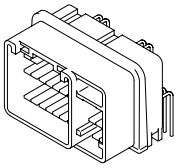
CX type

Number shows number of pins	Female connector	Male connector
CX30A		
CX32A		
CX32B		
CX32C		

CY type

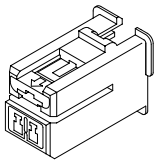
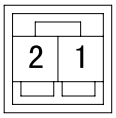
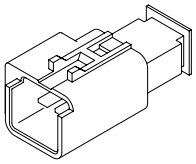
Number shows number of pins	Female connector	Male connector
CY17A	 	
CY22A		
CY24A	 	
CY28A	 	
CY31A	 	

DA type

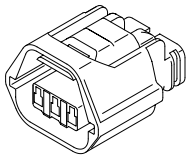
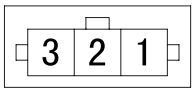
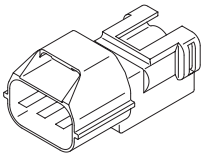
Number shows number of pins	Female connector	Male connector
DA20A	 	 
DA22A	 	 
DA25A		 

CONNECTOR CONFIGURATION CHART

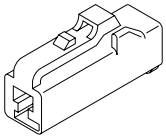
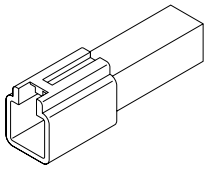
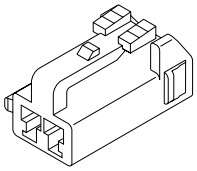
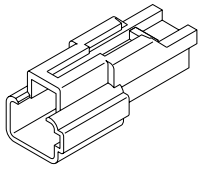
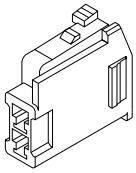
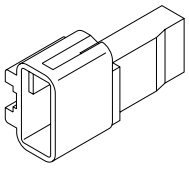
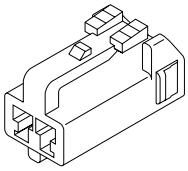
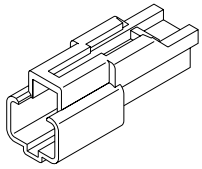
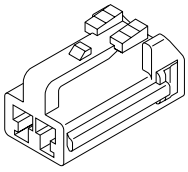
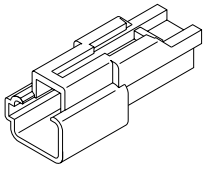
DB type

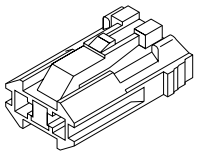
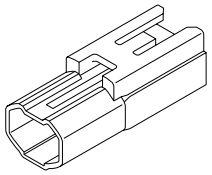
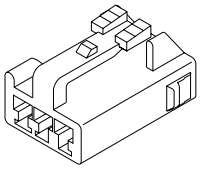
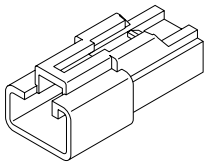
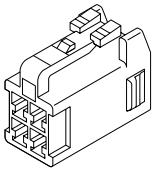
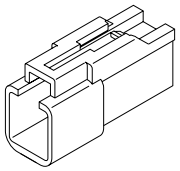
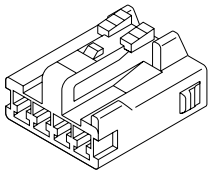
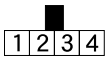
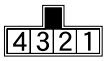
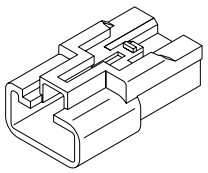
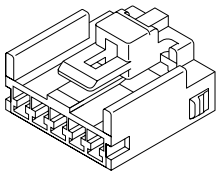
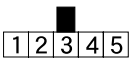
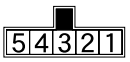
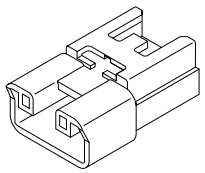
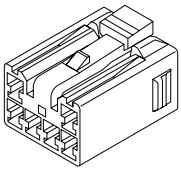
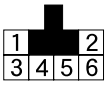
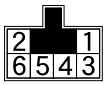
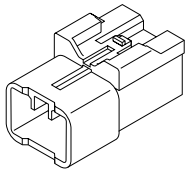
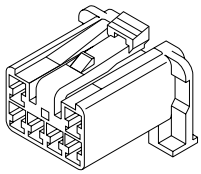
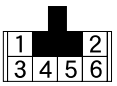
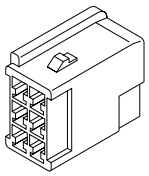
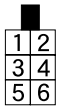
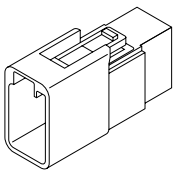
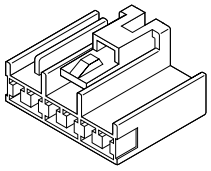
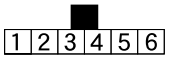
Number shows number of pins	Female connector	Male connector
DB2A		 

DC type

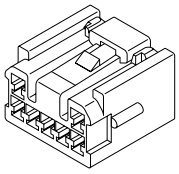
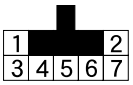
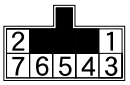
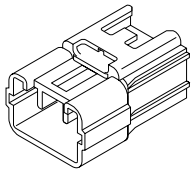
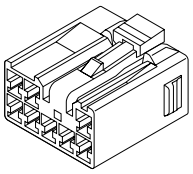
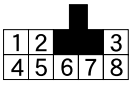
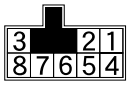
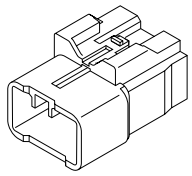
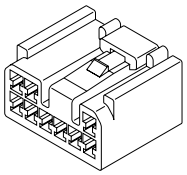
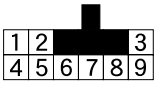
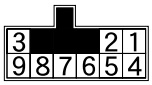
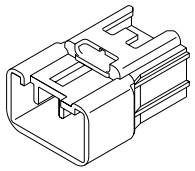
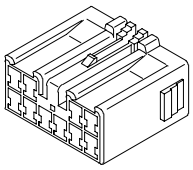
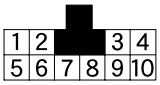
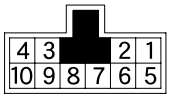
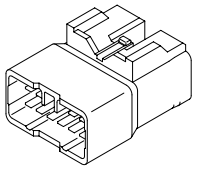
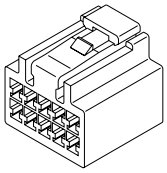
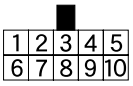
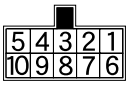
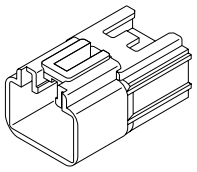
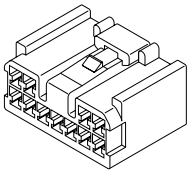
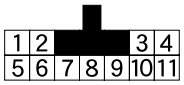
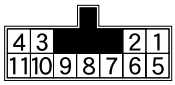
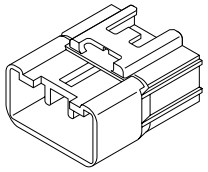
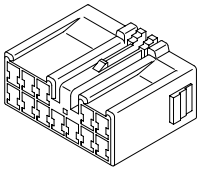
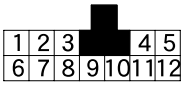
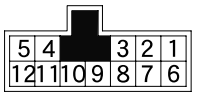
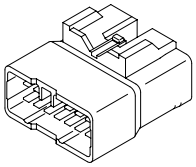
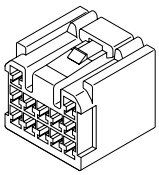
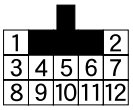
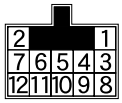
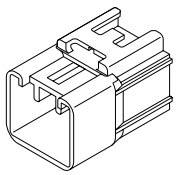
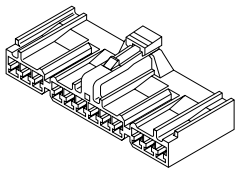
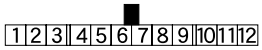
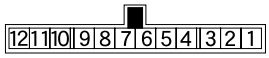
Number shows number of pins	Female connector	Male connector
DC3A		 

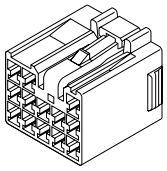
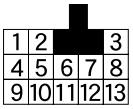
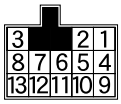
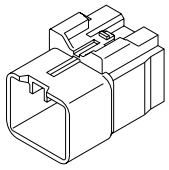
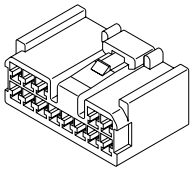
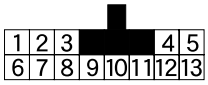
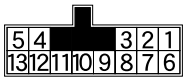
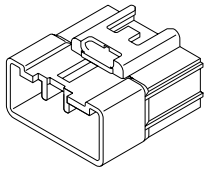
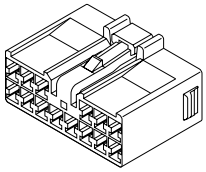
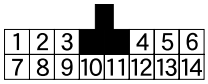
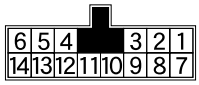
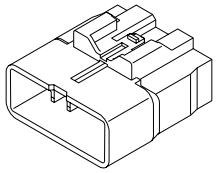
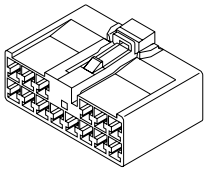
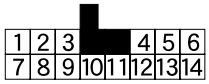
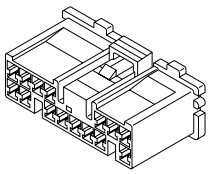
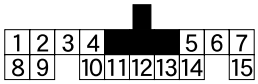
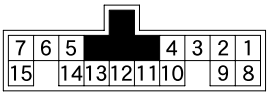
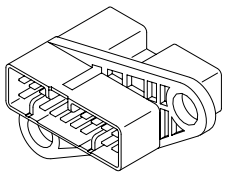
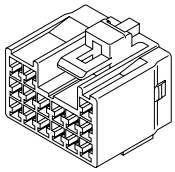
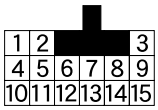
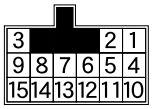
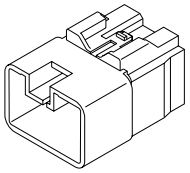
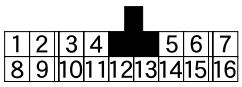
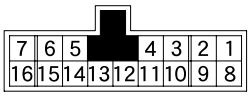
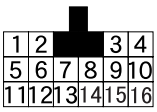
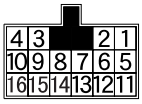
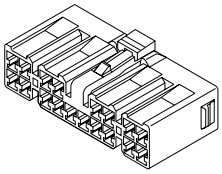
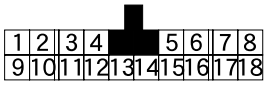
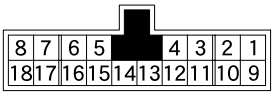
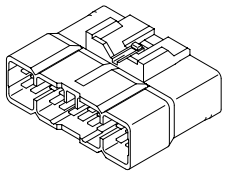
DD type

Number shows number of pins	Female connector	Male connector
DD1A		
DD2A		
DD2B		
DD2C		
DD2E		

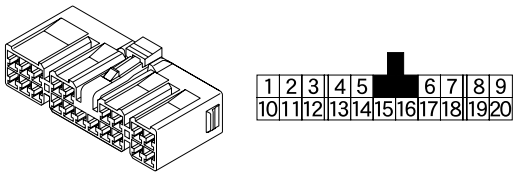
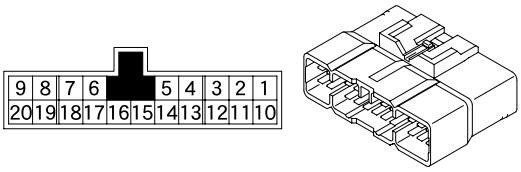
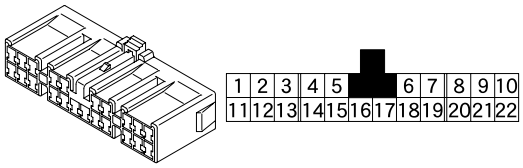
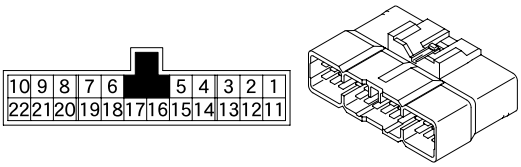
Number shows number of pins	Female connector	Male connector
DD2F		
DD3A		
DD4A		
DD4C	 	 
DD5A	 	 
DD6A	 	 
DD6B	 	
DD6C	 	
DD6E	 	

CONNECTOR CONFIGURATION CHART

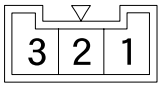
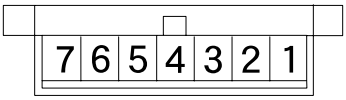
Number shows number of pins	Female connector	Male connector
DD7A	 	 
DD8A	 	 
DD9A	 	 
DD10A	 	 
DD10B	 	 
DD11A	 	 
DD12A	 	 
DD12B	 	 
DD12C	 	

Number shows number of pins	Female connector	Male connector
DD13A	 	 
DD13B	 	 
DD14A	 	 
DD14B	 	
DD15A	 	 
DD15B	 	 
DD16A		
DD16B		
DD18A	 	 

CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
DD20A		
DD22A		

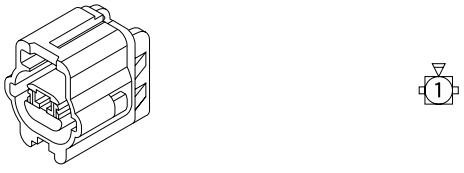
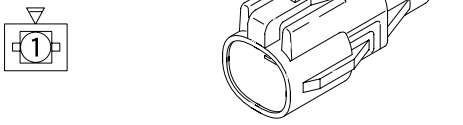
DE type

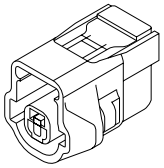
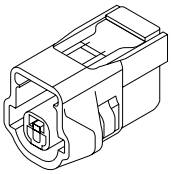
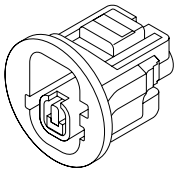
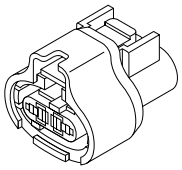
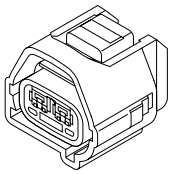
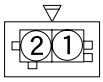
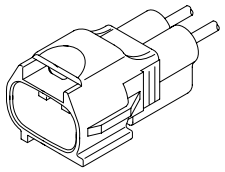
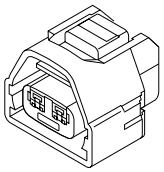
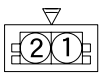
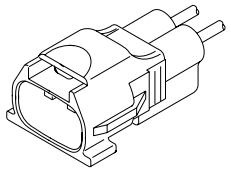
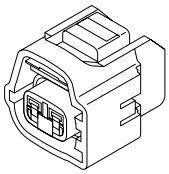
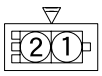
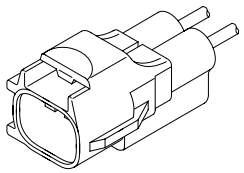
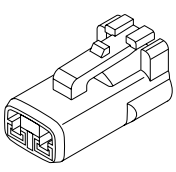
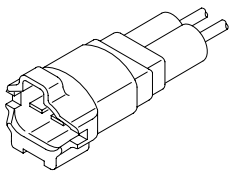
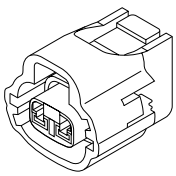
Number shows number of pins	Female connector	Male connector
DE3A		
DE7A		

DF type

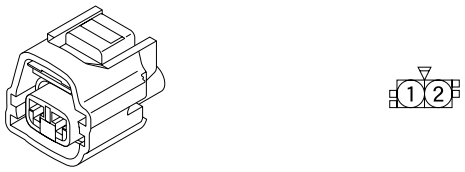
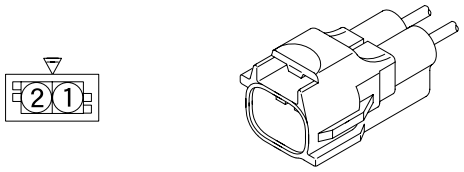
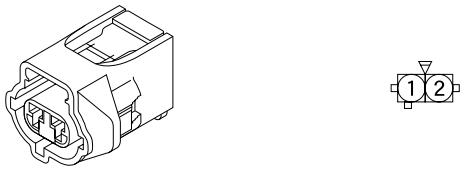
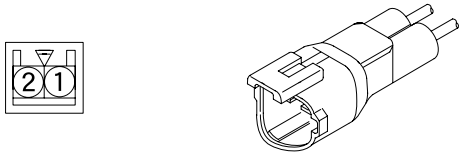
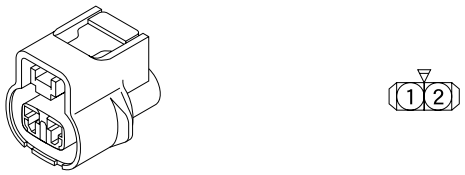
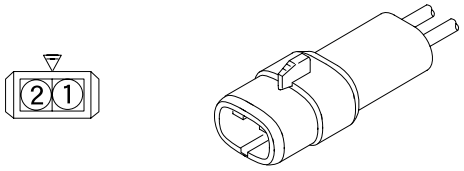
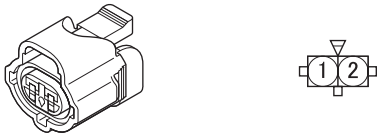
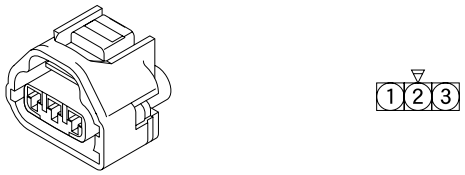
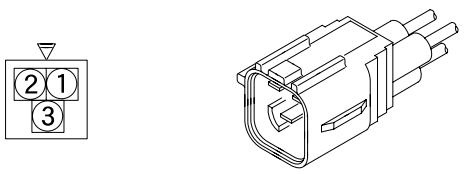
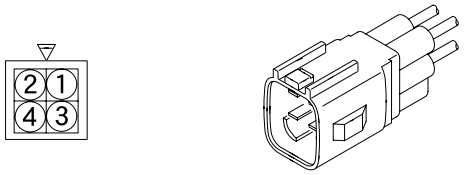
Number shows number of pins	Female connector	Male connector
DF3A		

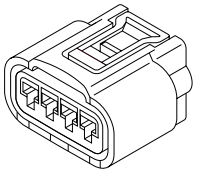
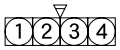
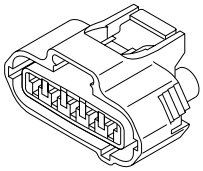
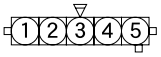
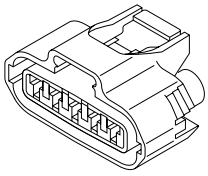
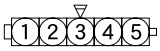
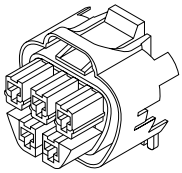
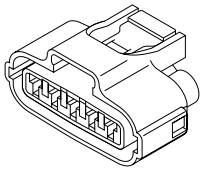
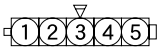
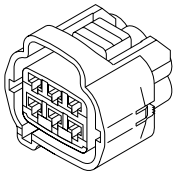
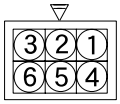
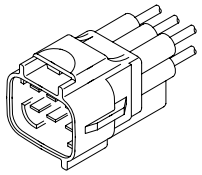
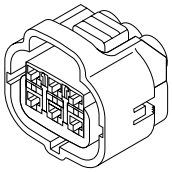
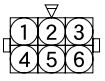
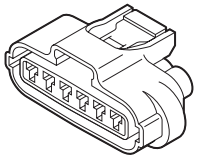
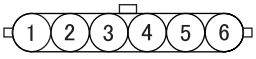
DG type

