

FOREWORD

This workshop manual has been prepared to provide information regarding repair procedures on Hino Trucks.

Applicable for J08E-VB, VC engine

When making any repairs on your vehicle, be careful not to be injured through improper procedures.

As for maintenance items, refer to the Driver's / Owner's Manual.

All information and specifications in this manual are based upon the latest product information available at the time of printing.

Hino Motors Sales U.S.A., Inc. reserves the right to make changes at any time without prior notice.

Hino Motors Sales U.S.A. , Inc.

CHAPTER REFERENCES REGARDING THIS WORKSHOP MANUAL

Use this chart to the appropriate chapter numbers for servicing your particular truck.

CHAPTER	MANUAL NO.	S5-UJ08E09A (U.S.A.), S5-CJ08E09A (CANADA)
	MODEL	J08E-VB, VC
GENERAL INTRODUCTION		GN01-001
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AIR INTAKE SYSTEM		EN03-001
EXHAUST SYSTEM		EN04-001
LUBRICATING SYSTEM		EN05-001
COOLING SYSTEM		EN06-001
FUEL SYSTEM		EN07-001
TURBOCHARGER		EN08-001
EMISSION CONTROL		EN10-001
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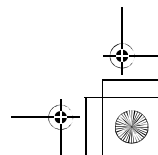
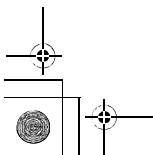
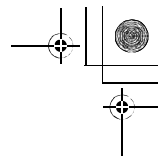
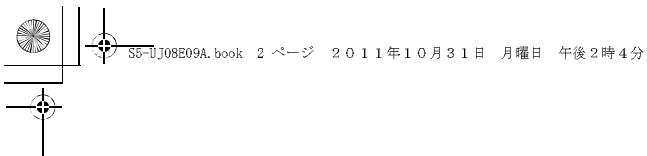
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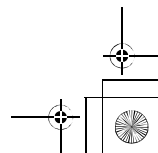
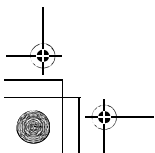
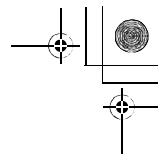
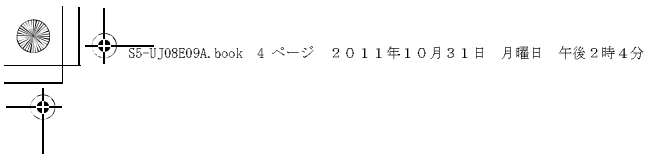




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GENERAL INTRODUCTION (ENGINE)

GENERAL PRECAUTIONS

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Some recommended and standard maintenance services for your engine are included in this section. When performing maintenance on your engine, be careful not to get injured by using improper work procedures. Improper or incomplete work can cause a malfunction of the engine, which may result in personal injury and/or property damage. If you have any questions about performing maintenance, please consult your Hino dealer.

WARNING

When working on your engine, observe the following general precautions to prevent death, personal injury and/or property damage, in addition to the particular DANGERS, WARNINGS, CAUTIONS and NOTICE in each chapter.

- Always wear safety glasses or goggles to protect your eyes.
- Remove rings, watches, ties, loose hanging jewelry and loose clothing before starting work on the vehicle.
- Bind long hair securely behind the head.
- When working on the vehicle, apply the parking brake firmly, place the gear shift lever in "Neutral" or "N" and block the wheels.
- Always stop the engine and turn off the starter switch, unless the operation requires the engine running. Removing the key from the switch is recommended.
- To avoid serious burns, keep yourself away from hot metal parts such as the engine, exhaust manifold, radiator, muffler, exhaust pipe and tail pipe.
- Do not smoke while working on the vehicle, since fuel and gas from battery are flammable.
- Take utmost care when working on the battery. It contains corrosive sulfuric acid.
- Large electric current flows through the battery cable and starter cable. Be careful not to cause a short, which can result in personal injury and/or property damage.
- Read carefully and observe the instructions placed on the jack before using it.
- Use safety stands to support the vehicle whenever you need to work under it. It is dangerous to work under a vehicle supported only by a jack.
- If it is necessary to run the engine after the hood is raised (tilted), make sure that the parking brake is firmly applied, the wheels are blocked, and the gear shift lever is positioned in "Neutral" before starting the engine.
- Run the engine only in a well-ventilated area to avoid inhaling of carbon monoxide.
- Keep yourself, your clothing and your tools away from moving parts such as the cooling fan and V-belt when the engine is running.
- Be careful not to damage lines and hoses by stepping or holding on them.
- Be careful not to leave any tool in the engine compartment. Tools may be hit by moving parts, which can cause personal injury.

DEFINITION OF SAFETY TERMS

 DANGER	Indicates an extremely hazardous situation if proper procedures are not followed and could result in death or serious injury.
 WARNING	Indicates a potential hazardous situation if proper procedures are not followed and could result in death or serious injury.
 CAUTION	Indicates a hazardous situation if proper procedures are not followed and could result in serious injury or damage to parts/equipment.
NOTICE	Indicates the need to follow proper procedures and to pay attention to precautions so that efficient service is provided.
HINT	Provides additional information to help you to perform the repair efficiently.

TOWING

- When being towed, always place the gear shift lever in "Neutral" and release the parking brake completely. In order to protect the bumper, fit a protection bar against the lower edge of the bumper and put a wood block under the frame near the No. 1 crossmember when attaching the towing chain. Never lift or tow the vehicle if the chain is in direct contact with the bumper.

1. Towing procedures

- (1) Make sure that the propeller shaft of the vehicle to be towed is removed. When the differential gear or rear axle shaft is defective, remove both right and left rear axle shafts, then cover the hub opening to prevent loss of axle lubricant and entry of dirt or foreign matter.
- (2) Use a heavy duty cable or rope when towing the vehicle. Fasten the cable securely to the towing hook on the frame. The hook should be used only if the towed vehicle is not loaded.
- (3) The angle of pulling direction of the cable fastened to the towing hook must not exceed 15° in horizontal and vertical directions from the straight ahead, level direction. Avoid using the hook in a way that subjects it to jerk, as in towing a vehicle trapped in a gutter.
- (4) Keep the gear shift lever in "Neutral".
- (5) Make sure that the starter switch is kept in the "ON" position.
- (6) Make sure that the engine of the towed vehicle is kept running. If the engine is off, no compressed air/ no vacuum will be available for the brake. This is dangerous, as the brake system does not function if the engine is not running. In addition, the power steering system will not function. The steering wheel, therefore, will become unusually hard to turn, making it impossible to control the vehicle.
- (7) Note that the engine brake and exhaust brake cannot be applied, if the propeller shaft is removed.
- (8) Make a slow start to minimize shock. Towing speed should be less than 30 km/h {18 mile/h}.

2. If the engine of the towed vehicle is defective, make sure that the vehicle is towed only by a tow truck designed for that purpose.

- (1) Front end towing (with front wheels raised off the ground)
When towing from the front end with the front wheels raised off the ground, remove the rear axle shafts to protect the transmission and differential gears from being damaged. The hub openings should be covered to prevent the loss of axle lubricant or the entry of dirt or foreign matter.
The above-mentioned precautions should be observed for vehicles equipped with either automatic or manual transmission, and for even short distance towing. After being towed, check and refill the rear axle housing with lubricant if necessary.
- (2) Rear end towing
When being towed with the rear wheels raised off the ground, fasten and secure the steering wheel in a straight ahead position.

CLEAN AIR ACT

1. Heavy-duty engine rebuilding practices.

§ 86.004-40

- The provisions of this section are applicable to heavy-duty engines subject to model year 2004 or later standards and are applicable to the process of engine rebuilding (or rebuilding a portion of an engine or engine system). The process of engine rebuilding generally includes disassembly, replacement of multiple parts due to wear, and reassembly, and also may include the removal of the engine from the vehicle and other acts associated with rebuilding an engine. Any deviation from the provisions contained in this section is a prohibited act under section 203(a) (3) of the Clean Air Act (42 U.S.C. 7522(a) (3)).
- (1) When rebuilding an engine, portions of an engine, or an engine system, there must be a reasonable technical basis for knowing that the resultant engine is equivalent, from an emissions standpoint, to a certified configuration (i.e., tolerances, calibrations, specifications) and the model year(s) of the resulting engine configuration must be identified. A reasonable basis would exist if:
 - a. Parts installed, whether the parts are new, used, or rebuilt, are such that a person familiar with the design and function of motor vehicle engines would reasonably believe that the parts perform the same function with respect to emissions control as the original parts; and
 - b. Any parameter adjustment or design element change is made only:
 - In accordance with the original engine manufacturer's instructions; or
 - Where data or other reasonable technical basis exists that such parameter adjustment or design element change, when performed on the engine or similar engines, is not expected to adversely affect in-use emissions.
- (2) When an engine is being rebuilt and remains installed or is reinstalled in the same vehicle, it must be rebuilt to a configuration of the same or later model year as the original engine. When an engine is being replaced, the replacement engine must be an engine of (or rebuilt to) a configuration of the same or later model year as the original engine.
- (3) At time of rebuild, emissions-related codes or signals from on-board monitoring systems may not be erased or reset without diagnosing and responding appropriately to the diagnostic codes, regardless of whether the systems are installed to satisfy requirements in § 86.004-25 or for other reasons and regardless of form or interface. Diagnostic systems must be free of all such codes when the rebuilt engine is returned to service. Such signals may not be rendered inoperative during the rebuilding process.
- (4) When conducting a rebuild without removing the engine from the vehicle, or during the installation of a rebuilt engine, all critical emissions-related components listed in § 86.004-25(2) not otherwise addressed by paragraphs (1) through (3) of this section must be checked and cleaned, adjusted, repaired, or replaced as necessary, following manufacturer recommended practices.
- (5) Records shall be kept by parties conducting activities included in paragraphs (1) through (4) of this section. The records shall include at minimum the mileage and/or hours at time of rebuild, a listing of work performed on the engine and emissions-related control components including a listing of parts and components used, engine parameter adjustments, emissions-related codes or signals responded to and reset, and work performed under paragraph (4) of this section.
 - a. Parties may keep records in whatever format or system they choose as long as the records are understandable to an EPA enforcement officer or can be otherwise provided to an EPA enforcement officer in an understandable format when requested.
 - b. Parties are not required to keep records of information that is not reasonably available through normal business practices including information on activities not conducted by themselves or information that they cannot reasonably access.
 - c. Parties may keep records of their rebuilding practices for an engine family rather than on each individual engine rebuilt in cases where those rebuild practices are followed routinely.
 - d. Records must be kept for a minimum of two years after the engine is rebuilt.

2. Maintenance instructions.

§ 86.010-38

- (1) For each new diesel-fueled engine subject to the standards prescribed in § 86.007-11, as applicable, the manufacturer shall furnish or cause to be furnished to the ultimate purchaser a statement that
"This engine must be operated only with ultra low-sulfur diesel fuel (meeting EPA specifications for highway diesel fuel, including a 15 ppm sulfur cap)."

HOW TO USE THIS WORKSHOP MANUAL

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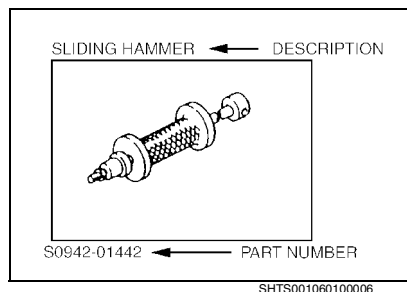
This workshop manual is designed as a guide for servicing the vehicles.
An INDEX is provided on the first page of each chapter.

TRoubleshooting is dealt with in each chapter.

When beginning operations, refer to the TROUBLESHOOTING section for a guide to appropriate diagnoses.

SPECIAL TOOLS are dealt with in each chapter.

When ordering a special tool, confirm the part number with the applicable parts catalog.

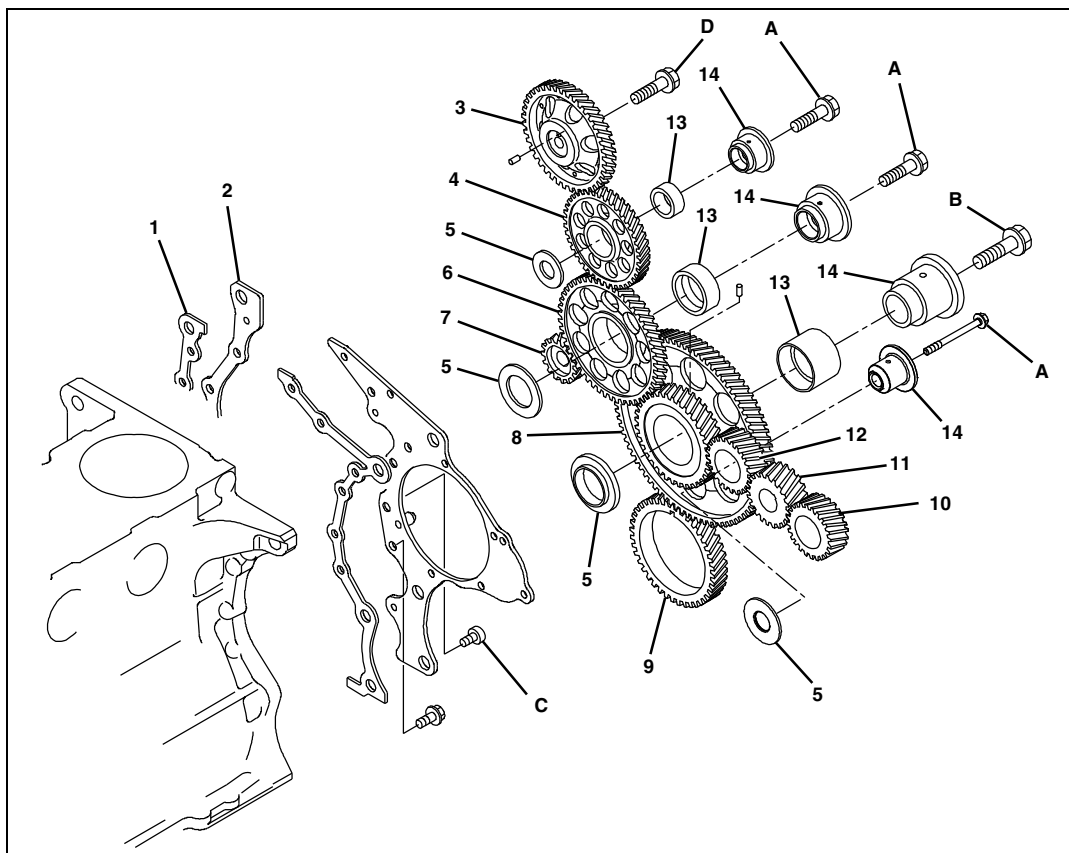


• REPAIR PROCEDURES

Repair procedures when self-explanatory, such as simple installation and removal of parts, have been omitted. Illustrations, such as the one below, have been provided to make such simple procedures clear. Only essential procedures requiring specific directions have been dealt with explicitly.

TIMING GEAR AND CAMSHAFT

EXAMPLE:



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1 Gasket	8 Main idle gear
2 Rear end plate	9 Crankshaft gear
3 Camshaft gear	10 Power steering pump drive gear
4 Cam idle gear	11 Air compressor drive gear
5 Idle gear thrust plate	12 Air compressor idle gear
6 Sub-idle gear	13 Idle drive bushing
7 Oil pump gear	14 Idle gear shaft

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

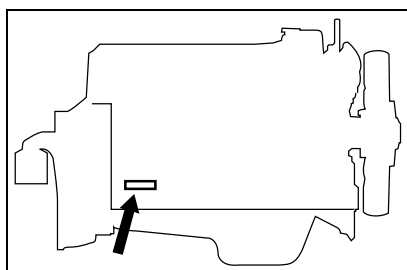
A 108 {1,100, 80}#	C 55 {560, 41} Application of lock sealant
B 172 {1,750, 127}#	D 59 {600, 43}+90°#

#=Apply oil to the threads and seat surfaces before tightening.

In some cases, illustrations may be of parts which differ in some nonessential way from the parts found on your particular vehicle. In such cases, the principle or procedure being illustrated applies regardless of such nonessential differences.

- DEFINITION OF TERMS**

This engine rotates counterclockwise viewed from the flywheel side.



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IDENTIFICATION INFORMATION

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- ENGINE SERIAL NUMBERS.
Please quote these numbers when ordering spare parts or reporting technical matter to receive prompt service attention.
The engine serial number is engraved on the engine cylinder block.

PRECAUTIONS

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PRECAUTIONS FOR ELECTRICAL SYSTEM

1. REMOVING THE BATTERY CABLE

⚠ WARNING

- Be sure to wait for at least ten minutes after the starter key is turned to "LOCK" position before you disconnect the battery terminals from the battery, as the vehicle data is recorded on ECU and DCU starts working for the exhaust gas after treatment after the starter key is turned to "LOCK" position. Otherwise, the vehicle data will not be recorded on ECU properly and DCU will not complete working properly, which may result in the malfunction of DPR system and DEF-SCR system.
- The MIL (malfunction indicator light) may come on when the starter key is turned to "ON" position again, even if you wait for at least ten minutes before disconnecting the battery terminals from the battery after the starter key is turned to "LOCK" position. In this case, use Hino-DX to clear the DTC (P204F and P068A), to turn off the MIL and to conduct DPR regeneration manually.

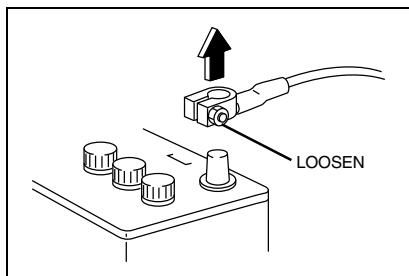
- (1) Before electrical system work, remove the cable from the minus terminal of the battery in order to avoid burning caused by short-circuiting.
- (2) To remove the battery cable, fully release the nut to avoid damage to the battery terminal. Never twist the terminal.

2. HANDLING OF ELECTRONIC PARTS

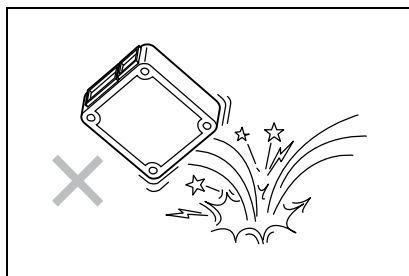
- (1) Never give an impact to electronic parts of a computer or relay.
 - (2) Keep electronic parts away from high temperatures and humidity.
 - (3) Never splash water onto electronic parts in washing the vehicle.
 - (4) Do not remove the harness connector, electric component box, and cover except for repair and inspection.
- If removal is necessary, pay attention that water and foreign matters do not attach or enter to the connector, terminals, electric component box, and cover.
- In restoration, make sure there is no attachment or entry of water and foreign matters and mount them properly, because it causes degradation of waterproof function.

3. HANDLING OF WIRE HARNESS

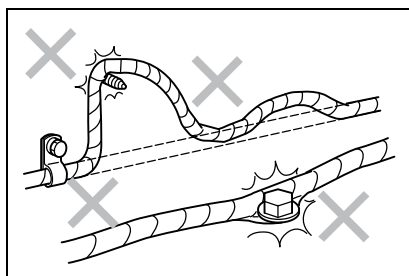
- (1) Perform marking on a clamp and a clip and secure then in original position so that the wire harness will not interfere with the end and acute angle section of the body and a bolt.
- (2) To attach a part, take care not to bite the wire harness.



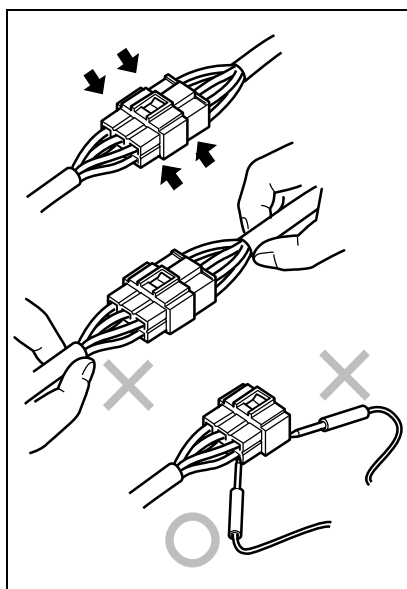
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4. HANDLING OF CONNECTOR

- (1) To remove a connector, hold the connector (indicated by an arrow in the figure) to pull it out. Never pull the harness.
- (2) To remove a connector with lock, release the lock then pull it out.
- (3) To connect a connector with lock, insert it until it clicks.
- (4) To insert a test lead into the connector, insert it from behind the connector.
- (5) In case it is difficult to insert a test lead from behind the connector, prepare a harness for inspection and perform inspection.

5. INSTALLATION OF BATTERY DISCONNECT SWITCH

⚠ WARNING

- Installation of the battery disconnect switch on the power supply circuit for the dosing control unit of DEF-SCR (DCU) may damage or result in the malfunction of DEF-SCR system.
- Be sure to read and follow the procedures and instructions on the service bulletin before the installation of the battery disconnect switch.

6. HANDLING OF BATTERY DISCONNECT SWITCH

⚠ WARNING

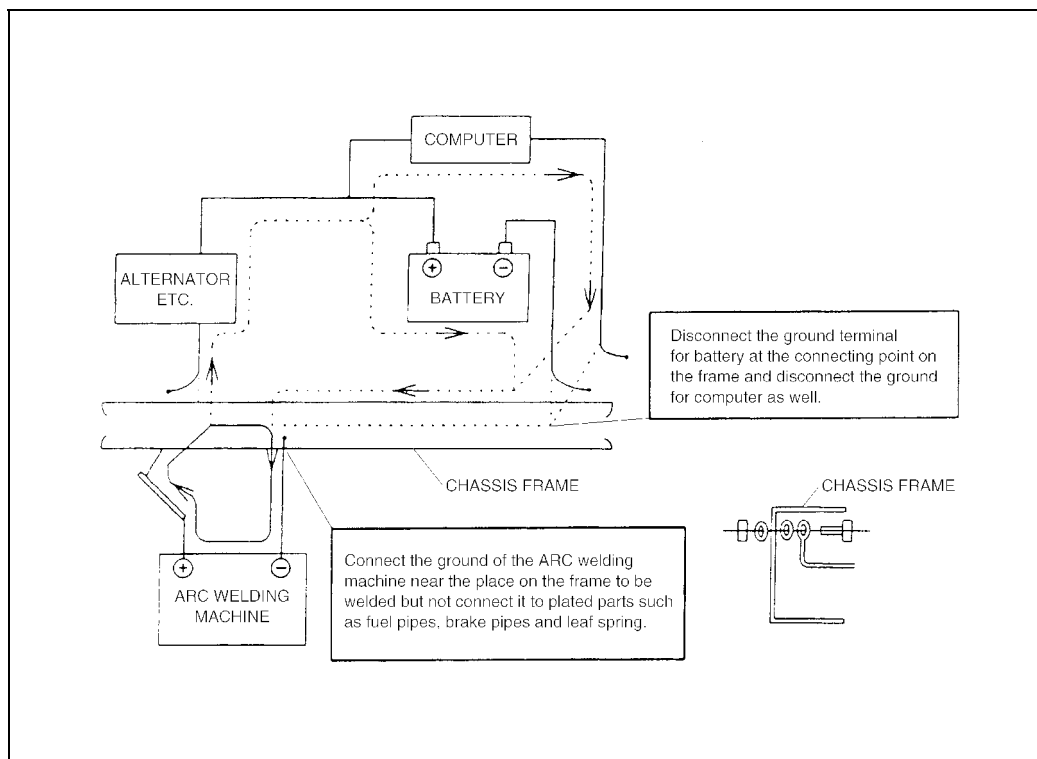
- Wait for at least one minute before using the battery disconnect switch after the starter key is turned to "LOCK" position. Otherwise, the vehicle data will not be recorded on ECU properly, which may result in the malfunction of DPR system.

PRECAUTIONS FOR ELECTRIC WELDING

1. PRECAUTION FOR ELECTRIC WELDING

Electrical components such as the alternator and tachograph are directly connected to the battery and one end is earthed to the chassis frame. Under these conditions, welding current will flow back along the earth circuit if electric welding is carried out and damage may be caused to the alternator, tachograph, electrical components, etc. Consequently, the following precautions are always to be taken during welding.

- (1) Disconnect the earth terminal of the battery at the frame fitment and earth the welding equipment securely to the frame itself. (Do not fit the welding equipment earth to such things as the tire rims, brake pipes or fuel pipes and leaf spring, etc.)
 - a. Turn the starter switch off.
 - b. Disconnect the battery's negative terminal of the battery.
 - c. Earth welding equipment securely, near to the area to be welded.
 - d. Put back battery negative ground as original condition.
 - e. Finally check the functioning of all instruments.



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- (2) In order to prevent damage to ancillary equipment components from sparks during welding, take steps such as putting fire-resistant covers over things like the engine, meters, steering wheel, hoses, tubes, leaf spring and tires.

SPECIFIED TORQUE FOR STANDARD BOLTS AND NUTS

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



1. FLANGE BOLT

Unit: N·m {kgf·cm, lbf·ft}

Class	7T	9T
Representation	 	
Diameter x Pitch		
M8 x 1.25	28.5 {290, 21.0}	36 {370, 26.8}
M10 x 1.25	60 {610, 44.1}	74.5 {760, 55.0}
M10 x 1.5	55 {560, 40.5}	68.5 {700, 50.6}
M12 x 1.25	108 {1,100, 79.6}	136 {1,390, 100.5}
M12 x 1.75	97 {990, 71.6}	125 {1,280, 92.6}
M14 x 1.5	171.5 {1,750, 126.6}	216 {2,210, 159.8}
M14 x 2	154 {1,570, 113.6}	199 {2,030, 146.8}

2. BOLT WITH WASHER

Unit: N·m {kgf·cm, lbf·ft}

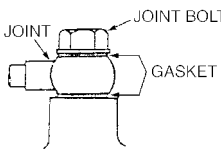
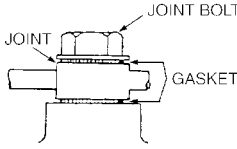
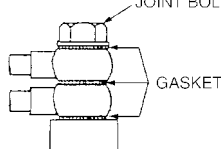
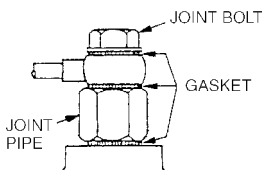
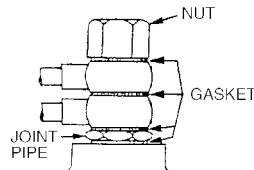
Class	4T	7T	9T
Representation		 	
Diameter x Pitch	No Mark		
M6 x 1	6 {60, 4.3}	10 {100, 7.2}	13 {130, 9.4}
M8 x 1.25	14 {140, 10.1}	25 {250, 18.1}	31 {320, 23.1}
M10 x 1.25	29 {300, 21.7}	51 {520, 37.6}	64 {650, 47.0}
M10 x 1.5	26 {270, 19.5}	47 {480, 34.7}	59 {600, 43.4}
M12 x 1.25	54 {550, 39.8}	93 {950, 68.7}	118 {1,200, 86.8}
M12 x 1.75	49 {500, 36.2}	83 {850, 61.5}	108 {1,100, 79.6}
M14 x 1.5	83 {850, 61.5}	147 {1,500, 108.5}	186 {1,900, 137.4}
M14 x 2	74 {750, 54.2}	132 {1,350, 97.6}	172 {1,750, 126.6}

DISMOUNTING AND MOUNTING

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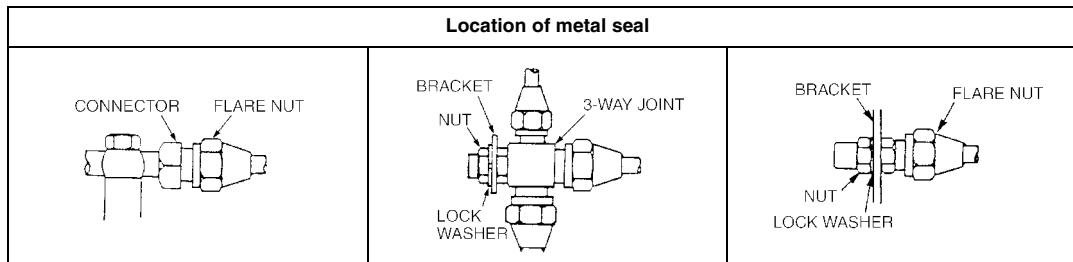
PROCEDURE FOR INSTALLING JOINTS AND GASKETS OF ENGINE PIPING

1. Gasket seal type (aluminum + rubber, asbestos or copper).

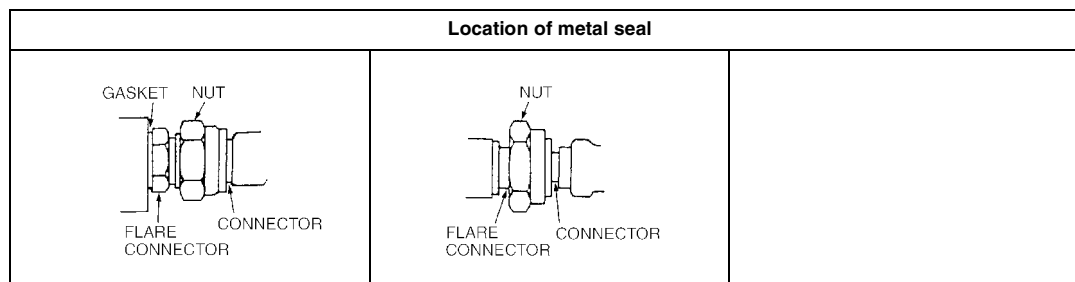
Location of gasket seal		
		
		

Tightening torque chart

Clamping screw size (Diameter) mm {in.}	Tightening torque N-m {kgf-cm, lbf-ft}
8 {0.315}	13 {130, 9}
10 {0.394}	20 {200, 14}
12 {0.472}	25 {250, 18}
14 {0.551}	25 {250, 18}
16 {0.630}	29 {300, 22}
18 {0.709}	39 {400, 29}
20 {0.787}	*39 {400, 29}
24 {0.945}	69 {700, 51}
28 {1.102}	127 {1,300, 94}

2. Metal seal type (Flare connector type).**Location of metal seal****Tightening torque chart**

Clamping screw size (Diameter) mm {in.}	Tightening torque N·m {kgf·cm, lbf·ft}
12 {0.472}	20 {200, 14}
14 {0.551}	31 {320, 23}
16 {0.630}	39 {400, 29}
18 {0.709}	59 {600, 43}
20 {0.787}	64 {650, 47}

3. Metal seal type (Nipple connector type).**Tightening torque chart**

Clamping screw size (Diameter) mm {in.}	Tightening torque N-m {kgf-cm, lbf-ft}
10 {0.394}	11 {110, 8}
24 {0.945}	20 {200, 14}

NOTICE

- Before installing the joints, ensure that there is no dirt or burrs adhering to the various seat faces (pipe joints, gasket, etc.)
- Because the pipes can move relatively freely during installation and the seat faces are liable to tilt, first temporarily tighten the pipes, then tighten them to the specified torque and ensure that there is no leakage from them.
- When tightening two pipes together, be very careful that they do not rotate together.
- After installing the pipes, apply the correct pressure to each pipe joint and ensure that there is no leakage.
- Ensure that the various tightening torques conform to the above table.

*If a soft washer #4840 FR-N (aluminum + rubber and carbon press fit part) is loosened or removed subsequent to being installed, be sure and replace it with a new one.

There is no need to replace it, however, for normal retightening.

SYMPTOM SIMULATION

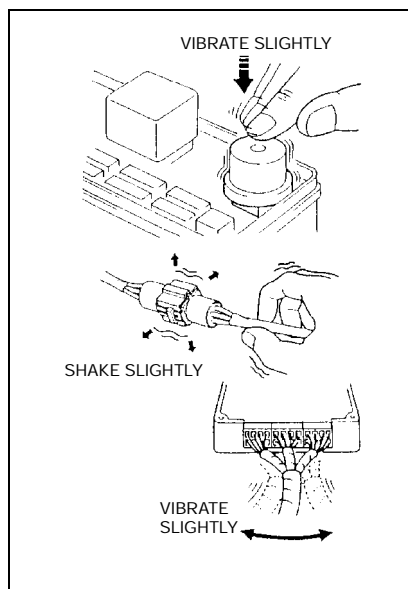
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HINT

The most difficult case in troubleshooting is when no problem symptoms occur. In such a case, a thorough problem analysis must be carried out. A simulation of the same or similar conditions and environment in which the problem occurred in the customer's vehicle should be carried out. No matter how much skill or experience a technician has, troubleshooting without confirming the problem symptoms will lead to important repairs being overlooked and mistakes or delays.

For example:

With a problem that only occurs when the engine is cold or as a result of vibration caused by the road during driving, the problem can never be determined if the symptoms are being checked on a stationary vehicle or a vehicle with a warmed-up engine. Vibration, heat or water penetration (moisture) is difficult to reproduce. The symptom simulation tests below are effective substitutes for the conditions and can be applied on a stationary vehicle. Important points in the symptom simulation test: In the symptom simulation test, the problem symptoms as well as the problem area or parts must be confirmed. First, narrow down the possible problem circuits according to the symptoms. Then, connect the tester and carry out the symptom simulation test, judging whether the circuit being tested is defective or normal. Also, confirm the problem symptoms at the same time. Refer to the problem symptoms table for each system to narrow down the possible causes.



1. VIBRATION METHOD: When malfunction seems to occur as a result of vibration.

(1) PART AND SENSOR

Apply slight vibration with a finger to the part of the sensor suspected to be the cause of the problem, and check whether or not the malfunction occurs.

NOTICE

Applying strong vibration to relays may open relays

(2) CONNECTORS

Slightly shake the connector vertically and horizontally.

(3) WIRE HARNESS

Slightly shake the wire harness vertically and horizontally.

HINT

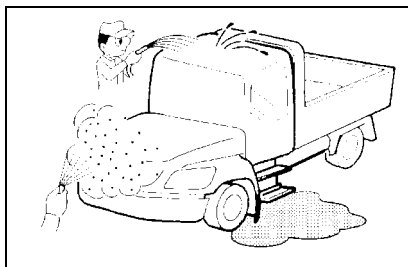
The connector joint and fulcrum of the vibration are the major areas that should be checked thoroughly.

2. HEAT METHOD: When a malfunction seems to occur when the area in question is heated.

- (1) Heat the component that is the possible cause of the malfunction with a hair dryer or similar device. Check if the malfunction occurs.

NOTICE

- Do not heat to more than 60°C (140°F). Exceeding this temperature may damage components.
- Do not apply heat directly to the parts in the ECU.



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3. WATER SPRINKLING METHOD: When a malfunction seems to occur on a rainy day or in high-humidity.

- (1) Sprinkle water onto the vehicle and check if the malfunction occurs.

NOTICE

- Never sprinkle water directly into the engine compartment. Indirectly change the temperature and humidity by spraying water onto the front of the radiator.
- Never apply water directly onto the electronic components.

HINT

If the vehicle has or had a water leakage problem, the leakage may have damaged the ECU or connections. Look for evidence of corrosion or short circuits. Proceed with caution during water tests.

4. HIGH ELECTRICAL LOAD METHOD: When a malfunction seems to occur when electrical load is excessive.

- (1) Turn on the heater blower, headlight, rear window defogger and all other electrical loads. Check if the malfunction reoccurs.

GLOSSARY OF SAE AND HINO TERMS

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This glossary lists all SAE-J2403 terms and abbreviations used in this manual in compliance with SAE recommendation, as well as their HINO equivalents.

SAE ABBREVIATIONS	SAE TERMS	HINO TERMS ()--ABBREVIATIONS
A/T	AUTOMATIC TRANSMISSION	Automatic transmission
AAT	AMBIENT AIR TEMPERATURE	Ambient Air Temperature
ACL	AIR CLEANER	Air cleaner
ACL Element	ACL (Air Cleaner) Element	Air Cleaner element
ACL Element	AIR CLEANER Element	Air Cleaner element
ACL Housing	AIR CLEANER Housing	Air cleaner body assembly
ACL Housing Cover	AIR CLEANER Housing Cover	Air Cleaner Housing Cover
AFTDEF	AFTERTREATMENT DIESEL EXHAUST FLUID	DEF
AFTDEFDU	AFTERTREATMENT DIESEL EXHAUST FLUID DOSING UNIT	DCU
AFTDOC	AFTERTREATMENT DIESEL OXIDATION CATALYST	Oxidation catalyst
AFTDOC	AFTERTREATMENT DIESEL OXIDATION CATALYST	Oxidation Catalytic Converter
AFTDOCDP	AFTERTREATMENT DIESEL OXIDATION CATALYST DIFFERENTIAL PRESSURE	Differential pressure
AFTDOS	AFTERTREATMENT DOSER AFTDOS	Dosing
AFTDPF	AFTERTREATMENT DIESEL PARTICULATE FILTER	DPR filter
AFTDPFDP	Aftertreatment Diesel Particulate Filter Differ- ential Pressure	DPR differential pressure
AFTEGT	AFTERTREATMENT EXHAUST GAS TEM- PERATURE	Exhaust gas temperature
AFTGOC	AFTERTREATMENT GAS OXIDATION CATA- LYST	Oxidation catalyst
AFTGOC	AFTERTREATMENT GAS OXIDATION CATA- LYST	Oxidation Catalytic Converter
AP	ACCELERATOR PEDAL	Accelerator pedal
AP Sensor	ACCELERATOR PEDAL Sensor	Accelerator Pedal Position Sensor
APP	ACCELERATOR PEDAL POSITION	Accelerator Pedal Position
CAC	CHARGE AIR COOLER	Intercooler
CPP Switch	CLUTCH PEDAL POSITION Switch	Clutch Switch
DCC	DIAGNOSTIC CONNECTOR, Cab	Diagnosis connector
DCU	DIAGNOSTIC CONNECTOR, Underhood	Diagnosis connector
DRIVER	DRIVER	driver

GN01-18

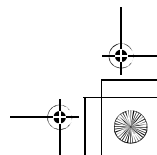
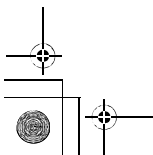
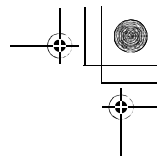
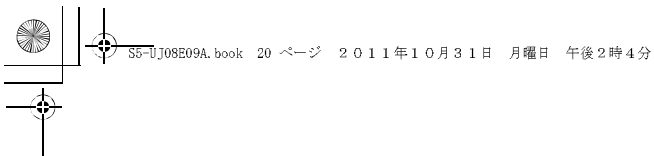
GENERAL INTRODUCTION (ENGINE)

SAE ABBREVIATIONS	SAE TERMS	HINO TERMS ()--ABBREVIATIONS
DTC	DIAGNOSTIC TROUBLE CODE	Diagnosis Trouble Code
DTM Switch	DIAGNOSTIC TEST MODE Switch	Diagnosis switch
EBP	EXHAUST BACK PRESSURE	Backpressure
EBP	EXHAUST BACK PRESSURE	Exhaust backpressure
EBP Sensor	EXHAUST BACK PRESSURE Sensor	Back Pressure Sensor
EBPR Valve	EXHAUST BACK PRESSURE REGULATOR Valve	Exhaust control valve
EC	ENGINE CONTROL	Engine control
ECT	ENGINE COOLANT TEMPERATURE	Coolant Temperature
ECT	ENGINE COOLANT TEMPERATURE	Water Temperature
EFT	ENGINE FUEL TEMPERATURE	Fuel temperature
EFT Sensor	ENGINE FUEL TEMPERATURE Sensor	Fuel temperature sensor
EGR	EXHAUST GAS RECIRCULATION	EGR
EGR Valve	EXHAUST GAS RECIRCULATION Valve	EGR valve
EGRT	EXHAUST GAS RECIRCULATION TEMPERATURE	EGR temperature
EGRT Sensor	EXHAUST GAS RECIRCULATION TEMPERATURE Sensor	EGR exit temperature sensor
EGT	EXHAUST GAS TEMPERATURE	Exhaust Temperature
EGT	EXHAUST GAS TEMPERATURE	Exhaust gas temperature
EI	ELECTRONIC IGNITION	Ignition coil
EOP	ENGINE OIL PRESSURE	Oil Pressure
EOT	ENGINE OIL TEMPERATURE	Oil Temperature
FP	FUEL PUMP	Fuel pump
FUEL PRESSURE Sensor	FUEL PRESSURE Sensor	Fuel Pressure sensor
GLOW PLUG	GLOW PLUG	Glow plug
GND	GROUND	GROUND
IA	INTAKE AIR	Air Intake
IA System	INTAKE AIR System	Air Intake System
IAT	INTAKE AIR TEMPERATURE	Intake temperature
IAT Sensor	INTAKE AIR TEMPERATURE Sensor	Intake temperature sensor
IDLE	IDLE	idle
IMAT	INTAKE MANIFOLD AIR TEMPERATURE	Intake manifold Air temperature sensor
IMAT	INTAKE MANIFOLD TEMPERATURE	Intake manifold temperature sensor
INJ	INJECTOR	Injector

GENERAL INTRODUCTION (ENGINE)

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SAE ABBREVIATIONS	SAE TERMS	HINO TERMS ()--ABBREVIATIONS
MAF Sensor	MASS AIR FLOW Sensor	Air flow sensor
MIL	MALFUNCTION INDICATOR LAMP	Check engine
OSS Sensor	OUTPUT SHAFT SPEED Sensor	Output Speed Sensor
OSS Sensor	OUTPUT SHAFT SPEED Sensor	Speed Sensor
PC Solenoid Valve	PRESSURE CONTROL Solenoid Valve	Solenoid control valves
PCV	POS CRANKCASE VENTILATION	PCV (Positive Crankcase Vent)
PCV Valve	POS CRANKCASE VENTILATION Valve	PCV (Positive Crankcase Vent) Valve
PCV Valve	POS CRANKCASE VENTILATION Valve	PCV Valve
PCV Valve	POSITIVE CRANKCASE VENT Valve	PCV Valve
PNP	PARK/NEUTRAL POSITION	Neutral position
PNP Switch	PARK/NEUTRAL POSITION Switch	Neutral switch
RFP	RAIL FUEL PRESSURE	Common rail Pressure
RFP Sensor	RAIL FUEL PRESSURE Sensor	Common rail pressure sensor
SPARK PLUG	SPARK PLUG	Spark plug
SRI	SERVICE REMINDER INDICATOR	Check engine
ST	SCAN TOOL	Diagnostic tool
TC	TURBOCHARGER	Turbocharger
TCC	TORQUE CONVERTER CLUTCH	Torque Converter
TP Sensor	THROTTLE POSITION Sensor	Throttle Sensor
TSS Sensor	TURBINE SHAFT SPEED Sensor	Turbine Speed Sensor
VAF Sensor	VOLUME AIR FLOW Sensor	Air flow sensor
VLS	VEHICLE LIMITING SPEED	Speed Limiter Upper Limit
VSS	VEHICLE SPEED SENSOR	Vehicle Speed sensor



ENGINE INTRODUCTION (J08E)

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ENGINE ASSEMBLY EN01-2

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ENGINE ASSEMBLY

DATA AND SPECIFICATIONS

EN01106011200001

Model		J08E-VC
Type		Diesel, 4 cycle, vertical, 6 cylinder, in-line overhead camshaft, water-cooled, direct injection
Aspiration		Turbocharged with intercooler
Bore and stroke		112x130 mm {4.41x5.11 in.}
Piston displacement		7.684 L {468.9 cu.in.}
Compression ratio		17.5: 1
Firing order		1-4-2-6-3-5 (The cylinder numbers are counted in order from the crankshaft pulley side)
Direction of rotation		Counterclockwise viewed from flywheel
Compression pressure		3.2-3.4 MPa {33-35 kgf/cm², 467-496 lbf/in.²} at 150 r/min
Maximum revolution (at full load)		2,600 r/min
Idling revolution		750 r/min
Dry weight		Approximately 640 kg {1,411 lb}
Valve seat angle	Intake	30°
	Exhaust	45°
Valve face angle	Intake	30°
	Exhaust	45°
Valve timing (flywheel travel)	Intake opens	14° before top dead center
	Intake closes	30° after bottom dead center
	Exhaust opens	54° before bottom dead center
	Exhaust closes	13° after top dead center
Valve clearance (when cold)	Intake	0.30 mm {0.0118 in.}
	Exhaust	0.45 mm {0.0177 in.}
Engine oil pump	Type	Full forced pressure feed by gear pump
	Drive	By gear
Engine oil cooler		Multi-plate type, water cooled
Injector	Type	Multi-hole nozzle type
Coolant pump	Type	Forced circulation by volute pump
	Drive	By V-belt
Thermostat Type		Wax.type, bottom bypass system
Injection timing (flywheel travel)		0° before top dead center for No.1 cylinder of the compression stroke

Model		J08E-VB
Type		Diesel, 4 cycle, vertical, 6 cylinder, in-line overhead camshaft, water-cooled, direct injection
Aspiration		Turbocharged with intercooler
Bore and stroke		112x130 mm {4.41x5.11 in.}
Piston displacement		7.684 L {468.9 cu.in.}
Compression ratio		17.5: 1
Firing order		1-4-2-6-3-5 (The cylinder numbers are counted in order from the crankshaft pulley side)
Direction of rotation		Counterclockwise viewed from flywheel
Compression pressure		3.2-3.4 MPa {33-35 kgf/cm², 467-496 lbf/in.²} at 150 r/min
Maximum revolution (at full load)		2,600 r/min
Idling revolution		750 r/min
Dry weight		Approximately 645 kg {1,422 lb}
Valve seat angle	Intake	30°
	Exhaust	45°
Valve face angle	Intake	30°
	Exhaust	45°
Valve timing (flywheel travel)	Intake opens	14° before top dead center
	Intake closes	30° after bottom dead center
	Exhaust opens	54° before bottom dead center
	Exhaust closes	13° after top dead center
Valve clearance (when cold)	Intake	0.30 mm {0.0118 in.}
	Exhaust	0.45 mm {0.0177 in.}
Engine oil pump	Type	Full forced pressure feed by gear pump
	Drive	By gear
Engine oil cooler		Multi-plate type, water cooled
Injector	Type	Multi-hole nozzle type
Coolant pump	Type	Forced circulation by volute pump
	Drive	By V-belt
Thermostat Type		Wax.type, bottom bypass system
Injection timing (flywheel travel)		0° before top dead center for No.1 cylinder of the compression stroke

TROUBLESHOOTING

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Engine overheating

Symptom	Possible cause	Remedy/Prevention
Engine overheating (Coolant)	Insufficient coolant	Add coolant
	Defective thermostat	Replace thermostat
	Overflow of coolant due to leakage of exhaust into cooling system	Repair
	Damaged rubber hose	Replace rubber hose
	Coolant leakage due to deteriorated rubber hose	Replace rubber hose
	Coolant leakage from coolant pump	Replace the coolant pump
	Coolant leakage from rubber hose connection	Retighten or replace clamp
	Coolant leakage from cylinder head gasket	Replace gasket
Engine overheating (Coolant pump)	Bearing seizure	Replace
	Damaged (corroded) vane	Replace vane
Engine overheating (Radiator)	Clogged with rust or scale	Clean radiator
	Clogged with iron oxide due to leakage of exhaust into cooling system	Clean coolant passage and correct exhaust leakage
	Coolant leakage	Repair or replace radiator
	Damaged cooling fan	Replace cooling fan
	Clogged radiator core due to mud or other debris	Clean radiator
	Defective radiator cap pressure valve	Replace radiator cap
Engine overheating (Abnormal combustion)	Poor fuel	Use good quality fuel
	Breakdown of injector	Replace the injector
Engine overheating (Other problems)	Defective or deteriorated engine oil	Change engine oil
	Unsatisfactory operation of oil pump	Replace or repair
	Insufficient oil	Add oil
	Brake drag	Repair or adjust
	Break water temperature sensor	Replace it
Engine overheating (Severe operating condition)	Lugging the engine	Operate engine properly

Excessive oil consumption

Symptom	Possible cause	Remedy/Prevention
Excessive oil consumption (Pistons, cylinder liners, and piston rings)	Wear of piston ring and cylinder liner	Replace piston rings and cylinder liner
	Worn, sticking or broken piston rings	Replace piston rings and cylinder liner
	Insufficient tension on piston rings	Replace piston rings and cylinder liner
	Unsatisfactory breaking in of piston rings	Replace piston rings and cylinder liner
	Unsuitable oil (viscosity too low)	Change oil as required and replace piston rings and cylinder liners
	Incorrectly fitted piston rings (upside down)	Replace piston rings
	Gaps of piston rings in cell with each other	Reassemble piston rings
Excessive oil consumption (Valve and valve guides)	Worn valve stem	Replace valve and valve guide
	Worn valve guide	Replace valve guide
	Incorrectly fitted valve stem seal	Replace the stem seal
	Excessive lubricant on rocker arm	Check clearance of rocker arm and shaft
Excessive oil consumption (Excess oil feed)	Defective oil level gauge	Replace oil level gauge
	Oil level too high	Drain excess oil
Excessive oil consumption (Oil leakage from miscellaneous parts)	Oil leakage from oil seal	Replace oil seal
	Cracks or blowhole in cylinder block	Replace cylinder block
	Oil leakage from connections of oil lines	Tighten connections of oil lines
	Oil leakage from oil cooler	Replace oil cooler
	Oil leakage from oil pan gasket	Replace oil pan gasket
	Oil leakage from O-ring	Replace O-ring
Excessive oil consumption (Other problems)	Overcooled engine (low temperature wear)	Warm up engine before moving vehicle. Check cooling system.

NOTICE

If oil consumption is excessive, the problems above will occur. Complaints from the customer are often related to such problems.

1. White smoke is emitted continuously when the engine is run at high speed.
2. White smoke is emitted only immediately after the engine speed is abruptly raised when idling.
3. The tail pipe is blackened with oil.
4. Oil leaks from the flanges of the exhaust manifold.
5. Lack of power.

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ENGINE INTRODUCTION (J08E)

Piston seizure

Symptom	Possible cause	Remedy/Prevention
Piston seizure (Pistons, cylinder liners and piston rings)	Incorrect clearance between piston and cylinder liner	Replace piston, piston rings and cylinder liner
	Unsatisfactory installation of piston pin	Replace piston, piston rings, cylinder liner and piston pin as required
	Broken piston ring	Replace piston, piston rings and cylinder liner
	Difference in expansion due to use of wrong piston	Replace piston, piston rings and cylinder liner
Piston seizure (Coolant)	Reduction in capacity of coolant pump (due to vane corrosion)	Replace the coolant pump
	Leakage of coolant	Repair
	Insufficient coolant	Add coolant
	Dirty coolant	Clean and replace coolant
	Defective radiator (coolant leakage, clogging)	Repair or replace the radiator
	Defective rubber hose (leakage)	Replace rubber hose
	Defective thermostat	Replace the thermostat
	Leakage of exhaust into cooling system	Repair
Piston seizure (Operation)	Abrupt stoppage of engine after running at high speed	Operate engine properly
	Hill climbing using unsuitable gear	Select suitable gear
Piston seizure (Oil)	Insufficient oil	Add oil
	Dirty oil	Change oil
	Poor quality oil	Replace with proper engine oil
	High oil temperature	Repair
	Low oil pressure	Repair
	Defective oil pump	Repair oil pump
	Reduced performance due to worn oil pump	Replace oil pump
	Suction strainer sucking air	Add oil and/or repair strainer
Piston seizure (Abnormal combustion)	Use of defective fuel	Change fuel
	Engine overheating	See Symptom: " Engine overheating "
	Breakdown of injector	Replace the injector

NOTICE

If piston seizure occurs, the problems above will occur. Complaints from the customer are often related to these problems.

1. White smoke is emitted.
2. Lack of power

Lack of power

Symptom	Possible cause	Remedy/Prevention
Lack of power (Supply pump)	Damaged suction control valve (SCV)	Replace the suction control valve (SCV)
	Use of poor fuel	Use good quality fuel
Lack of power (Intake)	Clogged air cleaner	Clean element or replace element
Lack of power (Overheating)		See Symptom: " Engine overheating "
Lack of power (Fuel and injector)	Air in fuel system	Repair and bleed air from fuel system
	Clogged fuel filter	Replace element
	Use of poor fuel	Use good quality fuel
	Breakdown of injector	Replace the injector
Lack of power (Pistons, cylinder liners and piston rings)	Seized or wear of piston	Replace the piston, piston rings and liner
	Worn or broken piston rings, piston and cylinder liner	Replace piston rings, piston and liner
Lack of power (Other problems)	Exhaust brake butterfly valve stuck in half-open position	Replace or repair exhaust brake
	Connecting rod bent	Replace or repair connecting rod
	Exhaust pipe or muffler crushed (increased back-pressure)	Replace exhaust pipe or muffler
	Breakage of turbine or blower	Replace turbocharger

Leakage of exhaust

Symptom	Possible cause	Remedy/Prevention
Leakage of exhaust (Head gasket)	Fatigued gasket (aging)	Replace gasket
	Damage	Replace gasket
	Improper installation	Replace gasket
Leakage of exhaust (Head bolts)	Loose bolts	Tighten bolts
	Elongated bolts	Replace bolts
	Improper tightening torque or tightening sequence	Tighten properly
Leakage of exhaust (Cylinder block)	Cracking	Replace cylinder block
	Surface distortion	Repair or replace
	Fretting of cylinder liner insertion portion (insufficient projection of cylinder liner)	Replace cylinder block
Leakage of exhaust (Cylinder head)	Cracking	Replace cylinder head
	Surface distortion	Repair or replace
Leakage of exhaust (Cylinder liners)	Cracking	Replace cylinder liner
	Corrosion	Replace cylinder liner
	Insufficient projection of cylinder liner	Replace cylinder liner

NOTICE

If leakage of the exhaust occurs, the problems above will occur. Complaints from the customer are often related to these problems.

1. Lack of power.
2. The engine overheats.
3. The coolant is discolored.

EN01-8

ENGINE INTRODUCTION (J08E)

Difficulty starting engine

Symptom	Possible cause	Remedy/Prevention
Difficulty starting engine (Electrical system)	Discharged battery	Charge battery
	Defective wiring in starter circuit	Repair wiring of starter
	Loose or open-circuit battery cable	Tighten battery terminal connections or replace battery cable
	Broken glow plug	Replace
Difficulty starting engine (Supply pump)	Defective supply pump	Replace the supply pump
	Use of poor fuel	Use good quality fuel
Difficulty starting engine (Air cleaner)	Clogged element	Replace the element
Difficulty starting engine (Fuel system)	No fuel in tank	Supply fuel
	Clogged fuel line	Clean fuel line
	Air sucked into fuel system through fuel line connections	Tighten fuel line connections
	Clogged fuel filter	Replace element
	Loose connection in high-pressure line	Tighten sleeve nut of high-pressure line
	Water in fuel	Drain and clean fuel system
Difficulty starting engine (Oil system)	Oil viscosity too high	Use proper viscosity oil, or install an oil immersion heater and warm up oil
Difficulty starting engine (Other problems)	Seized piston	Replace piston, piston rings, and liner
	Seized bearing	Replace bearing and/or crankshaft
	Reduced compression pressure	Overhaul engine
	Ring gear damaged or worn	Replace the ring gear and/or starter pinion
	Improperly adjusted or broken	Adjust

Rough idling

Symptom	Possible cause	Remedy/Prevention
Rough idling (Supply pump)	Damaged suction control valve	Replace the supply pump
	Use of poor fuel	Use good quality fuel
Rough idling (Injector)	Breakdown of injector	Replace the injector
	Use of poor fuel	Use good quality fuel
Rough idling (Engine proper)	Improper valve clearance	Adjust valve clearance
	Improper contact of valve seat	Replace or repair valve and valve seat
	Idling speed too low	Adjust idling speed
	Coolant temperature too low	Warm up engine
	Compression pressure of cylinders markedly different from one another	Overhaul engine
Rough idling (Other problems)	Clogged high pressure injection line	Replace line
	Leakage due to improper tightening of high pressure fuel line	Tighten sleeve nut
	Engine seizure	Replace pistons, piston rings and liners
	Incorrect valve timing	Replace camshaft

Diesel knock

Symptom	Possible cause	Remedy/Prevention
Diesel knock (Supply pump)	Damaged suction control valve (SCV)	Replace the suction control valve (SCV)
	Use of poor fuel	Use good quality fuel
Diesel knock (Injector)	Breakdown of injector	Replace the injector
	Use of poor fuel	Use good quality fuel
Diesel knock (Fuel system)	Use of poor fuel	Use good quality fuel
Diesel knock (Other problems)	Excessively cooled or heated engine	Warm up or cool engine
	Insufficient air intake	Correct
	Insufficient compression pressure	Repair
	Compression pressure leaks at cylinder head gasket	Replace head gasket
	Improper valve clearance or valve sticking	Adjust or repair
	Tappet sticking	Replace tappet and camshaft

Unusual engine noise

Symptom	Possible cause	Remedy/Prevention
Unusual engine noise (Piston)	Wear of piston pin boss or piston pin	Replace piston and/or piston pin
	Seized, damaged, or worn piston pin bushing	Replace piston pin bushing
	Worn pistons or cylinder liners	Replace piston or cylinder liner
	Damaged or seized piston	Replace piston and cylinder liner
	Foreign matter on top surface of the piston	Remove foreign matter and repair or replace piston, cylinder liner, and/or cylinder head
Unusual engine noise (Valve mechanism)	Incorrect valve clearance	Adjust valve clearance
	Valve cotter out of place	Replace valve cotter
	Seized valve stem	Replace valve and valve guide
	Broken valve	Replace valve
	Damaged rocker arm support	Replace rocker arm support
Unusual engine noise (Bearings seizure)	Broken valve spring	Replace valve spring
	Insufficient lubricating oil	Add oil
	Excessive or insufficient tightening of bearing housings	Retighten to specified torque
	Pits and scratches on bearing surface	Replace bearing and crankshaft
	Oil film formed on back of bearing	Replace bearing
	Improper installation of bearing	Replace bearing
	Reduction of spread dimension of bearing	Replace bearing
	Distorted bearing housing	Replace or correct bearing housing
	Excessive oil clearance	Replace bearing

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ENGINE INTRODUCTION (J08E)

Symptom	Possible cause	Remedy/Prevention
Unusual engine noise (Various other parts)	Exhaust gas leakage from exhaust pipe joints	Retighten joints
	Loosen or missing intake manifold flange gasket	Retighten or replace
	Intake valve seating is not concentric	Replace or correct the valve and valve seat
	Intake gas leakage	Retighten
Unusual engine noise (Other problems)	Loose cooling fan mounting bolts or fan pulley nut	Tighten the fan and crankshaft pulley
	Lack of lubricating oil (coolant pump, valves, etc.)	Lubricate
	Worn timing gear	Replace the timing gear
	Breakage of turbine or blower	Replace turbocharger

NOTICE

The items on this page concern unusual engine noise which is due to causes other than those given for diesel knock.

TROUBLESHOOTING (COMMON RAIL SYSTEM)

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Engine does not start

Symptom	Possible cause	Remedy/Prevention
Engine does not start (Fuel not reaching supply pump)	Fuel lines clogged or damaged	Clean or replace fuel lines
	Fuel filter clogged	Clean or replace the filter element
	Air in fuel caused by improper connections of fuel line between fuel tank and feed pump	Repair connections
	Filter incorporated in inlet side of feed pump clogged	Remove foreign material
	Breakdown feed pump	Replace the supply pump
Engine does not start (Fuel reaching supply pump)	Leakage due to improper tightening of high pressure fuel line	Tighten sleeve nut
	Breakdown ECU	Replace the ECU
Engine does not start (Injector faulty)	Injector broken	Replace the injector
Engine does not start (Electrical system)	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL".
Engine starts and stops	Fuel lines clogged	Clean or replace fuel lines
	Air in fuel caused by damaged fuel lines or improper connection of fuel lines	Repair fuel lines or replace fuel lines and gaskets
Engine has low power (Injector faulty)	Injector broken	Replace the injector
Engine has low power (Electrical system)	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL".

Excessive smoke

Symptom	Possible cause	Remedy/Prevention
Excessive smoke (Black smoke)	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL".
	Defective injector	Replace the injector
Excessive smoke (White smoke)	Water in fuel	Check and clean fuel lines
	Glow plug not operating	Check glow plug circuit

Low idle speed irregular

Symptom	Possible cause	Remedy/Prevention
Low idle speed irregular	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL".
	Defective injector	Replace the injector

ENGINE TUNEUP

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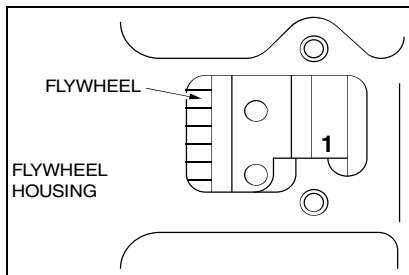
VALVE CLEARANCE CHECKING AND ADJUSTING PROCEDURES

NOTICE

Valve clearance adjustment is performed only when the checking result is not within the specified value.

1. PREPARATION OF CHECKING AND ADJUSTMENT

- (1) Positioning the No.1 or No.6 piston at Top Dead Center of the compression stroke.
 - a. Turn the crankshaft counterclockwise (viewed from the flywheel side) to align mark "1/6" on the outer periphery of the flywheel with the pointer of the flywheel housing.

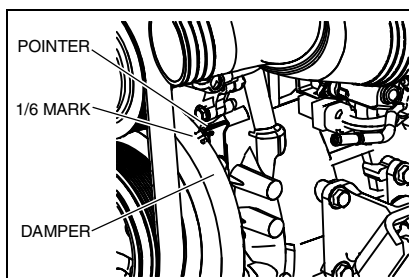


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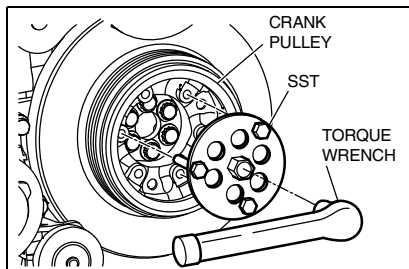
NOTICE

- Always turn the crankshaft counterclockwise (viewed from the flywheel side).
- In this position the No.1 or No.6 piston is at the Top Dead Center of the compression stroke.

- b. Turn the crankshaft clockwise in the engine direction and align the damper timing mark "1/6" to the pointer.



SHTS011060100002

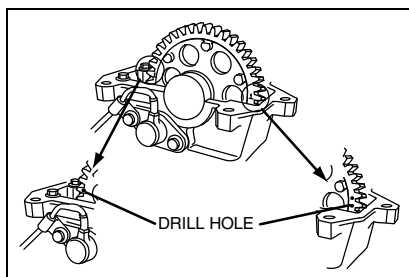


SHTS011060100003

NOTICE

When matching the pulley mark "1/6" of the crankshaft pulley, attach the 3 pins on the special tool to any of the 6 corresponding holes on the crankpulley. Then turn the torque wrench in a clockwise direction.

SST: Cranking Tool (S0940-91200)

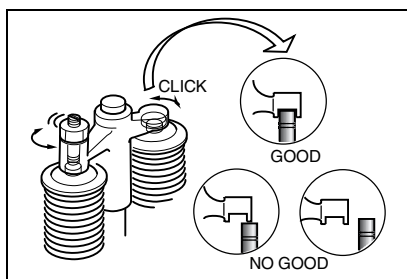


SHTS011060100004

- (2) Among three drill holes on the camshaft gear, when two drill holes are on horizontal position, and the rest of the drill hole is visible, the No.1 piston is at the Top Dead Center of the compression stroke.

NOTICE

If the rest of drill hole is invisible by camshaft housing, the No.6 piston is at the Top Dead Center of the compression stroke.



SHTS011060100005

- (3) Make sure that the valve stem is correctly inserted in the cross head.

NOTICE

Move the cross head with fingers right and left to confirm the valve stem is correctly inserted in the cross head by listening to the clicking sound.

- (4) Confirm that there are no foreign particles or dust between the cross head and the valve stem.

2. VALVE CLEARANCE CHECKING

NOTICE

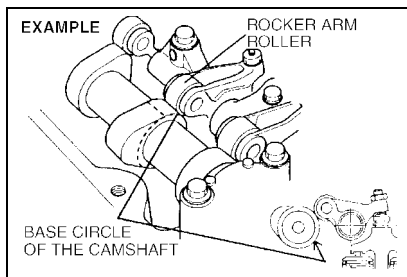
Before beginning the checking, you must perform "PREPARATION OF CHECKING AND ADJUSTMENT" described on page EN01-12.

- (1) You can understand which valve to adjust when No.1 or No.6 piston is at the Top Dead Center of the compression stroke by the following chart).

	Cylinder		1		2		3		4		5		6	
	Valve		IN	EX	IN	EX	IN	EX	IN	EX	IN	EX	IN	EX
With No.1 piston at T.D.C. on compression stroke	Camshaft gear condition		○	○		○	○			○	○			
With No.6 piston at T.D.C. on compression stroke					○			○	○			○	○	○

- #1= View from rear side of camshaft housing
- OMark: Possible to check valve clearance
- Firing order: 1-4-2-6-3-5
- T.D.C.: Top Dead Center

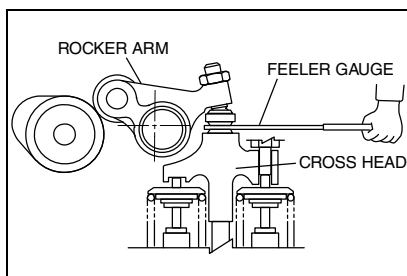
- (2) Before checking the valve clearance, make sure that the roller is on the base circle of the camshaft.



SHTS011060100008

EN01-14

ENGINE INTRODUCTION (J08E)



SHTS011060100009

- (3) Insert a feeler gauge of the specified thickness as below between the rocker arm and the cross head to check the valve clearance.

VALVE CLEARANCE (when cold)

Intake valve	0.30 mm {0.0118 in.}
Exhaust valve	0.45 mm {0.0177 in.}

NOTICE

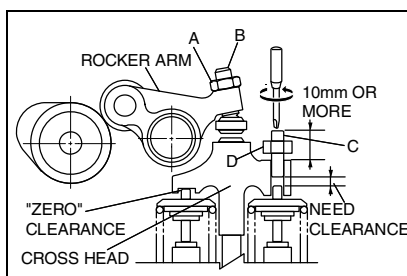
Valve clearance adjustment is performed only when the checking result is outside the specified value.