Number shows number of pins	Female connector	Male connector
DG1A		

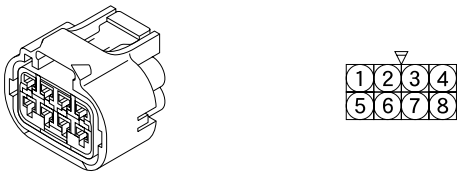
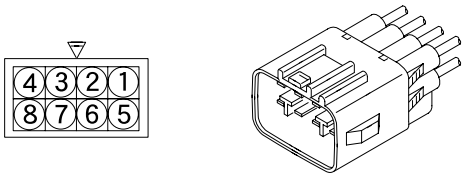
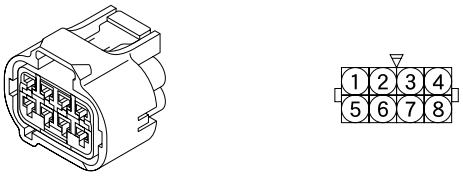
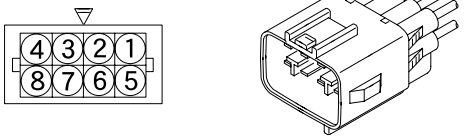
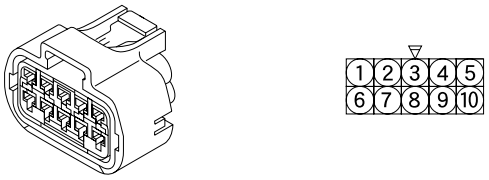
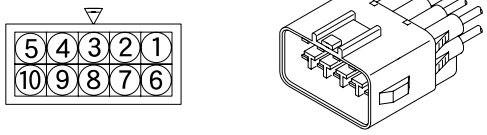
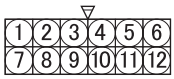
Number shows number of pins	Female connector	Male connector
DG1B		
DG1C		
DG1D		
DG2A		
DG2B		 
DG2C		 
DG2D		 
DG2E		
DG2F		

CONNECTOR CONFIGURATION CHART

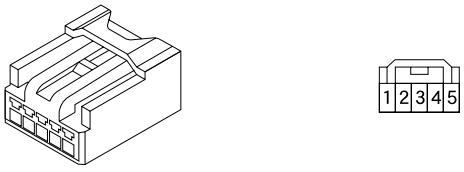
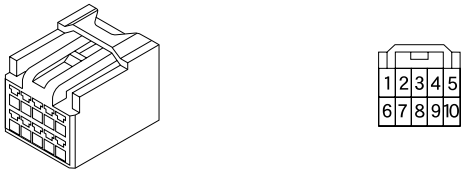
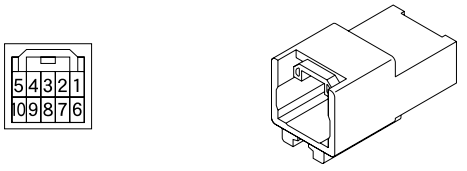
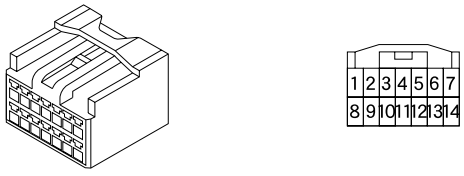
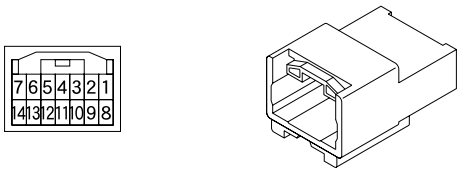
Number shows number of pins	Female connector	Male connector
DG2G		
DG2H		
DG2J		
DG2K		
DG2L		
DG2M		
DG3A		
DG3B		
DG4A		

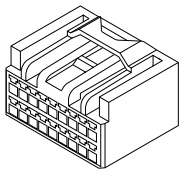
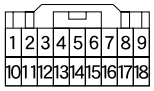
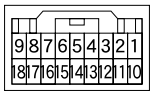
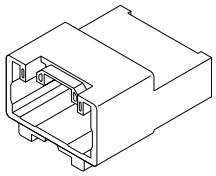
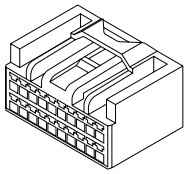
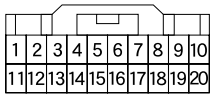
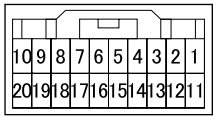
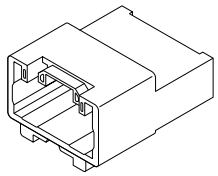
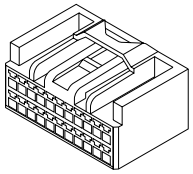
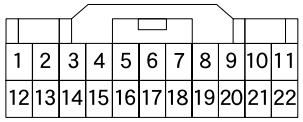
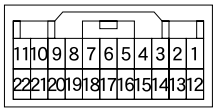
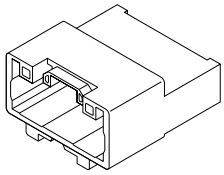
Number shows number of pins	Female connector	Male connector
DG4B	 	
DG4C		
DG5A	 	
DG5B	 	
DG5C		
DG5D	 	
DG6A		 
DG6B	 	
DG6C	 	

CONNECTOR CONFIGURATION CHART

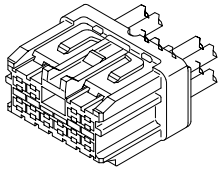
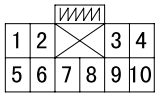
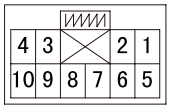
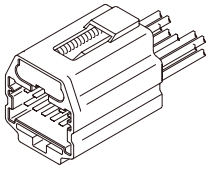
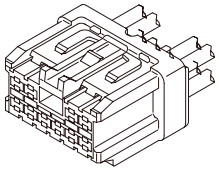
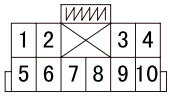
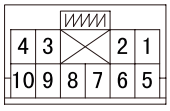
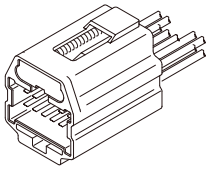
Number shows number of pins	Female connector	Male connector
DG8A		
DG8B		
DG10A		
DG12A		

DH type

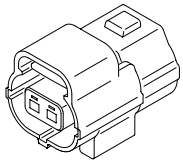
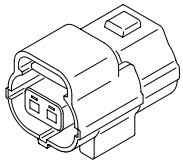
Number shows number of pins	Female connector	Male connector
DH2A		
DH5A		
DH10A		
DH14A		

Number shows number of pins	Female connector	Male connector
DH18A	 	 
DH20A	 	 
DH22A	 	 

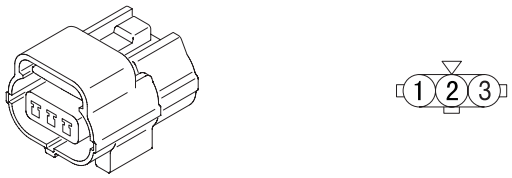
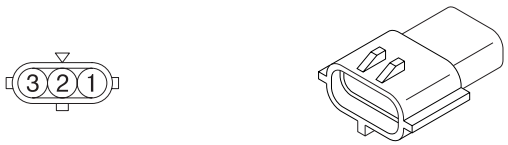
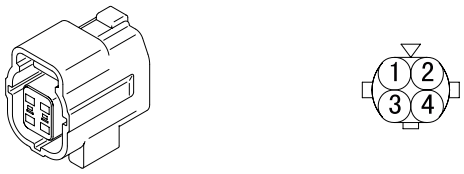
DJ type

Number shows number of pins	Female connector	Male connector
DJ10A	 	 
DJ10B	 	 

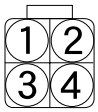
DK type

Number shows number of pins	Female connector	Male connector
DK2A		
DK2B		

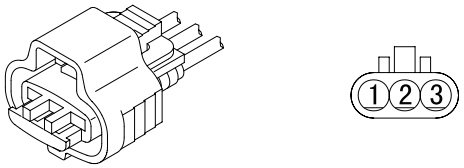
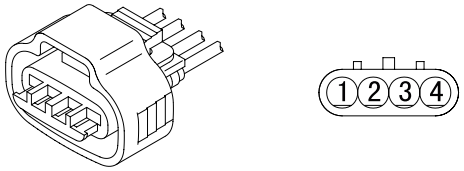
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
DK3A		
DK4A		

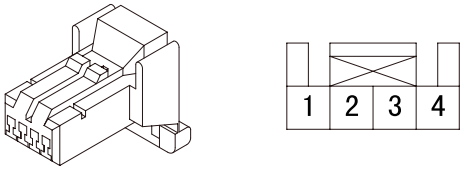
DL type

Number shows number of pins	Female connector	Male connector
DL4A		

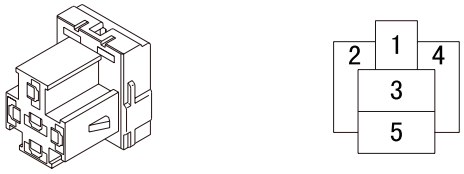
DM type

Number shows number of pins	Female connector	Male connector
DM3A		
DM4A		

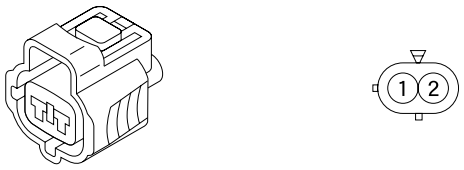
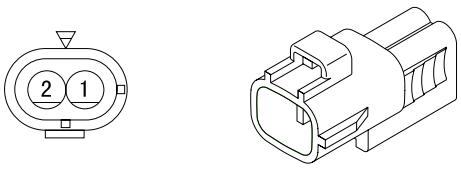
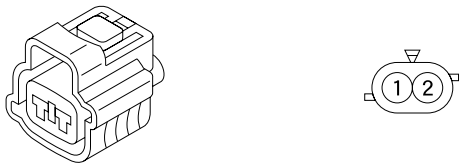
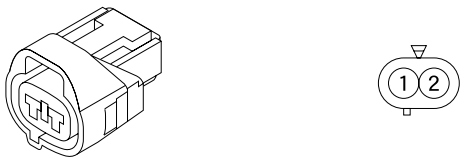
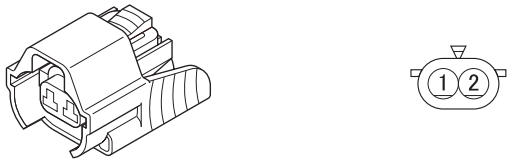
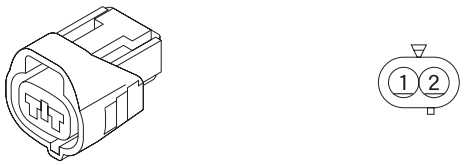
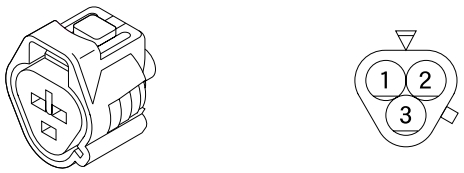
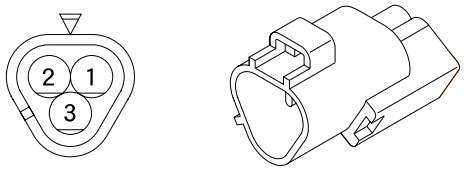
DN type

Number shows number of pins	Female connector	Male connector
DN4A		

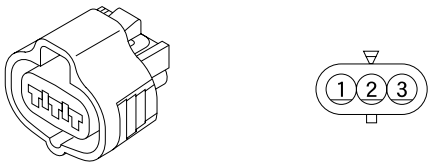
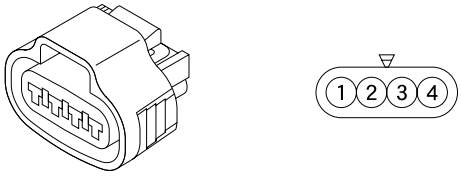
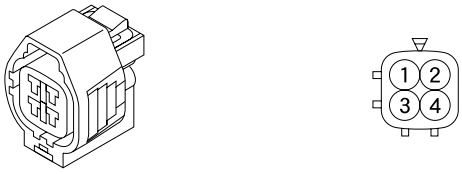
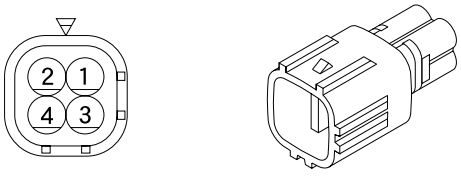
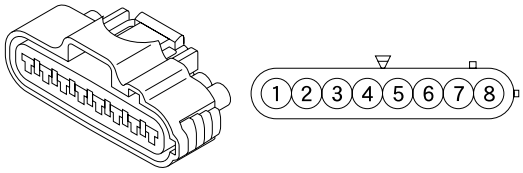
DP type

Number shows number of pins	Female connector	Male connector
DP5A		

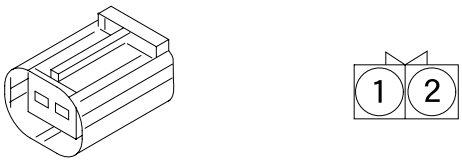
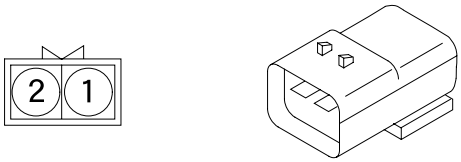
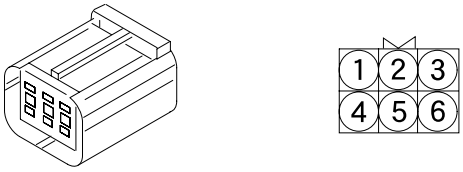
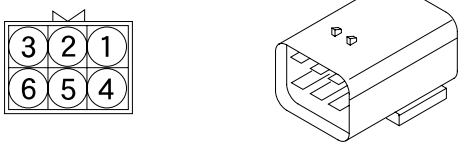
DQ type

Number shows number of pins	Female connector	Male connector
DQ2A		
DQ2B		
DQ2C		
DQ2D		
DQ2E		
DQ2F		
DQ3A		

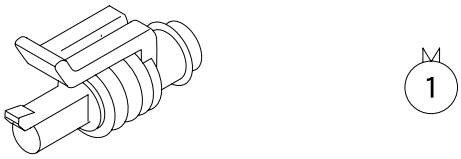
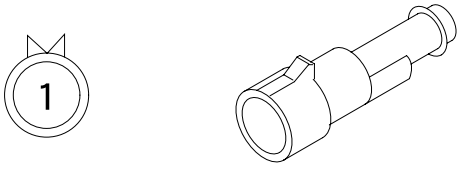
CONNECTOR CONFIGURATION CHART

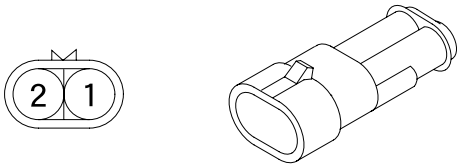
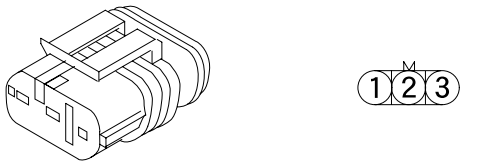
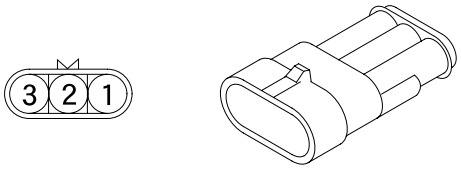
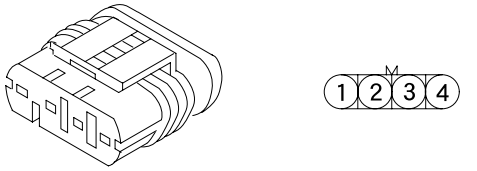
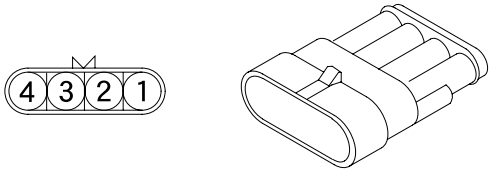
Number shows number of pins	Female connector	Male connector
DQ3B		
DQ4A		
DQ4B		
DQ8A		

DS type

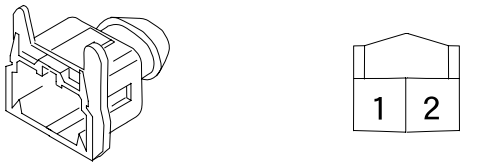
Number shows number of pins	Female connector	Male connector
DS2A		
DS6A		

DT type

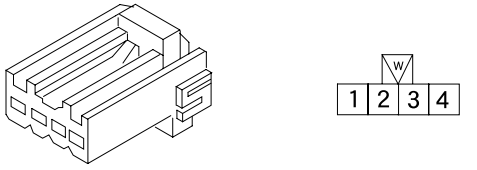
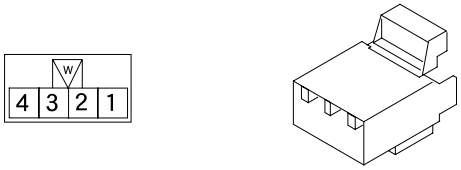
Number shows number of pins	Female connector	Male connector
DT1A		

Number shows number of pins	Female connector	Male connector
DT2A		
DT3A		
DT4A		

DU type

Number shows number of pins	Female connector	Male connector
DU2A		

DV type

Number shows number of pins	Female connector	Male connector
DV4A		

DW type

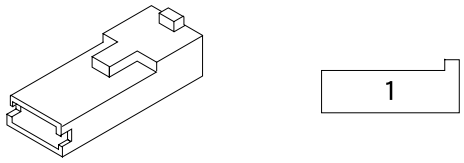
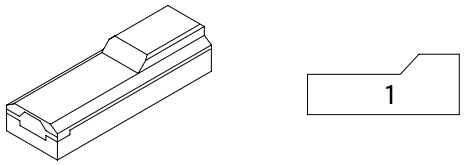
Number shows number of pins	Female connector	Male connector
DW2A		

CONNECTOR CONFIGURATION CHART

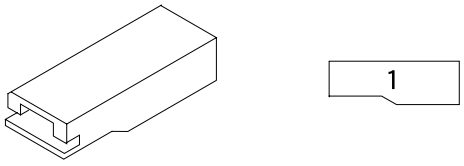
DX type

Number shows number of pins	Female connector	Male connector
DX2A		

DY type

Number shows number of pins	Female connector	Male connector
DY1A		
DY1B		

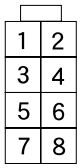
DZ type

Number shows number of pins	Female connector	Male connector
DZ1A		

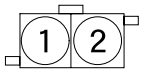
EA type

Number shows number of pins	Female connector	Male connector
EA8A		
EA8B		

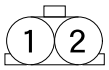
EB type

Number shows number of pins	Female connector	Male connector
EB8A		

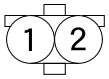
EC type

Number shows number of pins	Female connector	Male connector
EC2A		

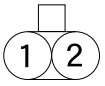
ED type

Number shows number of pins	Female connector	Male connector
ED2A		

EE type

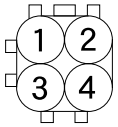
Number shows number of pins	Female connector	Male connector
EE2A		

EF type

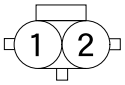
Number shows number of pins	Female connector	Male connector
EF2A		

CONNECTOR CONFIGURATION CHART

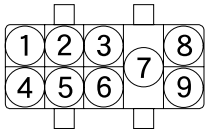
EG type

Number shows number of pins	Female connector	Male connector
EG4A		

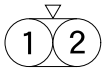
EH type

Number shows number of pins	Female connector	Male connector
EH2A		

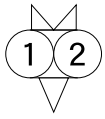
EJ type

Number shows number of pins	Female connector	Male connector
EJ9A		

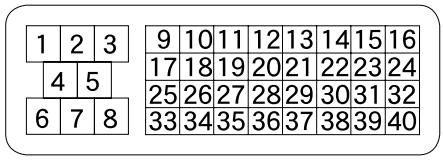
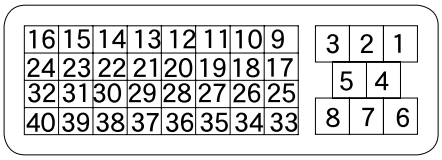
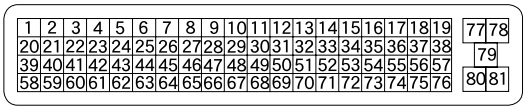
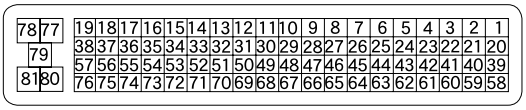
EK type