3. VALVE CLEARANCE ADJUSTMENT**NOTICE**

Valve clearance adjustment is performed only when the checking result is outside the specified value.

NOTICE

- Before beginning the adjustment you must perform "PREPARATION OF CHECKING AND ADJUSTMENT" described on page EN01-12.
- As for the valve which can adjust the valve clearance refer to the chart on page EN01-13.
- Make sure that the cylinder head bolt, rocker arm support bolt, nozzle clamp bolt, cam housing bolt and cam bearing cap bolt are tightened to the specified torque.

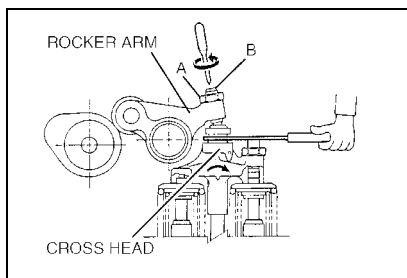


SHTS011060100010

- (1) Loosen the adjusting screw lock nut A, D of the rocker arm and cross head fully.
- (2) The cross head adjusting screw must protrude 10 mm {0.394 in.} or more from the cross head upper face.

NOTICE

Unless the adjusting screw is completely loose to the valve stem head, the following adjustments may be adversely affected.



SHTS011060100011

- (3) Insert a feeler gauge of the specified thickness shown below between the rocker arm and the cross head, and adjust the valve clearance with the adjust screw of the rocker arm.

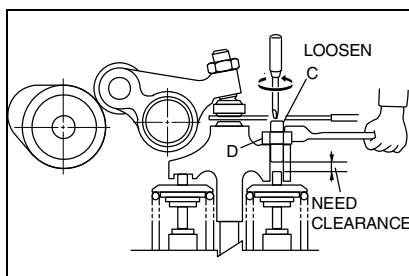
VALVE CLEARANCE (when cold)

Intake valve	0.30 mm {0.0118 in.}
Exhaust valve	0.45 mm {0.0177 in.}

- (4) After completion of the adjustment, tighten the lock nut A securely with the specified tightening torque.

Tightening Torque:

25 N·m {250 kgf·cm, 18.1 lbf·ft}

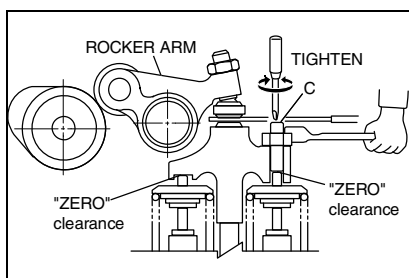


SHTS011060100012

- (5) The condition of inserted feeler gauge, loosen the adjusting screw of the cross head, make sure that the feeler gauge does not feel loose.

NOTICE

If the feeling of the feeler gauge becomes loose, repeat steps from (1).

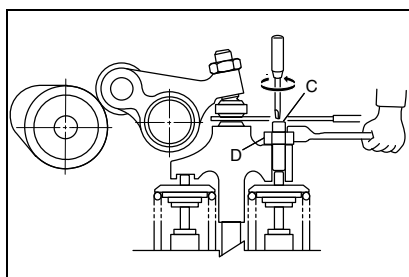


SHTS011060100013

- (6) Tighten the adjusting screw C of the cross head until the feeler gauge does not move.

NOTICE

In this situation, clearance between adjusting screw C and valve stem head is zero.

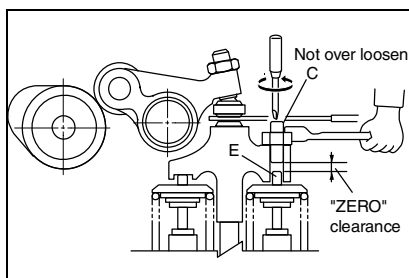


SHTS011060100014

- (7) While loosening the adjusting screw C of the cross head gradually, adjust the valve clearance. Tighten the lock nut D of the cross head securely with the specified tightening torque when the feeler gauge feels correct.

Tightening Torque:

25 N·m {250 kgf·cm, 18 lbf·ft}

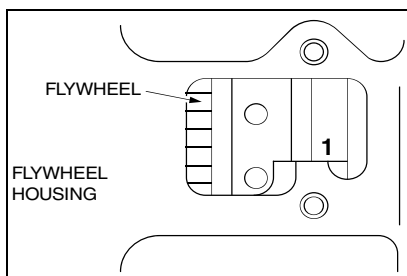


SHTS011060100015

NOTICE

- Do not over loosen the adjusting screw.
- Over loosening of the adjusting screw C will cause the same condition as in step (3) again. The feeler gauge may feel correct, but there may be excessive clearance between the adjusting screw C of the cross head and the valve stem head E. This does not allow for correct adjustment.

- (8) Position each piston at Top Dead Center of compression stroke by turning the crankshaft counterclockwise viewed from flywheel side. Then adjust the valve clearance for each cylinder in the firing order.

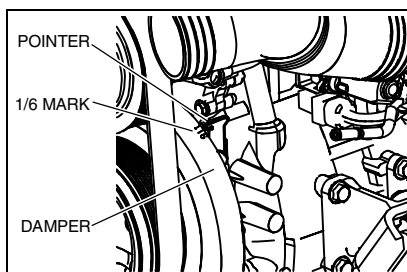


SHTS011060100001

INJECTION TIMING INSPECTION PROCEDURES

1. INSPECT THE INJECTION TIMING.

- (1) Turn the crankshaft counterclockwise, as viewed from the flywheel side, and then align the timing mark in the check window of the flywheel housing with a mark of "1/6". At this time, the No.1 cylinder or the No.6 cylinder is in the top dead center.

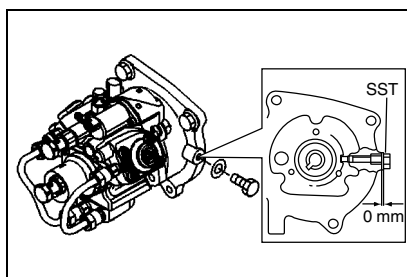


SHTS011060100016

- (2) Make sure that the timing mark "1/6" on the damper is aligned with the pointer.
- (3) At this time, insert a guide bolt (SST) through the plug hole in the side of the bearing holder case for installation of the supply pump.

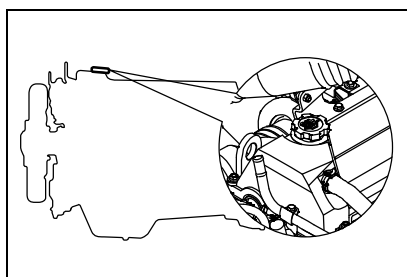
SST: Guide bolt (SZ105-08067)

- a. If the guide bolt is fully inserted, the No.1 cylinder is at Top Dead Center of compression stroke and the timing is correct.
- b. If the guide bolt cannot be fully inserted, turn the crankshaft 1 more turn to obtain the 1/6 mark.



SHTS011060100017

- (4) Insert the guide bolt again and confirm the correct timing.



SHTS011060100018

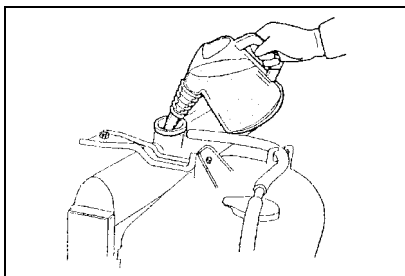
START THE ENGINE

⚠ WARNING

Do not leave tools on or around the engine. Contact of tools with moving parts may result in personal injury or damage to equipment.

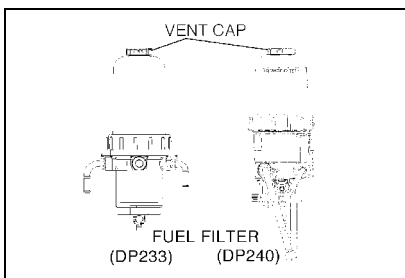
1. PREPARATION

- (1) Supply engine oil.



SHTS011060100019

- (2) Supply cooling water and bleed air from it.



SHTS011060100020

- (3) Bleed air from the fuel system.
Refer to the section "AIR BLEEDING" in the chapter "FUEL SYSTEM (J08E)" on page EN07-30.

- (4) Check connection to the alternator.

NOTICE

Starting the engine without wiring in place may burn out the alternator.

- (5) Check the engine stopping performance.

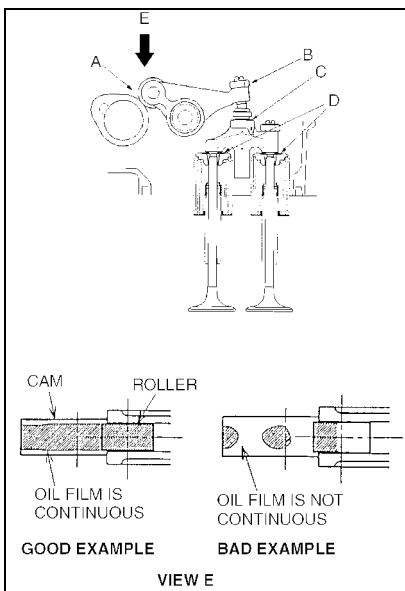
LUBRICATION

1. CHECK THE ROCKER ARM.

- (1) Remove the head cover.
- (2) Set the engine revolution to the specified idling revolution.
- (3) After the engine starts, check that oil is supplied to the following locations of all rocker arms within approximately 10 seconds.
 - a. Roller and cam face A
 - b. Cross head top C and spring upper seat top face D through adjusting screw B

NOTICE

If the supply of oil is delayed or not happening, hydraulic pressure may be low or the oil gallery may be clogged. Insufficient supply of oil may lead to seizure, abnormal wear or abnormal noise. Recheck the assembly.



SHTS011060100021




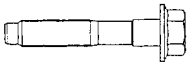
EN01-18

ENGINE INTRODUCTION (J08E)

SPECIAL TOOL

EN0110601K100001

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0955-21110	COMPRESSION GAUGE ADAPTER (A)	For Overhaul criteria
	S0955-21030 S0955-21060	COMPRESSION GAUGE ADAPTER (B)	
	S0940-91200	CRANKING TOOL	
	SZ105-08067	GUIDE BOLT	

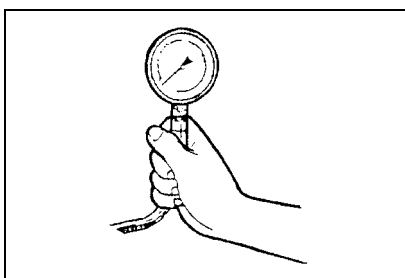
OVERHAUL CRITERIA

EN0110601H300002

FACTORS TO DETERMINE THE ENGINE OVERHAUL

1. LOW COMPRESSION PRESSURE.

- (1) Before measurement
 - a. Charge the battery completely.
 - b. Set the valve clearance to the correct value.
 - c. Idle the engine (Coolant temperature at 80°C {176°F}).
 - d. Remove the air cleaner.
 - e. Remove all injectors.



SHTS011060100026

- (2) Measurement
 - a. Insert the gauge adaptor into the nozzles.

SST:

Compression gauge adaptor (A) (S0955-21110)

Compression gauge adaptor (B) (S0955-21030)

Compression gauge adaptor (B) (S0955-21060)

- b. Run the engine with the starter and measure the compression pressure.

Standard	Limit	Difference between each cylinder
3.2-3.4 MPa {33-35 kgf/cm ² , 467-496 lbf/in ² }	2.3 MPa {24 kgf/cm ² , 341 lbf/in ² }	0.3 MPa {3 kgf/cm ² , 43 lbf/in ² } or less
Engine revolution 150r/min		

NOTICE

Do not operate the starter for more than 15 seconds.

- c. Measure the compression pressure of each cylinder.

NOTICE

Do not allow gas leakage from the seal face.

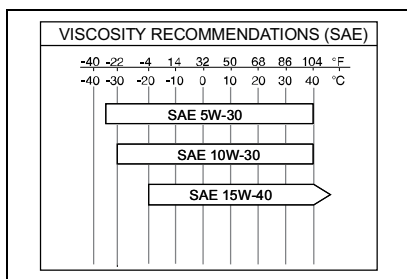
- (3) Reassemble the removed parts.

2. ENGINE OIL PRESSURE.

- (1) Check the oil pressure warning lamp when the oil and coolant temperature is hot [about 80°C {176°F}].
 - a. If the warning lamp lightens, check the oil level.
 - b. Check oil deterioration.
If oil quality is poor, replace with a suitable grade oil.
 - c. Remove the oil pressure switch and install the oil pressure gauge.



SHTS011060100027



- d. Measure the oil pressure at a coolant temperature of 80°C {176°F} or more.

Oil pressure

Standard	Limit
49-490 kPa {0.5-5.0 kgf/cm ² , 7.11-71.10 lbf/in. ² }	Less than 49kPa {0.5 kgf/cm ² , 7.11 lbf/in. ² }

3. OTHER FACTORS.

- (1) Increase of blow by gas
- (2) Defective engine start
- (3) Decrease of engine output
- (4) Increase of fuel consumption
- (5) Increase of engine noise
- (6) Increase of oil consumption

DISMOUNTING AND MOUNTING

EN0110601H100001

IMPORTANT POINT - DISMOUNTING

1. DISMOUNT THE ENGINE ASSEMBLY.

- (1) Park the vehicle on level ground and then block the wheels.
- (2) Tilt the hood.
- (3) Drain coolant from the radiator and cylinder block, and engine oil from the oil pan.

⚠ WARNING

To avoid the danger of burns, do not drain the coolant and engine oil while the engine and radiator are still hot.

- (4) Remove the splash board and fender.
- (5) Disconnect the power steering piping and hose.

NOTICE

Refer to CHAPTER POWER STEERING for details.

- (6) Disconnect the electric lines, fuel lines and air lines.

NOTICE

- Disconnect the battery cable from the negative terminal (-) of the battery and disconnect the electric lines.
- Cover open ends of the pipes, hoses and pumps to prevent entry of dirt.

- (7) Disconnect the hoses (coolant, heater and air intake) and remove the radiator with the intercooler.

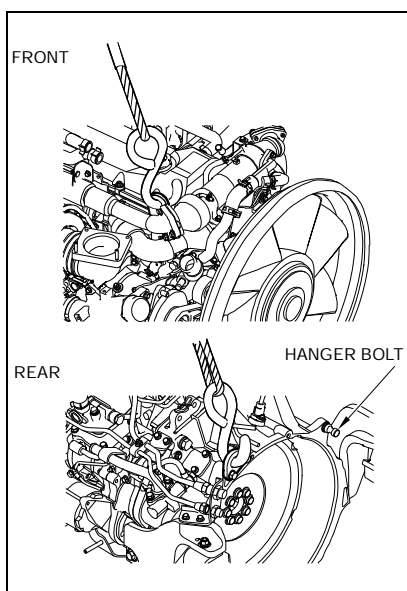
NOTICE

Do not damage the radiator.

- (8) Remove the air cleaner and bracket.
- (9) Disconnect the air intake and exhaust lines.
- (10) Disconnect the propeller shaft.
- (11) Disconnect the parking brake cable, transmission control lever and transmission with clutch housing from the flywheel housing.

NOTICE

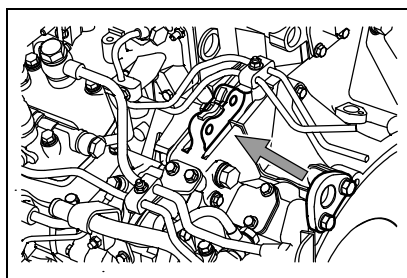
Refer to the chapter "TRANSMISSION/TRANSFER CONTROL" and the chapter "TRANSMISSION MAIN UNIT" for details.



SHTS011060100029

- (12) Connect a cable from an engine hanger to the hanger bracket (1 point) on the front of the engine, and to the hanger bracket (1 point) on the flywheel housing at the rear of the engine. Using a hoist, raise the hanger until there is a bit of slack in the cables.

Engine weight: **Refer to the section "DATA AND SPECIFICATIONS".**



SHTS011060100030

NOTICE

When the cable connection of the engine hanger to the hanger bracket causes infringement to the cab than follow procedure below.

1. Remove the fuel pipes (feed and return) to prevent damage.
2. Then remove the rear hanger bracket and install it on the front of the flywheel housing as shown in the figure.

- (13) Remove the engine mounting fitting nuts (front and rear, both sides).
 (14) Lift the engine hanger so that the cables are fully tightened, then, after checking that the cables are securely, lift gently and remove the engine from the vehicle.

NOTICE

When the transmission is attached to the engine, attach the third cable to the hanger bolt.

IMPORTANT POINTS - MOUNTING

1. MOUNT THE ENGINE ASSEMBLY.

- (1) Mount the engine assembly in the reverse order of dismounting.

Front side (chassis): 91 N·m {930 kgf·cm, 67 lbf·ft}

Front side (engine): 157 N·m {1600 kgf·cm, 115.7 lbf·ft}

Rear side (chassis): 91 N·m {930 kgf·cm, 67 lbf·ft}

Rear side (engine): 91 N·m {930 kgf·cm, 67 lbf·ft}

NOTICE

Check to see that there are no oil leaks, fuel leaks, coolant leaks, or air leaks.

LIQUID GASKET AND APPLICATION POINTS

EN0110601H200001

- Liquid gasket is used at the following positions for the J08E series engine.

Liquid gasket specification:

S0413-21217: Black

Liquid gasket specification:

S0413-21207: Silver

Liquid gasket specification:

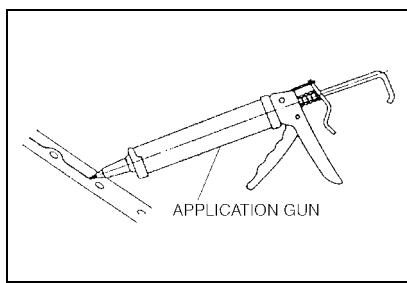
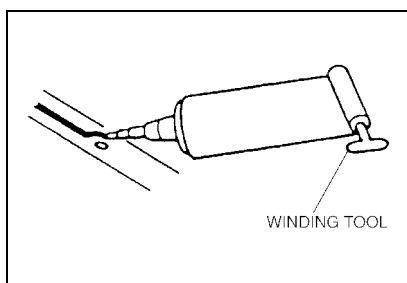
S0413-21211: White

1. LIQUID GASKET APPLICATION AND PART ASSEMBLY PROCEDURE.

- Remove old liquid gasket from each part and matching parts and wipe off oil, moisture or dirt with a rag.
- Overlap the liquid gasket at the start and end of application.
- Be careful of misalignment when assembling parts with liquid gasket. If they are misaligned, reapply the liquid gasket.
- Assemble parts within 20 minutes of application. If more than 20 minutes have passed, remove and reapply the liquid gasket.
- Wait for at least 15 minutes or more after assembly of parts before starting the engine.

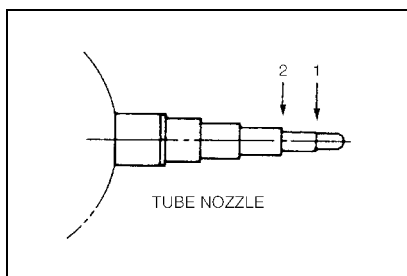
2. REMOVE PARTS.

- When removing parts, do not use a tool for removal at one location only. Use the tool at various locations such as a flange step or gap for removal. When removing the gasket, be careful that gasket residue does not enter the engine.



3. OTHERS.

- For tube-type liquid gasket, use the winding tool that comes with the liquid gasket.
- For cartridge-type gasket, use an application gun.



SHTS011060100033

(3) For tube-type liquid gasket, required width of application can be obtained by cutting the nozzle to suit.

1: Approximately 2 mm wide when cut at the first step

2: Approximately 5 mm wide when cut at the second step

4. PARTS AND POSITIONS FOR LIQUID GASKET.

(1) Apply liquid gasket to positions and types of gasket according to the table shown below.

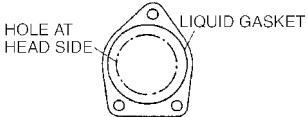
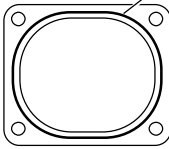
Follow the application pattern at each position shown in the figures.

Unit: mm {in.}

No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
1	Oil seal retainer	<p>Matching flange face with the block</p>	1.5-2.5 {0.0591-0.0984}	Black	
2	Coolant pump	<p>Matching flange face with the block</p>	1.5-2.5 {0.0591-0.0984}	Black	
3	Oil cooler	<p>Matching flange face with the block</p>	1.5-2.5 {0.0591-0.0984}	Silver	
4	Thermostat case	<p>Matching flange face with the cylinder head</p>	1.5-2.5 {0.0591-0.0984}	Silver	

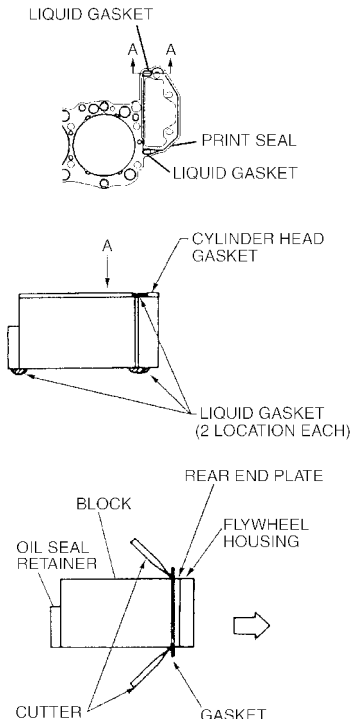
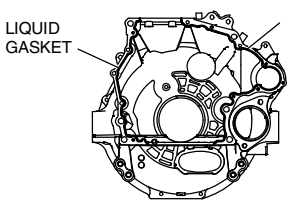
EN01-24

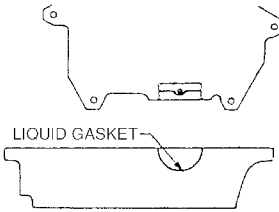
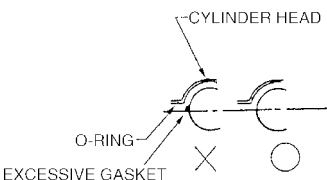


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No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
5	Flange	Matching face with the rear edge  <p>HOLE AT HEAD SIDE</p> <p>LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Silver	
6	Intake pipe	Matching face with the intake manifold MATCHING FACE WITH THE INTAKE MANIFOLD  <p>LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Black	
7	Front and rear ends of upper/lower faces of block	Matching parts of block upper face rear end, gasket, rear end plate, flywheel housing, cylinder head gasket Matching parts of oil seal retainer and block lower face front end Matching parts of block lower front end, gasket, rear end plate and flywheel housing	— 1.5-2.5 {0.0591-0.0984} 1.5-2.5 {0.0591-0.0984}	White Black Silver	

ENGINE INTRODUCTION (J08E)

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No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
8	Front and rear ends of upper/lower faces of block	 <p>NOTICE Cut the rear end plate gasket with a craft knife flush with the block upper face.</p>			
9	Flywheel housing	<p>Matching face of rear end plate</p> <p>MATCHING FACE OF REAR END PLATE</p> 	1.5-2.5 {0.0591-0.0984}	Silver	

No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
10	Cam housing	<p>1. Matching faces with cam housing and plug 2. Matching parts of cam housing, plug, cylinder head cover and gasket</p>  <p>LIQUID GASKET</p> <p>NOTICE</p> <ul style="list-style-type: none"> Application area of liquid gasket is half circle of cam housing. Never apply it to the upper half circle of the plug. Remove the excessive gasket completely.  <p>CYLINDER HEAD COVER O-RING EXCESSIVE GASKET</p> <ul style="list-style-type: none"> When the cylinder head cover is assembled, reapply the liquid gasket. (Assembly must be done within 20 minutes.)  <p>LIQUID GASKET LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Black	2 locations at front and rear ends
<p>NOTICE Figure on the right shows application "pattern" of the liquid gasket. Apply the liquid gasket to the center of seal flange inside whenever possible.</p> 					

ENGINE MECHANICAL (J08E)

EN02-001

CYLINDER HEAD EN02-2

COMPONENT LOCATOR EN02-2
SPECIAL TOOL EN02-5
OVERHAUL EN02-6
INSPECTION AND REPAIR EN02-17

CRANKSHAFT FRONT END EN02-21

COMPONENT LOCATOR EN02-21
SPECIAL TOOL EN02-22
OVERHAUL EN02-23

FLYWHEEL AND FLYWHEEL HOUSING EN02-25

COMPONENT LOCATOR EN02-25
SPECIAL TOOL EN02-26
OVERHAUL EN02-26
INSPECTION AND REPAIR EN02-32

TIMING GEAR EN02-33

COMPONENT LOCATOR EN02-33
SPECIAL TOOL EN02-34
OVERHAUL EN02-35
INSPECTION AND REPAIR EN02-37

MAIN MOVING PARTS AND

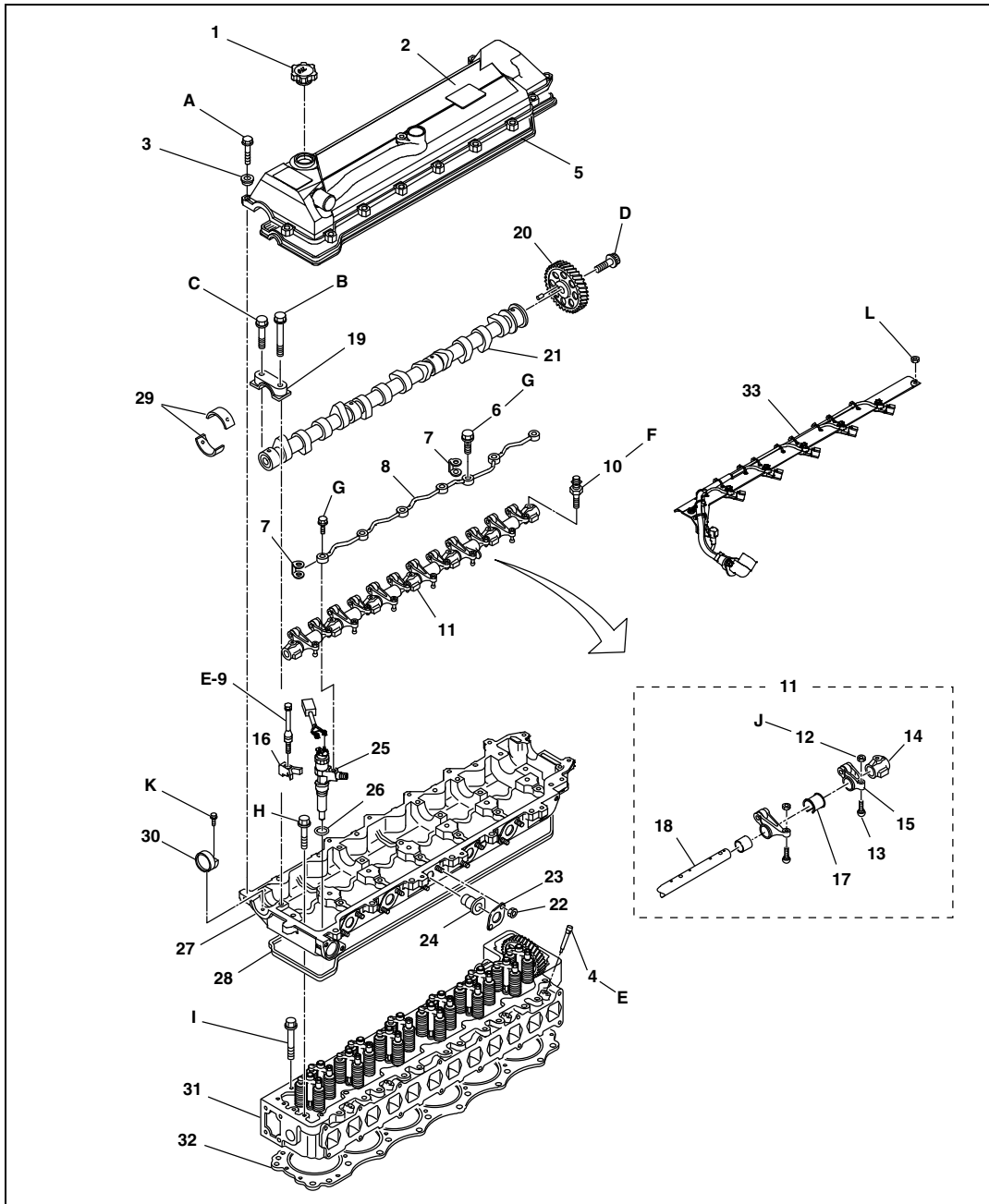
CYLINDER BLOCK EN02-39

COMPONENT LOCATOR EN02-39
SPECIAL TOOL EN02-42
OVERHAUL EN02-44
INSPECTION AND REPAIR EN02-57

CYLINDER HEAD

COMPONENT LOCATOR

EN0110602D100001



SHTS011060200001

ENGINE MECHANICAL (J08E)

EN02-3

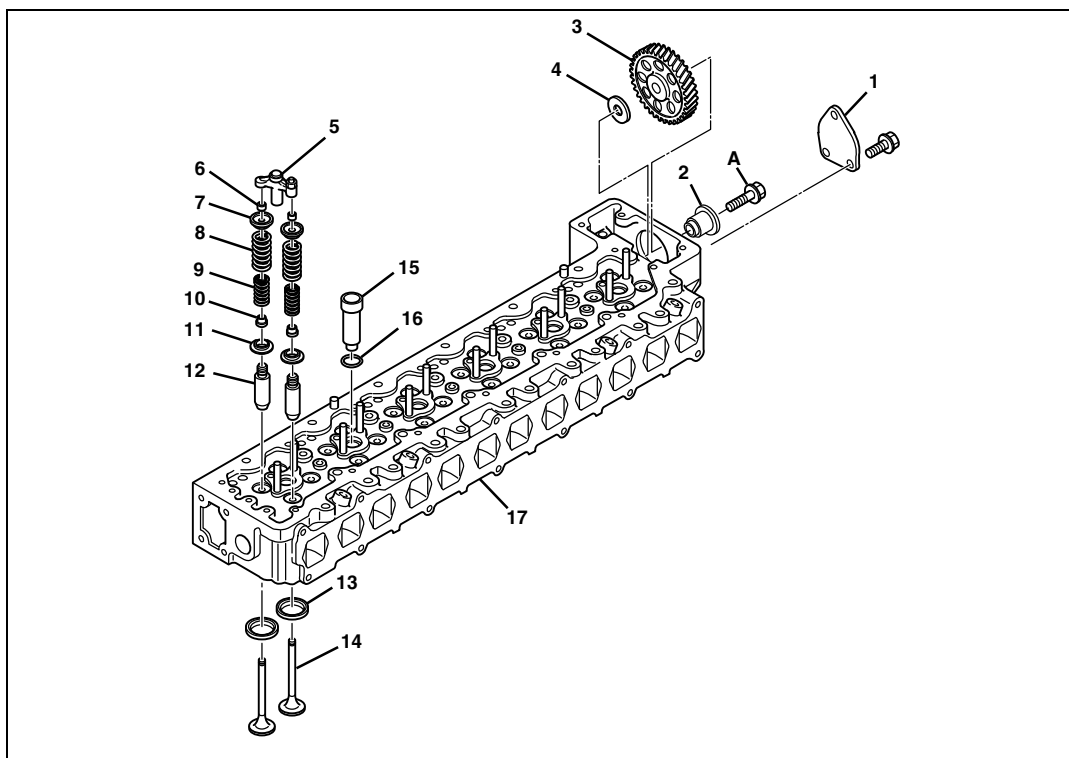
1 Oil filler cap	18 Valve rocker shaft
2 Cylinder head cover	19 Camshaft bearing cap
3 Silent block	20 Camshaft gear
4 Heater plug	21 Camshaft
5 Head cover gasket	22 Nut
6 Union bolt	23 Plate
7 Gasket	24 Injection pipe oil seal
8 Leakage pipe	25 Injector
9 Injector clamp bolt	26 O-ring
10 Rocker arm support bolt	27 Camshaft housing
11 Rocker arm assembly	28 Camshaft housing gasket
12 Lock nut	29 Camshaft bearing
13 Adjust screw	30 Plug
14 Rocker arm support	31 Cylinder head assembly
15 Rocker arm	32 Cylinder head gasket
16 Injector clamp	33 Harness assy
17 Collar	

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 28.5 {290, 21}	G 12.3 {126, 9}
B 31 {320, 23}	H 28.5 {290, 21}
C 31 {320, 23}	I 59 {600, 43.4}+90°+90°#
D 59 {600, 43.4}+90°#	J 25 {250, 18.1}
E 25 {250, 18.1}	K 6 {60, 4.3}
F 59 {600, 43.4}	L 25 {250, 18.1}

#=Apply oil to the threads and seat surfaces before tightening.



SHTS011060200002

1 Flange	10 Valve stem seal
2 Idle gear shaft	11 Valve spring seat lower
3 Camshaft idle gear	12 Valve stem guide
4 Idle gear thrust plate	13 Valve seat
5 Cross head	14 Valve
6 Valve spring retainer	15 Nozzle seat
7 Valve spring seat upper	16 O-ring
8 Valve spring outer	17 Cylinder head block
9 Valve spring inner	

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

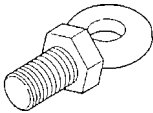
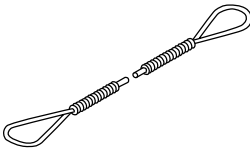
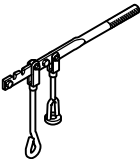
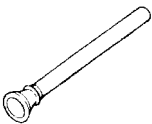
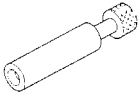
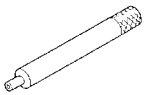


A 108 {1,100, 79.6}#

#=Apply oil to the threads and seat surfaces before tightening.

SPECIAL TOOL

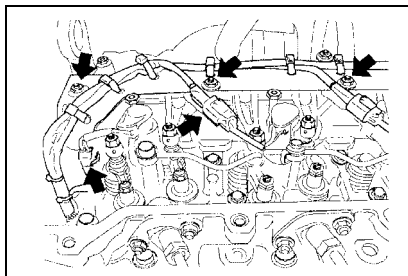
EN0110602K100001

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0943-31070	EYE BOLT	
	S0949-11010	WIRE	
	S0947-01170	VALVE SPRING PRESS	
	S0943-11020	VALVE LAPPING TOOL	
	S0947-22100	VALVE STEM SEAL PRESS	
	S0947-21210	BAR	For Nozzle sleeve
	SN441-00610	STEEL BALL	Used with S0947-21210
	S0947-11520	GUIDE	

OVERHAUL

EN0110602H200001



SHTS011060200011

IMPORTANT POINTS - DISASSEMBLY

1. DISASSEMBLE THE CYLINDER HEAD.

- (1) Clean parts around the injector and fuel system connections.

NOTICE

Entry of foreign particles into the combustion chamber may result in engine trouble.

- (2) Remove the injector harness assy.
 - a. Disconnect the connector of injector.
 - b. Remove the 7 nuts, disconnect the injector harness assy with plate.
- (3) Remove the injector assembly.

NOTICE

Refer to the chapter "FUEL SYSTEM".

- (4) Remove the rocker arm assembly.
 - a. Loosen the lock nut at the end of the rocker arm and turn the adjusting screw counterclockwise completely.

NOTICE

Not untightening the adjusting screw may result in a bent rocker shaft.

- b. Loosen the injector clamp bolt.

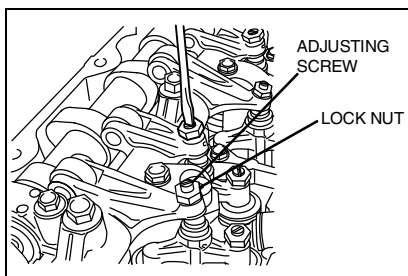
- c. Loosen the rocker arm support bolt as shown in the figure.

NOTICE

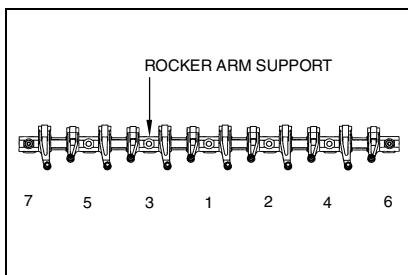
If the cross head is removed from the valve during disassembly of the rocker arm assembly, reassemble the cross head as it was.

- (5) Remove the camshaft.
- (6) Remove the camshaft housing.

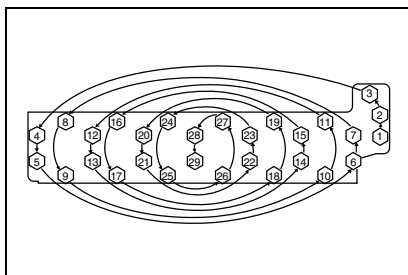
- (7) Remove the cylinder head bolts.
 - a. Gradually loosen bolts three times in the order shown in the figure.



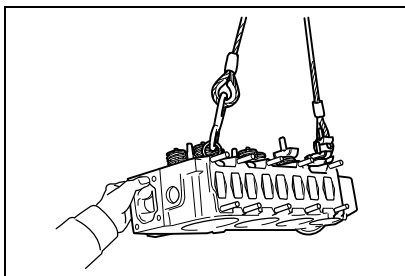
SHTS011060200012



SHTS011060200013



SHTS011060200014



SHTS011060200015

- (8) Lift and remove the cylinder head using the special tool and hoist.

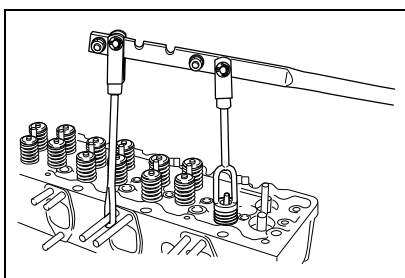
SST:

Eye bolt (S0943-31070)

Wire (S0949-11010)

NOTICE

- Do not damage the cylinder head lower surface or cylinder block upper surface during removal of the cylinder head.
- If it is difficult to lift off the cylinder head, pry with a chisel between the cylinder head and cylinder block.

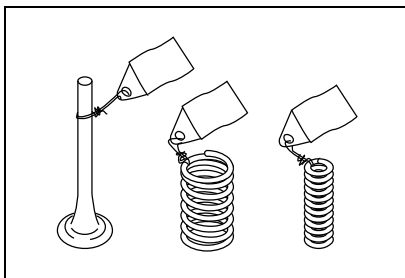


SHTS011060200016

2. DISASSEMBLE THE VALVE SYSTEM.

- (1) Remove the valve spring retainer using the special tool.

SST: Valve spring press (S0947-01170)

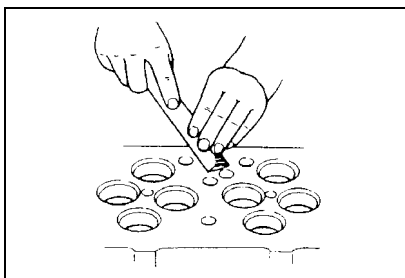


SHTS011060200017

- (2) Remove the intake and exhaust valve.

NOTICE

Attaching tags to the valves (giving corresponding cylinder Nos.) will eliminate time required for lapping the valve seats on reassembly.



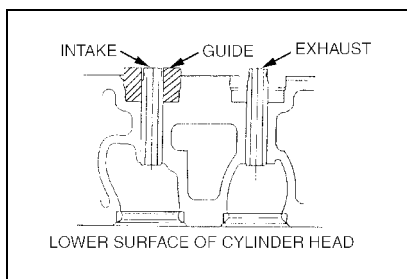
SHTS011060200018

3. CLEAN THE CYLINDER HEAD.

- (1) Clean the cylinder head and remove carbon deposits or foreign particles.

NOTICE

Be careful not to damage the cylinder head lower surface when removing carbon deposits or foreign particles.



SHTS011060200019

IMPORTANT POINTS - REPLACEMENT**1. REPLACE THE VALVE GUIDE.**

- (1) Remove the valve stem seal.
- (2) For removal, strike the valve guide with a brass bar and hammer.

⚠ WARNING

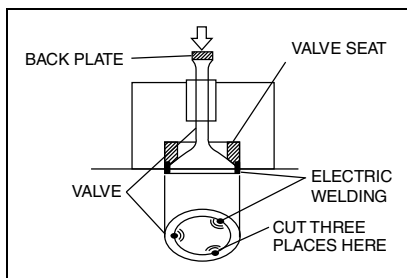
Be sure to wear protective goggles. Striking the valve guide when removing the valve guide may cause metal chips to fly up.

- (3) When installing a new valve guide, do not twist the end. Press fit the valve guide using the special tool.

SST: Guide (S0947-11520)

NOTICE

- Be careful not to damage the valve stem at the upper or lower end of the guide during press-fitting.
- Be sure to apply engine oil around the valve guide during press-fitting.



SHTS011060200020

2. REPLACE THE VALVE SEAT.

- (1) When replacing the valve seat, cut three places on the circumference of an unwanted valve and weld it to the valve seat.

NOTICE

To protect the lower surface of the cylinder head from welding spatter, be sure to apply grease before welding.

- (2) Place a (brass) back plate at the top of the valve system and strike it with a hammer to remove the valve seat.

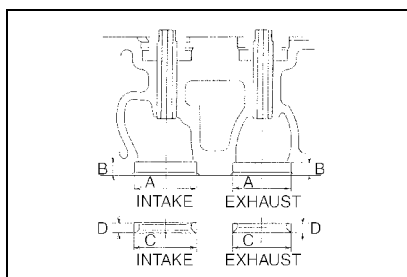
⚠ WARNING

Be sure to wear protective goggles. Striking the valve seat for removal of valve seat may cause metal chips to fly up.

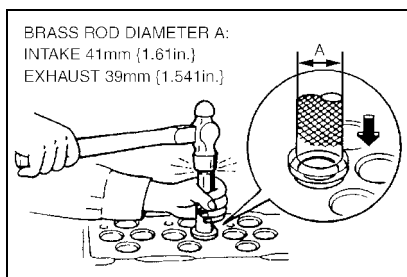
- (3) Machine the valve according to the valve seat dimensions.

Unit: mm {in.}

		Intake	Exhaust
Cylinder head side	A	41-41.016 {1.6142-1.6148}	39-39.016 {1.5355-1.5360}
	B	9.4-9.6 {0.3701-0.3779}	8.6-8.8 {0.3386-0.3464}
Valve seat side	C	41.085-41.1 {1.6176-1.6181}	39.12-39.135 {1.5402-1.5407}
	D	7-7.2 {0.2756-0.2834}	6-6.2 {0.2363-0.2440}



SHTS011060200021

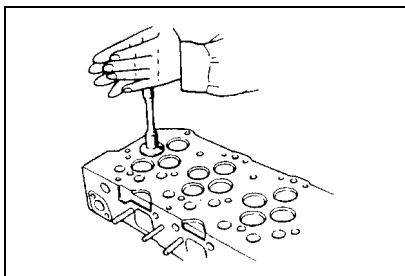


SHTS011060200022

- (4) Heat the cylinder head to 80 - 100°C {176 - 212°F} in hot water. After cooling the valve seat, insert it into the cylinder head.

⚠ WARNING

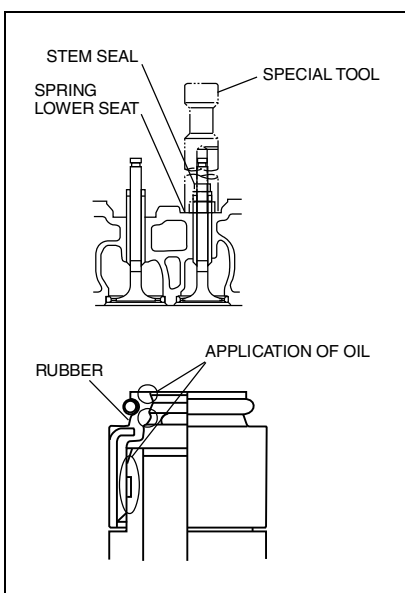
Be sure to wear protective goggles. Punching the nozzle seat when installing nozzle seat may cause metal chips to fly up.



SHTS011060200023

- (5) Apply a small amount of lapping compound to the contact surfaces of the valve and valve seat. Turn the valve using the special tool and tap it lightly to lap.

SST: Valve lapping tool (S0943-11020)



SHTS011060200024

3. REPLACE THE VALVE STEM SEAL.

- (1) After removing the valve stem seal, assemble the spring lower seat and apply engine oil to the stem seal lip. Punch it into the valve guide using the special tool.

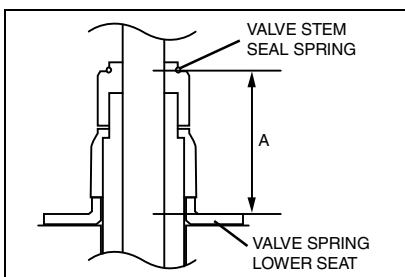
SST: Valve stem seal press (S0947-22100)

⚠ WARNING

Be sure to wear protective goggles. Striking the valve stem seal for installing of valve stem seal may cause metal chips to fly up.

NOTICE

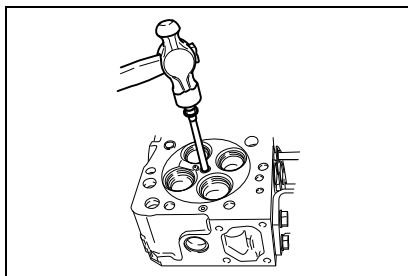
After assembly of the stem seal, check for deformation or cracking of the rubber or incline.



SHTS011060200025

- (2) After punching the valve stem seal, measure the height A.

Height A: 22.5-23.0 mm {0.886-0.906 in.}



SHTS011060200026

4. REPLACE THE NOZZLE SEAT.

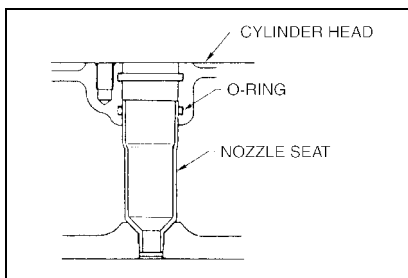
- (1) Tap the nozzle seat from the cylinder head lower surface.
Then, screw in a suitable bolt and strike the bolt head with a hammer to remove the nozzle seat from the cylinder head.

⚠ WARNING

Be sure to wear protective goggles. Punching the nozzle seat when installing nozzle seat may cause metal chips to fly up.

NOTICE

After removing the nozzle seat, remove the rest of liquid gasket or the adhesion such as dust completely.

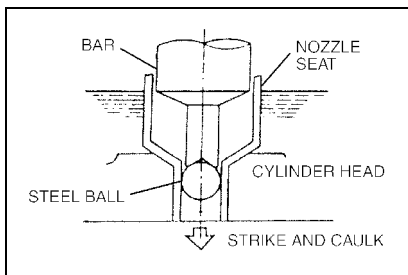


SHTS011060200027

- (2) After inserting the O-ring into the nozzle seat insertion hole of the cylinder head, apply liquid packing (Three Bond No. 1211 or equivalent) to the lower part of the new nozzle seat and assemble it onto the cylinder head.

NOTICE

Be sure to replace the O-ring with a new one. Reuse of the O-ring may cause water or gas leakage, resulting in overheating or cracking of the cylinder head.



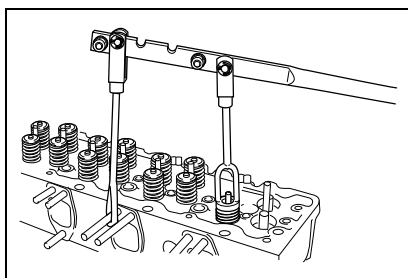
SHTS011060200028

- (3) Caulk the nozzle seat with the special tools.

SST:

Bar (S0947-21210)

Steel ball (SN441-00610)



SHTS011060200016

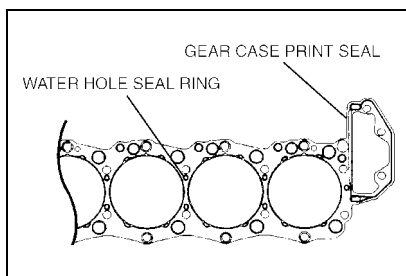
IMPORTANT POINTS - ASSEMBLY

1. ASSEMBLE THE VALVE AND VALVE SPRING.

- (1) Install the valve spring retainer at the valve spring upper seat using the special tool.
SST: Valve spring press (S0947-01170)

NOTICE

- Be sure to apply engine oil to the contact surface of each part before assembly.
- Be sure to place each valve in its original position.
- When the valve spring is compressed, be careful of damage to the stem seal due to contact of the upper seat.
- Since this valve spring is evenly pitched, it can be installed either end up.



SHTS011060200029

2. INSTALL THE CYLINDER HEAD GASKET.

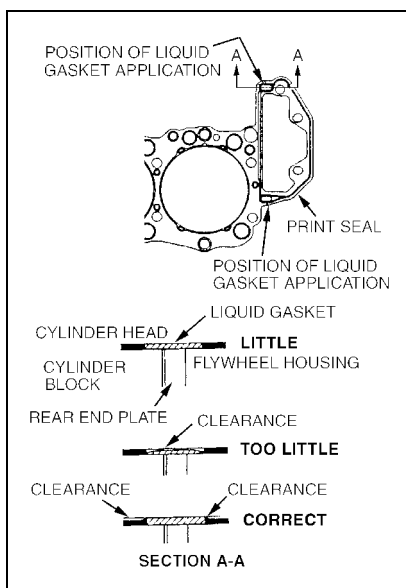
NOTICE

- When installing the cylinder head, install the new gasket after removing dirt, moisture and oil on the cylinder head and cylinder block surface.
- Never reuse the gasket as it may cause engine damage.
- The twelve water hole seal rings between the bores are easily damaged. Do not touch them with your hands or other objects. Make sure that the seal rings are not loose or damaged.
- Since silicon material is used for the gear case print seal, make sure that there is no peeling before assembly.

- (1) Install the cylinder head gasket on the cylinder block and flywheel housing.
- (2) Fill the hole at the back of the cylinder head gasket with liquid gasket.

NOTICE

Make sure that the liquid gasket surface will be in a convex shape above the head gasket upper surface.



SHTS011060200030

3. INSTALL THE CYLINDER HEAD.

- (1) Using the special tool and hoist, install the cylinder head.

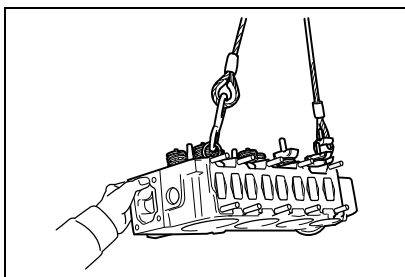
SST:

Eye bolt (S0943-31070)

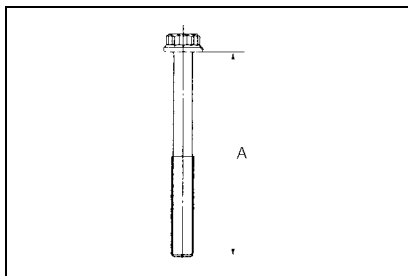
Wire (S0949-11010)

NOTICE

When installing the cylinder head, pay attention to cam idle gear and sub idle gear engagement.



SHTS011060200015

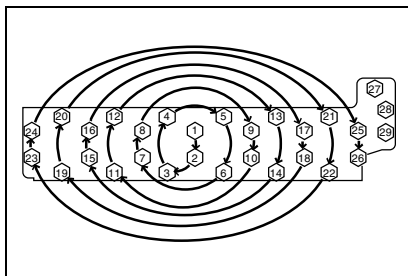


SHTS011060200031

4. TIGHTEN THE CYLINDER HEAD BOLT.

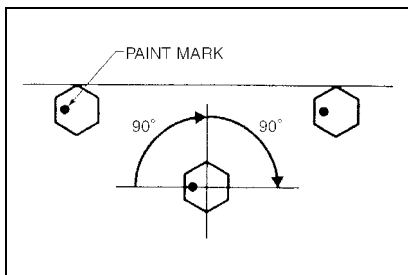
- (1) Measure the length of the M12 head bolts, if the length is A or more, replace with new bolts.

Dimension A	125.5 mm {4.941 in.}
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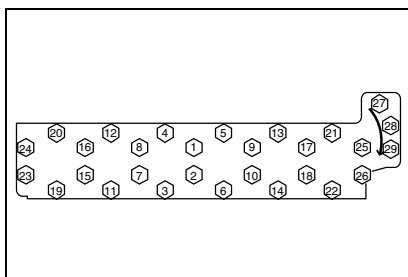
SHTS011060200032

- (2) Apply clean engine oil to the bolt surface and bolt threads of the M10 and M12 bolts.
 (3) Clean the bolt seats completely on the cylinder head upper surface.
 (4) Tighten No. 1 - No. 26 (M12 bolts) in the order shown in the figure to the specified torque.

Tightening Torque:**59 N·m {600 kgf·cm, 43.4 lbf·ft}**

SHTS011060200033

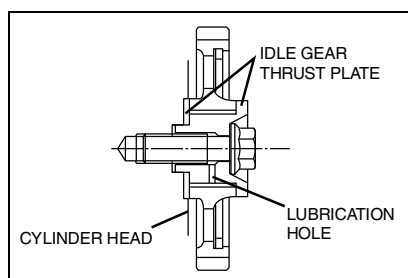
- (5) Mark the M12 bolts with paint to indicate the same directions as shown in the figure.
 (6) Turn No. 1 - No. 26 (M12 bolts) 90° (1/4 turn) in the same order as in (4).
 (7) Retighten them 90° (1/4 turn) as step (6).
 (8) Make sure that all paint marks face the same direction.

NOTICE**When adding torque, never untighten the bolts, even if they have been overtightened.**

SHTS011060200034

- (9) Tighten No. 27 - No. 29 (M10 bolts) in the order shown in the figure to the specified torque below.

Tightening Torque:**59 N·m {600 kgf·cm, 43.4 lbf·ft}****5. INSTALL THE CAMSHAFT HOUSING.**

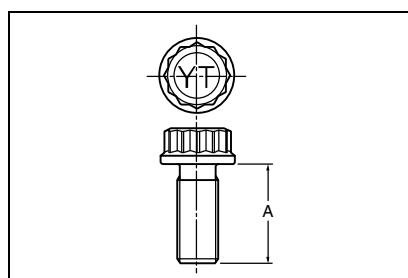


SHTS011060200035

6. INSTALL THE CAM IDLE GEAR.

NOTICE

- Install the cam idle gear shaft through the thrust plate as shown in the figure so that the lubrication hole is downward.
- Apply clean engine oil to the bolt seat and bolt threads.

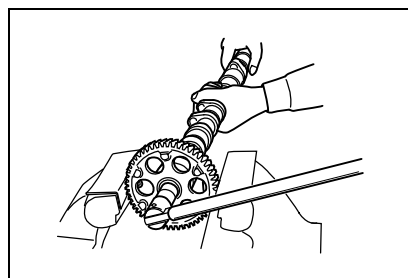


SHTS011060200036

7. ASSEMBLE THE CAMSHAFT GEAR.

- (1) Measure the length of the camshaft gear bolts, if the length is A or more, replace with new bolts.

Dimension A	30 mm {1.18 in.}
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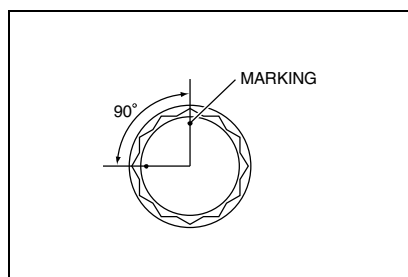


SHTS011060200037

- (2) Make sure that there is neither damage to the camshaft gear or camshaft nor dirt on them.
- (3) Apply clean engine oil to the bolt surface and bolt threads and tighten them to the specified torque below.

Tightening Torque:

59 N·m {600 kgf·cm, 43.4 lbf·ft}

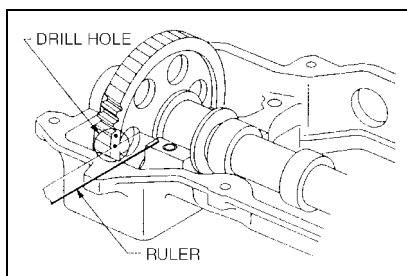


SHTS011060200038

- (4) Turn bolts an additional 90° (1/4 turn).

NOTICE

When adding torque, never untighten the bolt, even if it has been overtightened.



SHTS011060200039

8. INSTALL THE CAMSHAFT.

- (1) Align the mark on the flywheel with the flywheel housing pointer to set the No. 1 piston to top dead center of the compression stroke.

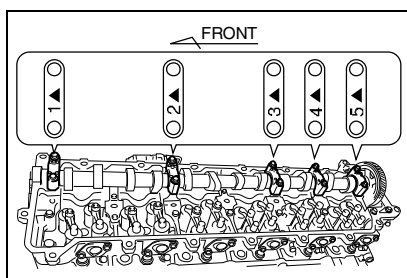
NOTICE

Engine adjustment - Refer to "PREPARATION OF CHECKING AND ADJUSTMENT".

- (2) Install the camshaft into the cam housing.

NOTICE

Two drill holes on the camshaft gear should be located at left side and lower drill hole should match with the camshaft housing upper surface.

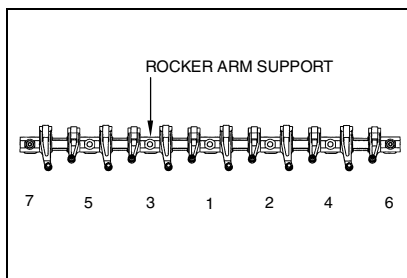


SHTS011060200040

- (3) Install Camshaft bearing caps by fitting the position, in the stamped order of 1, 2, 3, 4 and 5, with each engraved mark headed toward engine front.

Tightening Torque:

31 N·m {320 kgf·cm, 23 lbf·ft}



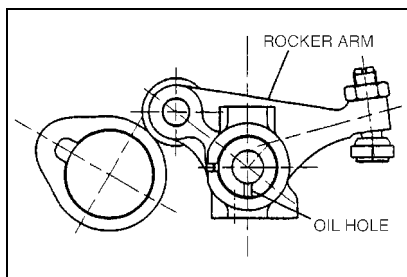
SHTS011060200041

9. INSTALL THE ROCKER ARM ASSEMBLY.

- (1) Make sure that the cross head is on each valve.

NOTICE

If the cross head is assembled whilst off the valve, the upper seat will be pressed, resulting in a loose valve.



SHTS011060200042

- (2) Make sure that the adjusting screw at the end of the rocker arm is completely screwed in.

NOTICE

Make sure the oil hole is placed below.

- (3) Tighten the rocker arm support bolt as shown in the figure to the specified torque.

Tightening Torque:

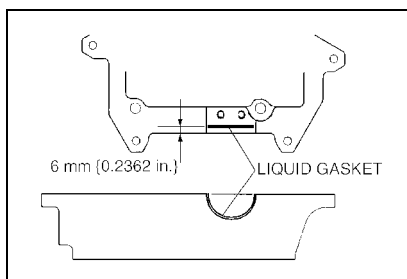
59 N·m {600 kgf·cm, 43.4 lbf·ft}

- (4) Tighten the injector clamp bolt to the specified torque.

Tightening Torque:

25 N·m {250 kgf·cm, 18.1 lbf·ft}

- (5) Make sure that the rocker arm moves smoothly.



SHTS011060200043

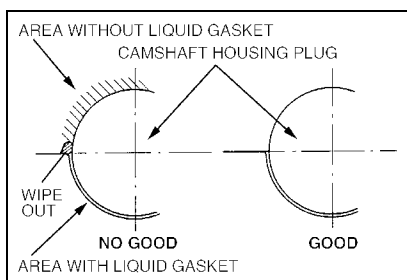
10. INSTALL THE HEAD COVER.

- (1) Remove the camshaft housing plugs at the front and rear ends of the camshaft housing.

NOTICE

Do not remove the plug except when there is oil leakage from plug.

- (2) Remove the liquid gasket from camshaft housing plugs and camshaft housing completely.

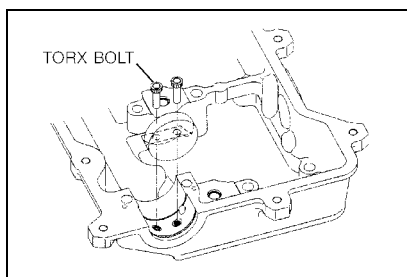


SHTS011060200044

- (3) Apply liquid gasket to the front and rear half circles of the camshaft housing.

NOTICE

Wipe out excess liquid gasket completely.



SHTS011060200045

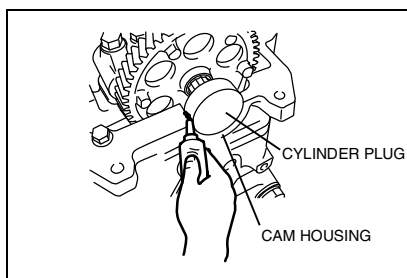
- (4) Install the camshaft housing plug to camshaft housing with torx bolt.

Tightening Torque:

6 N·m {60 kgf·cm, 4.3 lbf·ft}

NOTICE

Make sure that the camshaft housing plug is installed with no tilt.



SHTS011060200046

- (5) Install the head cover gasket into the gasket groove at the head cover lower surface.

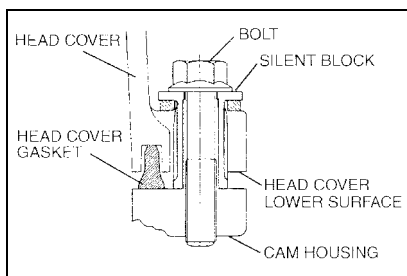
NOTICE

Make sure that there are no foreign particles (including liquid gasket), or oil on the gasket grooves of the head cover, gasket or cam housing upper surface nor damage to them.

- (6) Apply liquid gasket to plug corner at the front and rear ends of the cam housing before installing the head cover.

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ENGINE MECHANICAL (J08E)



SHTS011060200047

- (7) Insert the silent block from the head cover upper surface.
- (8) Tighten the bolt through the silent block to the specified torque below and fix the head cover on the cam housing.

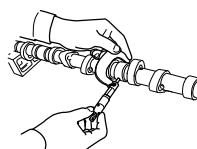
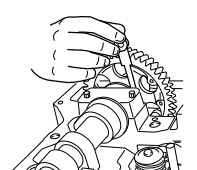
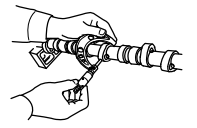
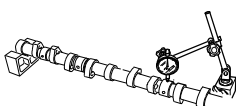
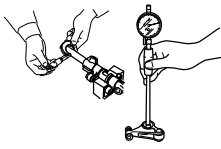
Tightening Torque:

28.5 N·m {290 kgf·cm, 21 lbf·ft}

INSPECTION AND REPAIR

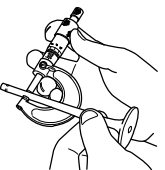
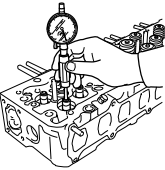
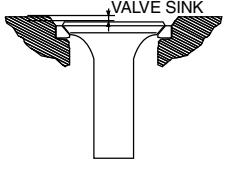
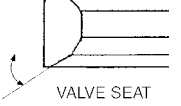
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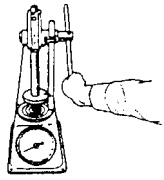
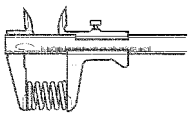
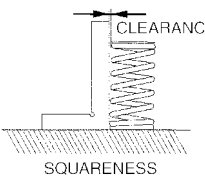
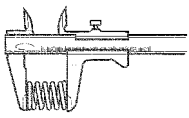

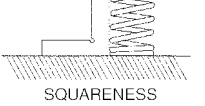

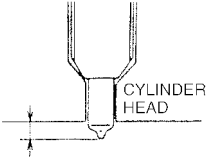
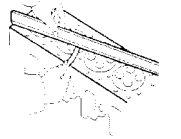
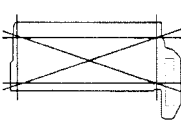
Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Camshaft journal outside diameter		40 {1.5748}	39.85 {1.5689}	Replace camshaft.	Measure 
Camshaft bearing inside diameter		40 {1.5748}	40.15 {1.5807}	Replace cam bearing.	
Clearance between camshaft journal and camshaft bearing		0.020-0.063 (0.0008-0.0024)	—	Replace camshaft and/or cam bearing.	
Camshaft end play		0.100-0.178 (0.0040-0.0070)	—	Replace camshaft.	Measure 
Cam height	IN	50.046 {1.9703}	49.966 {1.9672}	Replace camshaft.	Measure 
	EX	52.739 {2.0763}	52.659 {2.0732}		
Camshaft deflection		0.04 {0.0016}	0.1 {0.0039}	Replace camshaft.	Measure 
Rocker arm bushing inside diameter		22 {0.866}	22.08 {0.8693}	Replace rocker arm.	Measure 
Rocker shaft outside diameter		22 {0.866}	21.92 {0.8630}	Replace rocker shaft.	
Clearance between rocker shaft and rocker arm bushing		0.030-0.101 {0.0012-0.0039}	0.15 {0.0059}	Replace rocker arm and/or rocker shaft.	