Number shows number of pins	Female connector	Male connector
EK2A		

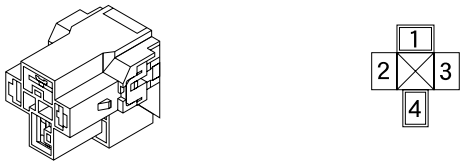
EL type

Number shows number of pins	Female connector	Male connector
EL2A		

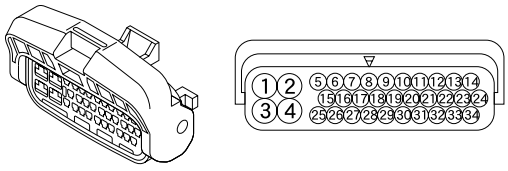
EM type

Number shows number of pins	Female connector	Male connector
EM40A		
EM81A		

EN type

Number shows number of pins	Female connector	Male connector
EN4A		
EN5A		

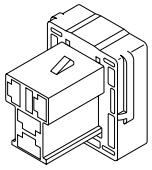
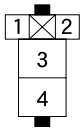
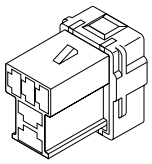
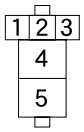
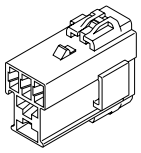
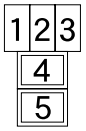
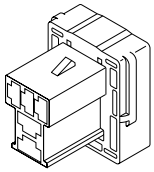
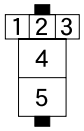
EP type

Number shows number of pins	Female connector	Male connector
EP34A		

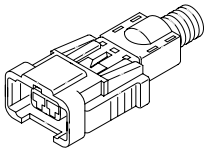
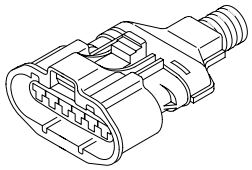
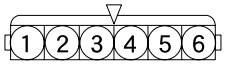
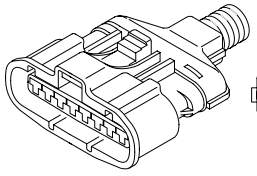
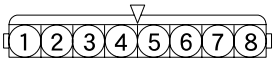
EQ type

Number shows number of pins	Female connector	Male connector
EQ4A		

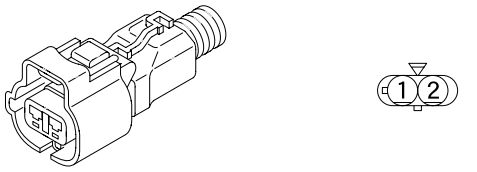
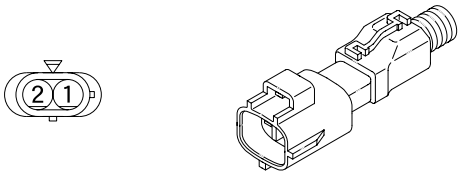
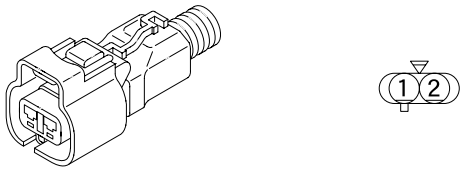
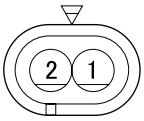
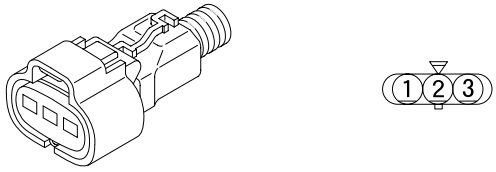
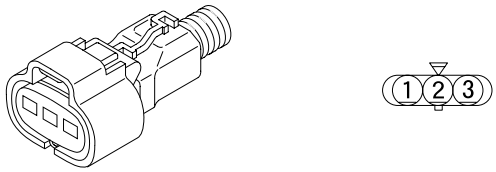
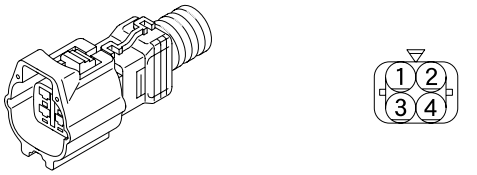
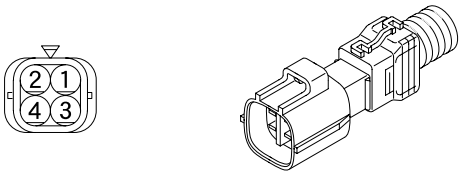
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
EQ4B	 	
EQ5A	   	
EQ5B	 	

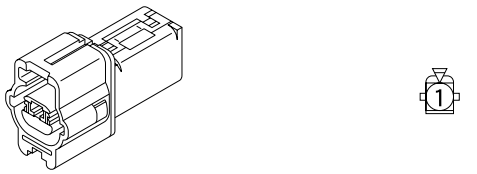
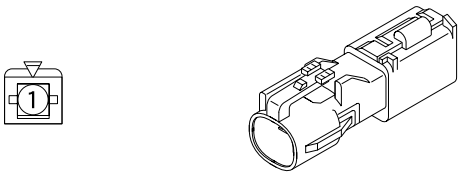
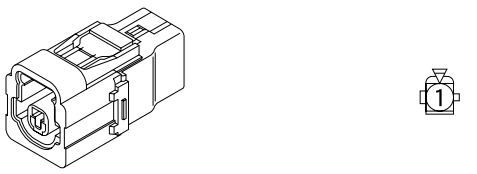
ER type

Number shows number of pins	Female connector	Male connector
ER2A		
ER6A	 	
ER8A	 	

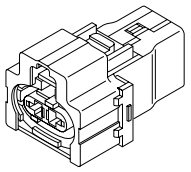
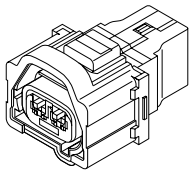
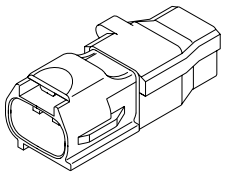
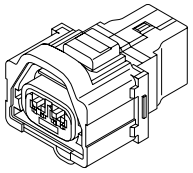
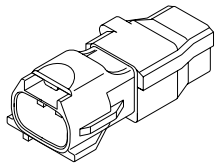
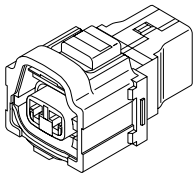
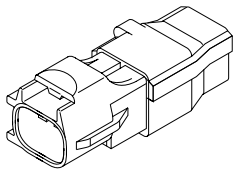
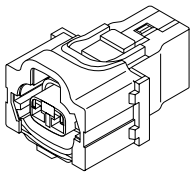
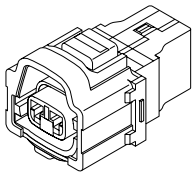
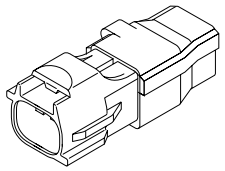
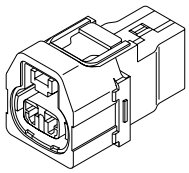
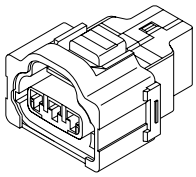
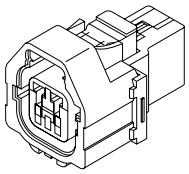
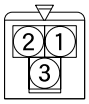
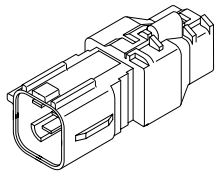
ES type

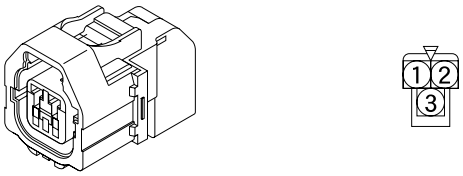
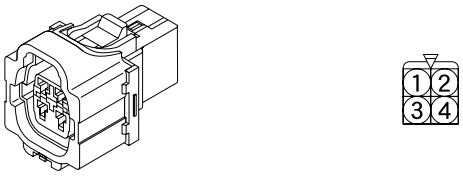
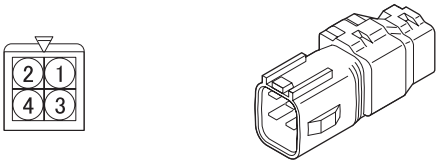
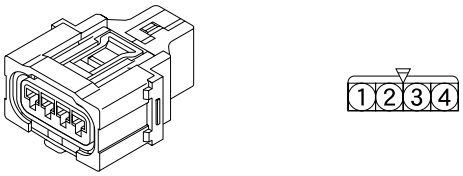
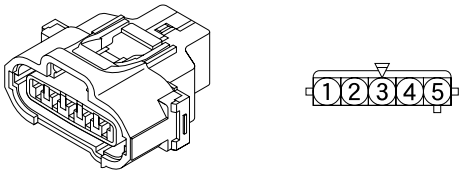
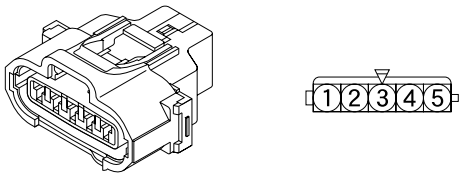
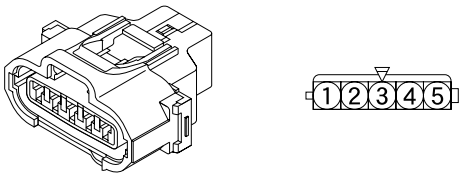
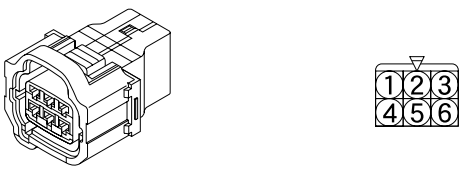
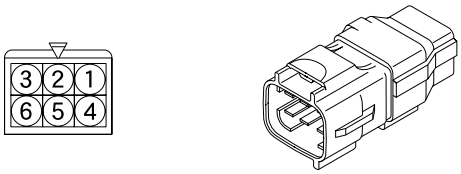
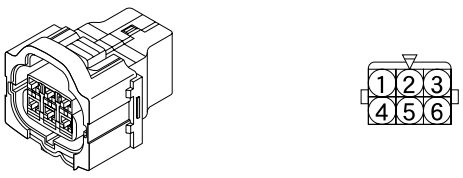
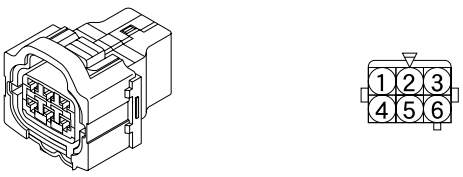
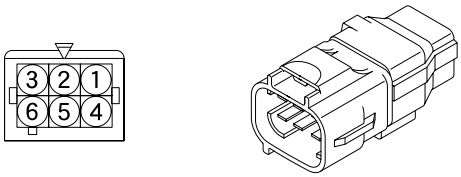
Number shows number of pins	Female connector	Male connector
ES2A		
ES2B		
ES2C		
ES3A		
ES3B		
ES4A		

ET type

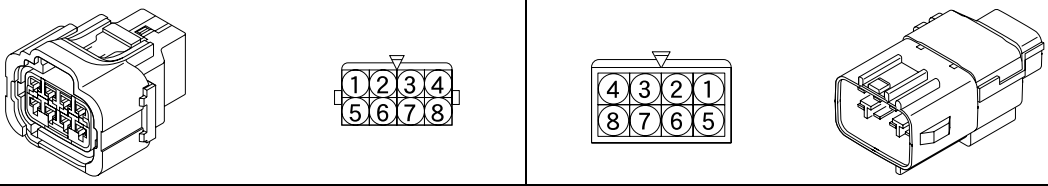
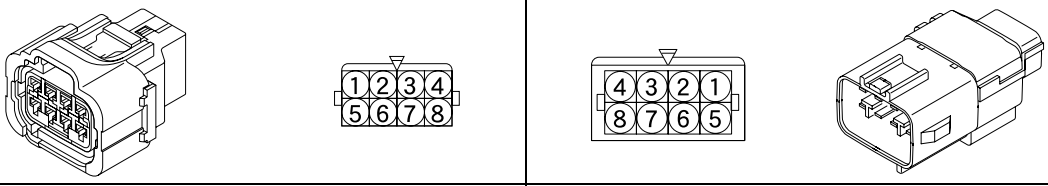
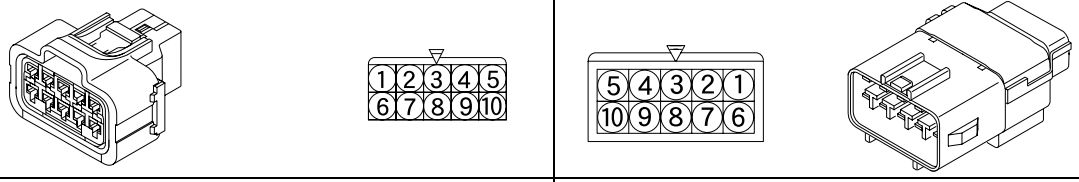
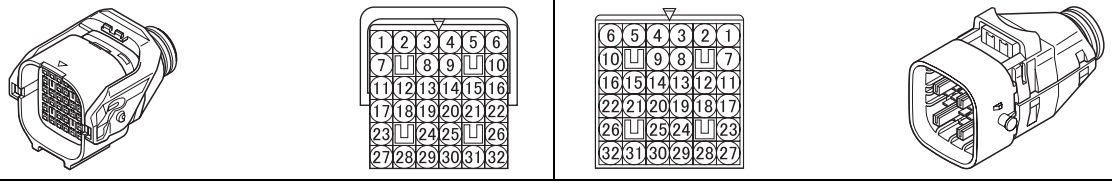
Number shows number of pins	Female connector	Male connector
ET1A		
ET1B		

CONNECTOR CONFIGURATION CHART

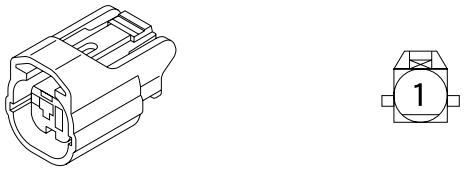
Number shows number of pins	Female connector	Male connector
ET2A		
ET2B		
ET2C		
ET2D		
ET2F		
ET2G		
ET2L		
ET3A		
ET3B		 

Number shows number of pins	Female connector	Male connector
ET3C		
ET4A		
ET4B		
ET5A		
ET5B		
ET5D		
ET6A		
ET6B		
ET6C		

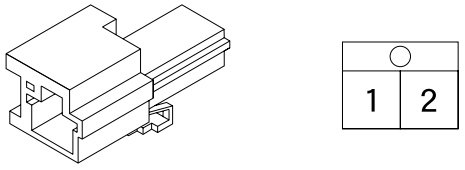
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
ET8A		
ET8B		
ET10A		
ET32A		

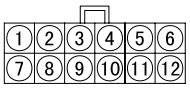
EU type

Number shows number of pins	Female connector	Male connector
EU1A		

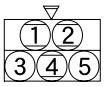
EV type

Number shows number of pins	Female connector	Male connector
EV2A		

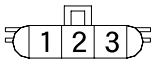
EW type

Number shows number of pins	Female connector	Male connector
EW12A		

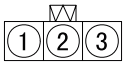
EX type

Number shows number of pins	Female connector	Male connector
EX5A		

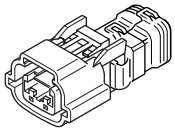
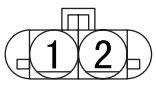
EY type

Number shows number of pins	Female connector	Male connector
EY3A		

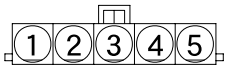
EZ type

Number shows number of pins	Female connector	Male connector
EZ3A		

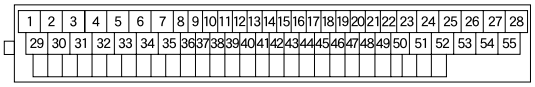
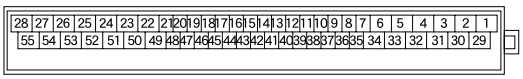
FA type

Number shows number of pins	Female connector	Male connector
FA2B	 	

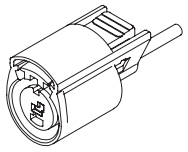
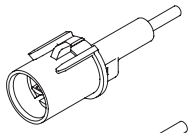
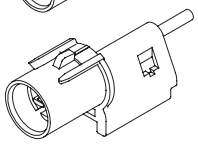
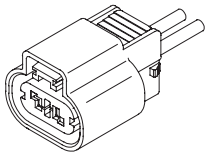
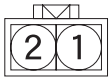
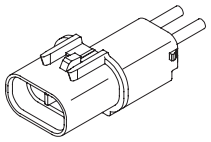
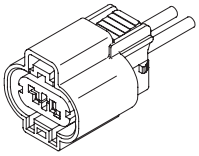
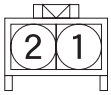
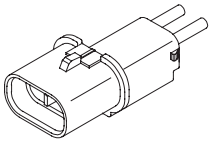
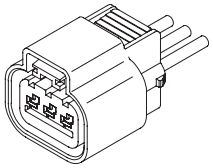
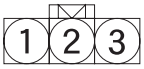
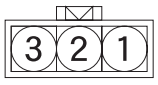
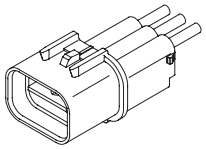
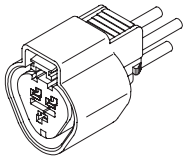
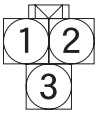
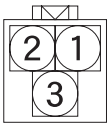
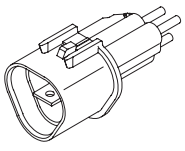
CONNECTOR CONFIGURATION CHART

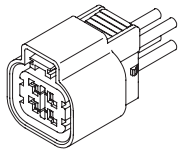
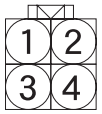
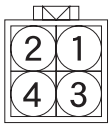
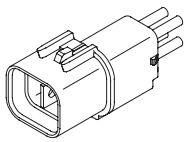
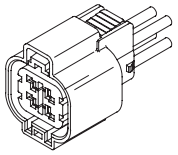
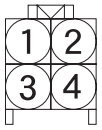
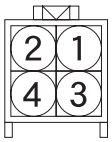
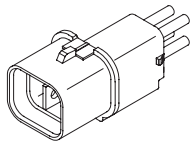
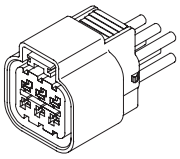
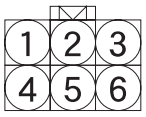
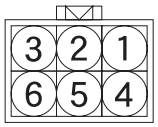
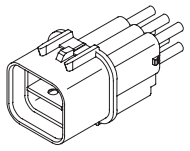
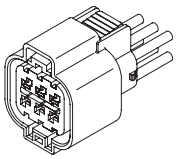
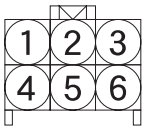
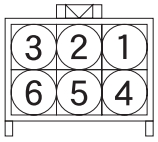
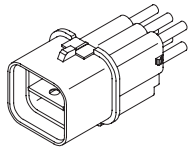
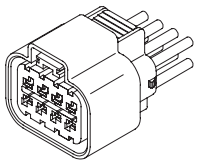
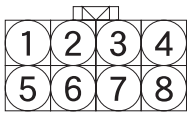
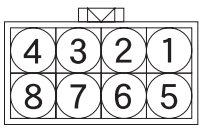
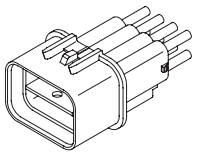
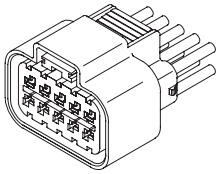
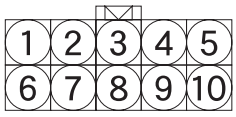
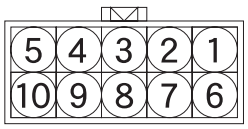
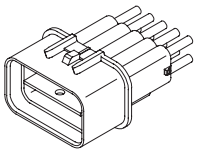
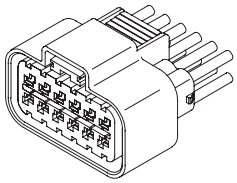
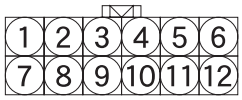
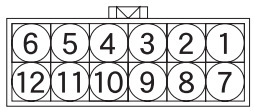
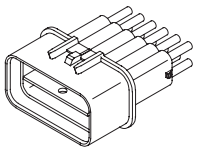
Number shows number of pins	Female connector	Male connector
FA5A		