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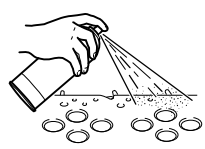
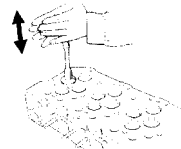
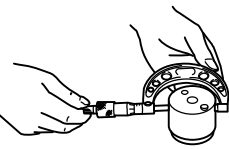
ENGINE MECHANICAL (J08E)

Inspection item		Standard	Limit	Remedy	Inspection procedure
Intake valve	Stem outside diameter	7 {0.2756}	6.92 {0.2724}	Replace the valve.	Measure 
	Guide inside diameter	7 {0.2756}	7.04 {0.2772}	Replace the valve guide.	
	Clearance	0.023-0.058 {0.0010-0.0022}	0.12 {0.0047}	Replace the valve and/or valve guide.	
Exhaust valve	Stem outside diameter	7 {0.2756}	6.85 {0.2697}	Replace the valve.	
	Guide inside diameter	7 {0.2756}	7.04 {0.2772}	Replace the valve guide.	
	Clearance	0.050-0.083 {0.0020-0.0032}	0.15 {0.0059}	Replace the valve and/or valve guide.	
Valve sink	IN	0.55-0.85 {0.0217-0.0334}	1.1 {0.0433}	Replace the valve and valve seat.	Measure 
	EX	1.15-1.45 {0.0453-0.0570}	1.7 {0.0669}	Replace the valve and valve seat.	
Valve seat angle	IN	30°	30°-30°35'	Resurface the valve and/or valve seat.	Measure 
	EX	45°	45°-45°30'		
Valve face angle	IN	30°	29°30'-30°		
	EX	45°	44°30'-45°		

Inspection item		Standard	Limit	Remedy	Inspection procedure
Outer valve spring	Setting load	314 N {32.0 kgf, 70.5 lbf} at 46.8 {1.843}	291.8 N {29.8 kgf, 65.6 lbf} at 46.8 {1.843}	Replace.	Measure  SETTING LOAD  FREE LENGTH  CLEARANCE SQUARENESS
	Free length (reference value)	75.7 {2.980}	72.7 {2.862}	Replace.	
	Squareness	—	2.0 {0.0787}	Replace.	
Inner valve spring	Setting load	129 N {13.2 kgf, 29.1 lbf} at 44.8 {1.764}	119.5 N {12.2 kgf, 26.9 lbf} at 44.8 {1.764}	Replace.	 SETTING LOAD  FREE LENGTH  CLEARANCE SQUARENESS
	Free length (reference value)	64.6 {2.543}	61.6 {2.425}	Replace.	
	Squareness	—	2.0 {0.0787}	Replace.	
Wear and damage of valve spring seat upper and lower		—	—	Replace.	Visual check 
Nozzle protrusion		2.45-2.95 {0.0965-0.1161}	—	Replace nozzle seat.	Measure  CYLINDER HEAD
Cylinder head lower surface flatness		0.06 or less {0.0024 or less} for longitudinal direction	0.20 {0.0078}	Replace. NOTICE: Do not grind for repair.	Measure  
		0.03 or less {0.0012 or less} for lateral direction			

EN02-20

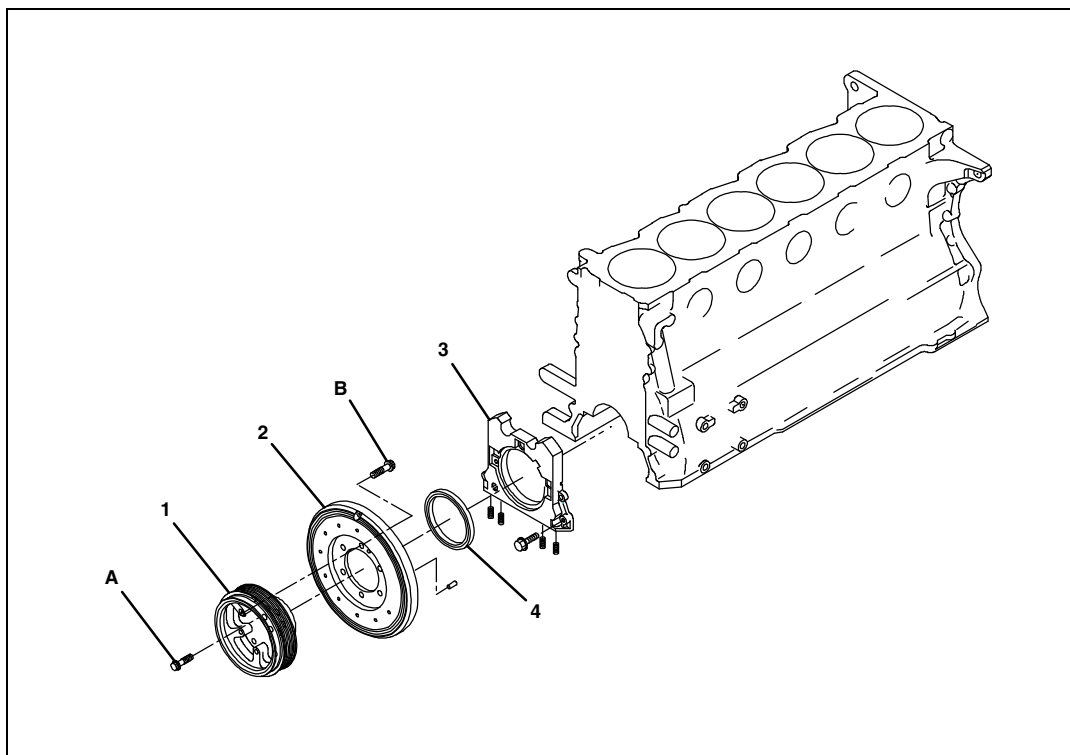
ENGINE MECHANICAL (J08E)

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cracks or damage to cylinder head (Dye penetrant check)	—	—	Replace.	Visual check 
Contact of valve (Use of Red lead marking compound)	Entire periphery of valve head evenly in contact	—	Matches valve.	Visual check 
Cam idle gear shaft outside diameter	34 {1.3386}	—	—	Measure 
Cam idle gear shaft bushing inside diameter	34 {1.3386}	—	—	
Clearance between cam idle gear shaft and cam idle gear bushing	0.025-0.075 {0.0010-0.0029}	0.2 {0.0078}	Replace idle gear shaft and/or idle gear.	

CRANKSHAFT FRONT END

COMPONENT LOCATOR

EN0110602D100002



SHTS011060200063

1	Crankshaft pulley	3	Oil seal retainer
2	Torsional damper	4	Crankshaft oil seal

Tightening torque**Unit: N·m {kgf·cm, lbf·ft}**

A	118 {1,200, 86.8}#	B	108 {1,100, 79.6}#
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#=Apply oil to the threads and seat surfaces before tightening.

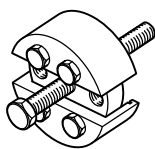
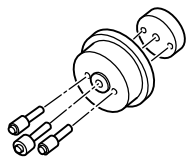
EN02-22

ENGINE MECHANICAL (J08E)

SPECIAL TOOL

EN0110602K100002

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0942-01731	OIL SEAL PULLER	
	S0940-71030	OIL SEAL PRESS	

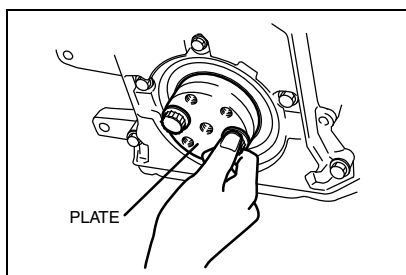
OVERHAUL

EN0110602H200002

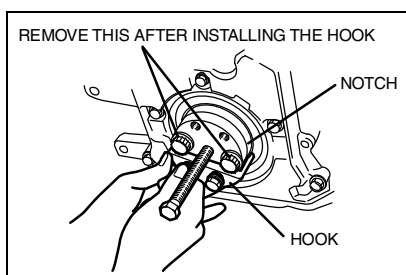
IMPORTANT POINTS - REPLACEMENT

1. **REMOVE THE CRANKSHAFT FRONT OIL SEAL.**
SST: Oil seal puller (S0942-01731)

- (1) Place the plate at the crankshaft end using the crankshaft pulley bolts.

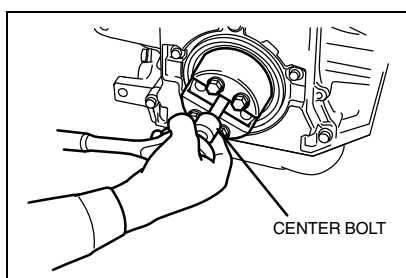


SHTS011060200066



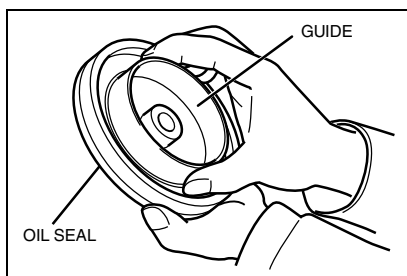
SHTS011060200067

- (2) Engage the hook with the oil seal notch and install the hook using the bolt supplied.
- (3) Remove the installed bolt in step (1).



SHTS011060200068

- (4) Install the center bolt and tighten it to remove the oil seal.

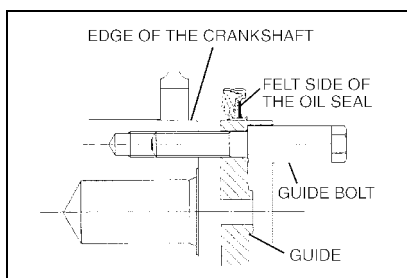


SHTS011060200069

2. INSTALL THE CRANKSHAFT FRONT OIL SEAL.

SST: Oil seal press (S0940-71030)

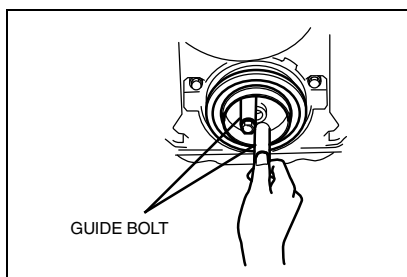
- (1) Clean the edges and surface of the crankshaft and the special tools.
- (2) Insert a new crankshaft oil seal into the guide of the oil seal press.



SHTS011060200070

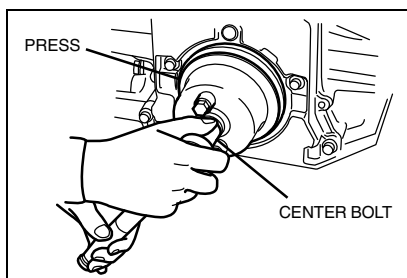
NOTICE

Pay attention to the orientation of the crankshaft oil seal (The felt side should face the outside of the cylinder block).



SHTS011060200071

- (3) Apply a little engine oil to the seal portion of the crankshaft oil seal.
- (4) Attach the oil seal press guide with the new crankshaft oil seal onto the crankshaft using the attached guide bolt.



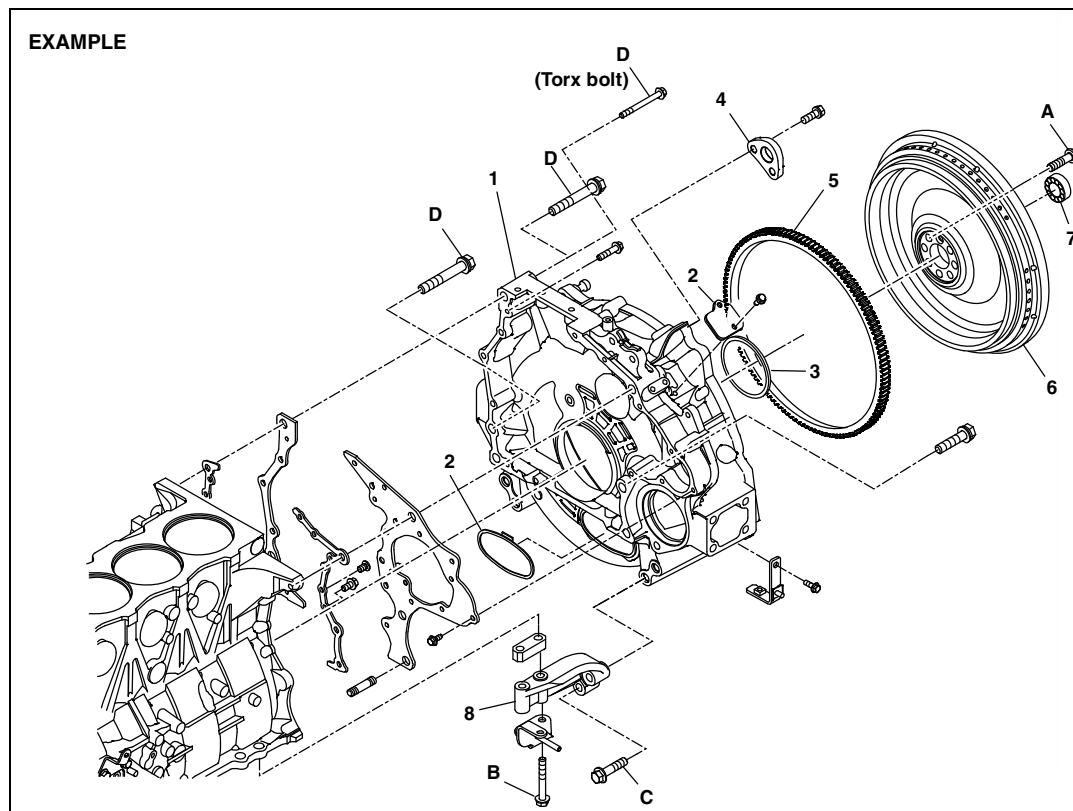
SHTS011060200072

- (5) Insert the oil seal press by adjusting the oil seal press hole to the guide bolt.
- (6) Press the crankshaft oil seal inside by attaching the accompanying center bolt onto the oil seal press and tightening it until it stops.

FLYWHEEL AND FLYWHEEL HOUSING

COMPONENT LOCATOR

EN0110602D100003



SHTS011060200073

1 Flywheel housing	5 Ring gear
2 Dust cover	6 Flywheel
3 Crankshaft oil seal	7 Pilot bearing
4 Hanger bracket	8 Stay

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 186 {1,900, 137.4}#O	D M8: 28.5 {290, 21}
B 97 {990, 71.6}	D M8 Torx bolt: 36 {370, 26.8}
C 171.5 {1,750, 126.6}	D M10: 55 {560, 40.5}
	D M16: 196 {2,000, 145}

#=Apply oil to the threads and seat surface before tightening.

O=Tighten the bolt to the specified torque, then loosen it. Tighten to the specified torque again.

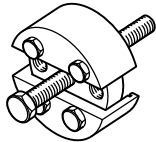
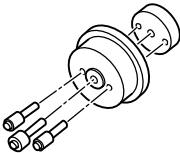
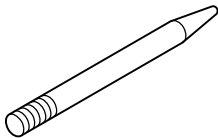
EN02-26

ENGINE MECHANICAL (J08E)

SPECIAL TOOL

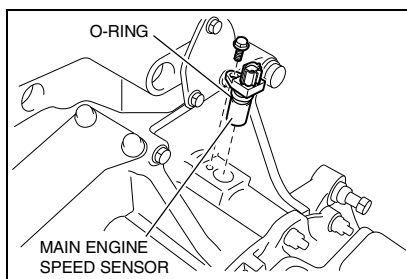
EN0110602K100003

Prior to starting an engine overhaul, it is necessary to have these special tools.

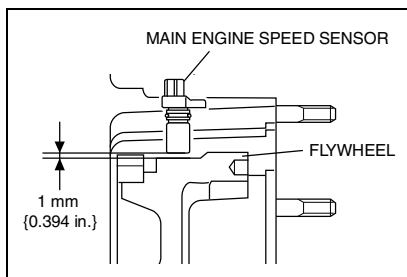
Illustration	Part number	Tool name	Remarks
	S0942-01742	REAR OIL SEAL PULLER	
	S0940-71040	OIL SEAL PRESS	
	S0948-11340	GUIDE BAR	

OVERHAUL

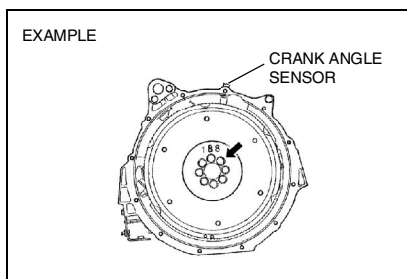
EN0110602H200003

IMPORTANT POINT - DISASSEMBLY**1. REMOVE THE FLYWHEEL ASSY.**

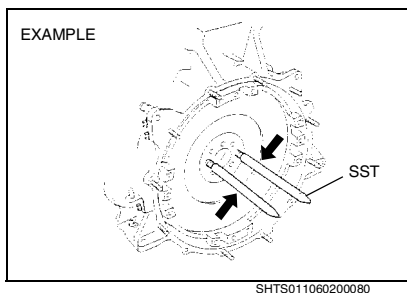
- (1) Remove the main engine speed sensor from the flywheel housing.

**NOTICE**

When dismounting and remounting the flywheel. Remove the main engine speed sensor. If not removed, it will result in damage of the sensor.

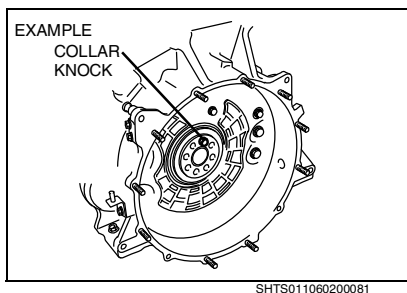


- (2) Remove the 8 bolts of the flywheel assy.



- (3) Install the special tool, remove the flywheel assy.
SST: Guide bar (S0948-11340)

⚠ WARNING
Be careful not to drop the flywheel on your foot when removing it, because it is very heavy.

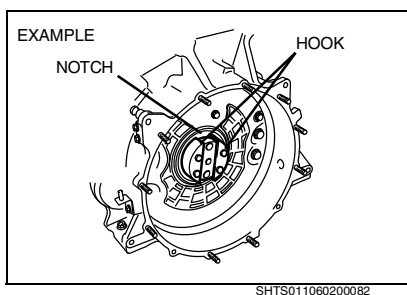


IMPORTANT POINTS - REPLACEMENT

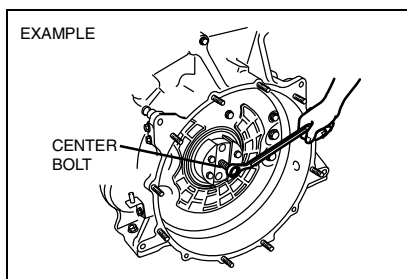
1. **REMOVE THE CRANKSHAFT REAR OIL SEAL.**
SST: Oil seal puller (S0942-01742)

- (1) Place the plate at the crankshaft end using the flywheel bolts.

NOTICE
Match the plate hole to the crankshaft collar knock part.

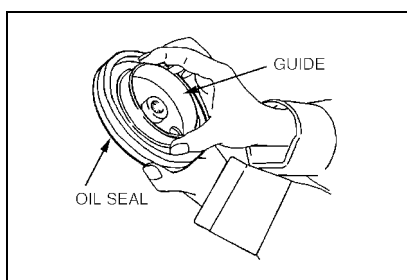


- (2) Engage the hook with the oil seal notch and install the hook using the bolt supplied.
(3) Remove the installed flywheel bolts in step (1).



SHTS011060200083

- (4) Install the center bolt and tighten it to remove the oil seal.

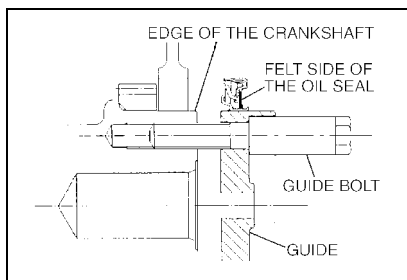


SHTS011060200084

2. INSTALL THE CRANKSHAFT REAR OIL SEAL.

SST: Oil seal press (S0940-71040)

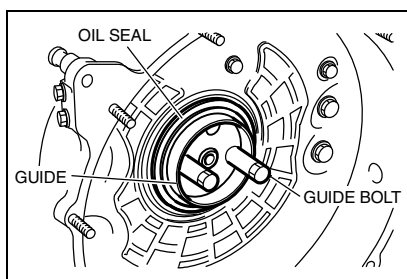
- (1) Clean the edges and surface of the crankshaft and the special tools.
- (2) Insert a new crankshaft oil seal into the guide of the oil seal press.



SHTS011060200085

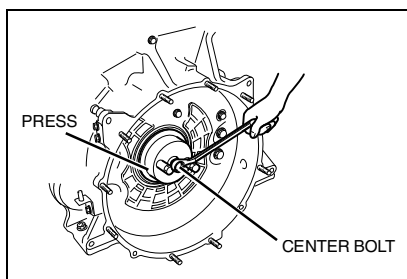
NOTICE

Pay attention to the orientation of the crankshaft oil seal (The felt side should face the outside of the cylinder block).



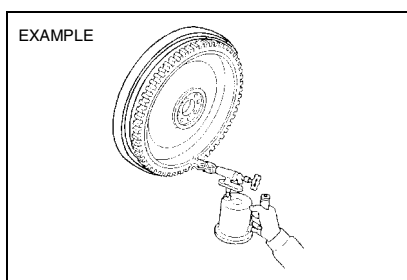
SHTS011060200086

- (3) Apply a little engine oil to the seal portion of the crankshaft oil seal.
- (4) Attach the oil seal press guide with the new crankshaft oil seal onto the crankshaft using the attached guide bolt.



SHTS011060200087

- (5) Insert the oil seal press by adjusting the oil seal press hole to the guide bolt.
- (6) Press the crankshaft oil seal inside by attaching the accompanying center bolt onto the oil seal press and tightening it until it stops.



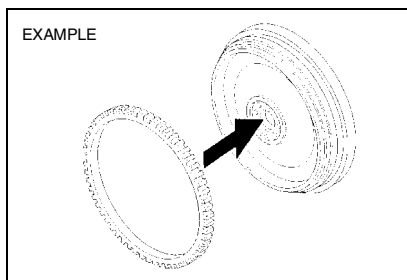
SHTS011060200088

3. REPLACE THE FLYWHEEL RING GEAR.

- (1) Heat the ring gear evenly to about 200°C {392°F} with a torch. Tap the ring gear periphery lightly using a cushion bar to remove the gear.

⚠ WARNING

Never touch the heated ring gear or flywheel with your bare hand. This can result in personal injury.

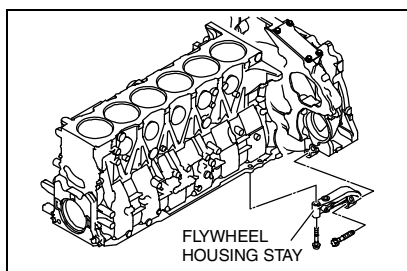


SHTS011060200089

- (2) Heat the ring gear evenly to about 200°C {392°F} with a torch. Insert the ring gear into the flywheel so that the chamfered side is upward.

⚠ WARNING

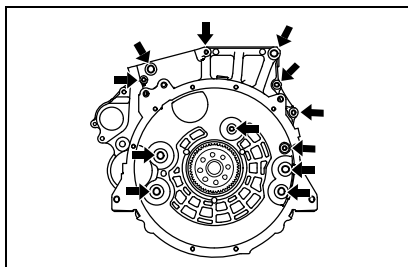
Never touch the heated ring gear or flywheel with your bare hand. This can result in personal injury.



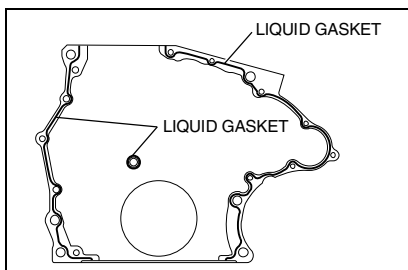
SHTS011060200090

4. REPLACE THE FLYWHEEL HOUSING.

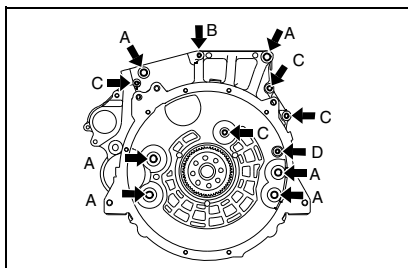
- (1) Removing the flywheel housing.
 - a. Remove the flywheel housing stay.



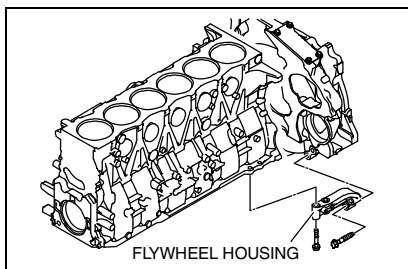
SHTS011060200091



SHTS011060200092



SHTS011060200093



SHTS011060200094

- b. Unfasten the bolts to remove the flywheel housing.

(2) Mounting the flywheel housing.

- a. Using the scraper, remove dirt on the joint surfaces of the axle housing and differential carrier assembly.
b. Apply a liquid gasket to the flywheel housing as shown in the figure.

NOTICE

- Apply it seamlessly.
- Apply the liquid gasket with 1.5 to 2.5 mm width.
- Mount the case within 20 minutes after applying the liquid gasket.

- c. Mount the rear engine mounting to the flywheel housing with bolts.

Tightening torque:

196 N·m {2,000 kgf·cm, 145 lbf·ft} (A)

36 N·m {370 kgf·cm, 26.8 lbf·ft} (B)

55 N·m {560 kgf·cm, 40.5 lbf·ft} (C)

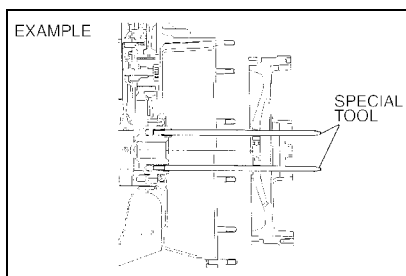
55 N·m {560 kgf·cm, 40.5 lbf·ft} (D)

- d. Mount the flywheel housing stay.

Tightening torque:

97 N·m {990 kgf·cm, 71.6 lbf·ft} (M12)

171.5 N·m {1,750 kgf·cm, 126.6 lbf·ft} (M14)



SHTS011060200095

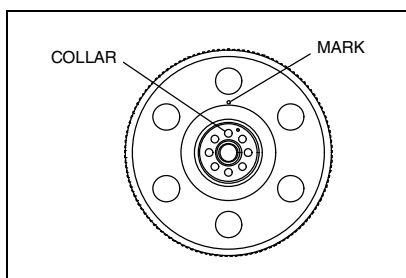
IMPORTANT POINT - ASSEMBLY**1. INSTALL THE FLYWHEEL.**

- (1) Make sure that there are no burns or dirt on the contact surface or in the threaded holes of the crankshaft or flywheel. Install the special tool onto the crankshaft.

SST: Guide bar (S0948-11340)

NOTICE

Place one guide bar at the collar knock and another at the opposite side of the collar knock.



SHTS011060200096

- (2) Insert the flywheel slowly until it contacts the collar knock to prevent impact on the guide bar. Adjust the position, then insert the flywheel completely.

⚠ WARNING

Be careful not to drop the flywheel on your foot when removing it, because it is very heavy.

NOTICE

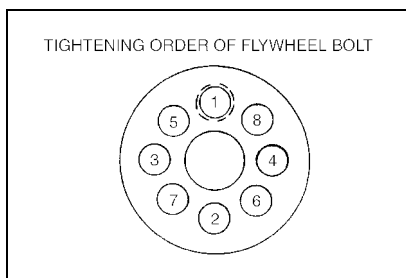
Align the "O" mark on the flywheel and crankshaft collar knock-pin.

- (3) Apply clean engine oil to the threads of the flywheel bolt and the flywheel bolt seat. Be sure to tighten the flywheel bolts (6 pieces) with a low-torque impact wrench.
- (4) Pull out the guide bar and tighten the remaining two flywheel bolts provisionally as in step (3).
- (5) Tighten the flywheel in the order shown in the figure to the specified torque below.

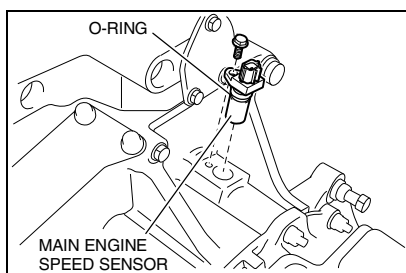
Tightening Torque:

186 N·m {1,900 kgf·cm, 137.4 lbf·ft}

- (6) Loosen all bolts and tighten them again to the specified torque.



SHTS011060200097



SHTS011060200098

- (7) Install the main engine speed sensor.

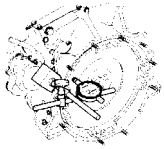
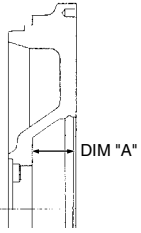
Tightening Torque:

10 N·m {102 kgf·cm, 7.3 lbf·ft}

INSPECTION AND REPAIR

EN0110602H300002

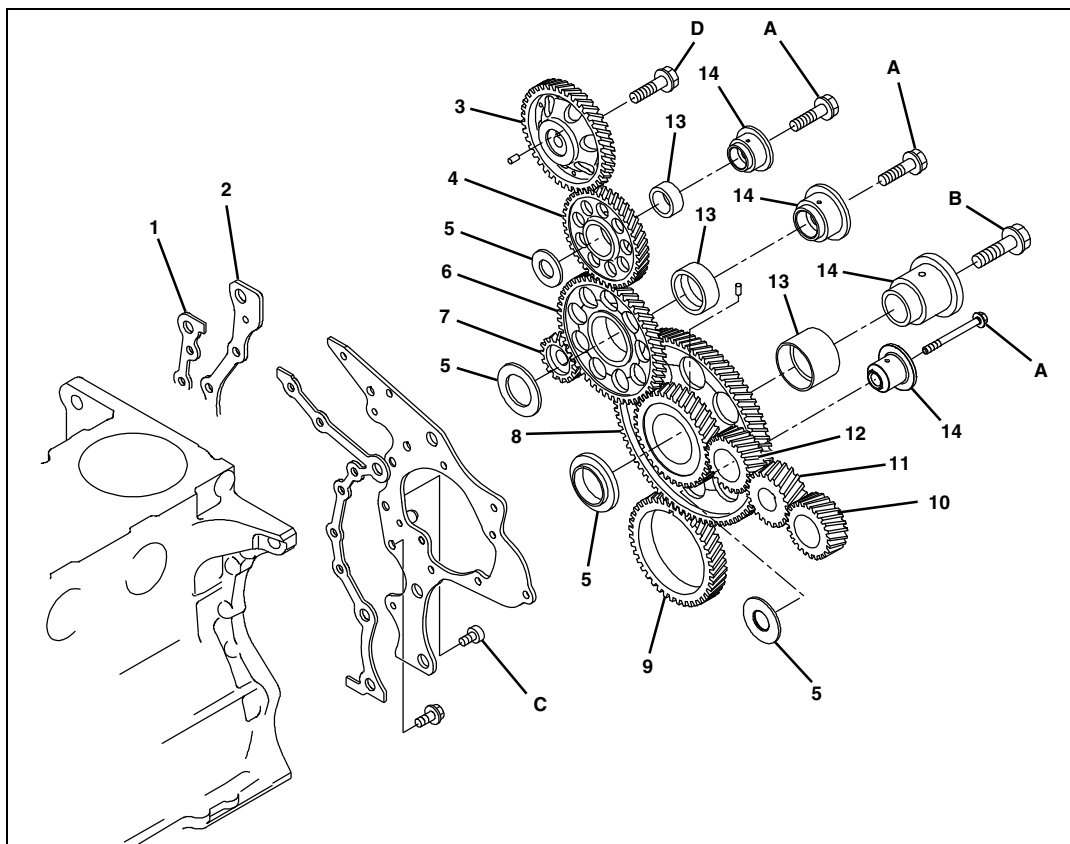
Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Flywheel surface deflection		—	0.15 {0.0059}	Repair.	Measure 
Flywheel thickness (Dimension A)	EATON SAS1401 SAS1402 MD DM series (Diameter 350 mm {14 in.})	43.5 {1.7126}	42.5 {1.6732}	Repair.	Measure 
Flywheel surface crank on heat spot		—	—	Repair.	Visual check

TIMING GEAR

COMPONENT LOCATOR

EN0110602D100004



SHTS011060200101

1 Gasket	8 Main idle gear
2 Rear end plate	9 Crankshaft gear
3 Camshaft gear	10 Power steering pump drive gear
4 Cam idle gear	11 Air compressor drive gear
5 Idle gear thrust plate	12 Air compressor idle gear
6 Sub-idle gear	13 Idle gear bushing
7 Oil pump gear	14 Idle gear shaft

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 108 {1,100, 79.6}#	C 55 {560, 41} Application of lock sealant
B 172 {1,750, 127}#	D 59 {600, 43}+90°#

#=Apply oil to the threads and seat surfaces before tightening.

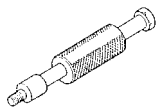
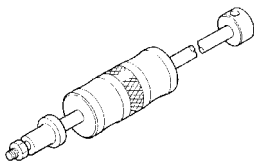
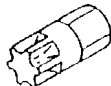
EN02-34

ENGINE MECHANICAL (J08E)

SPECIAL TOOL

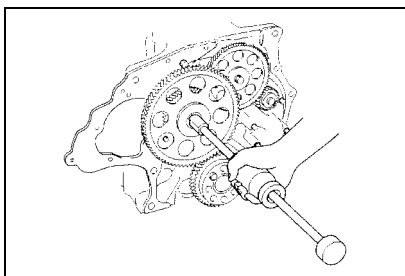
EN0110602K100004

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0942-01100	SLIDING HAMMER	For MAIN IDLE GEAR
	S0942-01442	SLIDING HAMMER	For SUB AND CAM IDLE GEAR
	S0941-11300	SOCKET WRENCH	For TORX BOLT

OVERHAUL

EN0110602H200004



SHTS011060200105

IMPORTANT POINT - DISASSEMBLY

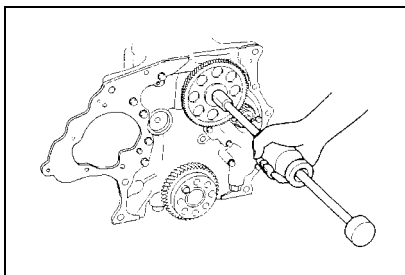
1. REMOVE THE IDLE GEAR SHAFT.

- (1) Remove the idle gear shaft using the special tool.