FB type

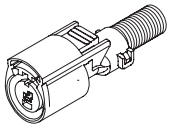
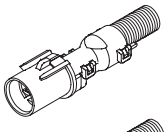
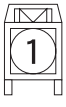
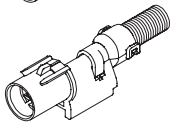
Number shows number of pins	Female connector	Male connector
FB55A		

GA type

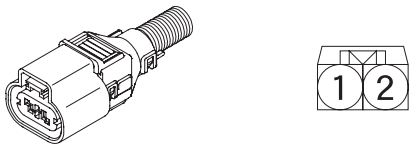
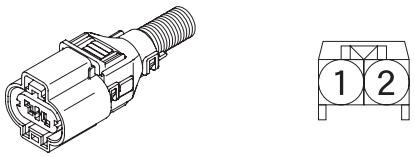
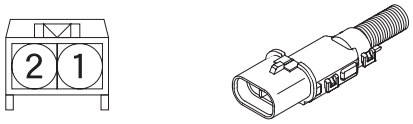
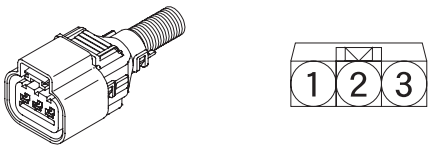
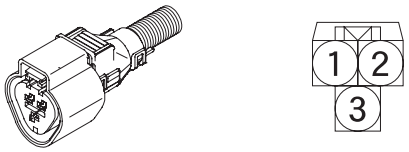
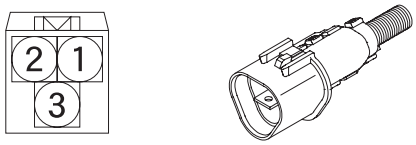
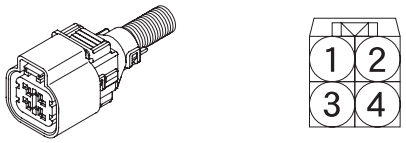
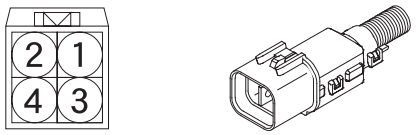
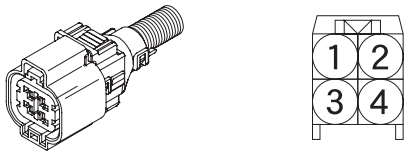
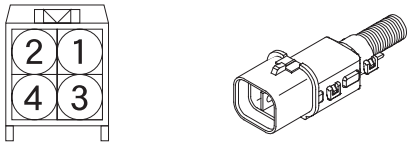
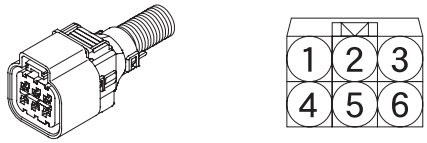
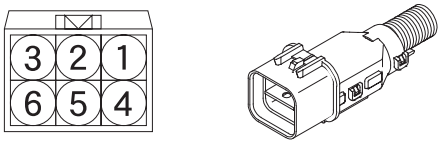
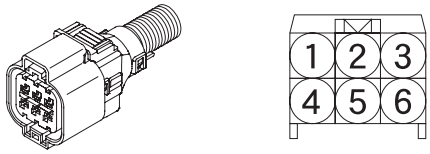
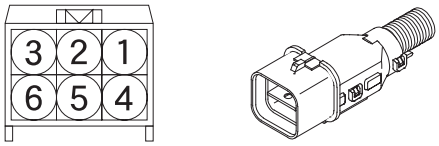
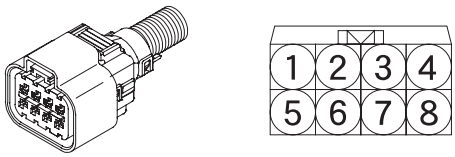
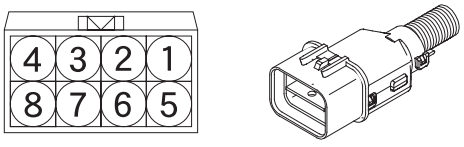
Number shows number of pins	Female connector	Male connector
GA1A		 
GA2A		 
GA2B		 
GA3A	 	 
GA3B	 	 

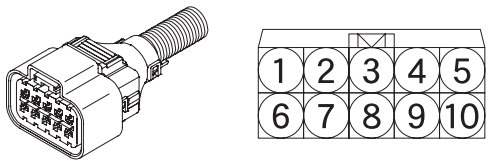
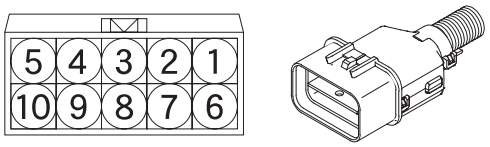
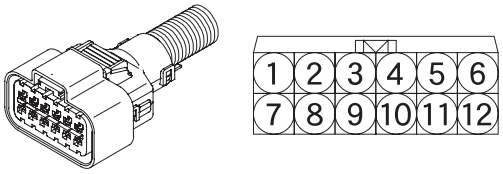
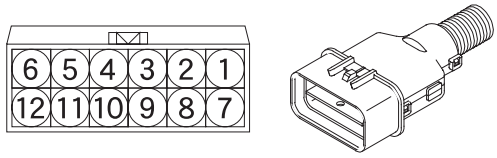
Number shows number of pins	Female connector	Male connector
GA4A	 	 
GA4B	 	 
GA6A	 	 
GA6B	 	 
GA8A	 	 
GA10A	 	 
GA12A	 	 

GB type

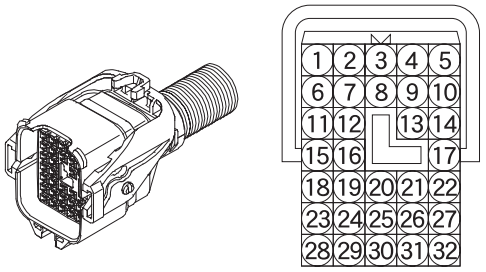
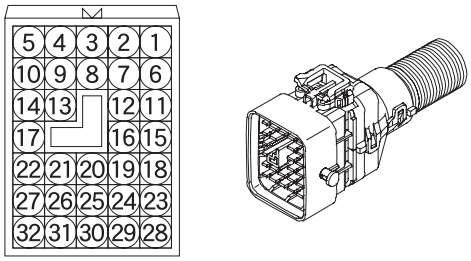
Number shows number of pins	Female connector	Male connector
GB1A		  

CONNECTOR CONFIGURATION CHART

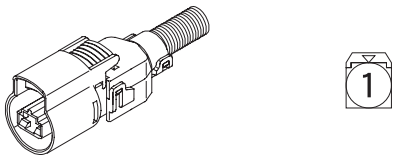
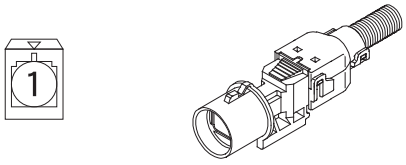
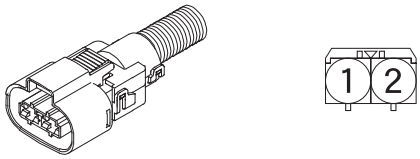
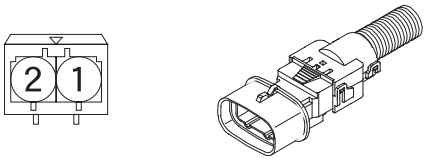
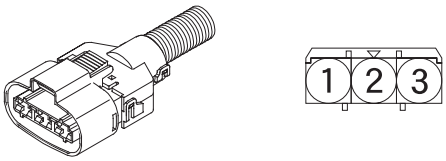
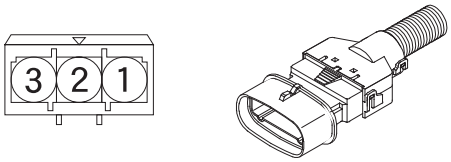
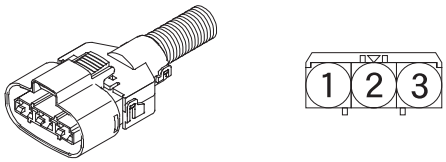
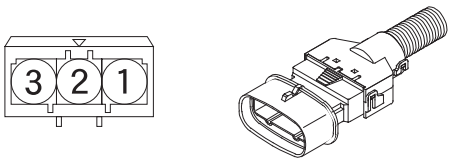
Number shows number of pins	Female connector	Male connector
GB2A		
GB2B		
GB3A		
GB3B		
GB4A		
GB4B		
GB6A		
GB6B		
GB8A		

Number shows number of pins	Female connector	Male connector
GB10A		
GB12A		

GC type

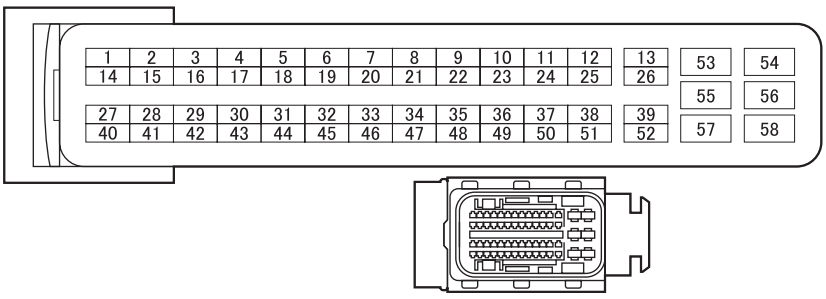
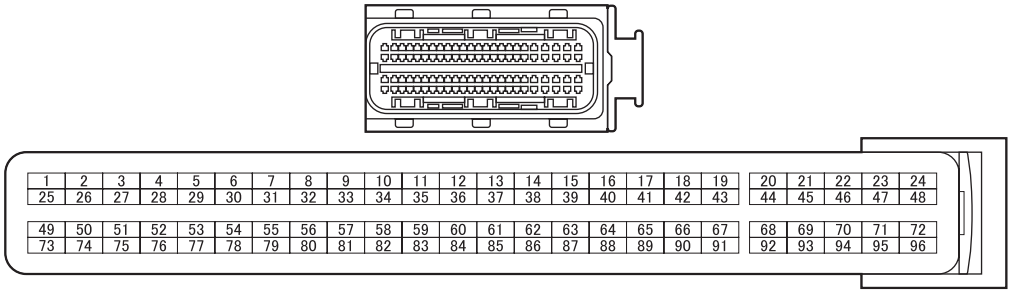
Number shows number of pins	Female connector	Male connector
GC32A		

GD type

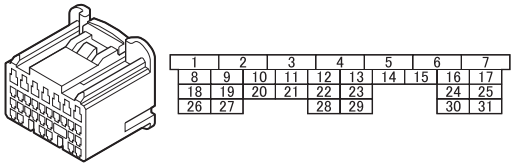
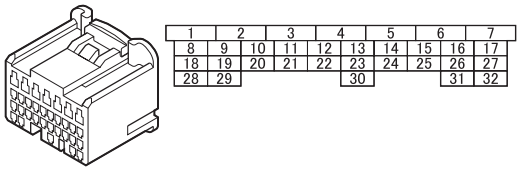
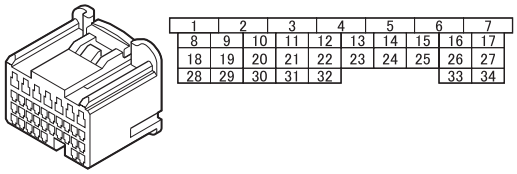
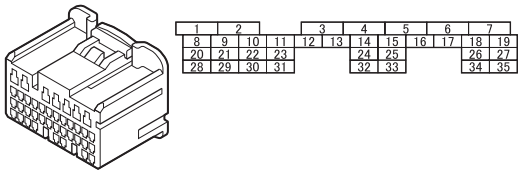
Number shows number of pins	Female connector	Male connector
GD1A		
GD2A		
GD3A		
GD3B		

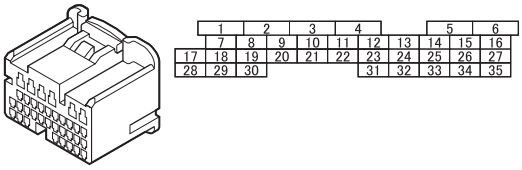
CONNECTOR CONFIGURATION CHART

GE type

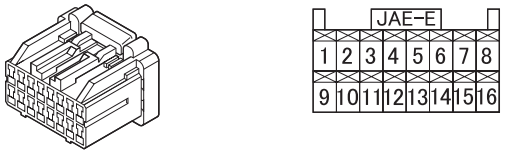
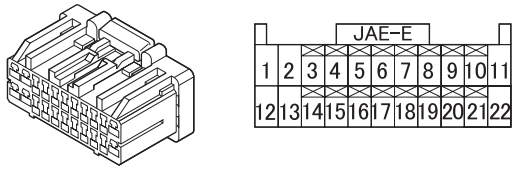
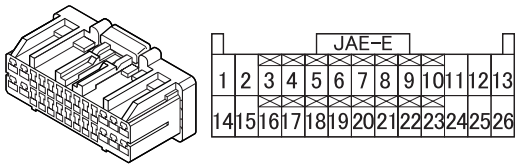
Number shows number of pins	Female connector
GE58A	
GE96A	

GF type

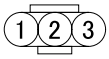
Number shows number of pins	Female connector	Male connector
GF31A		
GF32A		
GF34A		
GF35A		

Number shows number of pins	Female connector	Male connector
GF35B		

GG type

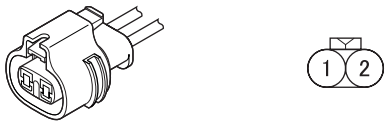
Number shows number of pins	Female connector	Male connector
GG12A		
GG16A		
GG22A		
GG26A		

GH type

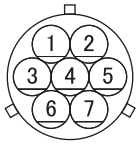
Number shows number of pins	Female connector	Male connector
GH3A		

CONNECTOR CONFIGURATION CHART

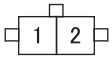
GJ type

Number shows number of pins	Female connector	Male connector
GJ2A		
GJ2B		

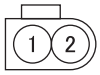
GK type

Number shows number of pins	Female connector	Male connector
GK7A		

GL type

Number shows number of pins	Female connector	Male connector
GL2A		

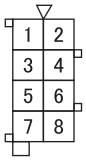
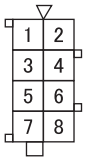
GM type

Number shows number of pins	Female connector	Male connector
GM2A		

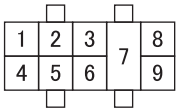
GN type

Number shows number of pins	Female connector	Male connector
GN2A		

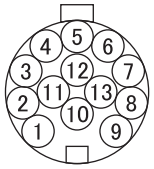
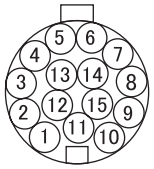
GP type

Number shows number of pins	Female connector	Male connector
GP8A		
GP8B		

GQ type

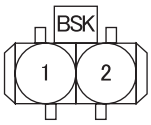
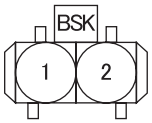
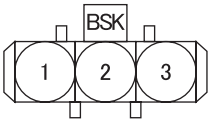
Number shows number of pins	Female connector	Male connector
GQ9A		

GR type

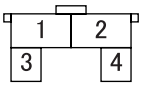
Number shows number of pins	Female connector	Male connector
GR13A		
GR15A		

CONNECTOR CONFIGURATION CHART

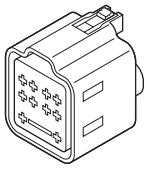
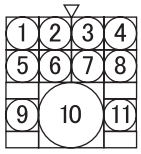
GS type

Number shows number of pins	Female connector	Male connector
GS2A		
GS2B		
GS3A		

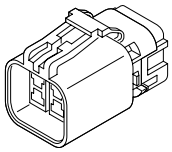
HB type

Number shows number of pins	Female connector	Male connector
HB4A		

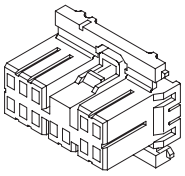
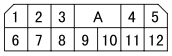
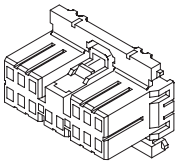
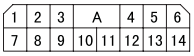
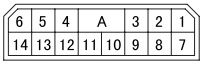
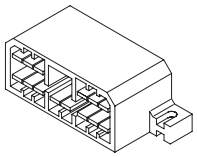
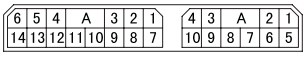
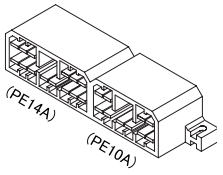
HC type

Number shows number of pins	Female connector	Male connector
HC11A	 	

PC type

Number shows number of pins	Female connector	Male connector
PC4A		

PE type

Number shows number of pins	Female connector	Male connector
PE12A	 	
PE14A	 	   

INDEX

SPECIFICATIONS 55-2

STRUCTURE AND OPERATION

1. **Heater 55-4**
2. **Air Conditioner 55-5**
3. **Air Duct 55-6**
4. **Heater Control 55-7**

TROUBLESHOOTING 55-10

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. **Recovery of Refrigerant 55-12**
2. **Recharging the System with Refrigerant 55-13**
3. **Checking Refrigerant Charge Level 55-15**
4. **Adding Refrigerant 55-16**

CONNECTING AIR CONDITIONER PIPING 55-17

COMPRESSOR 55-18

CONDENSER, RECEIVER 55-20

HEATER CONTROL 55-22

AIR DUCT 55-26

HEATER AND COOLING UNIT, BLOWER 55-28

SPECIFICATIONS

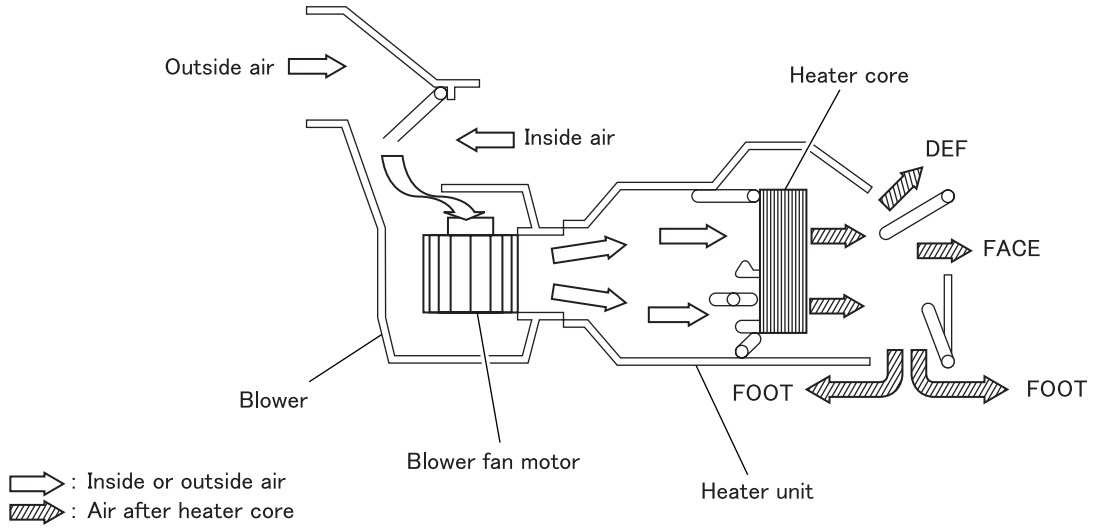
<Without Air Conditioner>

Item			Specifications
System	Damper change-over system	Mode selection	Manual cable type
		Air mixing	Manual cable type
		Fresh/recirculation changeover	Servomotor
	Servomotor rated voltage V		12
Heater unit	Manufacturer		MITSUBISHI HEAVY INDUSTRIES, LTD.
	Heating capacity W {kcal/h}		4370 ± 437 {3758 ± 376}
	Temperature control system		Air mixing type
Blower	Manufacturer		MITSUBISHI HEAVY INDUSTRIES, LTD.
	Blower motor voltage V		12