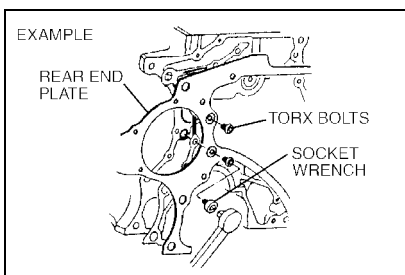
SST:

Sliding hammer (for main idle gear) (S0942-01100)

Sliding hammer (for sub and cam idle gear) (S0942-01442)



SHTS011060200106



SHTS011060200107

IMPORTANT POINTS - ASSEMBLY

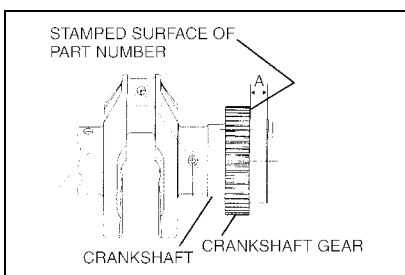
1. INSTALL THE REAR END PLATE.

- (1) Apply lock sealant (Nut Lock Super 5M or equivalent) to the threads of the torx bolts in the side of bearing holder case fitting (2 places) and tighten to the specified torque using the special tool.

SST: Socket wrench (S0941-11300)

Tightening Torque:

55 N·m {560 kgf·cm, 41 lbf·ft}



SHTS011060200108

2. INSTALL THE CRANKSHAFT GEAR.

- (1) Heat the crankshaft gear in oil heated to 100°C -150°C {212°F-302°F}.

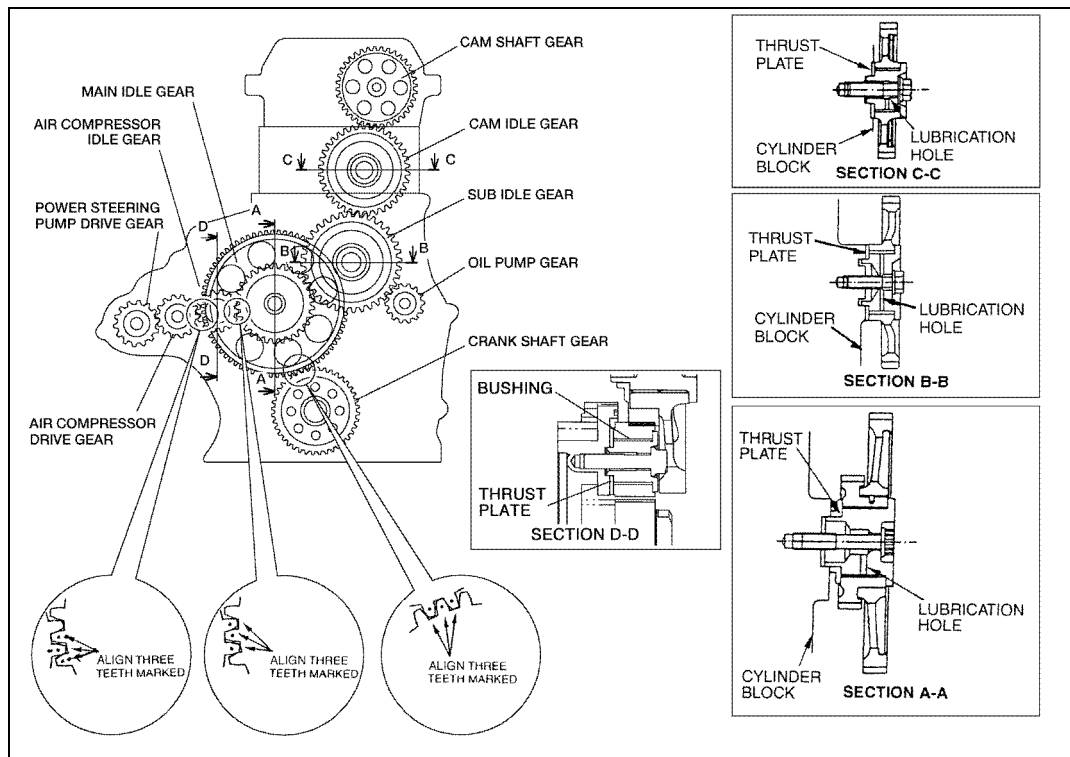
⚠ WARNING

Never touch the heated gear with your bare hand. This can result in personal injury.

- (2) Align the crankshaft gear groove with crankshaft pin.
- (3) Install the crankshaft gear onto the crankshaft as shown in the figure.

Dimension A: 22 mm {0.866 in.}

3. INSTALL THE IDLER GEAR SHAFT AND GEAR.



SHTS011060200109

NOTICE

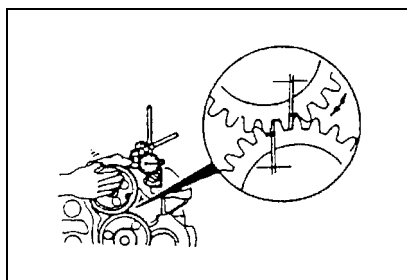
- Install each idle gear shaft through the thrust plate as shown in the figure so that the lubrication hole is downward.
- Adjust the timing of the main idle gear to align with the air compressor gear as shown in the figure.

4. MEASUREMENT OF GEAR BACKLASH.

- (1) Measure the backlash between the gears with a dial gauge. (Refer to the table of "INSPECTION AND REPAIR")

NOTICE

- Measure the backlash with the drive-side gear fixed.
- After measurement of the backlash, apply engine oil to each gear surface.

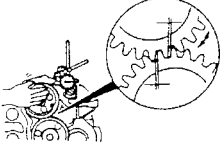


SHTS011060200110

INSPECTION AND REPAIR

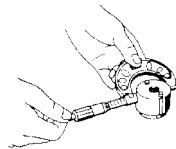
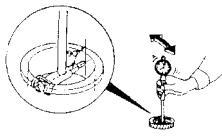
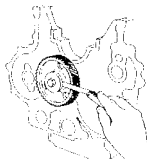
EN0110602H300003

Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Timing gear back- lash	Crankshaft- Main idle	0.030-0.167 {0.0012-0.0065}	0.30 {0.0118}	Replace gear.	<p>Measure</p> 
	Main idle-Air compressor idle	0.020-0.096 {0.0008-0.0038}	0.10 {0.0039}		
	Air compres- sor idle-Air compressor gear	0.020-0.083 {0.0008-0.0033}	0.10 {0.0039}		
	Air compres- sor-Power steering pump	0.030-0.134 {0.0012-0.0052}	0.30 {0.0118}		
	Main idle-Sub idle	0.030-0.113 {0.0012-0.0044}	0.30 {0.0118}		
	Sub idle-Oil pump	0.030-0.131 {0.0012-0.0052}	0.30 {0.0118}		
	Sub idle-Cam idle	0.050-0.218 {0.0020-0.0085}	0.30 {0.0118}		
	Cam idle- Camshaft	0.030-0.253 {0.0012-0.0099}	0.30 {0.0118}		

EN02-38

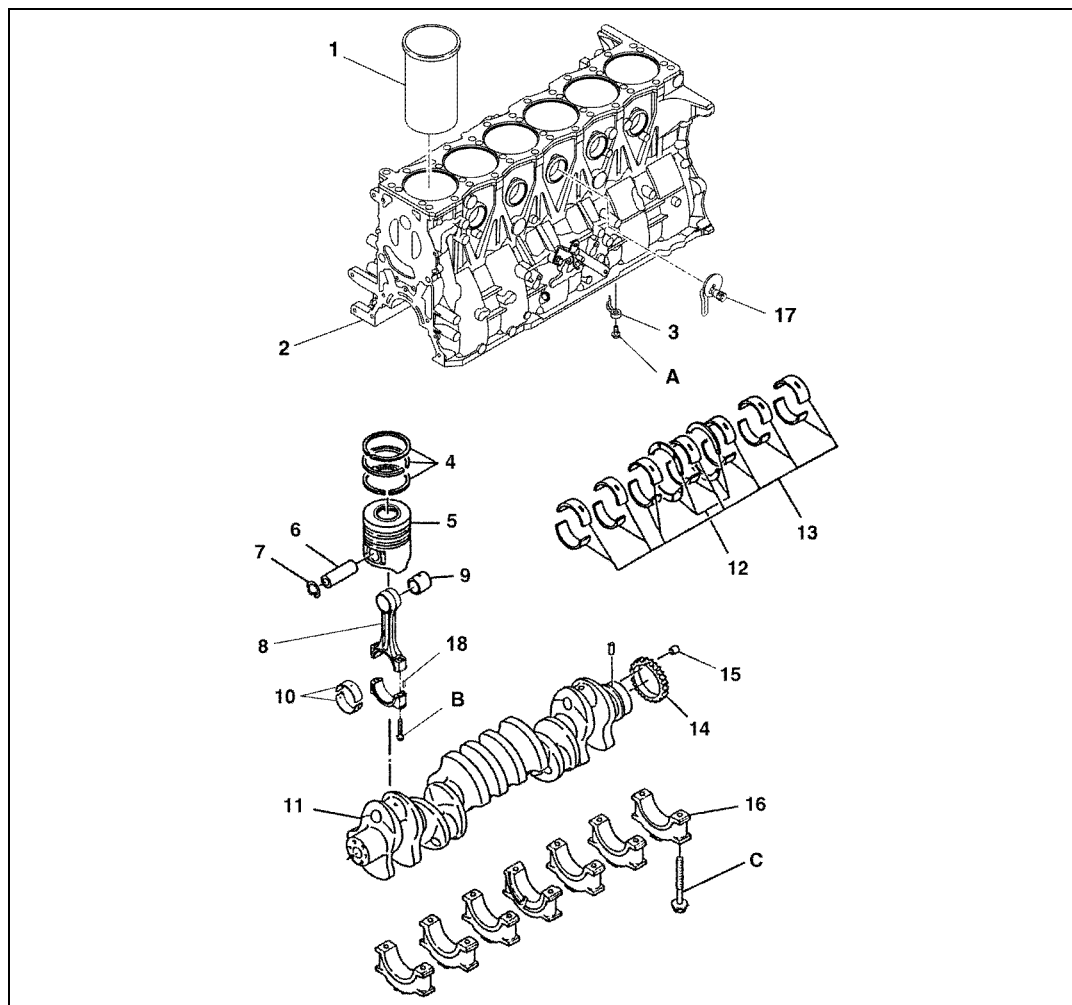
ENGINE MECHANICAL (J08E)

Inspection item		Standard	Limit	Remedy	Inspection procedure
Main idle shaft	Shaft outside diameter	57 {2.244}	—	—	Measure
	Bushing inside diameter	57 {2.244}	—	—	
	Clearance	0.030-0.090 {0.0012-0.0035}	0.20 {0.0079}	Replace gear and/or shaft.	
	Gear width	44 {1.732}	—	—	
	Shaft length	44 {1.732}	—	—	
	End play	0.114-0.160 {0.0045-0.0062}	0.30 {0.0118}	Replace gear and/or shaft.	
Sub idle shaft	Shaft outside diameter	50 {1.969}	—	—	 OUTSIDE DIAMETER
	Bushing inside diameter	50 {1.969}	—	—	
	Clearance	0.025-0.075 {0.0010-0.0029}	0.20 {0.0079}	Replace gear and/or shaft.	
	Gear width	22 {0.866}	—	—	
	Shaft length	22 {0.866}	—	—	
	End play	0.040-0.120 {0.0016-0.0047}	0.30 {0.0118}	Replace gear and/or shaft.	
Cam idle shaft	Shaft outside diameter	34 {1.339}	—	—	 INSIDE DIAMETER
	Bushing inside diameter	34 {1.339}	—	—	
	Clearance	0.025-0.075 {0.0010-0.0029}	0.20 {0.0079}	Replace gear and/or shaft.	
	Gear width	22 {0.866}	—	—	
	Shaft length	22 {0.866}	—	—	
	End play	0.040-0.120 {0.0016-0.0047}	0.30 {0.0118}	Replace gear and/or shaft.	
Air compressor idle	Shaft outside diameter	34 {1.339}	—	—	 END PLAY
	Bushing inside diameter	34 {1.339}	—	—	
	Clearance	0.025-0.057 {0.0010-0.0022}	0.10 {0.0039}	Replace gear and/or shaft.	
	Gear width	28.5 {1.1220}	—	—	
	Shaft length	28.5 {1.1220}	—	—	
	End play	0.160-0.220 {0.0063-0.0086}	0.30 {0.0118}	Replace gear and/or shaft.	

MAIN MOVING PARTS AND CYLINDER BLOCK

COMPONENT LOCATOR

EN0110602D100005



SHTS011060200113

1	Cylinder liner	10	Connecting rod bearing
2	Cylinder block	11	Crankshaft
3	Piston cooling jet	12	Crankshaft thrust bearing
4	Piston ring	13	Crankshaft main bearing
5	Piston	14	Crankshaft gear
6	Piston pin	15	Collar knock
7	Retainer ring	16	Main bearing cap
8	Connecting rod	17	Block heater assy
9	Connecting rod bushing	18	Dowel pin

EN02-40

ENGINE MECHANICAL (J08E)

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

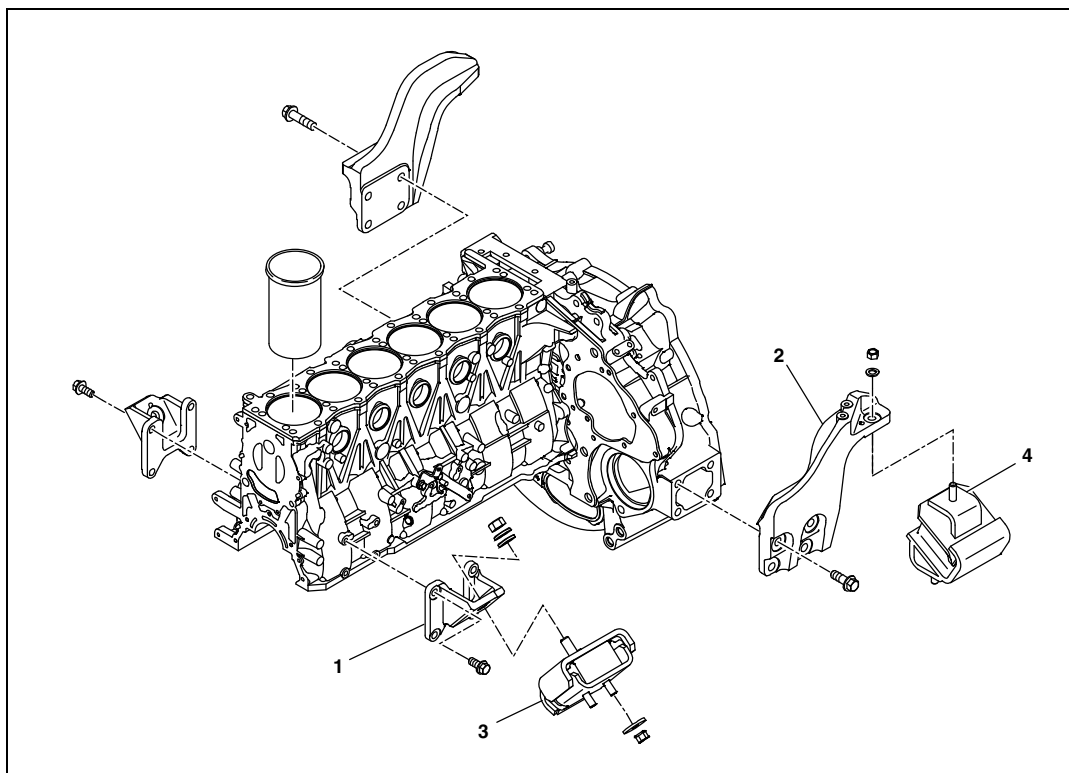
A 22 {220, 15.9}

C 69 {700, 51}+90°+45°#O

B 69 {700, 51}+90°+45°#

#=Apply oil to the threads and seat surfaces before tightening.

O=Tighten the bolt to the specified torque, then loosen it. Tighten to the specified torque again.

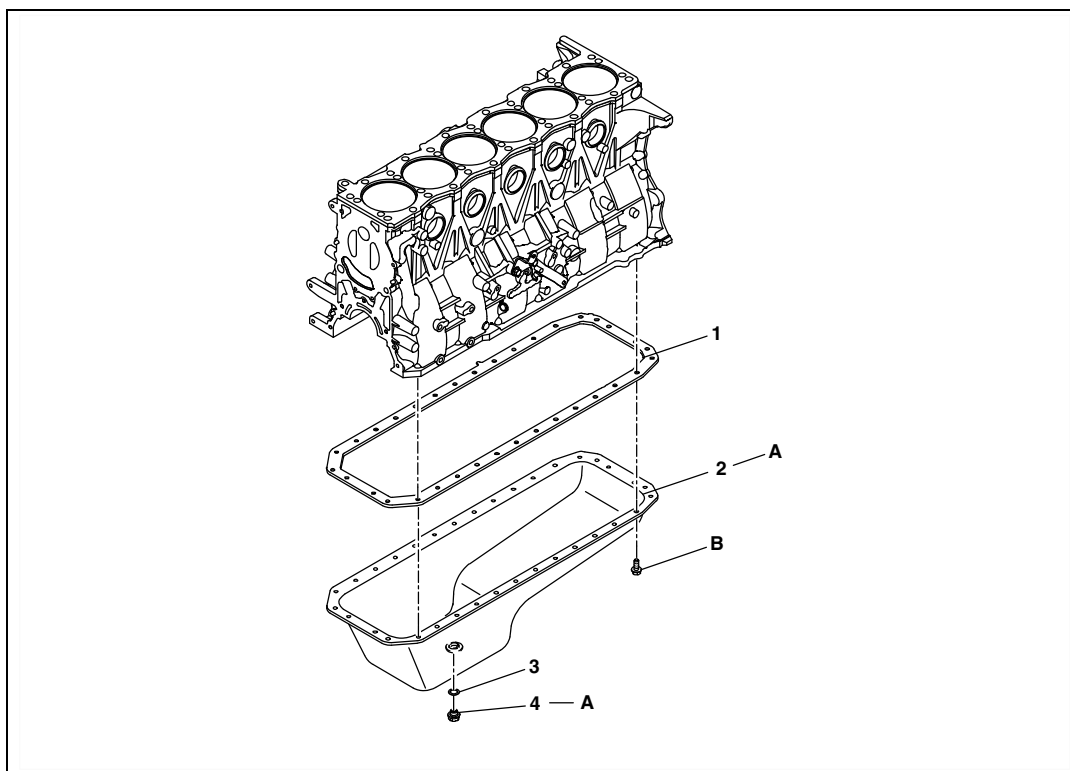


1 Engine mounting bracket, front

3 Engine mounting, front

2 Engine mounting bracket, rear

4 Engine mounting, rear



SHTS011060200115

1 Gasket	3 Soft washer
2 Oil pan	4 Drain plug

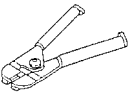
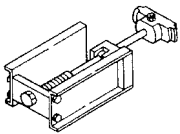
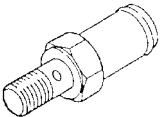

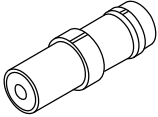
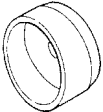
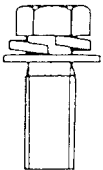
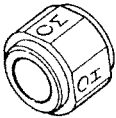
Tightening torque
Unit: N·m {kgf·cm, lbf·ft}

A 41 {420, 30}	B 30 {310, 22.4}
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SPECIAL TOOL

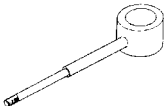
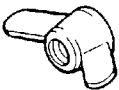
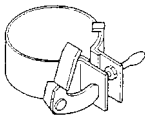
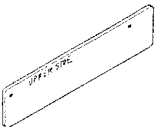
EN0110602K100005

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0944-21011	PISTON RING EXPANDER	For Piston ring
	S0942-02100	PULLER	For Cylinder liner
	SZ910-24098	CONNECTOR BOLT	For Piston cooling jet
	S0947-11490	GUIDE	
	S0940-21540	SPINDLE	
	S0948-11540	GUIDE	
	SH691-20825	BOLT	
	S0948-11130	GUIDE	For Connecting rod bushing

ENGINE MECHANICAL (J08E)

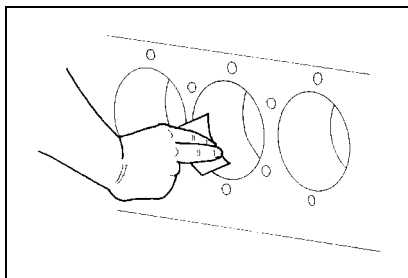
EN02-43

Illustration	Part number	Tool name	Remarks
	S0940-21530	PRESS SUB-ASSEMBLY	
	SL271-01036	WING NUT	
	S0944-11370	PISTON RING HOLDER	
	09219-E4010	GAGE	

OVERHAUL

EN0110602H200005

IMPORTANT POINTS - DISASSEMBLY



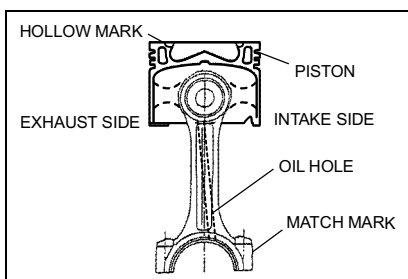
SHTS011060200128

1. REMOVE THE PISTONS WITH CONNECTING RODS.

- (1) Remove the pistons and connecting rods from the cylinder block upper side.

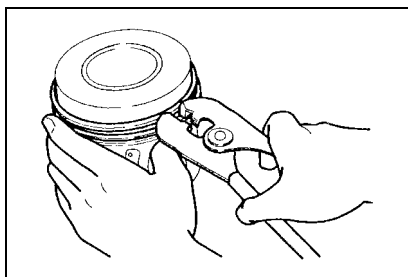
NOTICE

- Remove carbon deposits from the end inside the cylinder liner with a scraper or emery paper (recommended: No. 150) in a circular direction.



SHTS011060200129

- Arrange the removed pistons and connecting rod caps in the order of cylinder numbers. Be careful not to change the combination of the connecting rod and cap.



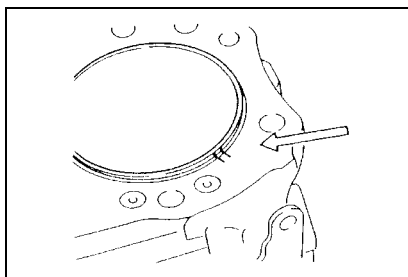
SHTS011060200130

2. REMOVE THE PISTON RINGS.

- (1) Remove the piston ring using the special tool.
SST: Piston ring expander (S0944-21011)

NOTICE

- Handle the piston rings carefully because they are made of a special casting which is easily broken.
- Keep the piston rings for each cylinder separately.



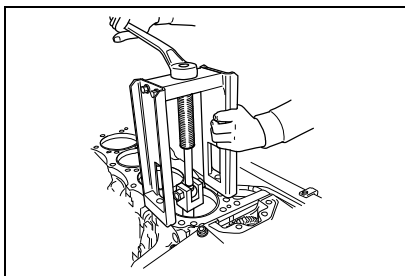
SHTS011060200131

3. REMOVE THE CYLINDER LINER.

- (1) Before removing the cylinder liner, put alignment marks on the cylinder block and liner flange.

NOTICE

Do not make alignment marks with a punch.

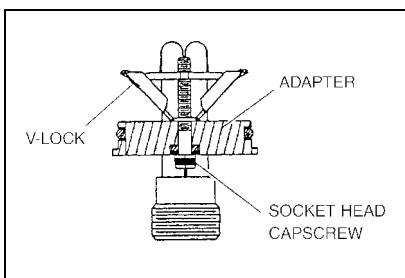


SHTS011060200132

- (2) Pull the cylinder liner from the cylinder block using the special tool.
SST: Puller (S0942-02100)

NOTICE

- Carefully set the special tool to prevent touching the piston cooling jet.
- After removing the cylinder liners, arrange them in sequence.



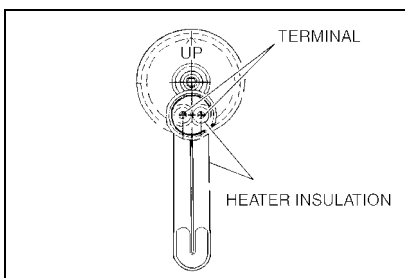
SHTS011060200133

4. REMOVE THE BLOCK HEATER.

- (1) Remove the harness by loosening the cord nut.
- (2) Loosen the socket head cap screw.
- (3) Lever the heater out by using a bar.

NOTICE

- Do not damage the adapter installation hole, otherwise water will leak.
- Do not reuse the V-lock.



SHTS011060200134

IMPORTANT POINT - ON - VEHICLE INSPECTION

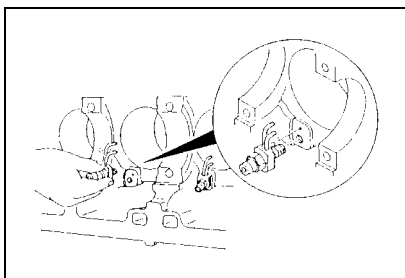
1. INSPECT THE BLOCK HEATER.

- (1) Measure the resistance between terminals.
If not standard value, replace block heater assembly.

Standard	13.1-15.2 Ω
----------	--------------------

- (2) Measure the resistance of insulation between terminals and heater insulation. If not standard value, replace block heater assembly.

Standard	More than 5 M Ω
----------	------------------------



SHTS011060200135

IMPORTANT POINTS - ASSEMBLY

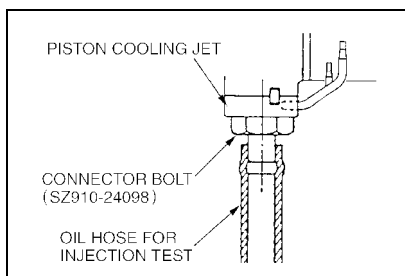
1. INSPECT AND ADJUST THE PISTON COOLING JET.

- (1) Install the piston cooling jet on the cylinder block using the special tool.

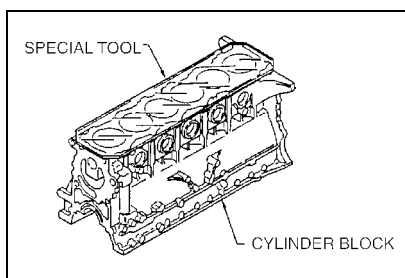
SST: Connector bolt (SZ910-24098)

EN02-46

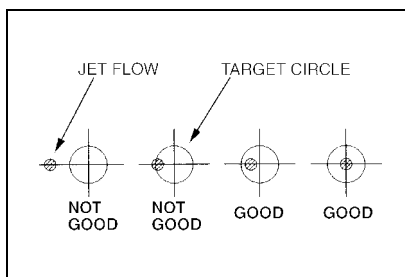
ENGINE MECHANICAL (J08E)



SHTS011060200136



SHTS011060200137



SHTS011060200138

- (2) For the jet test, connect the oil hose to the connector bolt from the cylinder block lower side.

NOTICE

Use clean engine oil for jet flow.

- (3) Set the special tool on the cylinder block upper surface against the dowel pin.
SST: Gage (09219-E4010)

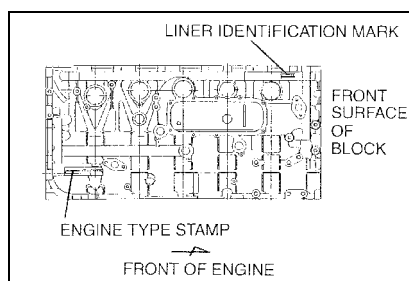
- (4) Test jet oil flow from the piston cooling jet nozzle at a hydraulic pressure of 245 kPa {2.5 kgf/cm², 35 lbf/in²}.

- (5) If the center of the jet flow is within the two target circles (8 mm {0.3150 in} and 15 mm {0.5906 in} diameter: Red), the test is acceptable.

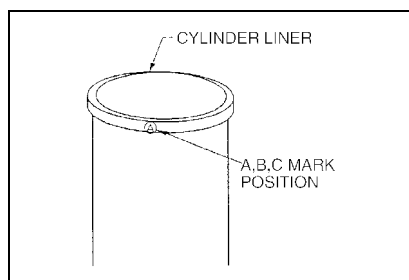
⚠ WARNING

- Engine oil is flammable.
- Never use an open flame or a naked bulb.
- Carry out the following inspection only in a well-ventilated area.

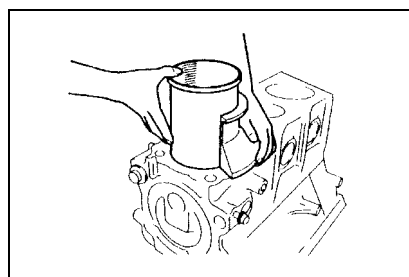
- (6) If the center of the jet flow is out of the two target circles, adjust or replace the jet.



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SHTS011060200141

2. INSTALL THE CYLINDER LINER.

NOTICE

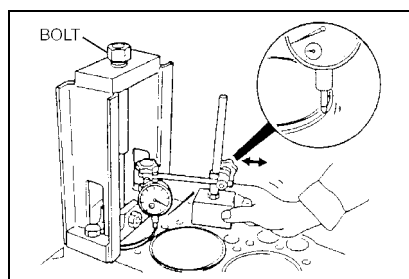
- When assembling the cylinder liner with the cylinder block, clearance can be set to three levels.
- The upper surface and side surface of the cylinder block are stamped A, B or C depending on the inside diameter. Insert a matching cylinder liner having the same symbol.

- Apply engine oil to the inner surface of the block bore and insert the cylinder liner using the special tool.

SST: Guide (S0947-11490)

NOTICE

Handle the cylinder liner carefully because it is thin.
(If it falls on the floor, it cannot be used.)



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3. MEASURE THE PROTRUSION AT THE CYLINDER LINER FLANGE.

SST: Puller (S0942-02100)

Tightening Torque:

9.8 N·m {100 kgf·cm, 7 lbf·ft}

Standard	0.01-0.08 mm {0.0004-0.0031 in.}
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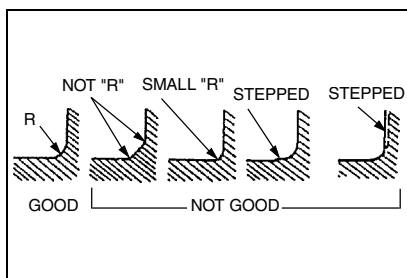
4. MEASURE THE CRANKSHAFT.

- (1) If necessary, grind the crankshaft and use an undersize bearing.

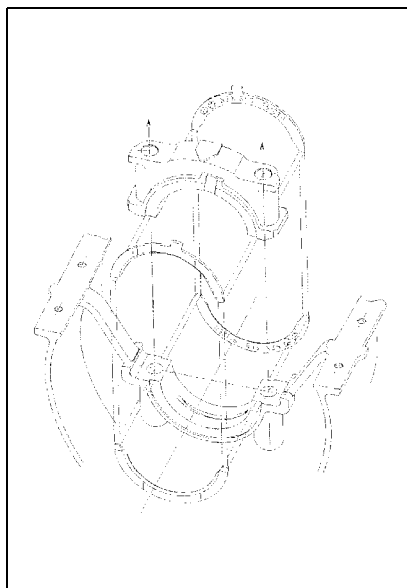
Bearing size	Outside diameter	
	Crank pin	Journal
Standard	64.94-64.96 mm {2.5567-2.5574 in.}	79.94-79.96 mm {3.1473-3.1480 in.}
0.25US	64.69-64.71 mm {2.5469-2.5476 in.}	79.69-79.71 mm {3.1375-3.1381 in.}
0.50US	64.44-64.46 mm {2.5371-2.5377 in.}	79.44-79.46 mm {3.1276-3.1283 in.}

- (2) Dimension of fillet "R".

Crank pin	2.5-3.0 mm {0.0985-0.1181 in.}
Journal	



SHTS011060200143



SHTS011060200144

5. INSTALL THE CRANKSHAFT.

- (1) Install the main bearing onto the bearing caps and the cylinder block.

NOTICE

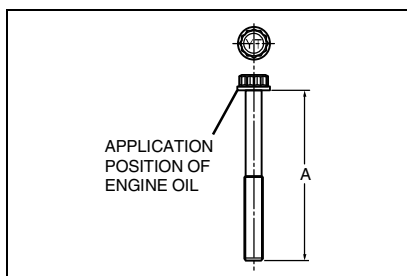
- Install the bearing with the oil hole on the block side and the bearing without the oil hole on the cap side.
- Apply clean engine oil to inner surfaces of the bearings.

- (2) Install the thrust bearing with the groove side (front) toward the crank arm and with the part No. stamp (back) toward the main bearing cap or cylinder block.

HINT

Apply engine oil or grease to the back of the bearing to prevent loosening during installation.

- (3) Install the crankshaft onto the cylinder block.



SHTS011060200145

6. INSTALL THE MAIN BEARING CAP.

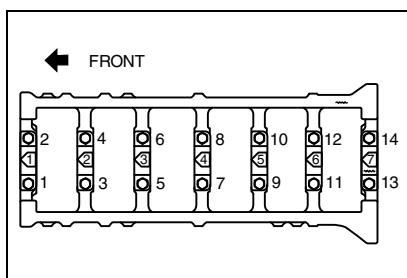
- (1) Install the main bearing cap onto the cylinder block.

NOTICE

Check the number stamped on the cap.

- (2) Measure the length below the head of the bearing cap bolt and replace any bolts not meeting the limit with new ones.