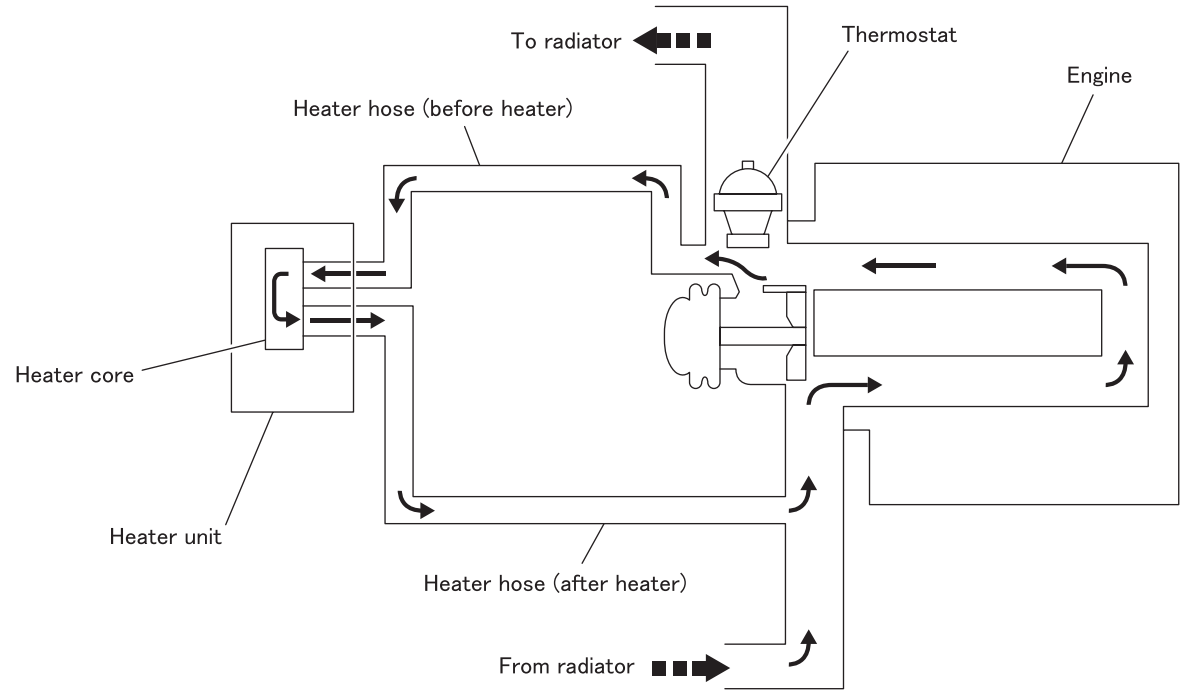
<Air Conditioner>

Item			Specifications
System	Type		Manual type air conditioner
	Refrigerant	Type	HFC134a
		Charged quantity g {oz}	650 {22.9}
	Damper change-over system	Mode selection	Manual cable type
		Air mixing	Manual cable type
		Fresh/recirculation changeover	Servomotor
	Servomotor rated voltage V		12
Heater and cooling unit	Manufacturer		MITSUBISHI HEAVY INDUSTRIES, LTD.
	Heating capacity W {kcal/h}		4370 ± 437 {3758 ± 376}
	Cooling capacity W {kcal/h}		4340 ± 434 {3732 ± 373}
	Temperature control system		Air mixing type
Blower	Manufacturer		MITSUBISHI HEAVY INDUSTRIES, LTD.
	Blower motor voltage V		12
Compressor	Manufacturer		MITSUBISHI HEAVY INDUSTRIES, LTD.
	Model		MSC90TA
	Discharge cm^3 {mL}/1 rotation		90 {90}
	Lubricant	Type	SUN PAG56
		Quantity cm^3 {cu.in.}	$140\ ^{+20}_{0}$ {$8.54\ ^{+1.22}_{0}$}
Condenser	Manufacturer		MITSUBISHI HEAVY INDUSTRIES, LTD.
	Rated current A	Wide cab	$7\ ^{+1.0}_{-1.5}$
		Standard wide cab	$9.5\ ^{+1.8}_{-2.0}$
Receiver	Manufacturer		MITSUBISHI HEAVY INDUSTRIES, LTD.
	Capacity cm^3 {cu.in.}		350 {21.4}

1. Heater



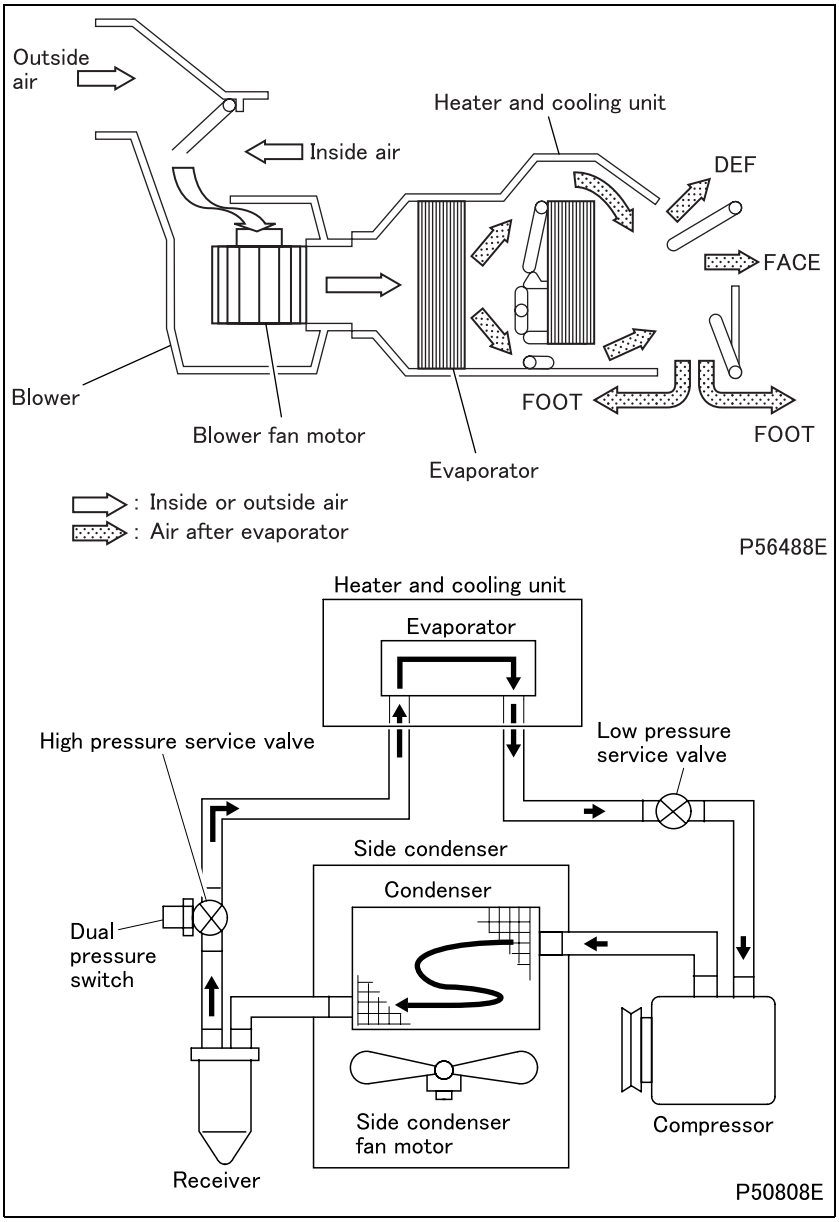
P56487E



P11955E

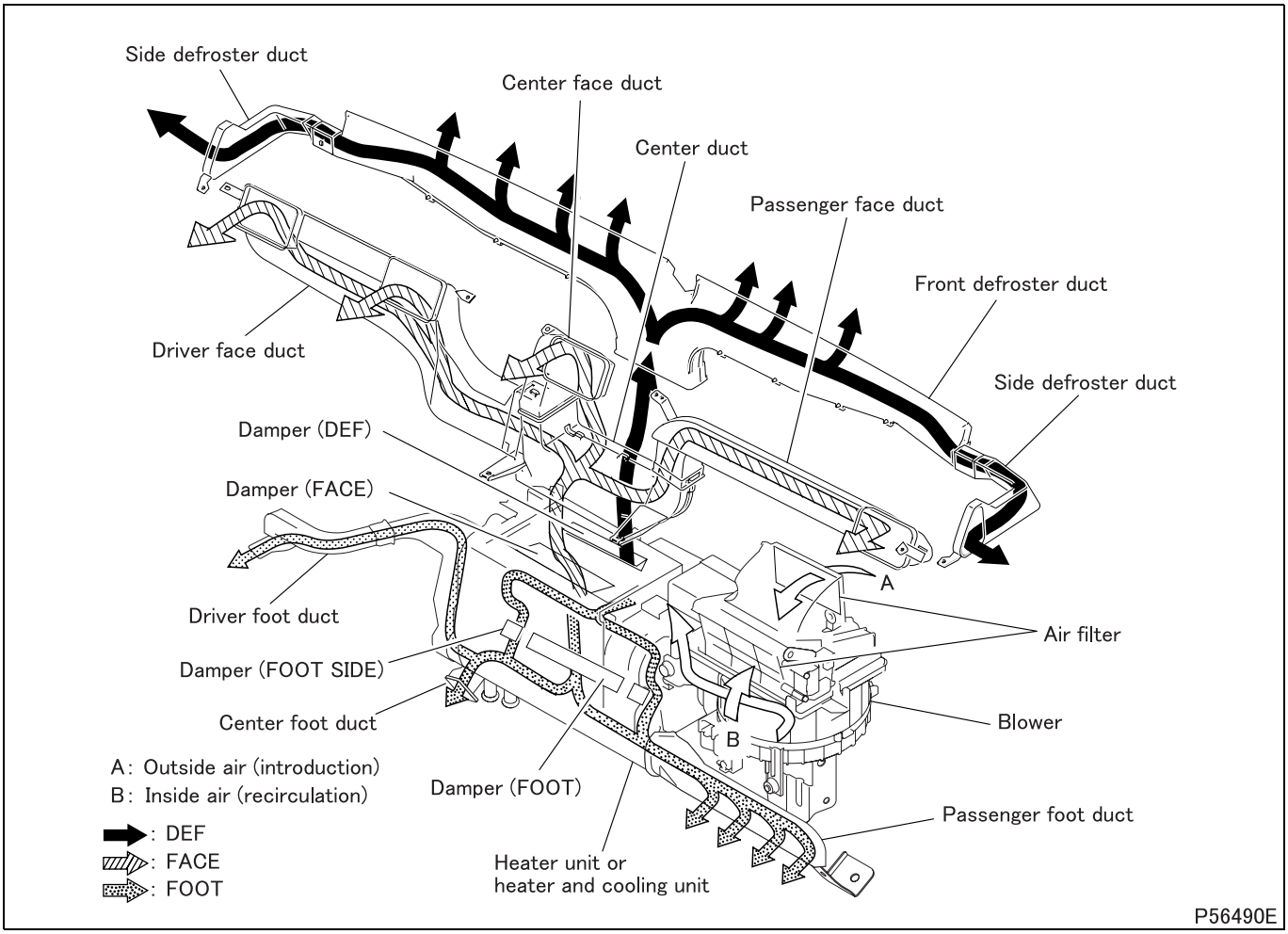
- The blower sends air to the heater unit, where the air is heated by the heater core (heat exchanger). The warmed-up air is then sent through the ducts into the cab.
- Water (engine coolant) warmed up by the heat from the engine circulates permanently through the heater core, irrespective of whether the thermostat is open or closed.

2. Front Air Conditioner



- The blower sends air to the heater and cooling unit, where the air is cooled by the evaporator. The cooled air is then sent through the ducts into the cab.
- Refrigerant in gas form is compressed by the compressor. The compressed gas is then sent to the side condenser, where it is cooled by outside air and condenses into liquid form.
- The liquid refrigerant is sprayed into the evaporator, where it quickly evaporates into gas form while at the same time absorbing heat from the surrounding air.
- The refrigerant in gas form is again sent to the compressor and is compressed there.
- When the refrigerant pressure in the high pressure line reaches the specified limit, the dual pressure switch senses this and turns itself OFF. At the same time, the magnet clutch is turned OFF.

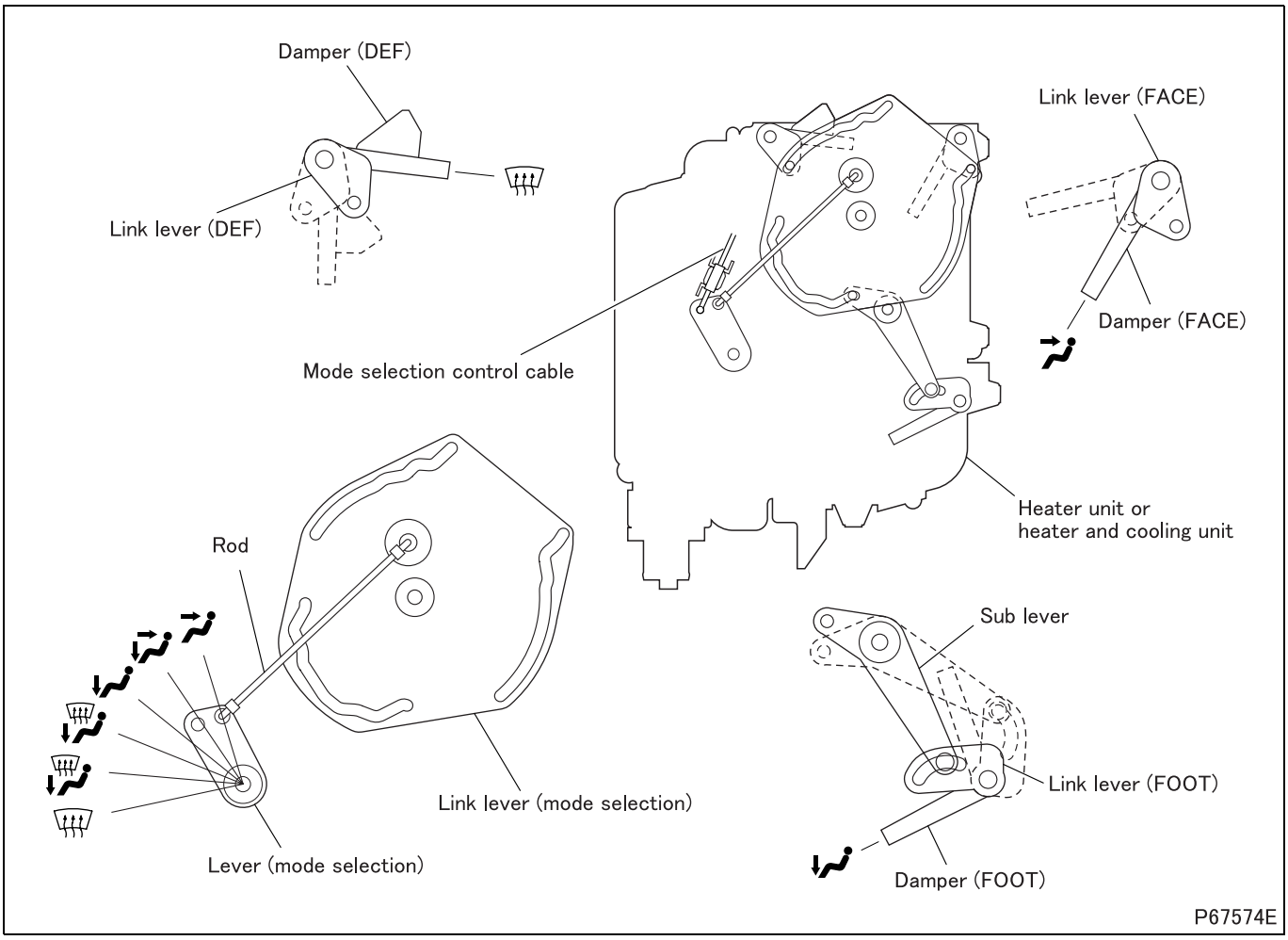
3. Air Duct



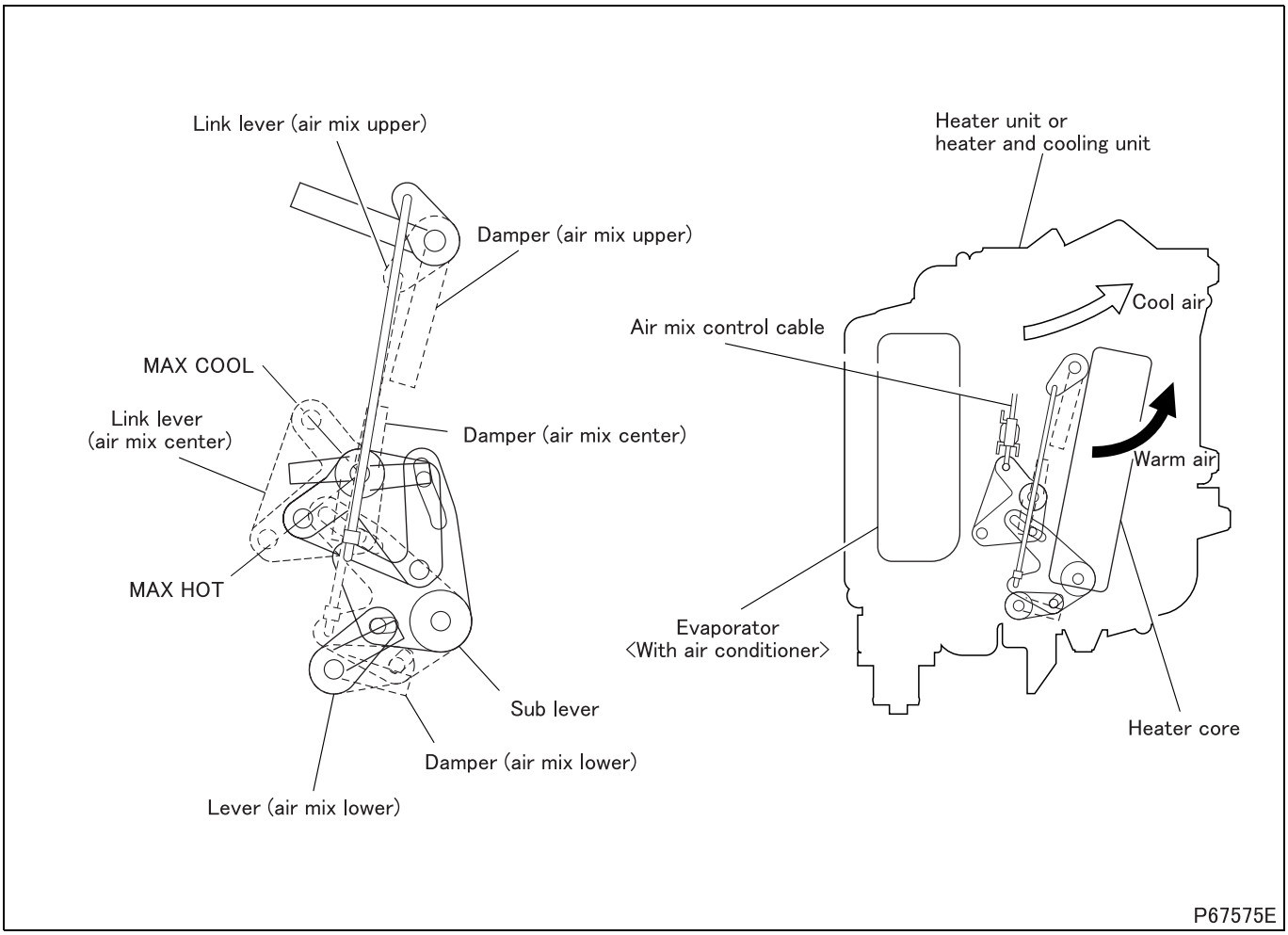
- The blower sends outside air **A** or inside air **B** through the heater unit or heater and cooling unit to the ducts. The flow of air is dependent on the open/closed positions of the various dampers.

4. Heater Control

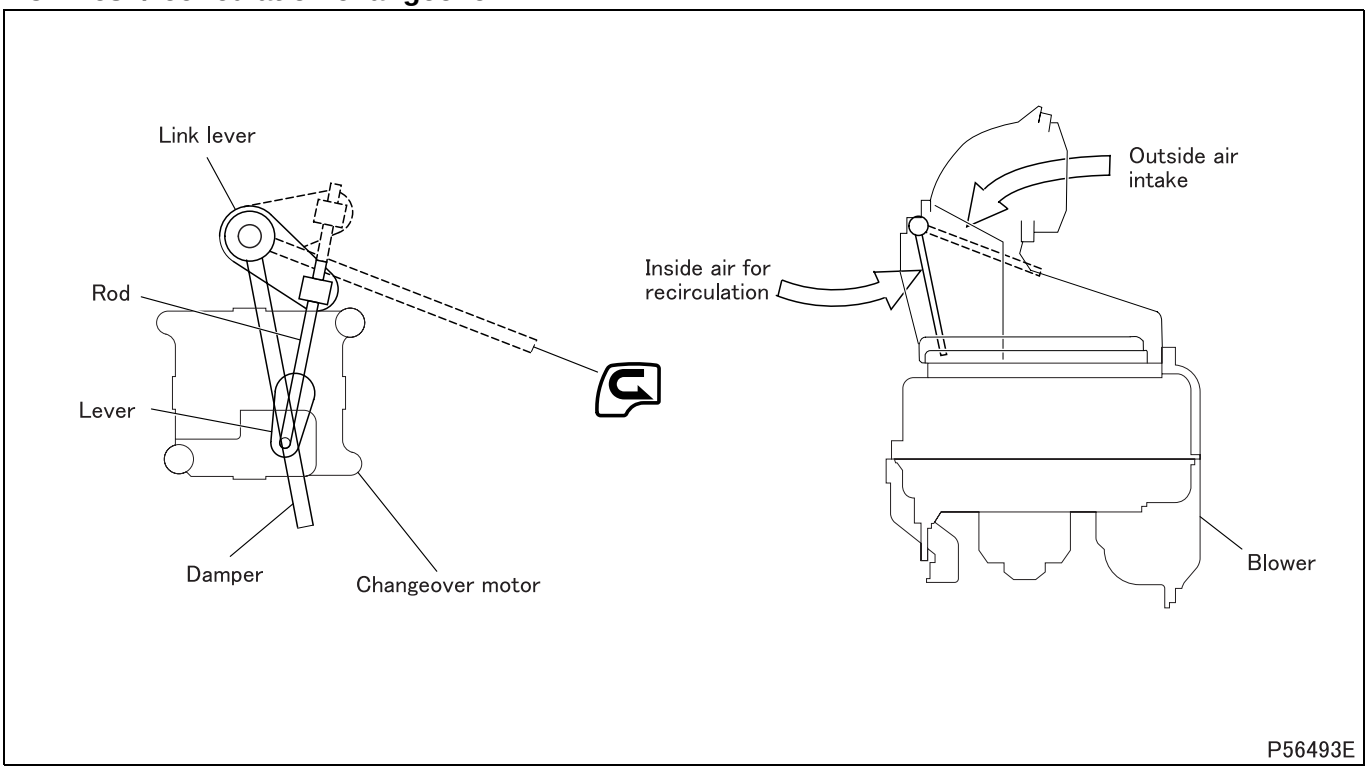
4.1 Mode selection



4.2 Air mix selection <Air conditioner>



4.3 Fresh/recirculation changeover



- The fresh/recirculation changeover damper is operated by means of motor.

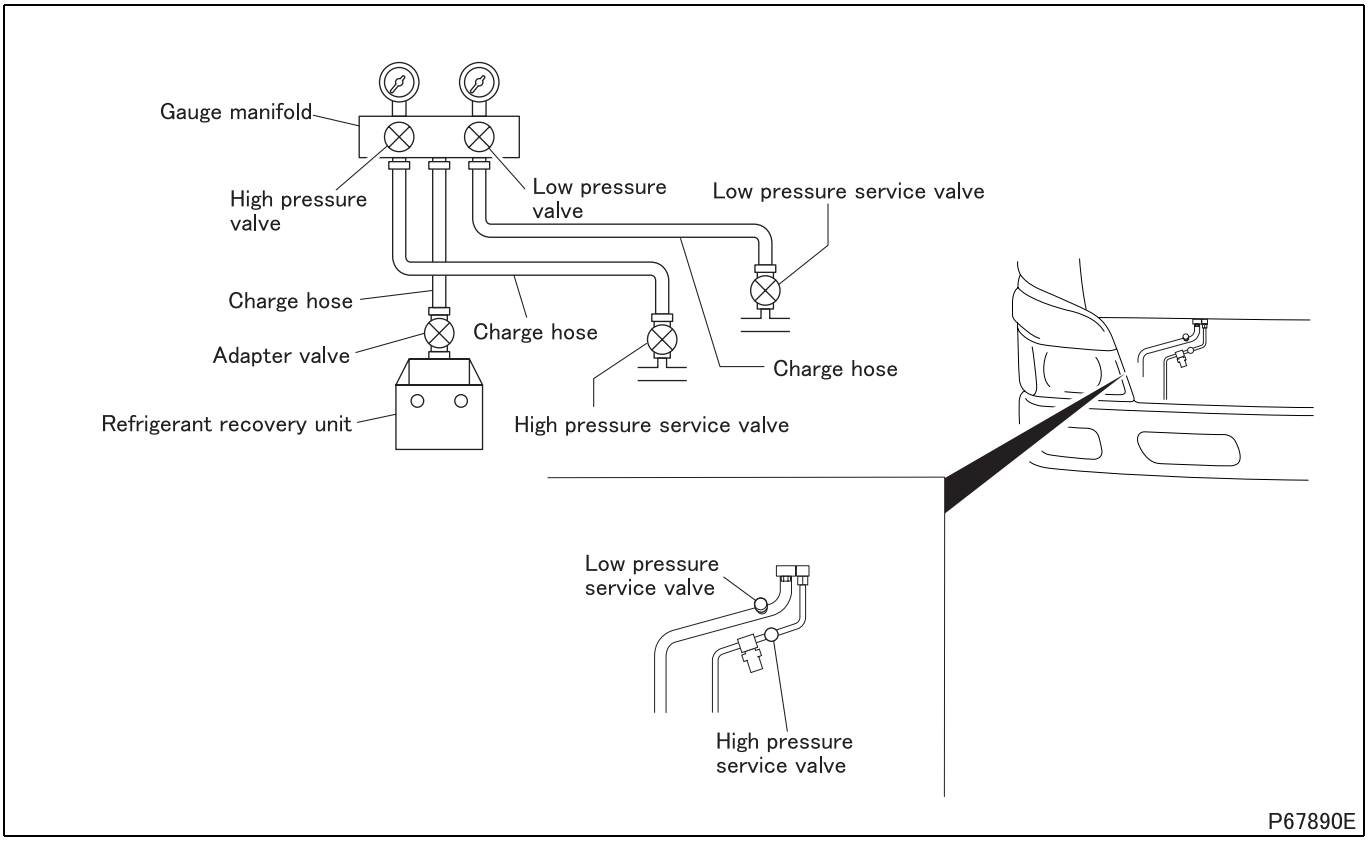
Heater, Front Air Conditioner

Symptoms / Possible causes	No air from vents	Poor cooling	Poor heating	No mode selection	Draft from vents	No temperature setting	No ventilation/recirculation selection	Air volume from vents unstable	Controls require too much effort	Reference Gr
Blower motor coil open, shorted	O									Gr54
Blower motor relay contacts stuck closed, coil open, shorted	O									
Blower resistor malfunction <A/C>								O		
Compressor seized, malfunction <A/C>		O								
Refrigerant charge low <A/C>		O					O			
Air conditioner relay contacts stuck closed, coil open, shorted <A/C>		O								
Mode damper malfunction, not fully closed				O	O				O	
Air mix damper malfunction, not fully closed					O	O			O	
Ventilation/recirculation selection damper malfunction, not fully closed					O		O		O	
Condenser fan motor coil open, shorted <A/C>		O								Gr54
Condenser relay contacts stuck closed, coil open, shorted <A/C>		O								
Dual pressure switch coil open, shorted <A/C>		O								
Heater control malfunction	O	O	O	O	O	O	O			
Thermostat stays open			O							Gr14
Coolant level low			O							
Connector poor contact, harness open, faulty earth	O	O		O	O	O	O			Gr54
Fuse blown	O	O								
Air conditioner piping clogged, loose, incorrectly connected <A/C>		O								
Heater piping clogged, loose, incorrectly connected			O							
Duct incorrectly connected					O					
Heater and cooling unit clogged			O							
Condenser clogged <A/C>		O								
Condenser core restricted, accumulation of foreign matter <A/C>		O								
Receiver clogged, inefficient desiccant <A/C>		O								
Evaporator clogged <A/C>		O								
Control wire jammed, incorrectly installed				O	O		O		O	
Lever bent				O	O		O		O	
Lever sliding section worn, out of grease				O	O		O		O	

<A/C>: Air conditioner

M E M O

1. Recovery of Refrigerant



- Recover refrigerant from the air conditioning system in accordance with the following flow chart.
  - Installation of the refrigerant recovery unit

Close both the low pressure and high pressure valves.

Connect the charge hose to the low pressure service valve.

Connect the charge hose to the high pressure service valve.

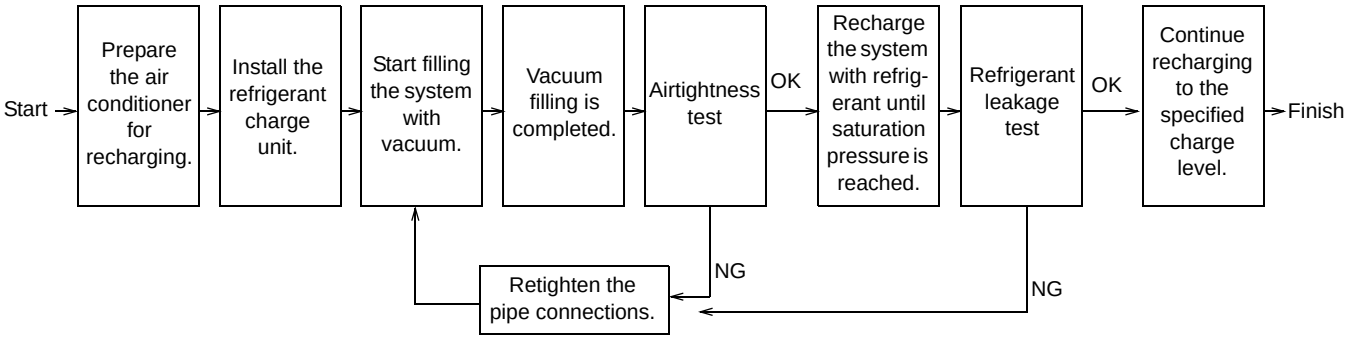
Connect the charge hose to the adapter valve.

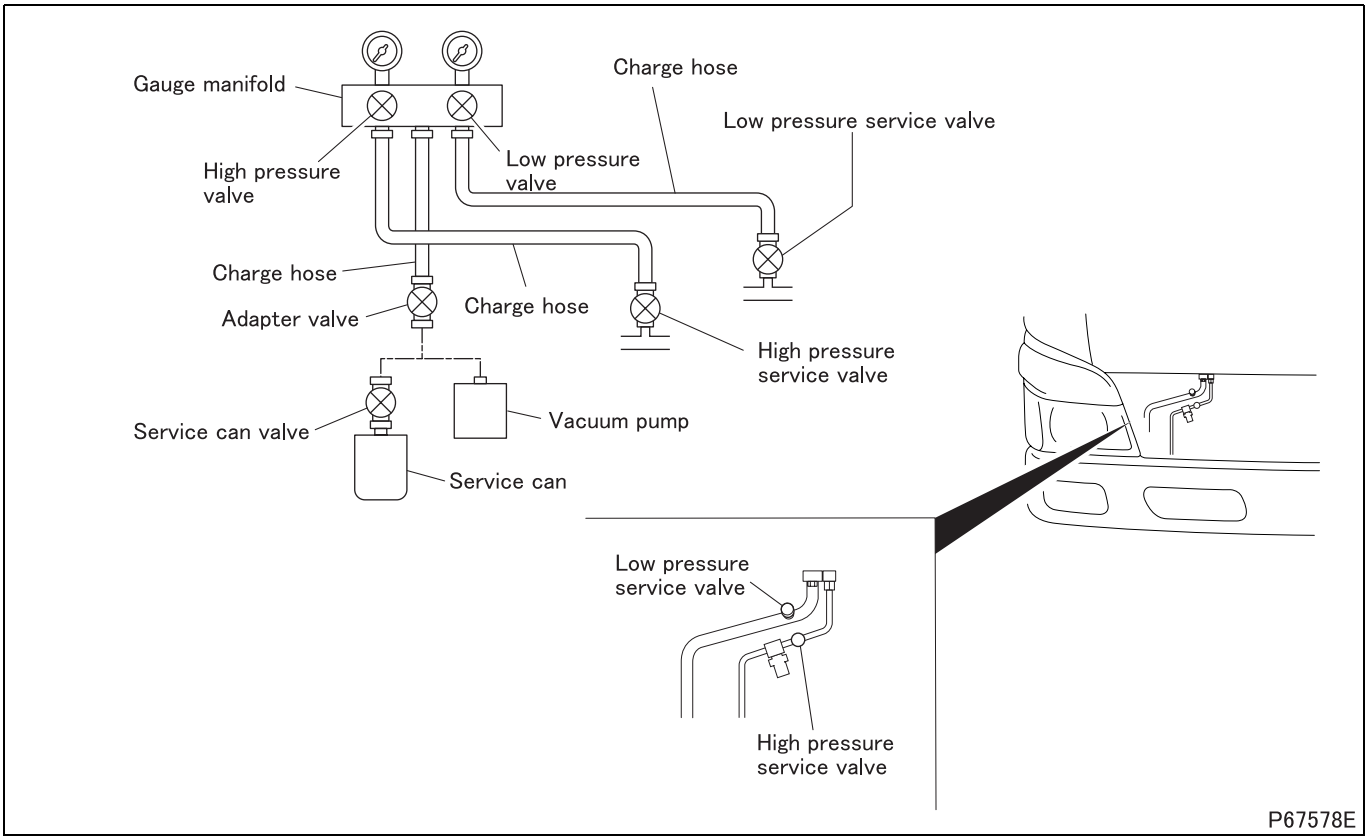
Open both the low pressure and high pressure valves.

Open the adapter valve.

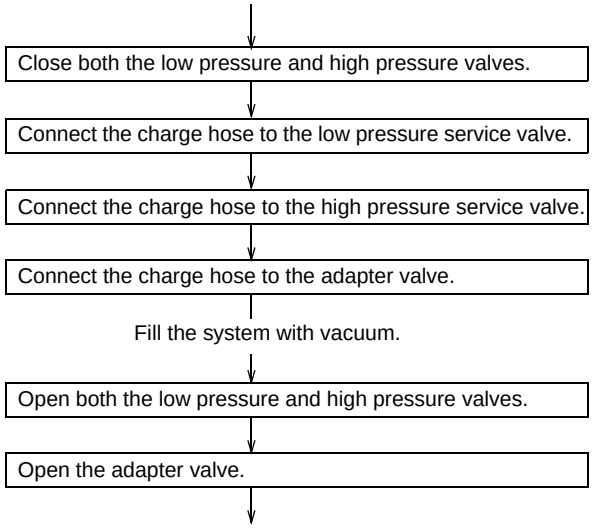
Run the recovery unit to collect the refrigerant.

2. Recharging the System with Refrigerant





- Recharge the system with refrigerant in accordance with the following flow chart.
  - Installation of the refrigerant charge unit



Run the vacuum pump.

Continue to run the pump for a minimum of 10 to 15 minutes. Close the adapter valve.

Stop the vacuum pump.

CAUTION ⚠

- **Make sure that the adapter valve is closed before stopping the vacuum pump.**

Close both the low pressure and high pressure valves.

Wait for 5 minutes. During this interval, the readings on the gauges installed on the gauge manifold should stay where they are and should not move towards zero.

Vacuum filling is now completed.

Recharging the system with refrigerant

With the adapter valve still closed, remove it from the vacuum pump. Connect the valve to the refrigerant container via the container valve.

Open the container valve and then the adapter valve.

Open the low pressure valve to fill refrigerant in gas form.

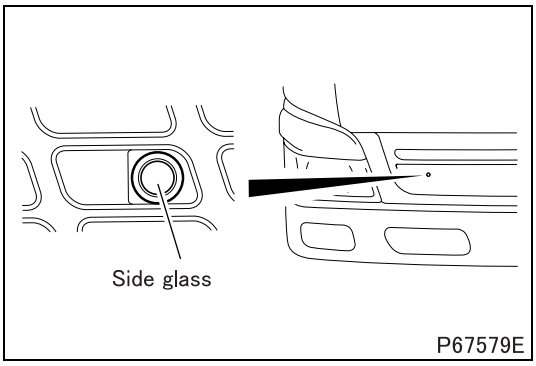
CAUTION ⚠

- **Filling refrigerant into the system in liquid form may damage the compressor. To prevent this, keep the refrigerant container in the upright position so that refrigerant is filled in gas form.**

When the refrigerant container is empty, close the adapter valve and install a new container. Continue filling the system.

When the air conditioning system is saturated, start the engine. Turn on the air conditioner to run the compressor, and continue recharging until the specified charge level is reached.

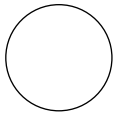
3. Checking Refrigerant Charge Level



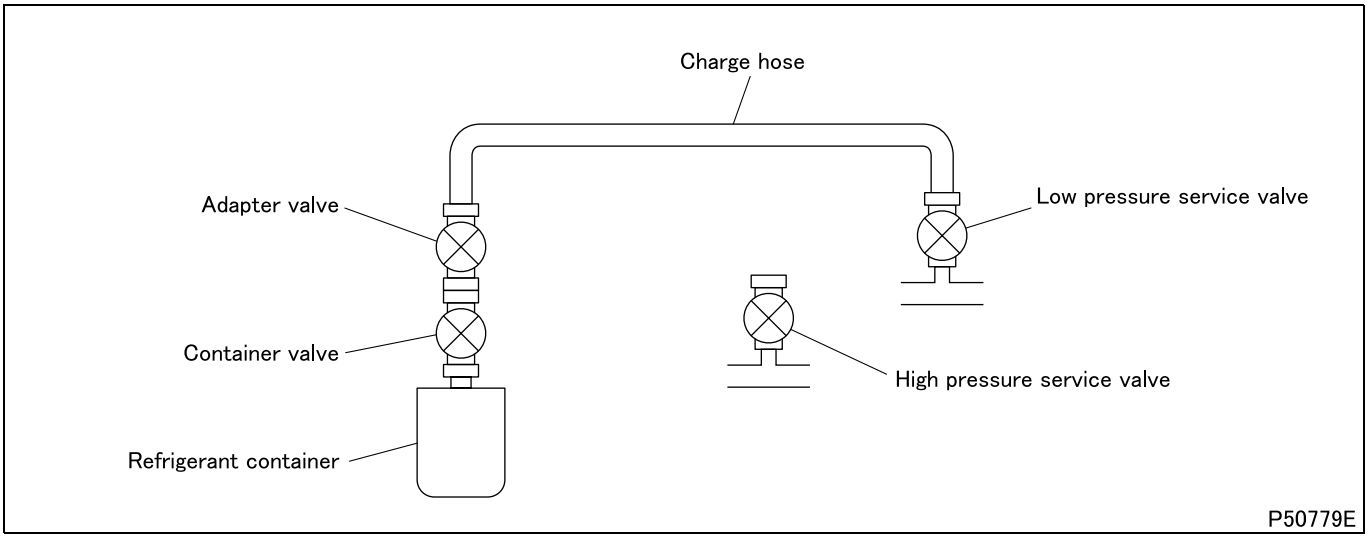
- To check the refrigerant charge level, observe the flow of refrigerant through the sight glass. If the visual inspection indicates a low charge level, add refrigerant.
- The visual check should be performed under the following conditions.
  - Engine speed: 1400 rpm
  - Air conditioner switch: ON
  - Fan speed control dial: 4 (MAX)
  - Temperature control dial: MAX COOL
  - Fresh/recirculation changeover switch: Indicator lamp in the switch (OFF Fresh)
  - Doors: Fully open

CAUTION ⚠

- **When no or low level of refrigerant is checked, stop the air conditioner immediately. Running it with this condition for long time causes the compressor to seize.**

	Normal level	Low level	No refrigerant
Sight glass	P06554 With a careful look, something like mist can be seen flowing.	P06553 Air bubbles are seen flowing at all times. The refrigerant may be transparent or whitish.	 P06552 The refrigerant is almost transparent. Air bubbles may be seen flowing, but they disappear when the engine is revved up and down.
High/low pressure piping	The high pressure piping is hot while the low pressure piping is cold.	The high pressure piping is warm while the low pressure piping is slightly cold.	There is almost no difference in temperature between the high and low pressure piping.