Dimension A	106.5 mm {4.193 in.}
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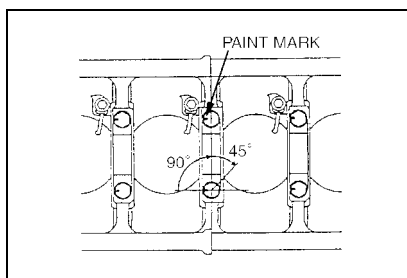
SHTS011060200146

- (3) Apply clean engine oil to the bolt seat and bolt threads.
- (4) Tighten the bolts in the order as shown in the figure to the specified torque.

Tightening Torque:

69 N·m {700 kgf·cm, 51 lbf·ft}

- (5) Loosen all bolts, tap the front and back ends of the crankshaft using a plastic hammer.
- (6) Tighten the bolts as in step (4).
- (7) Mark the bolt heads with paint.



SHTS011060200147

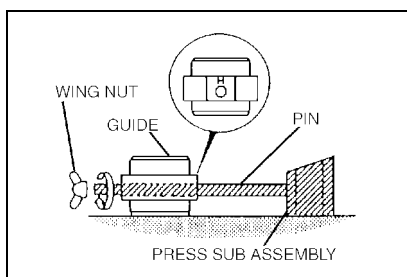
- (8) Tighten the bolts 90° (1/4 turn) in the same order as in step (4).
- (9) Retighten the bolts 45° (1/8 turn) as in step (8).

- (10) Make sure that all paint marks face the same direction.

NOTICE

When adding torque, never untighten the bolts, even if they have been overtightened.

- (11) After tightening, tap the front and back ends of the crankshaft using a plastic hammer to allow complete fit.



SHTS011060200148

7. REPLACE THE CONNECTING ROD BUSHING.

- (1) Prepare the special tools.
 - a. Assembly the guide and press sub-assembly inserting its pin into the guide then secure them with the wing nut.

SST:

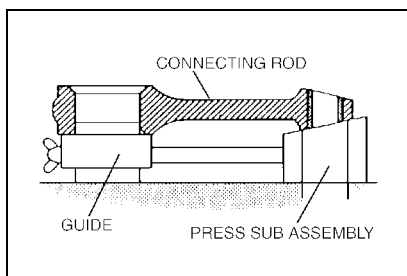
Guide (S0948-11130)

Press sub-assembly (S0940-21530)

Wing nut (SL271-01036)

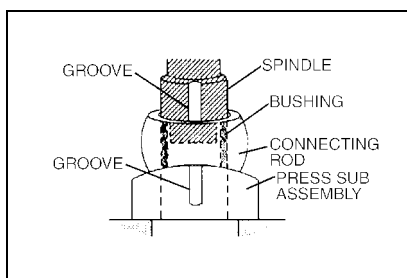
NOTICE

- Bring lever "H" punched on the guide above the pin.
- Making sure to align both supporting surfaces of the guide and press sub-assembly flush on a flat plane.



SHTS011060200149

- (2) Using a special tool, remove the connecting rod bushing.
- Set the connecting rod assembled without connecting rod bearing on the guide and press sub-assembly.



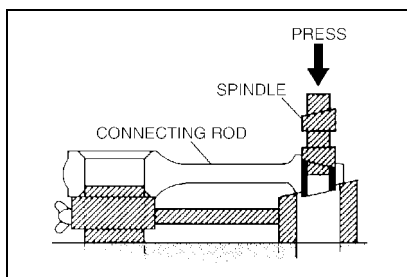
SHTS011060200150

- Install the spindle into the bushing.

SST: Spindle (S0940-21540)

NOTICE

Align the groove of the spindle with the groove of the press sub assembly.

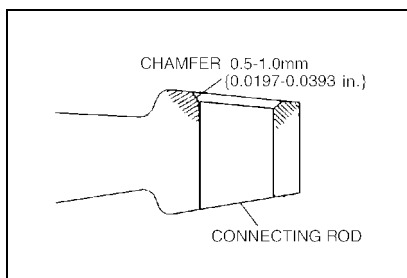


SHTS011060200151

- Using a hydraulic press, remove the bushing.

NOTICE

Always operate the press slowly and smoothly.

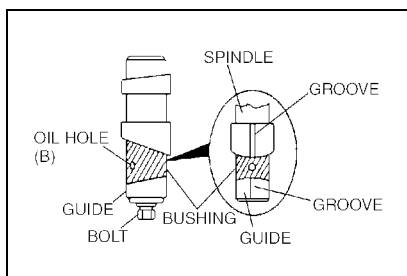


SHTS011060200152

- (3) Chamfer one edge of the bushing hole at the small end of the connecting rod uniformly by 0.5-1.0 mm {0.0197-0.0393 in.}.

NOTICE

- Irregular chamfering can cause out-of-roundness of the pressed bushing, which may result in jamming during insertion.
- Remove dust from the inner surface of the small-end hole.



SHTS011060200153

- (4) Mount the bushing on the spindle.
 - a. Set the bushing and guide on the spindle as shown in the figure, then secure them with the bolt.

SST:
Spindle (S0940-21540)
Guide (S0948-11540)
Bolt (SH691-20825)
Tightening Torque:
5.0-6.8 N·m {50-70 kgf·cm, 3.62-5.06 lbf·ft} (Bolt)
NOTICE

- Align the groove of the spindle with the groove of the press sub assembly.
- Make sure that the contact surfaces of the bushing seats firmly against the contact surfaces of the spindle and guide.

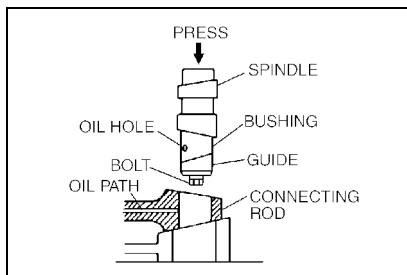
- b. Apply the fresh engine oil around the bushing and guide.

- (5) Align the oil hole of the bushing with the oil hole of the connecting rod.

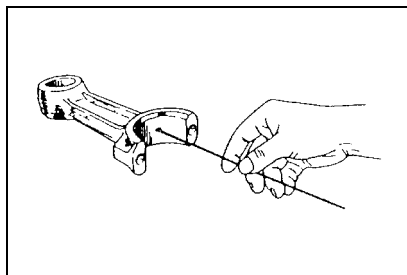
NOTICE

- Put the connecting rod to the press sub assembly and the chamfer side of the small end to the bushing side.
- Apply the fresh engine oil to the bore of the connecting rod.

- (6) Using a press, install the bushing in the connecting rod.



SHTS011060200154

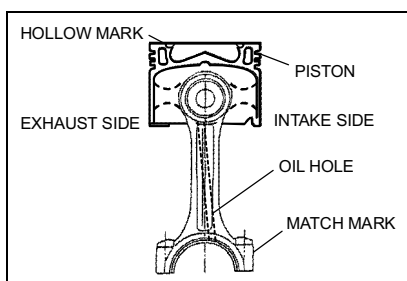


SHTS011060200155

- (7) Inspect the bushing positioning after installation.
 - a. Make sure that the oil hole of the bushing and the oil path of the connecting rod are suitably aligned allowing a 6 mm {0.2362 in.} diameter rod to penetrate.

NOTICE
Misalignment can lead to insufficient lubrication, which may result in seizure.

- b. Insert a new piston pin. When it is turned gently, make sure that there is no catch or rough movement.

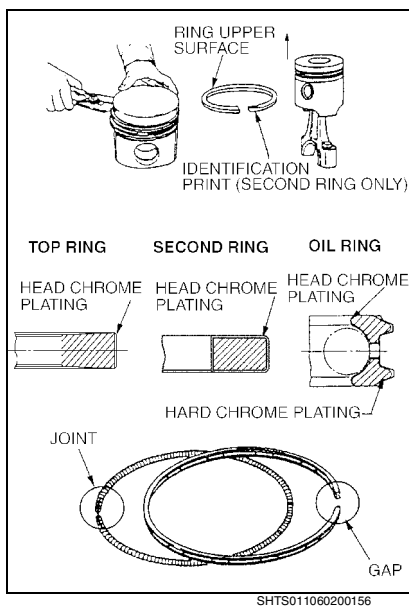


SHTS011060200129

8. ASSEMBLE THE PISTON AND CONNECTING ROD.

- (1) Heat the piston to 50°C {122°F}.
- (2) Assemble the piston O-mark to be opposite to the connecting rod match mark.

NOTICE
Replace the retainer ring with a new one.



9. ASSEMBLE THE PISTON RING.

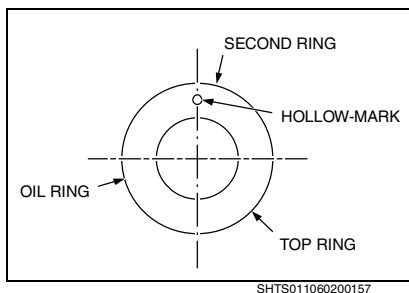
- (1) Install in the order of oil ring, second ring and top ring using the special tool.

SST: Piston ring expander (S0944-21011)

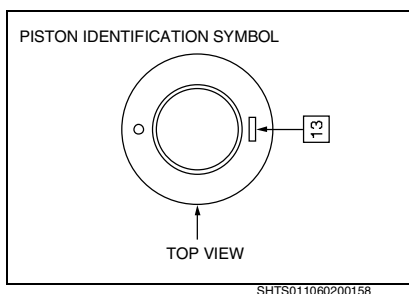
NOTICE

Install the second ring with the identification print on the piston ring facing towards the upper surface.

- (2) Connect the joint of the coil expander for the oil ring and install it inside the piston ring. Assemble the ring with the joint 180° opposite to the matching point.



- (3) Position the matching points of the piston ring at an even distance as shown in the figure.



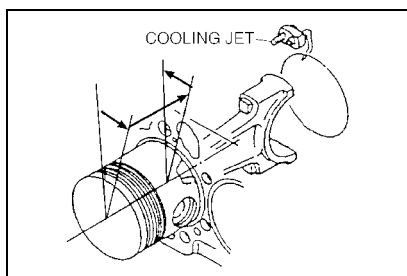
10. CHECK THE PISTON.

Before assembling the piston with the connecting rod, check whether the piston is specified for this engine.

NOTICE

Check using the engine compatible identification code on the top of the piston.

Engine compatible identification code.



SHTS011060200159

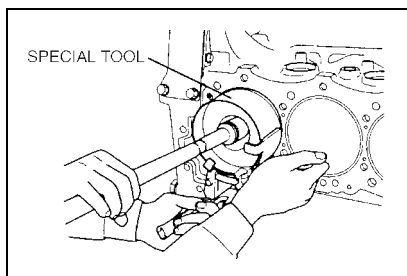
11. INSTALL THE PISTON.

- (1) Apply engine oil to the piston, cylinder liner and connecting rod bearing, then compress the piston ring using the special tool.

SST: Piston ring holder (S0944-11370)

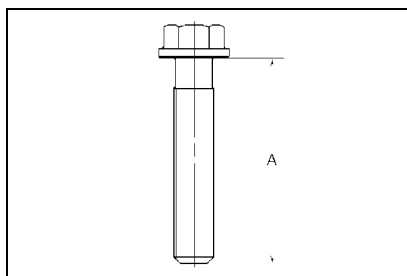
NOTICE

- When installing the piston, be careful that the cooling jet is not struck by the connecting rod.
- Make sure that the hollow-mark on the piston is at the exhaust side.



SHTS011060200160

- (2) Insert the piston into the cylinder liner.



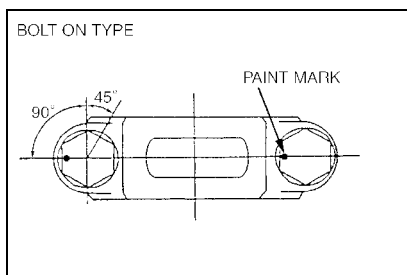
SHTS011060200161

12. TIGHTEN THE CONNECTING ROD BOLT.

- (1) Measure the length of the bolts, if the length is A or more, replace with new bolts.

Dimension A	67 mm {2.638 in.}
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- (2) Apply clean engine oil to the bolt thread and the bolt seat surface of the connecting rod cap.



SHTS011060200162

- (3) Tighten the connecting rod bolt to the specified torque.

Tightening Torque:

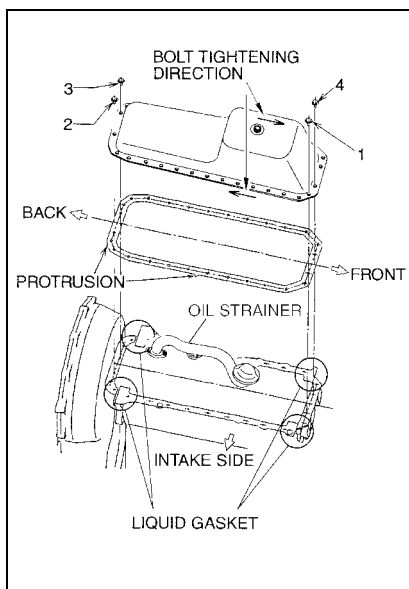
69 N·m {700 kgf·cm, 51 lbf·ft}

- (4) Mark the bolt heads in the same direction with paint.
- (5) Tighten the connecting rod bolt 90° (1/4 turn).
- (6) Tighten the connecting rod bolt 45° (1/8 turn).
- (7) Make sure that the paint marks face the same direction.

NOTICE

When retightening the bolts, never adjust them by turning counterclockwise, even if they have been retightened more than the specified angle above.

If the angle of bolts is adjusted to the specified angle by turning counterclockwise, the axial force of the bolts might fall short and it is feared that this could reduce the engine reliability. Also there is a possibility that this could reduce the number of times a bolt can be reused.



SHTS011060200163

13. INSTALL THE OIL PAN.

- (1) Make sure that there is no deformation, impact marks or foreign particles on the cylinder block, oil pan or flange surface. Apply liquid gasket to the front and back ends of the cylinder block lower surface.

NOTICE

Refer to "PARTS AND POSITIONS FOR LIQUID GASKET".

- (2) Install the gasket so that the protrusion is at the flywheel housing side and the intake side. (the print seal surface is at the cylinder block side)
- (3) Place a guide pin of 70 mm or more in the cylinder block and assemble the oil pan against the guide.
- (4) Tighten oil pan fitting bolts in the order 1 - 2 - 3 - 4 with an impact wrench.

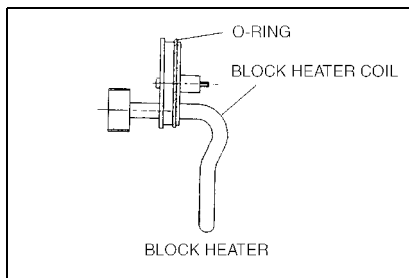
Tightening Torque:

19.7-24.5 N·m {200-250 kgf·cm, 15-18 lbf·ft}

- (5) Finish tightening the bolts with a torque wrench to the specified torque. Tighten the bolts according to the arrow in the figure.

NOTICE

Make sure that the washer is not on the flange.



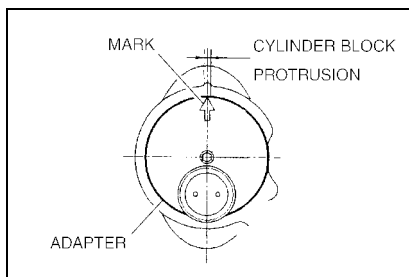
SHTS011060200164

14. INSTALL THE BLOCK HEATER.

- (1) Apply silicone spray to O-ring. (LPS Laboratories: Parts No.01516 or equivalent.)

NOTICE

If O-ring is not applied, it could damage and allow water to leak.

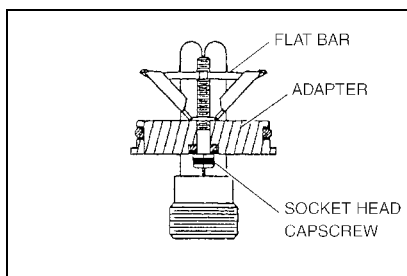


SHTS011060200165

- (2) When installing the block heater, match the arrow mark on the heater to the mark on the cylinder block protrusion.

NOTICE

- Do not damage the adapter installation hole, otherwise water will leak.
- If the marks do not match, the heater coil will touch the cylinder block.



SHTS011060200166

- (3) Tighten the socket head cap screw.

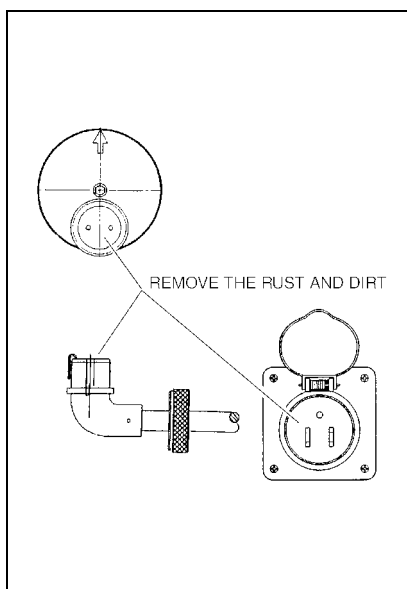
Tightening Torque:

2.3-3.3 N·m {23-33 kgf·cm, 1.7-2.3 lbf·ft}

NOTICE

Do not overtighten. If overtightened, the flat bar could come off the socket head cap screw and drop into the water jacket. This could cause the engine to over heat due to cooling system damage.

- (4) Install the harness by tightening the cord nut fully by hand only.



SHTS011060200167

- (5) Handling precaution

NOTICE

- Before using it, remove all the rust and dirt. Any rust and water attached to the terminal can trip the breaker.
- First, put the harness in the socket of the chassis side and turn on power (120 V).

CAUTION

Make sure to disconnect the power source plug outlet before starting the engine.

Starting the engine without disconnecting it can cause the breakdown of the block heater.

15. REFILL THE HINO LONG LIFE COOLANT.

(1) Concentration of Hino long life coolant.

- The freezing point of the coolant varies with the concentration of anti-freeze. Select the appropriate concentration to protect against freezing according to the following table.

NOTICE

If water to coolant ratio is not mixed according to the following table the engine will overheat and block heater coil will melt.

LLC-Water Mixing Table											
	Freezing protection		Freezing temperature		LLC				Water		
	°F	°C	°F	°C		US Qt	Liter	%	%	US Qt	Liter
J08E engine	-27	-33	-36	-37.6	MT	12.4	11.75	50	50	12.4	11.75
					AT	12.2	11.5			12.2	11.5
*AT=Available with automatic transmission MT=Available with manual transmission											

NOTICE

Do not mix more than 60% or less than 50% LLC.

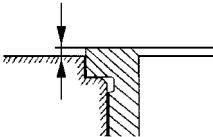
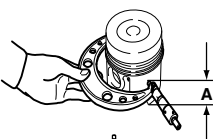
Concentrations more than 63% result in a loss of freezing protection.

Concentrations below 50% result in a loss of corrosion protection.

INSPECTION AND REPAIR

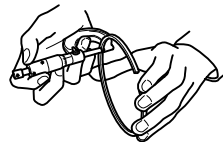
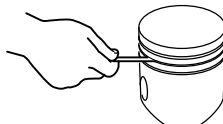
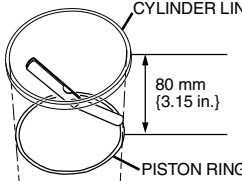
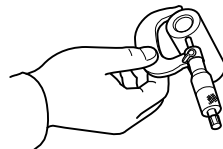
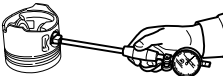
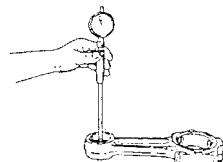
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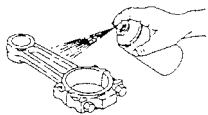
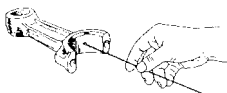
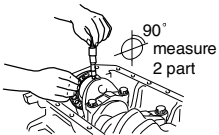
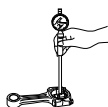
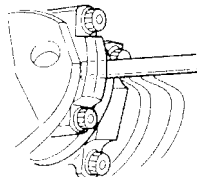
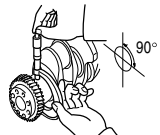
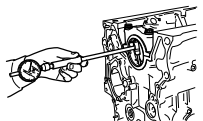
Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Cylinder block flange depth		3 {0.1181}	—	—	Measure 
Cylinder liner thickness		3 {0.1181}	—	—	
Cylinder liner protrusion		0.01-0.08 {0.0004-0.0031}	—	—	
Block inside diameter	A	117-117.008 {4.6063-4.6066}	—	—	Reference only
	B	117.008-117.014 {4.6067-4.6068}			
	C	117.014-117.022 {4.6069-4.6071}			
Liner outside diameter	A	116.982-116.990 {4.6056-4.6058}	—	—	Reference only
	B	116.990-116.996 {4.6059-4.6061}			
	C	116.996-117.004 {4.6062-4.6064}			
Clearance between block and liner	A	0.010-0.026 {0.0004-0.0010}	—	—	Reference only
	B	0.012-0.024 {0.0005-0.0009}			
	C	0.010-0.026 {0.0004-0.0010}			
Piston outside diameter at A: 17 {0.6693}		111.927-111.943 {4.40657-4.40720}	—	Replace piston and/or liner.	Measure 
Liner inside diameter (Apply the value obtained at the most worn point to the cylinder liner inside diameter.)		112 {4.409}	112.15 {4.415}		
Clearance between piston and cylinder liner		0.057-0.073 {0.0023-0.0028}	—		

EN02-58

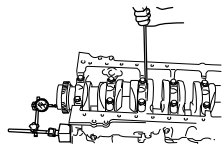
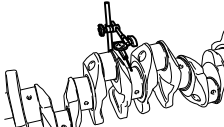
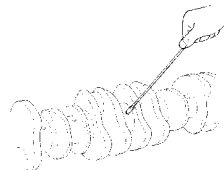

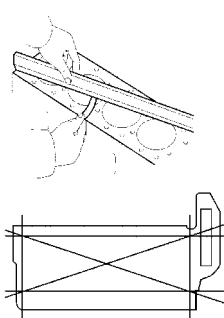
ENGINE MECHANICAL (J08E)

Inspection item		Standard	Limit	Remedy	Inspection procedure
Piston ring width	Top	—	—	Replace ring.	Measure 
	Second	1.970-1.990 {0.0776-0.0783}	1.9 {0.0748}		
	Oil	3.970-3.990 {0.1563-0.1570}	3.9 {0.1535}		
Piston groove width	Top	—	—	Replace piston.	Measure 
	Second	2.055-2.075 {0.0809-0.0817}	2.2 {0.0866}		
	Oil	4.015-4.035 {0.1581-0.1588}	4.1 {0.1614}		
Clearance between piston ring and piston ring groove	Top	—	—	—	—
	Second	0.065-0.105 {0.0026-0.0041}			
	Oil	0.025-0.065 {0.0010-0.0025}			
Gap between ends of piston ring	Top	0.30-0.40 {0.0119-0.0157}	1.5 {0.0591}	Replace piston ring.	Measure 
	Second	0.75-0.90 {0.0296-0.0354}	1.2 {0.0472}		
	Oil	0.15-0.30 {0.0059-0.0118}	1.2 {0.0472}		
Piston pin outside diameter		37 {1.4567}	36.96 {1.4551}	Replace piston pin.	Measure 
Piston pin bore inside diameter		37 {1.4567}	37.05 {1.4586}	Replace piston.	
Clearance between piston pin and piston pin bore		0.011-0.032 {0.00043-0.00126}	0.05 {0.0020}	Replace piston and/or piston pin.	
Connecting rod bushing inside diameter		37 {1.4567}	37.1 {1.4606}	Replace connecting rod bushing.	Measure 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Clearance between piston pin and connecting rod bushing	0.035-0.056 {0.0014-0.0022}	0.08 {0.0031}	Replace piston pin and/or connecting rod bushing.	—
Wear or damage of connecting rod *Dye penetrant check (Color check)	—	—	Replace.	Visual check 
Clogging of connecting rod oil hole	—	—	Replace.	Visual check 
Crank pin outside diameter	65 {2.559}	More than 0.2 {0.0079} (Repair)	Regrind under size.	Measure 
		64.3 {2.5314} (Service)	Replace crankshaft.	
Clearance between connecting rod bearing and crankpin	0.031-0.082 {0.0013-0.0032}	0.2 {0.0079}	Replace connecting rod bearing.	
Connecting rod large end width	34 {1.339}	33.2 {1.3071}	Replace connecting rod.	Measure 
Crankpin width	34 {1.339}	34.8 {1.371}	Replace crankshaft.	
Connecting rod end play	0.20-0.52 {0.0079-0.0204}	1.0 {0.0394}	Replace connecting rod and/or crankshaft.	
Crank journal outside diameter	80 {3.150}	More than 0.2 {0.0079} (Repair)	Regrind under size.	Measure 
		79.3 {3.1220} (Service)	Replace crankshaft.	
Clearance between crank journal and main bearing	0.051-0.102 {0.0021-0.0040}	0.2 {0.0079}	Replace main bearing.	

EN02-60

ENGINE MECHANICAL (J08E)

Inspection item	Standard	Limit	Remedy	Inspection procedure
Center journal width	36 {1.417}	37 {1.456}	Replace crankshaft.	Measure 
Thrust bearing thickness	2.5 {0.0984}	—	—	
Crankshaft end play	0.050-0.270 {0.0020-0.0106}	More than 0.5 {0.0197} (Repair) 1.270 {0.0499} (Service)	Replace over size thrust bearing. Replace crankshaft.	
Crankshaft deflection	—	0.15 {0.0059}	Regrind under size.	Measure 
Clogging of crankshaft oil hole	—	—	Clean.	Visual check 
Crack and wear of crankshaft *Dye penetrant check (Color check)	—	—	Replace.	Visual check 
Cylinder block upper surface flatness	Longitudinal direction: 0.06 {0.0024} Right angle direction: 0.03 {0.0012} or less	0.20 {0.0078}	Replace. NOTICE: Do not grind for repair.	Measure 

AIR INTAKE SYSTEM (J08E)

EN03-001

AIR INTAKE MANIFOLD AND PIPEEN03-2

COMPONENT LOCATOR..... EN03-2

DISMOUNTING AND MOUNTING EN03-3

AIR INTAKEEN03-4

COMPONENT LOCATOR..... EN03-4

AIR CLEANEREN03-5

DESCRIPTION EN03-5

OVERHAUL EN03-6

AIR HOSEEN03-7

COMPONENT LOCATOR..... EN03-7

OVERHAUL EN03-8

AIR FLOW SENSOR.....EN03-9

COMPONENT LOCATOR..... EN03-9

REPLACEMENT EN03-10

BOOST PRESSURE SENSOR.....EN03-11

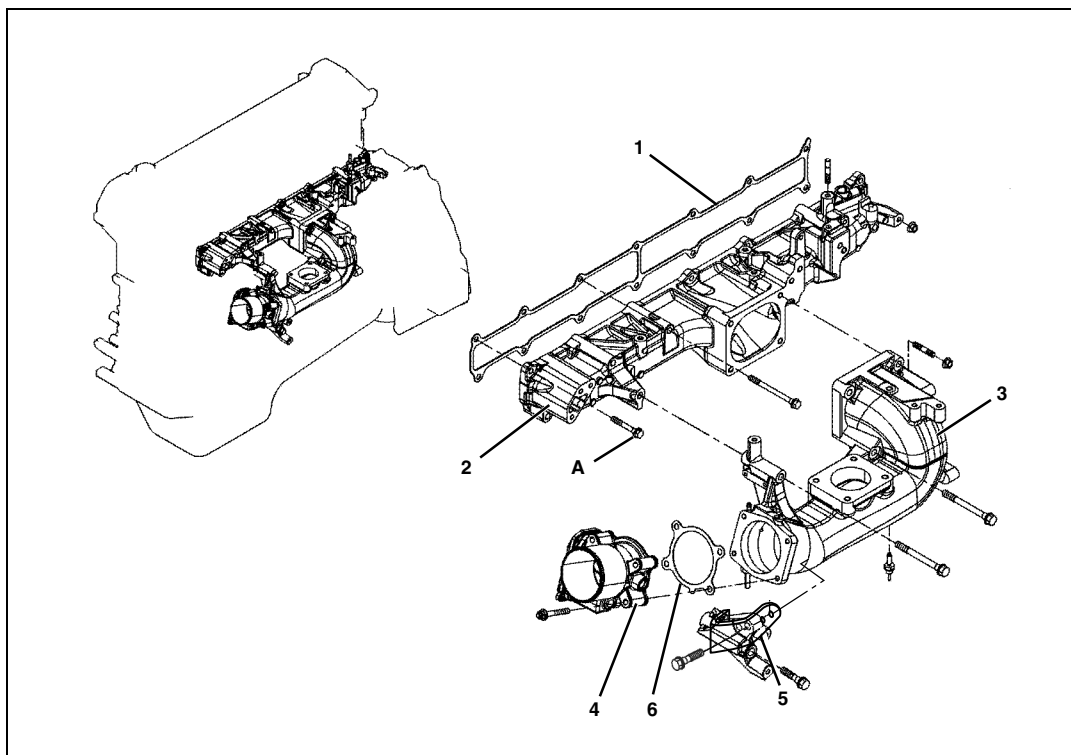
COMPONENT LOCATOR..... EN03-11

REPLACEMENT EN03-12

AIR INTAKE MANIFOLD AND PIPE

COMPONENT LOCATOR

EN0110603D100001



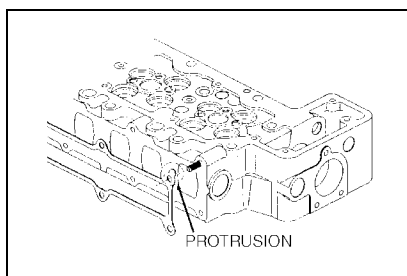
SHTS011060300001

1	Intake manifold gasket	4	Intake throttle valve
2	Intake manifold	5	Bracket
3	Intake pipe	6	Gasket

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	28.5 {290, 21}	
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SHTS011060300002

DISMOUNTING AND MOUNTING

EN0110603H100001

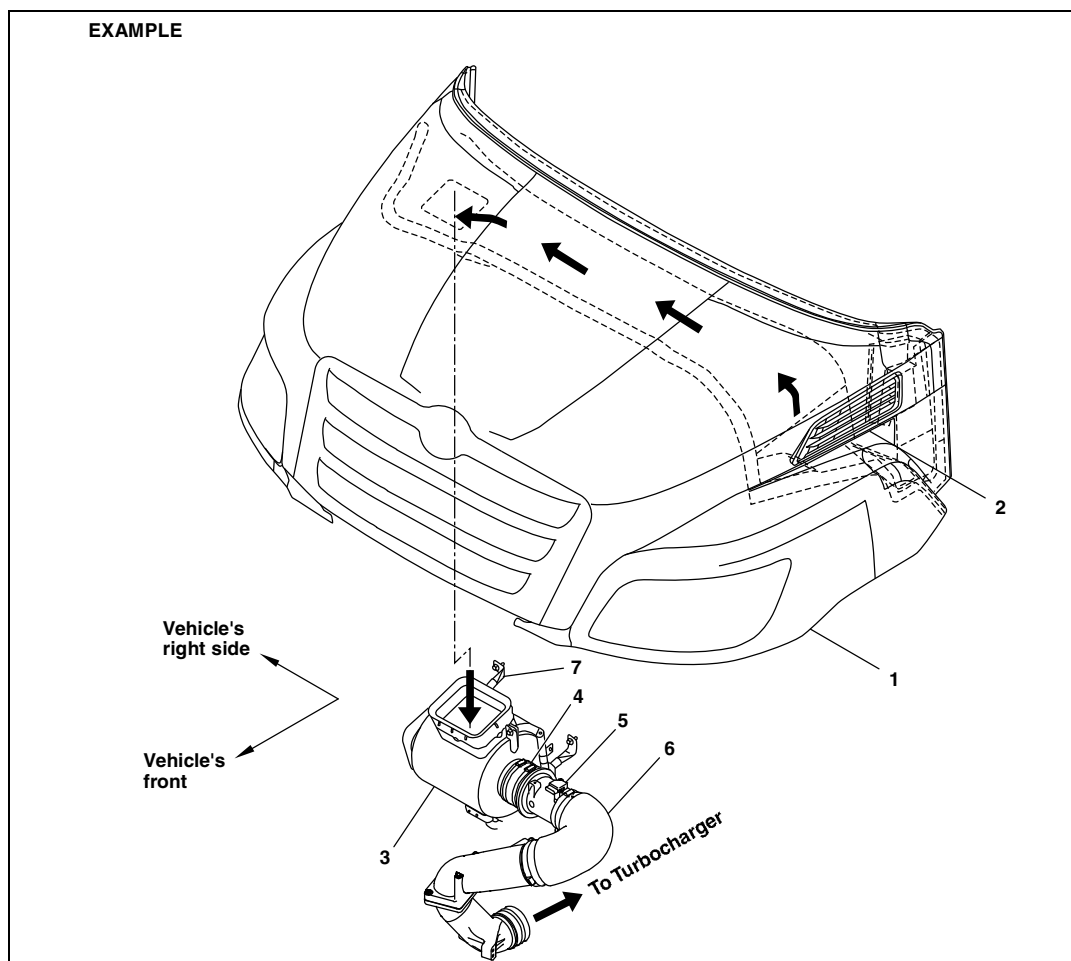
IMPORTANT POINT - MOUNTING

1. **INSTALL THE INTAKE MANIFOLD GASKET.**
 - (1) Install the intake manifold gasket so that the protrusion is positioned at the stud bolt side of the cylinder head rear end.