4. Adding Refrigerant



- Add refrigerant in accordance with the following flow chart.

With the adapter valve closed, connect the charge hose to the low pressure service valve.

CAUTION ⚠

- **If the charge hose is connected to the high pressure service valve, refrigerant may flow back, possibly damaging the refrigerant container and charge hose.**

Open and close the adapter valve to bleed air of the charge hose.
After air bleeding is completed, close the adapter valve.

Take the refrigerant container and valve assembly. With the container valve closed, connect the assembly to the adapter valve.

CAUTION ⚠

- **Filling refrigerant into the system in liquid form may damage the compressor. To prevent this, keep the refrigerant container in the upright position so that refrigerant is filled in gas form.**

Open the container valve and then the adapter valve.

Start the engine.

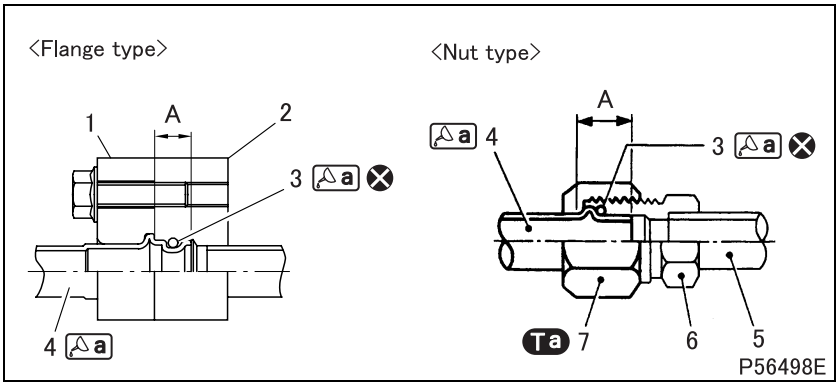
Set the temperature control to MAX COOL. Turn on the air conditioner to run the compressor.

Continue adding refrigerant while observing the sight glass for charge level.

When “normal level” is confirmed through the sight glass, add refrigerant further 50 g {1.76 oz}.

When charging is completed, close the adapter and container valves. Remove the charge hose and the refrigerant container from the low pressure service valve.

If there is still some refrigerant in the container, keep it for the next opportunity. Be sure to keep the container valve closed.



1 Flange (pipe end) <Flange type>
2 Flange (mating end) <Flange type>
3 O-ring
4 Pipe
5 Pipe <Nut type>
6 Union <Nut type>
7 Nut <Nut type>

A: Refrigerating machine oil application area
⊗: Non-reusable parts

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut	11.8 to 14.7 {1.2 to 1.5}	–

Lubricant and/or sealant

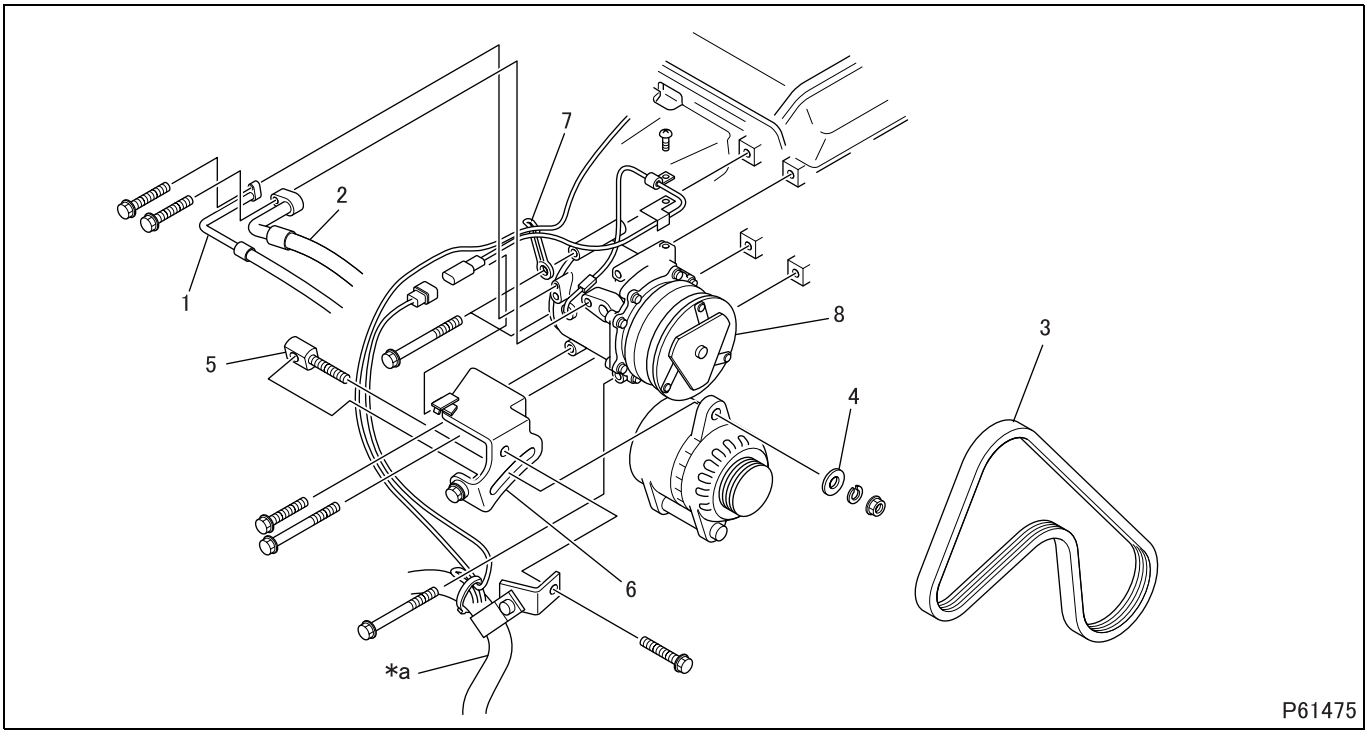
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Refrigerating machine oil SUN PAG56	As required
	Outer periphery of pipe end (area A)		

- There are 2 types of air conditioner pipe/hose connections: flange type and nut type. When connecting/tightening the connections, observe the following precautions.

CAUTION ⚠

- **The connected parts are sealed by the O-ring. Be careful not to damage the O-ring, such as by twisting.**
- **The O-rings are exclusively designed for HFC-134a refrigerant and are not reusable. The O-rings are available at the MITSUBISHI HEAVY INDUSTRIES, LTD. service stations.**
- **Never tighten the nut-type connection by rotating the union. This will deform the piping, allowing refrigerant to leak out. Tighten by rotating the nut while holding the union in position.**

COMPRESSOR



● Disassembly sequence

1 Discharge hose (high pressure side)
(See AIR CONDITIONER PIPE CONNECTING.)
2 Suction hose (low pressure side)
(See AIR CONDITIONER PIPE CONNECTING.)
3 V-ribbed belt
4 Spacer
5 Shaft
6 Adjusting plate
7 Clamp
8 Compressor

***a**: Vehicle harness

CAUTION ⚠

- **Recover the refrigerant before removing the discharge hose and suction hose.**
- **Plug discharge hose, suction hose, and compressor after removal to keep them free from dust etc.**

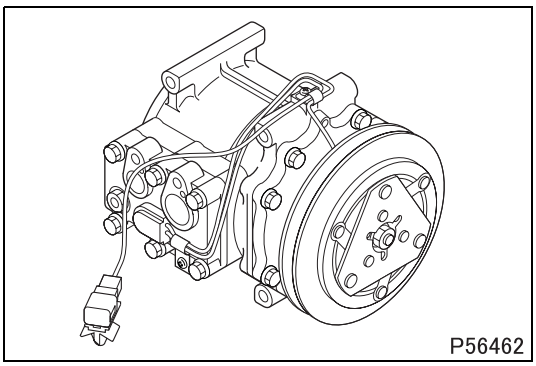
● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- **After installation, tension the V-belt to specification. (See Gr14.)**

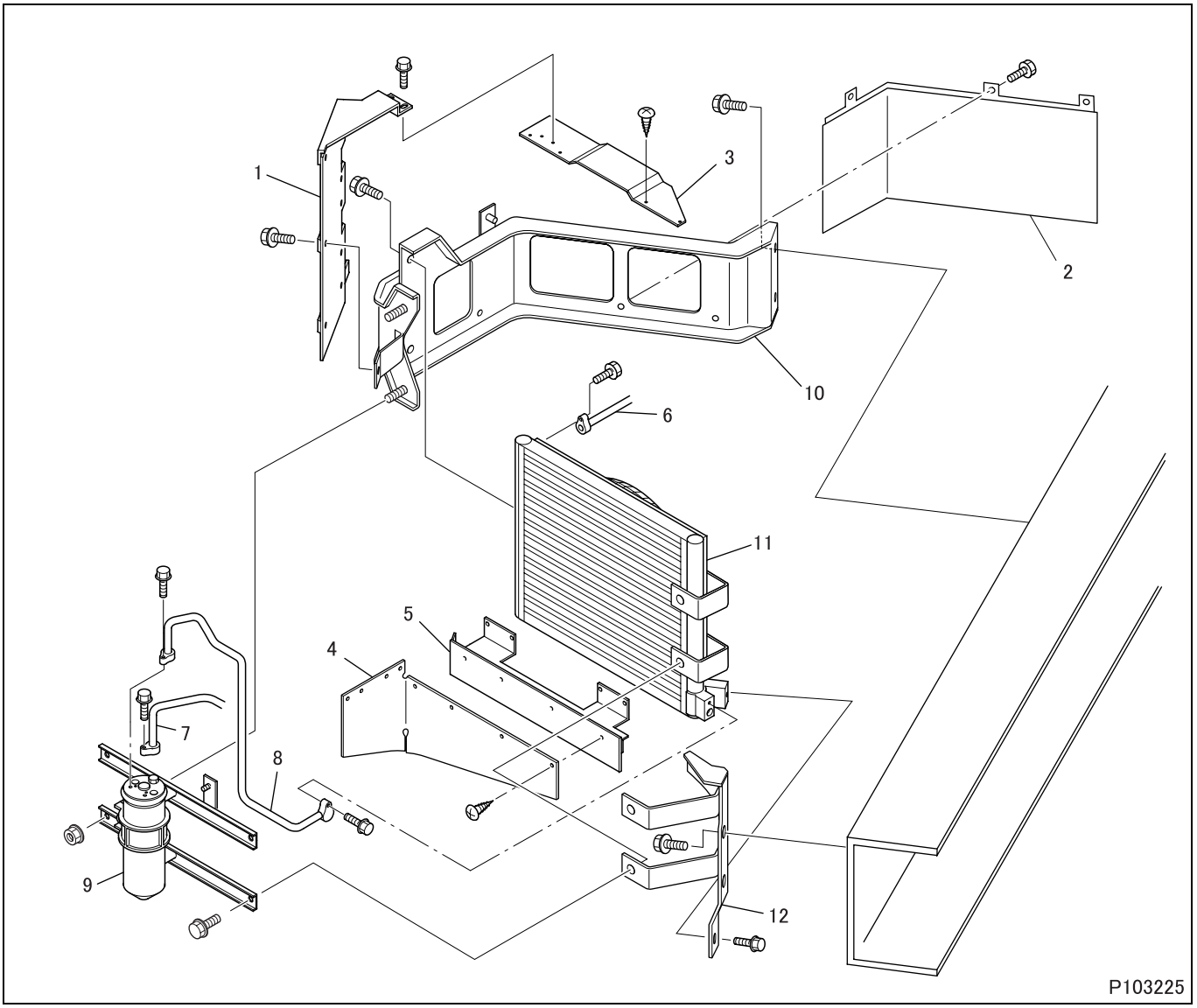
◆Inspection procedure◆



■Inspection: Compressor

- Check the compressor proper for malfunction and oil leakage.
- If there is anything wrong with the compressor, have it overhauled at a nearest MITSUBISHI HEAVY INDUSTRIES, LTD. service station.

CONDENSER, RECEIVER



● Removal sequence

1 Baffle plate
2 Intercept plate
3 Baffle plate (upper)
4 Eva plate
5 Baffle plate (lower)
6 Discharge hose (compressor end)
7 Liquid hose (heater and cooling unit end)
8 Liquid pipe
9 Receiver
10 Condenser rear bracket
11 Condenser
12 Condenser front bracket

● Installation sequence

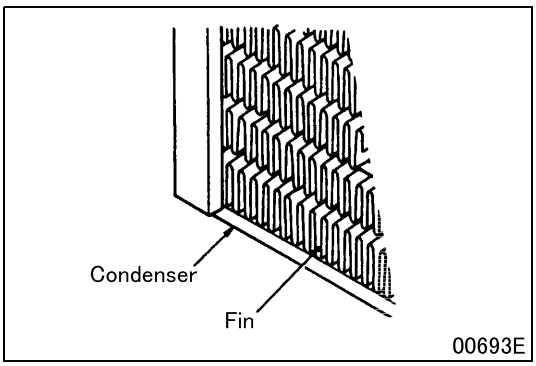
Follow the removal sequence in reverse.

- See the CONNECTING AIR CONDITIONER PIPING section for the installation of hose and pipe.

● Installation sequence

Follow the removal sequence in reverse.

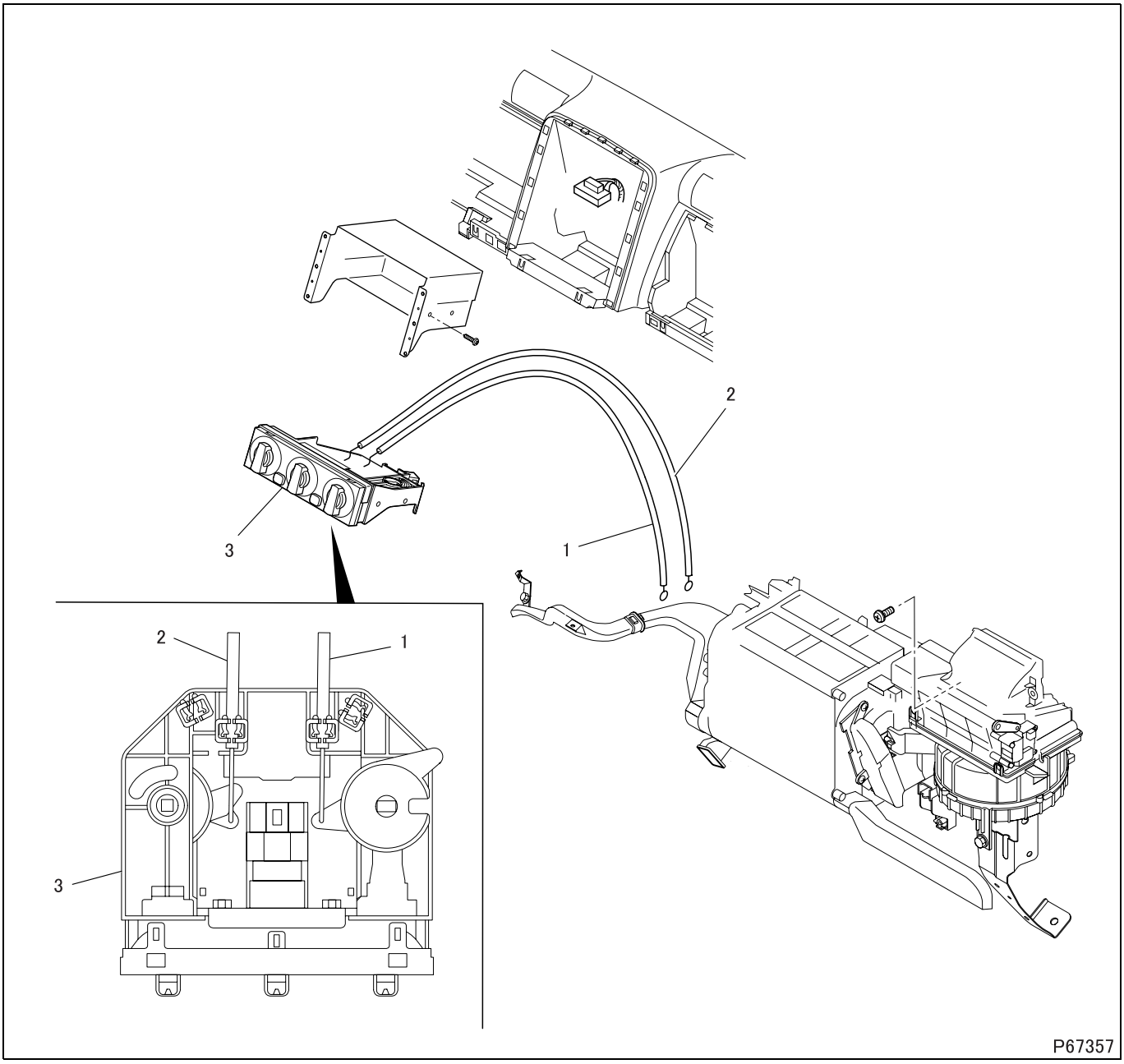
◆Inspection procedure◆



■ Inspection: Condenser

- If the condenser fins are clogged with dirt, dust or other foreign matter, wash it out. Any deformed fins should be straightened using a spatula or the like.

<Left-hand Drive Vehicle>



● Removal sequence

1 Air mix control cable (BLACK)
2 Mode selection control cable (NATURAL)
3 Heater control unit

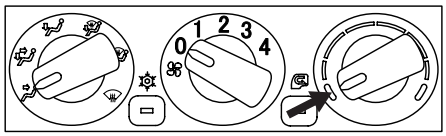
CAUTION ⚠

- **Never remove the cable(s) from the heater control(s) except when the control cable(s) needs to be replaced. Failure to observe this may damage the claws of the cable clip.**

● Installation sequence

Follow the removal sequence in reverse.

◆Work before removal◆

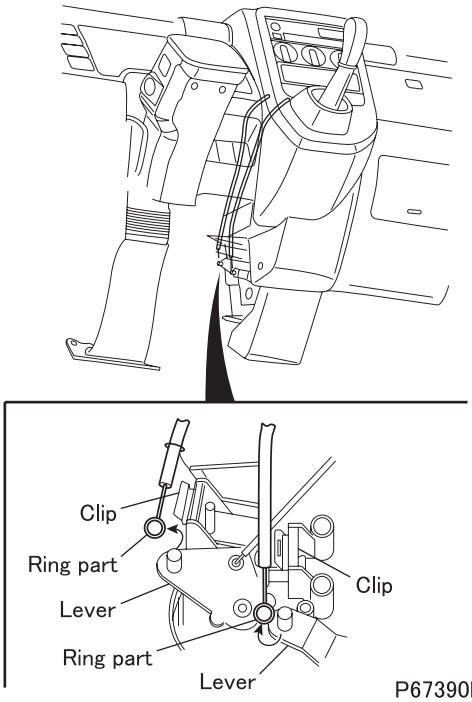


P65915

■ **Adjustment: Temperature control knob**

- Before disconnecting the control cables, turn the temperature control knob of the heater controls to the MAX-COOL position.

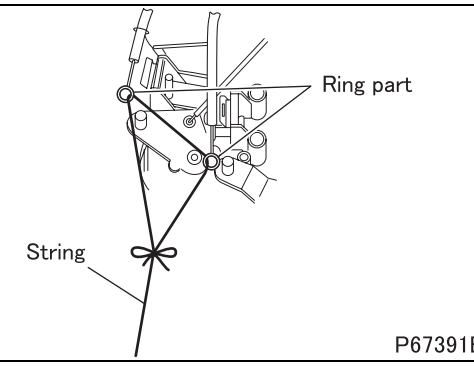
◆Removal procedure◆



P67390E

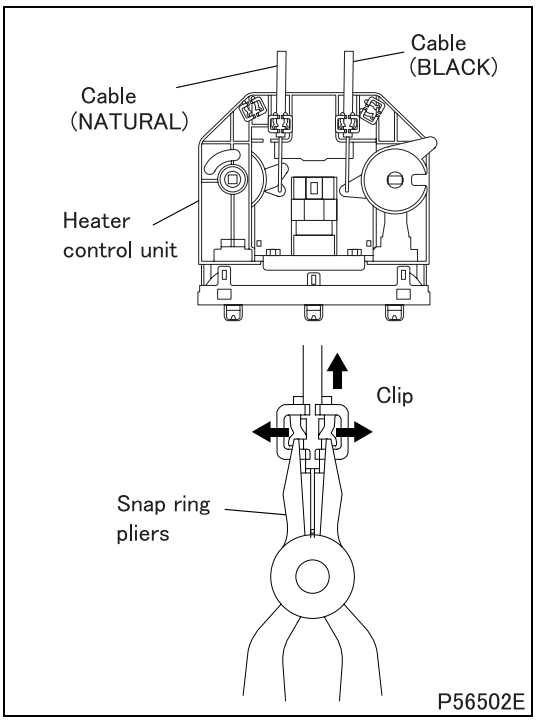
■ **Removal: Control cables**

- Before disconnecting the cables from the levers, put pairing marks on each cable and its lever.
- Disconnect the control cables from the heater unit.



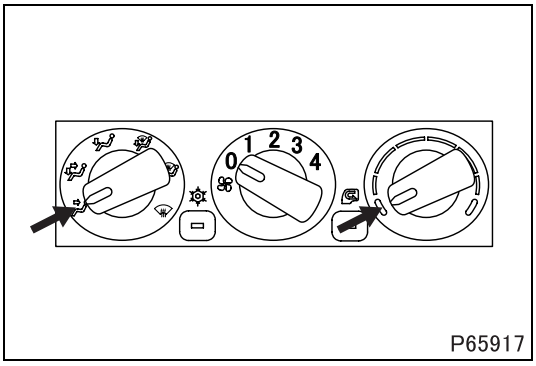
P67391E

- In order that the control cables can be pulled back at the time of installation, attach string to the ring parts of the cables as shown in the illustration.



- Remove the heater control unit from the instrument panel.
- Use snap ring pliers to disconnect the cable(s) from the heater control(s).

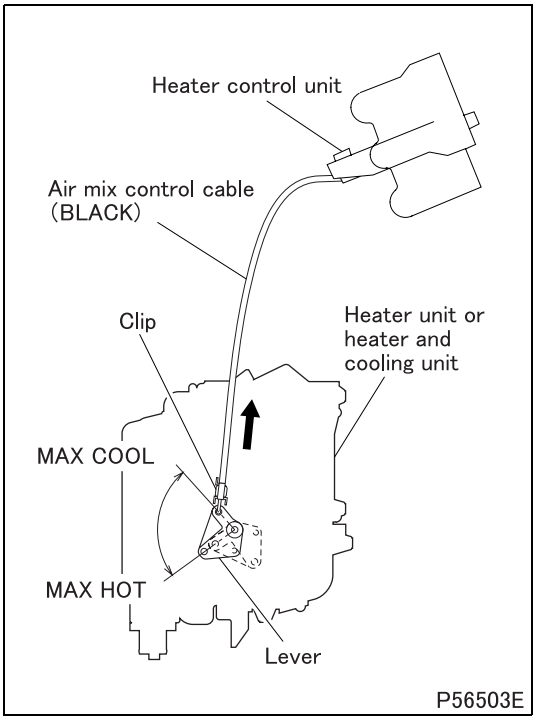
◆Work before installation◆



■Adjustment: Heater control unit knobs

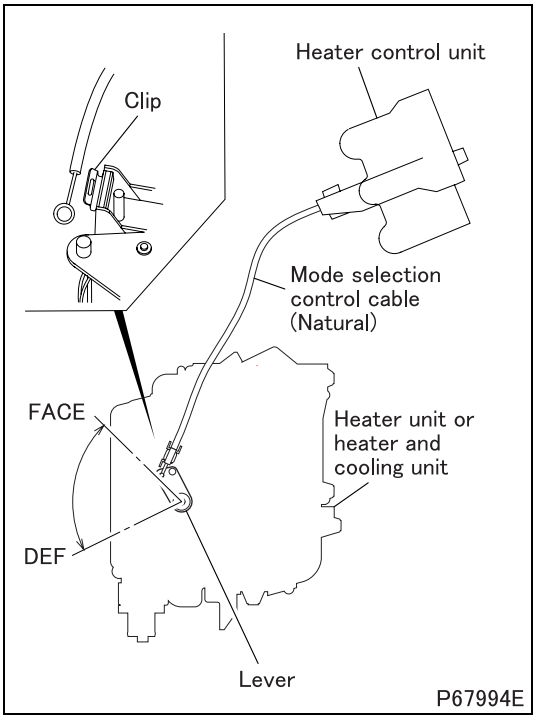
- At the heater controls, turn the temperature control knob to the MAX-COOL position and turn the mode selector knob to the face position before reconnecting the control cables.

◆Installation procedure◆



■ Installation: Air mix control cable

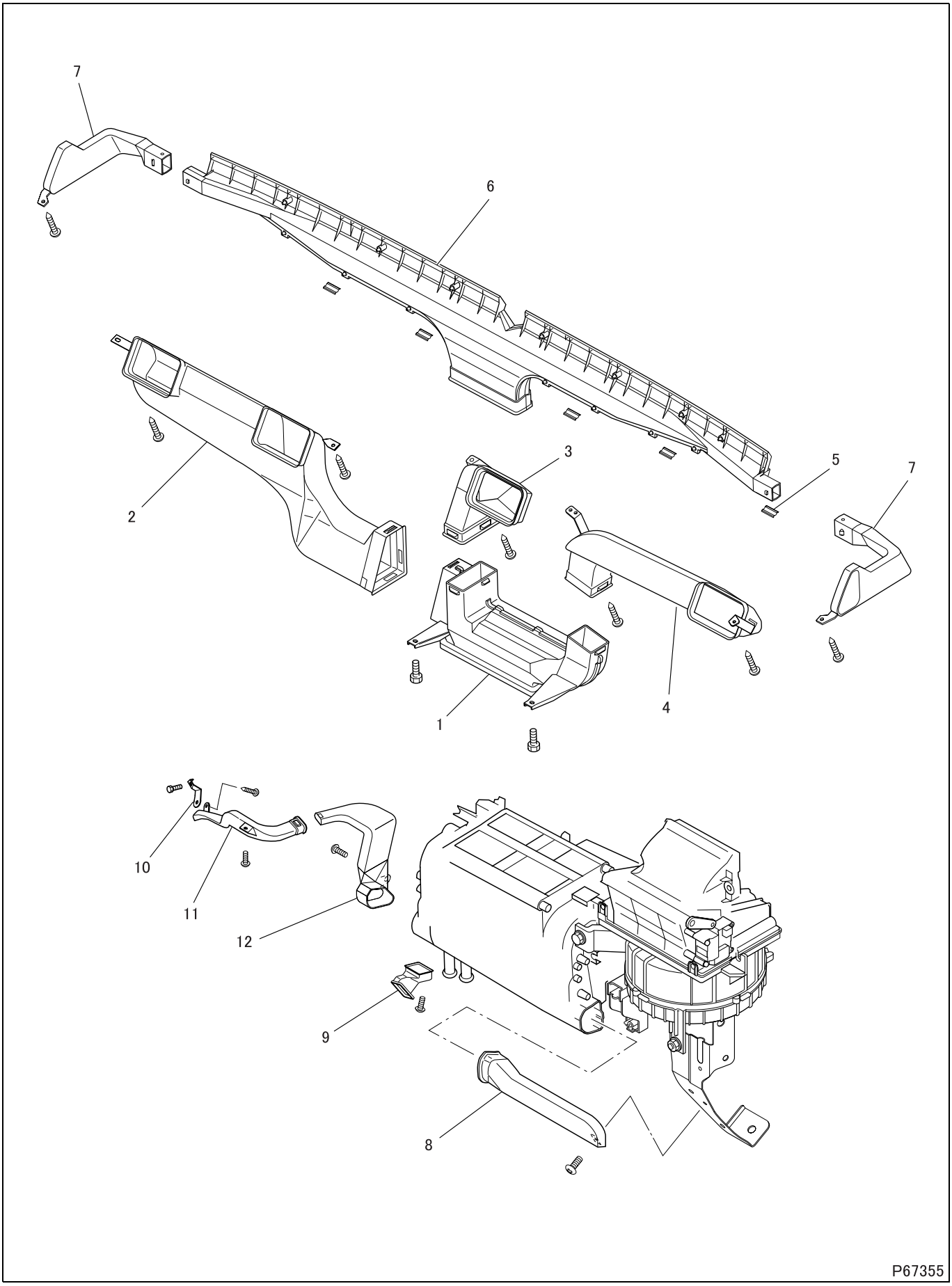
- Install one end of the air mix control cable to the heater control unit.
- Set the unit's temperature control dial to MAX COOL.
- Pull back the control cable using the string attached at the removal procedure.
- Install the other end of the air mix control cable to the lever on the heater unit or heater and cooling unit.
- With the air mix control cable connected to the lever, pull the cable in the direction of the arrow to move the lever to MAX COOL (upper) position. Clip the cable into the position.
- Move the temperature control knob to MAX COOL and MAX HOT. Make sure that the lever moves to the corresponding MAX COOL and MAX HOT positions. If not, repeat the above sequence to correctly install the cable. Also, make sure that the cable being installed is in the correct color.



■ Installation: Mode selection control cable

- Install one end of the mode selection control cable to the heater control unit.
- Set the unit's mode control dial to FACE.
- Pull back the control cable using the string attached at the removal procedure.
- Install the other end of the mode selection control cable to the lever on the heater unit or heater and cooling unit.
- With the mode selection control cable connected to the lever, and push the cable into the clip.
- Move the mode control knob to FACE and DEF. Make sure that the lever moves to the corresponding FACE and DEF positions. If not, repeat the above sequence to correctly install the cable. Also, make sure that the cable being installed is in the correct color.

AIR DUCT



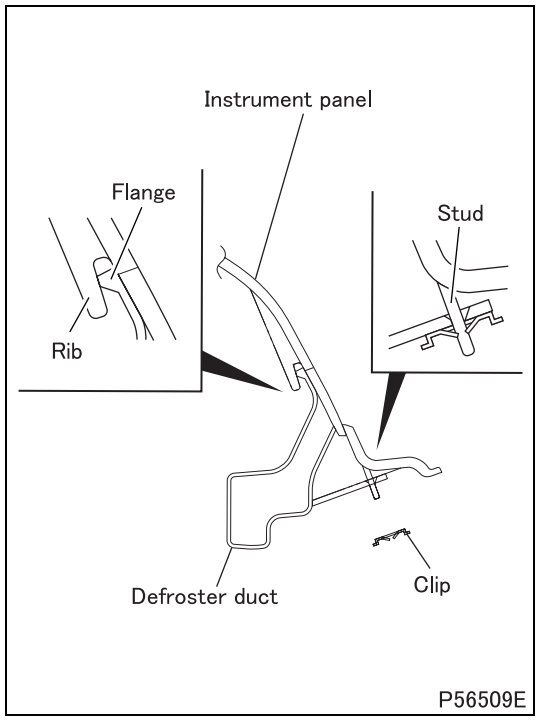
●Removal sequence

1 Center duct
2 Driver face duct
3 Center face duct
4 Passenger face duct
5 Clip (× 7)
6 Front defroster duct
7 Side defroster duct
8 Passenger foot duct
9 Center foot duct
10 Foot duct bracket
11 Driver foot duct B
12 Driver foot duct A

●Installation sequence

Follow the removal sequence in reverse.

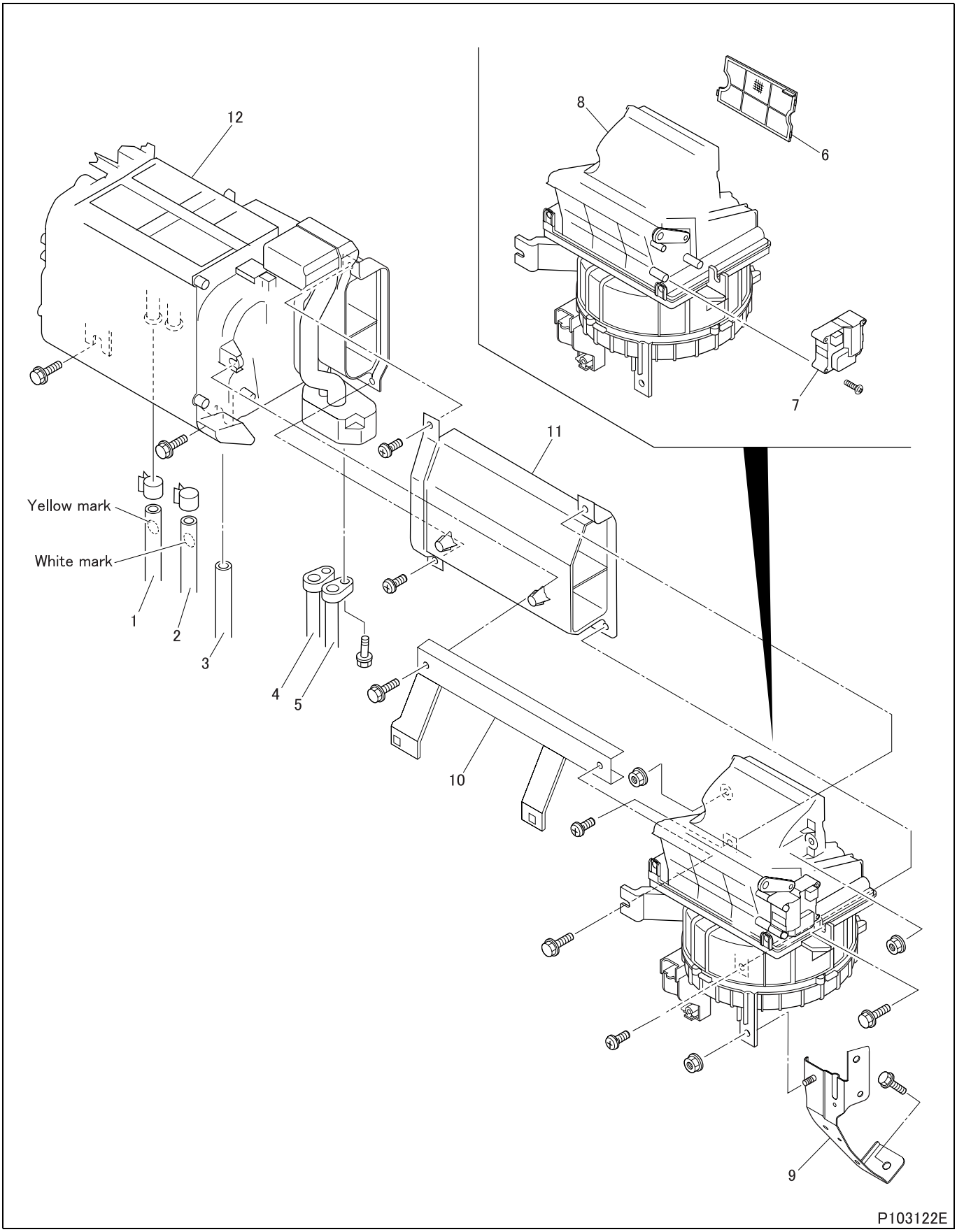
◆Installation procedure◆



■Installation: Front defroster duct

- Insert the front defroster duct flanges into the instrument panel ribs.
- Insert the instrument panel studs into the front defroster duct holes and clip them together.

HEATER AND COOLING UNIT, BLOWER



●Removal sequence

1 Heater hose (outlet)
2 Heater hose (return)
3 Drain hose
4 Discharge hose (high pressure)
5 Suction hose (low pressure)
6 Air filter
7 Fresh/recirculation changeover motor
8 Blower
9 Bracket
10 Bracket
11 Joint duct
12 Heater and cooling unit (See later sections.)

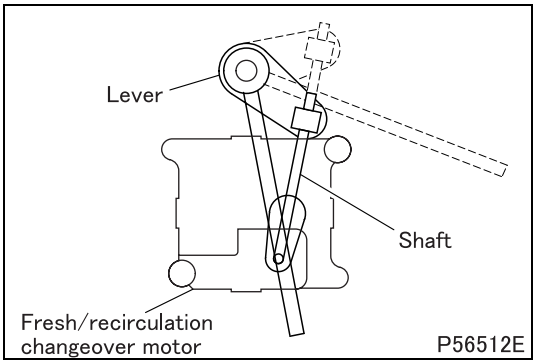
- Remove the front grill before removing hoses. (See Gr51.)
- Drain coolant out of the radiator when removing the heater hoses. (See Gr14.)

●Installation sequence

Follow the removal sequence in reverse.

- See the CONNECTING AIR CONDITIONER PIPING section for the installation of hose and pipe.

◆Installation procedure◆

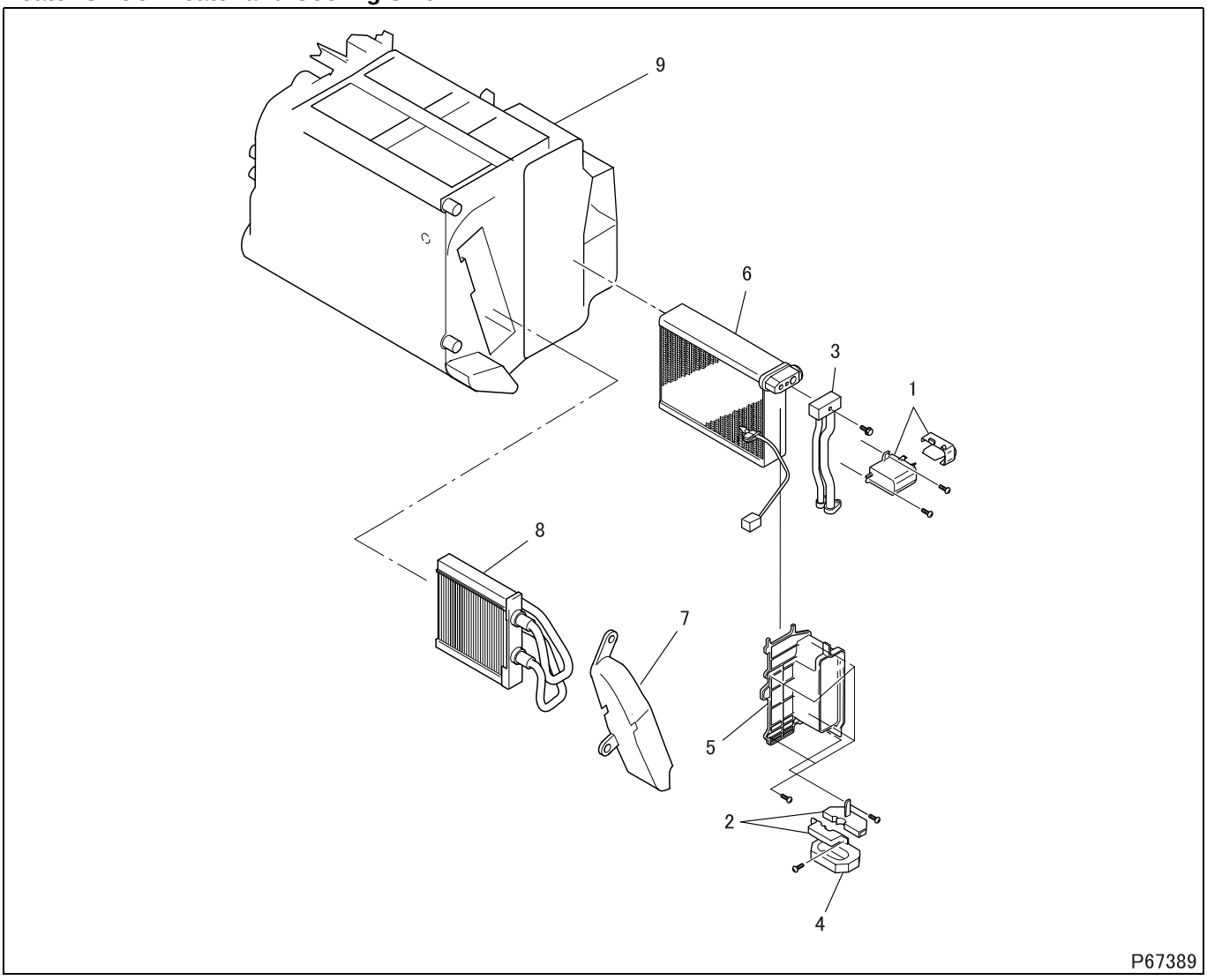


■Installation: Fresh/recirculation changeover motor

- With the lever set to the “Fresh” position, install the motor shaft through the lever.

HEATER AND COOLING UNIT, BLOWER

Heater Unit or Heater and Cooling Unit



● Disassembly sequence

1 Cover <A/C>
2 Baffle cover <A/C>
3 Pipe assembly <A/C>
4 Rubber insulation <A/C>
5 Case cover
6 Evaporator assembly <A/C>
7 Cover
8 Heater core
9 Heater and cooling unit case

<A/C>: With air conditioner

● Assembly sequence

Follow the disassembly sequence in reverse.