AIR INTAKE

COMPONENT LOCATOR

EN0110603D100002



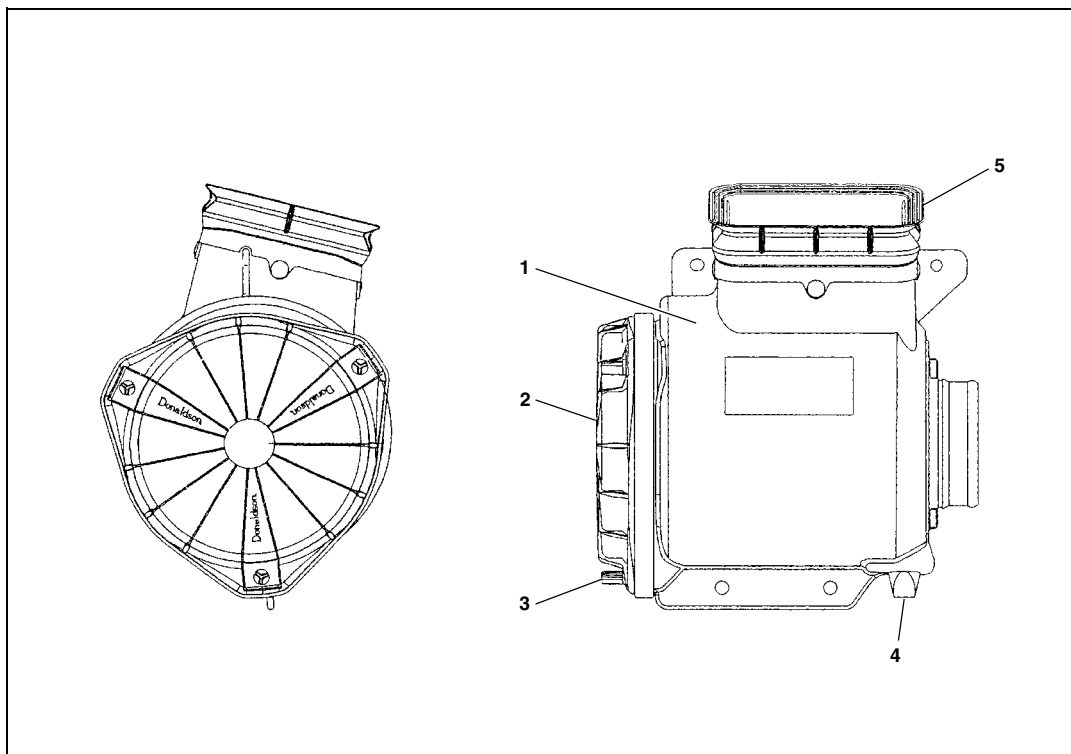
SHTS011060300003

1 Hood	5 Intake pipe
2 Air intake grille	6 Air hose
3 Air cleaner	7 Air cleaner bracket
4 Air hose	

AIR CLEANER

DESCRIPTION

EN0110603D100003

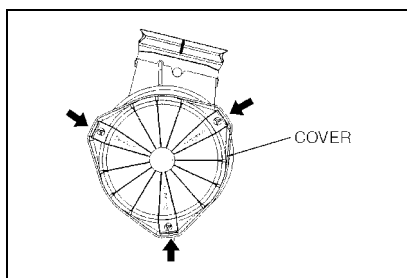


SHTS011060300004

1	Body assembly	4	Unloader valve
2	Cover	5	Adapter
3	Thumb screw		

OVERHAUL

EN0110603H100002



SHTS011060300005

IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE AIR CLEANER ELEMENT.

- (1) Remove the thumb screw as shown in the figure and remove the cover.
- (2) Hold the outer projection end of the element and turn slightly, then detach the element.

⚠ CAUTION

- Never clean the element filter.
- When the element filter is subjected to blowing with compressed air, is washed, hit, or dropped, the filter function will be impaired and engine damage can be caused.

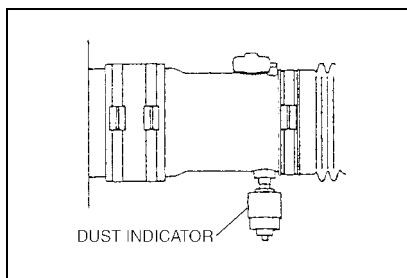
IMPORTANT POINTS - MOUNTING

1. INSTALL THE AIR CLEANER ELEMENT.

- (1) Install in the reverse order of removing.

NOTICE

Ensure the cover over the thumb screw is properly affixed.

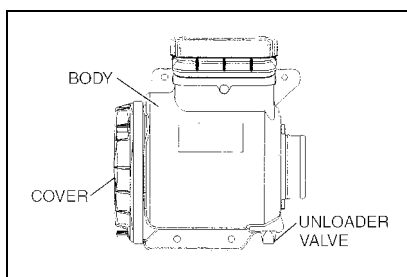


SHTS011060300006

IMPORTANT POINTS - INSPECTION

1. INSPECTING

- (1) If on inspection the dust indicator is red replace it.



SHTS011060300007

- (2) If the cover, case or unloader valve is damaged, replace the part.
- (3) Check the element to see if it is flattened or deformed, or whether the filter paper of the element is torn.
- (4) Check to see if the sealing of the gasket is complete.

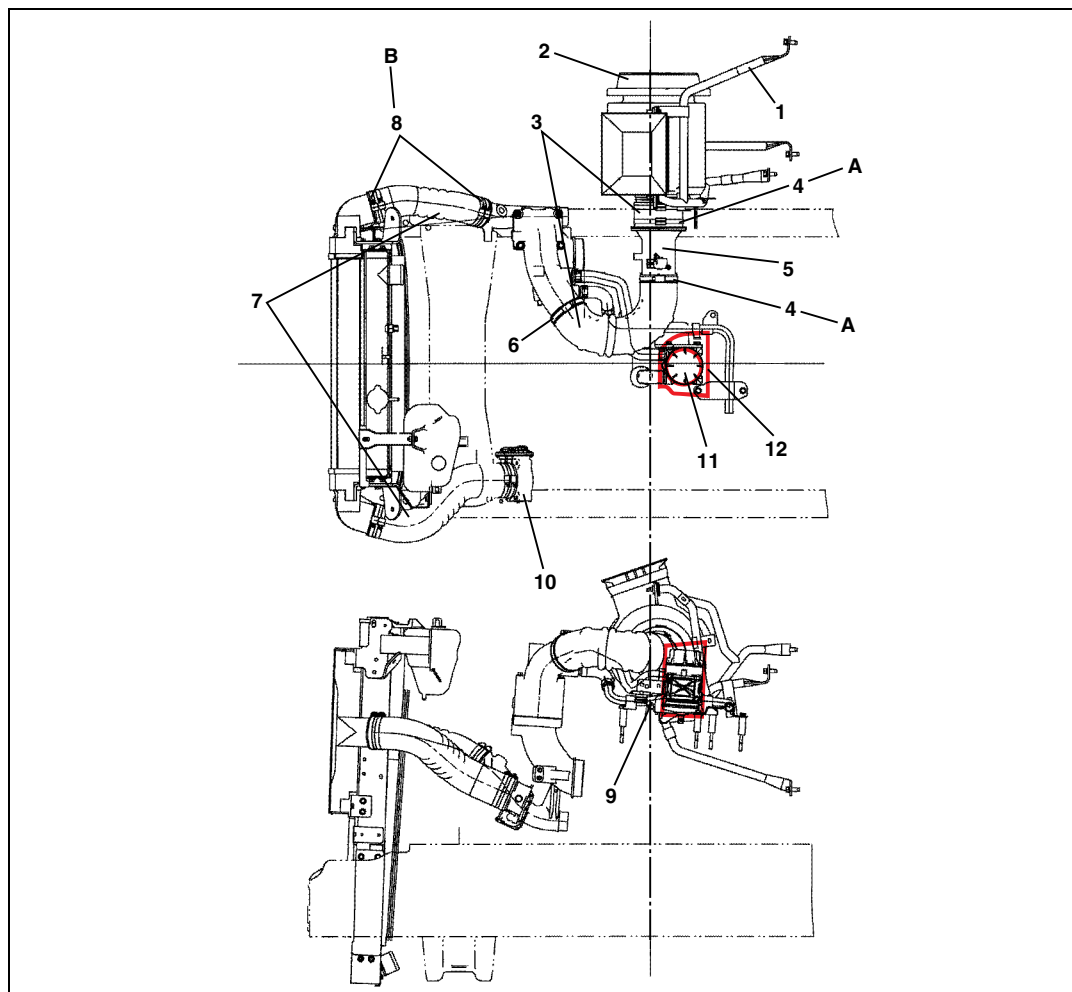
⚠ CAUTION

If an abnormality is found during the above inspection, replace the element with a new one. If dust is taken into the engine, the engine will wear and its performance will deteriorate.

AIR HOSE

COMPONENT LOCATOR

EN0110603D100004



SHTS011060300008

1 Air cleaner bracket	7 Air hose (Intercooler)
2 Air cleaner	8 Clamp (B)
3 Air hose	9 Dust indicator
4 Clamp (A)	10 Intake throttle valve
5 Intake pipe	11 Separator
6 Air hose	12 Cover (If so equipped)

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 4.5-5.5 {46-56, 3,326-4,049}	B 5.4-6.6 {55-67, 3,976-4,844}
--------------------------------	--------------------------------

OVERHAUL

EN0110603H100003

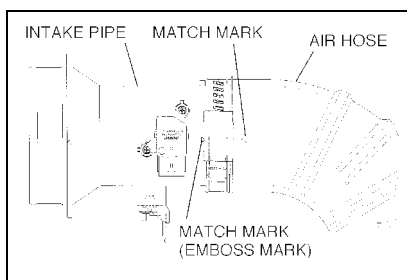
IMPORTANT POINTS - MOUNTING

1. INSTALL THE AIR HOSE.

- (1) Location of the rotation direction of the intake pipe and the air hose should match emboss mark as shown in the figure.
- (2) Tighten the clamp.

Tightening Torque:

4.5-5.5 N·m {46-56 kgf·cm, 3,326-4,049 lbf·ft}



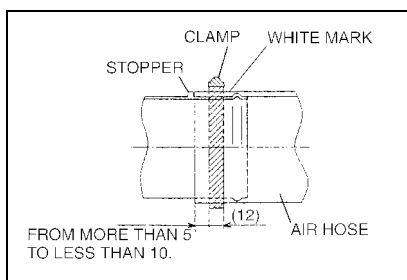
SHTS011060300009

2. INSTALL THE AIR HOSE (INTER COOLER).

- (1) Install the air hose against the stopper as shown in the figure.
- (2) Match the white mark of the air hose and match mark (stopper) of the intercooler.
- (3) Tighten the clamp at the white paint portion as shown in the figure.

Tightening Torque:

5.4-6.6 N·m {55-67 kgf·cm, 3,976-4,844 lbf·ft}

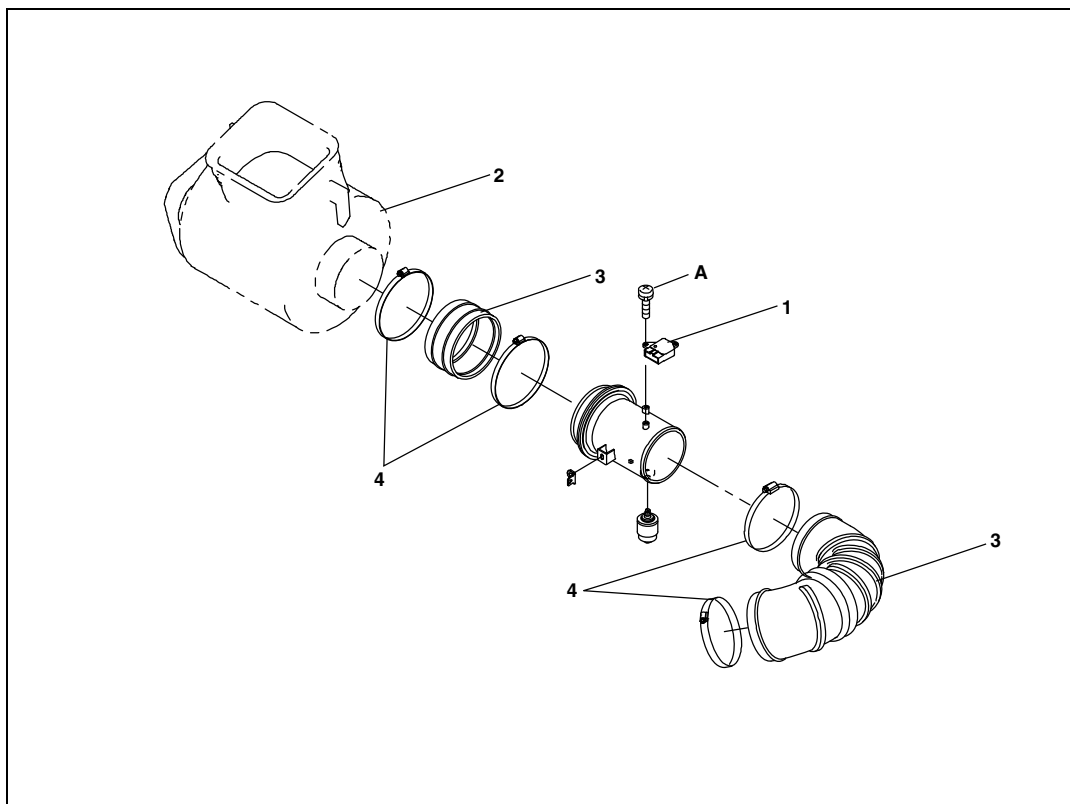


SHTS011060300010

AIR FLOW SENSOR

COMPONENT LOCATOR

EN0110603D100005



SHTS011060300011

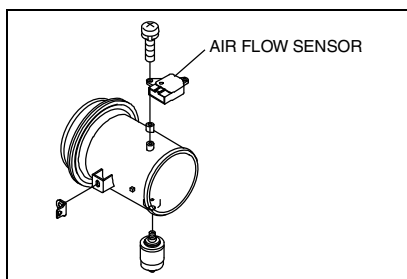
1 Air flow sensor	3 Air hose
2 Air cleaner	4 Clamp

Tightening torque**Unit: N·m {kgf·cm, lbf·ft}**

A 1.17-1.77 {12-17, 0.9-1.3}	
------------------------------	--

REPLACEMENT

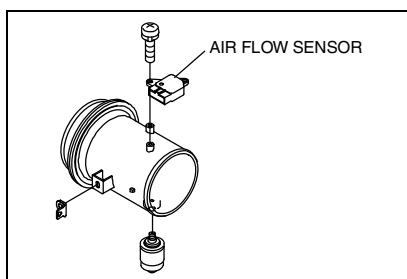
EN0110603H300001



SHTS011060300012

1. REMOVE THE AIR FLOW SENSOR.

- (1) Disconnect the connector of the air flow sensor.
- (2) Remove a bolt to remove the air flow sensor.



SHTS011060300013

2. INSTALL THE AIR FLOW SENSOR.

- (1) Install the air flow sensor, and tighten a bolt.

Tightening Torque:

1.17-1.77 N·m {12-18 kgf·cm, 0.9-1.3 lbf·ft}

NOTICE

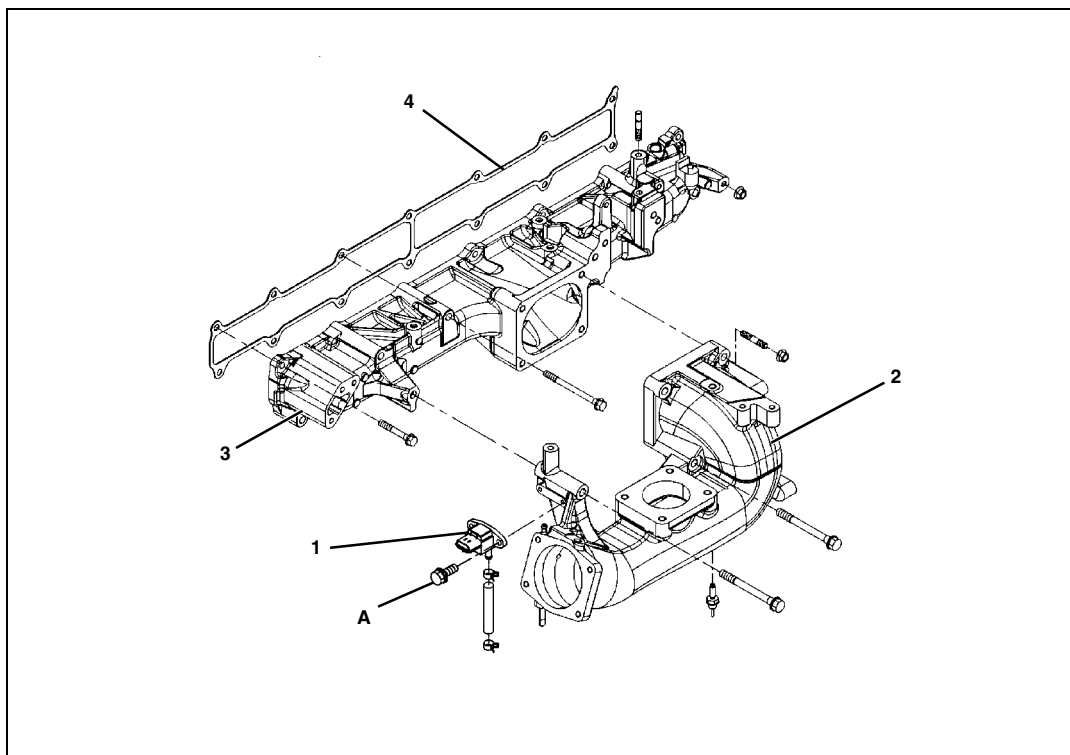
- Do not apply an excessive torque in tightening the mounting bolt (M4) for air flow sensor.
- The connector of the air flow sensor must be positioned in the frontward direction of the vehicle.

- (2) Connect the connector of the air flow sensor.

BOOST PRESSURE SENSOR

COMPONENT LOCATOR

EN0110603D100006



SHTS011060300014

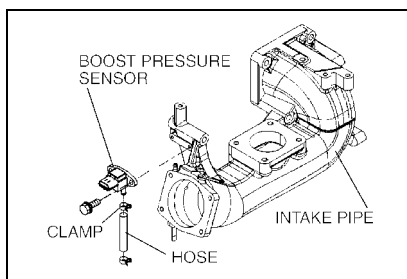
1	Boost pressure sensor	3	Intake manifold
2	Intake pipe	4	Intake manifold gasket

Tightening torque**Unit: N·m {kgf·cm, lbf·ft}**

A	10 {102, 7.3}	
---	---------------	--

REPLACEMENT

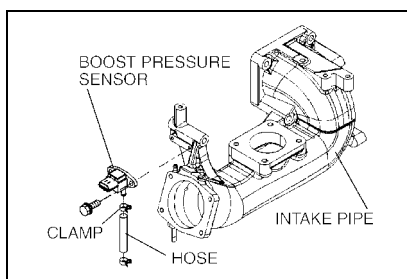
EN0110603H300002



SHTS011060300015

1. REMOVE THE BOOST PRESSURE SENSOR.

- (1) Disconnect the connector of the boost pressure sensor.
- (2) Remove two clamps to remove the hose from the boost pressure sensor.
- (3) Remove two bolts to remove the boost pressure sensor from the intake pipe.



SHTS011060300016

2. INSTALL THE BOOST PRESSURE SENSOR

- (1) Install the boost pressure sensor to the intake pipe, and tighten two bolts.

Tightening Torque:

10 N·m {102 kgf·cm, 7.3 lbf·ft}

- (2) Insert a hose into the boost pressure sensor, and fasten two clamps.
- (3) Connect the connector of the boost pressure sensor.

EXHAUST SYSTEM (J08E)

EN04-001

EXHAUST MANIFOLD AND PIPE..... EN04-2

COMPONENT LOCATOR..... EN04-2

DISMOUNTING AND MOUNTING EN04-3

EXHAUST PIPE AND MUFFLER UNIT EN04-4

DESCRIPTION EN04-4

COMPONENT LOCATOR..... EN04-5

OVERHAUL EN04-11

DPR (DIESEL PARTICULATE REDUCTION SYSTEM)..... EN04-22

SYSTEM CONFIGURATION EN04-22

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DPR INSPECTION EN04-24

INSPECTION PROCEDURE FOLLOWED

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INSPECTION BY WAY OF HINO-DX EN04-26

INSPECTION PROCEDURE FOLLOWED

WHEN CHECK ENGINE LIGHT ILLUMINATES

(ABNORMAL) EN04-29

DETERMINATION BY WAY OF DPR STATE

DETERMINATION MONITOR

OF HINO-DX..... EN04-32

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OVERALL OPERATION FLOW EN04-37

DIFFERENTIAL PRESSURE SENSOR.. EN04-45

COMPONENT LOCATOR..... EN04-45

DISMOUNTING AND MOUNTING EN04-46

EXHAUST CONTROL CYLINDER..... EN04-49

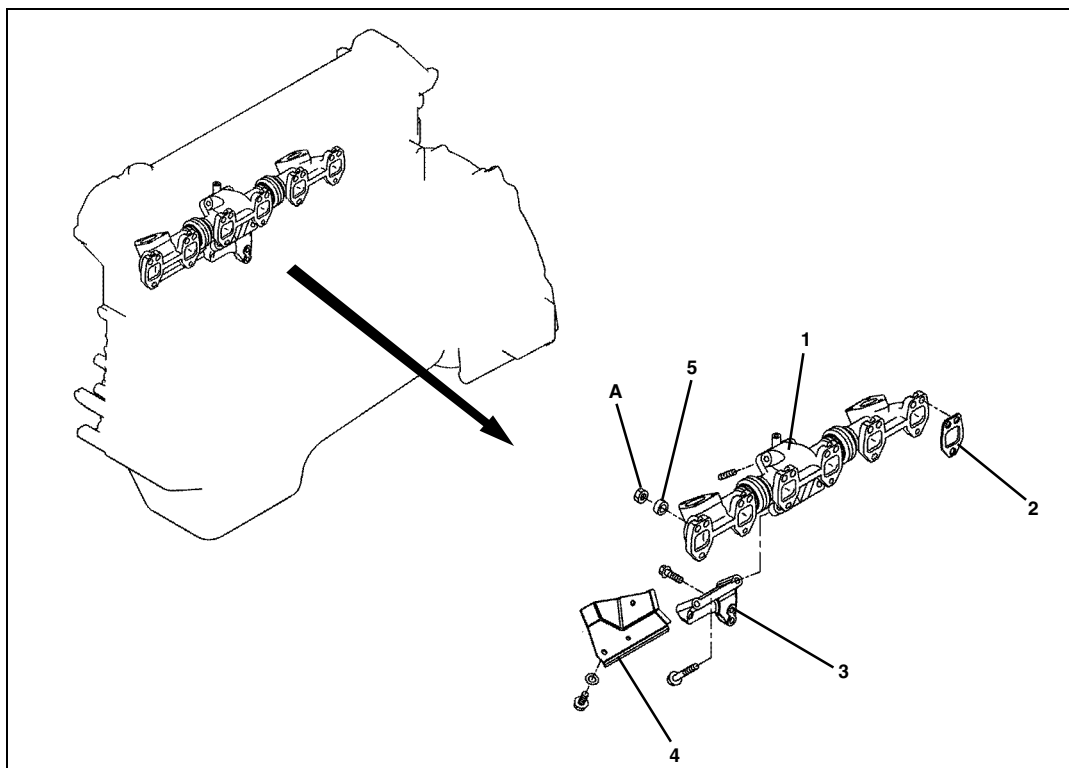
SYSTEM CONFIGURATION EN04-49

DPR INSPECTION CHECK SHEET EN04-50

EXHAUST MANIFOLD AND PIPE

COMPONENT LOCATOR

EN0110604D100001



SAPH011060400001

1 Exhaust manifold sub assembly	4 Heat insulator
2 Gasket	5 Spacer
3 Bracket	

Tightening torque**Unit: N·m {kgf·cm, lbf·ft}**

A 65 {660, 48}	
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DISMOUNTING AND MOUNTING

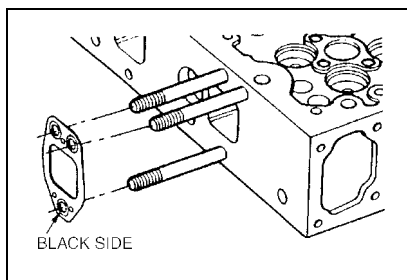
EN0110604H100001

IMPORTANT POINT - MOUNTING

1. INSTALL THE EXHAUST MANIFOLD GASKET.

NOTICE

Since the exhaust manifold gasket must be installed in one way, install the gasket with the black side facing toward the exhaust manifold.



SAPH011060400002

2. INSTALL THE EXHAUST MANIFOLD.

- (1) Install the exhaust manifold onto the cylinder head and tighten the mounting nut in the order shown in the figure to the specified torque.

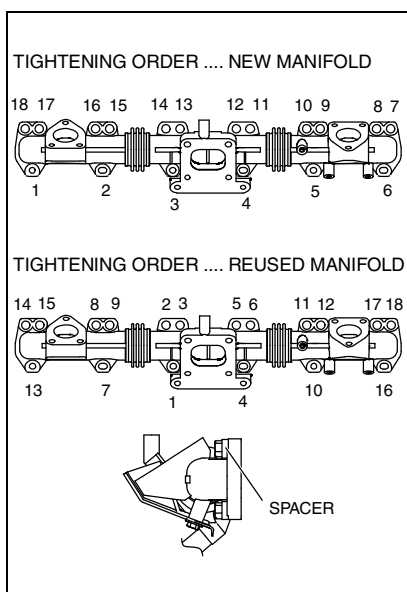
Tightening Torque:

65 N·m {660 kgf·cm, 48 lbf·ft}

- (2) Retighten the same nuts according to the same procedure again.

NOTICE

Be sure to carry out the procedure.



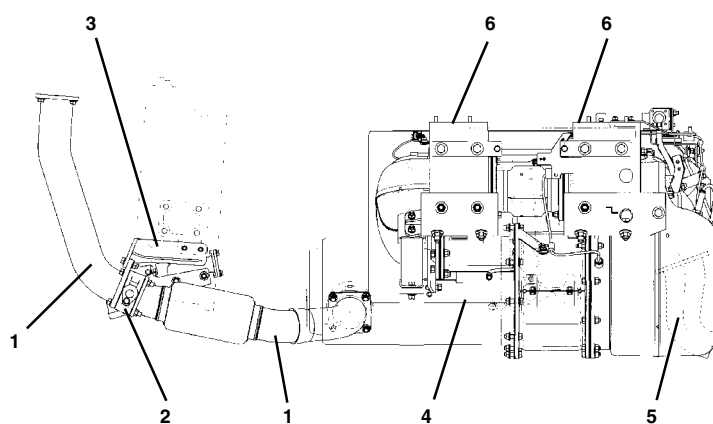
SAPH011060400003

EXHAUST PIPE AND MUFFLER UNIT

DESCRIPTION

EN0110604H200001

(EXAMPLE)



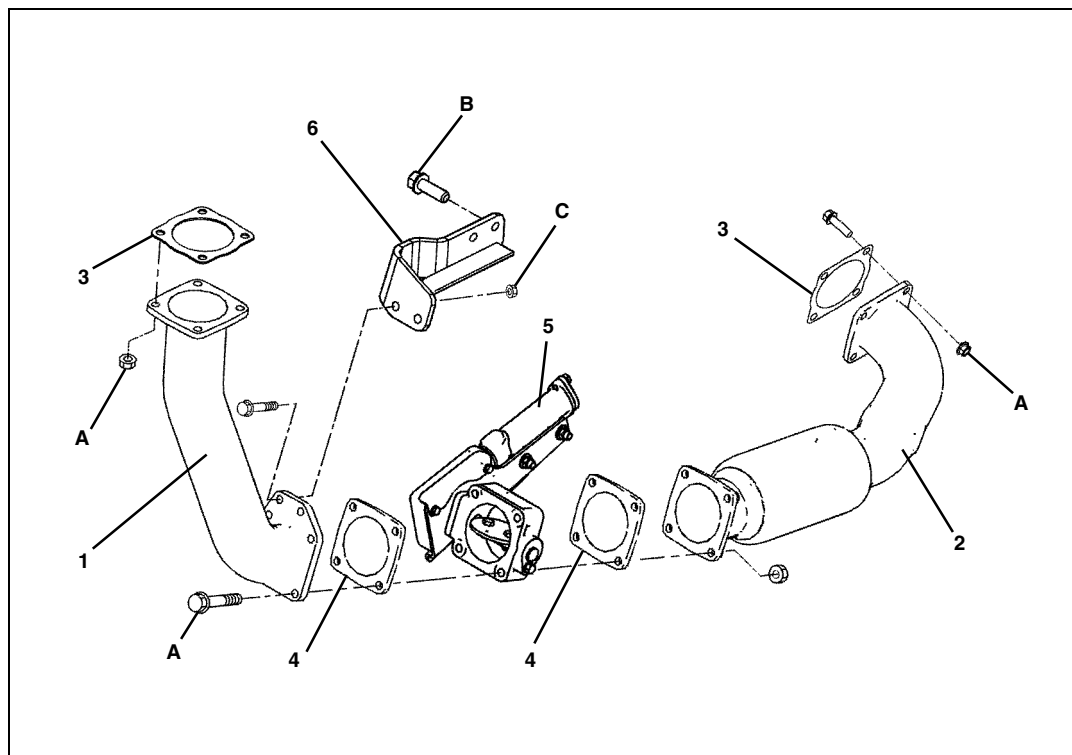
SAPH011060400004

1	Exhaust pipe	4	Muffler unit with burner
2	Exhaust control cylinder (Exhaust brake)	5	Tail pipe
3	Bracket	6	Bracket sub assembly

COMPONENT LOCATOR

EN0110604D100002

EXHAUST PIPE



SAPH011060400005

1 Exhaust pipe No.1	4 Gasket
2 Exhaust pipe No.2	5 Exhaust control cylinder (Exhaust brake)
3 Gasket	6 Bracket

Tightening torque

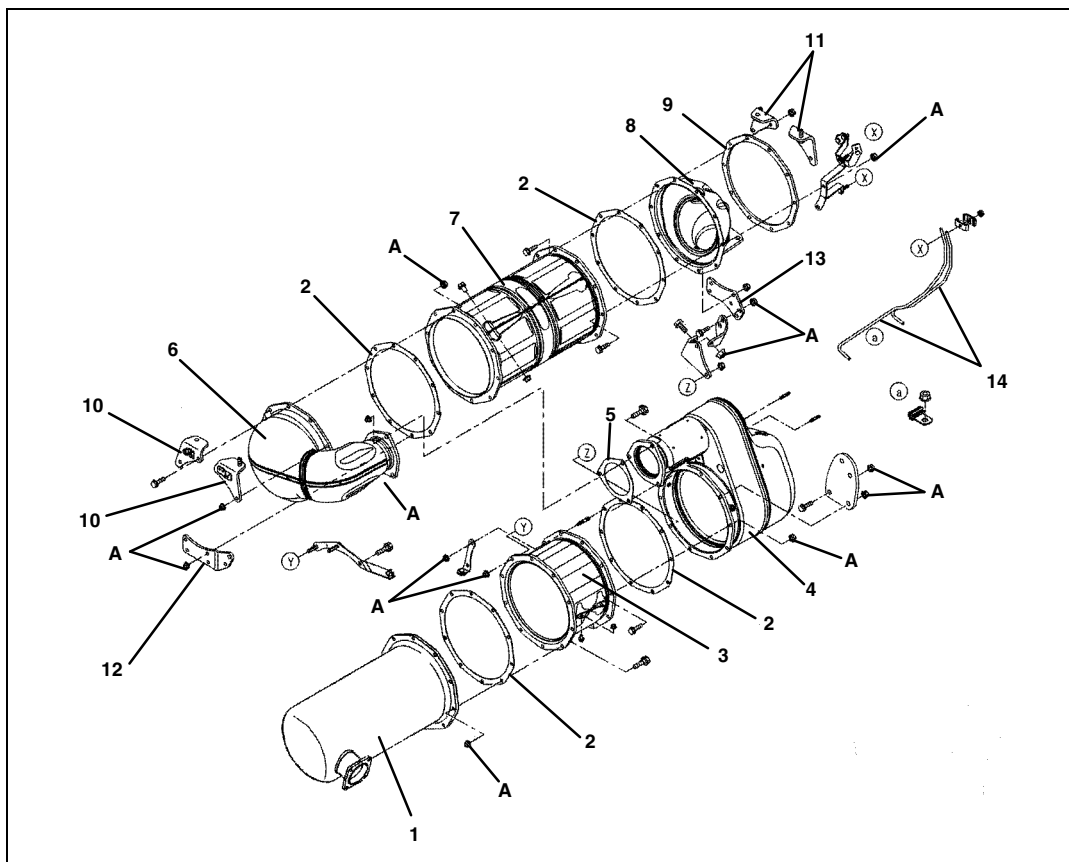
Unit: N·m {kgf·cm, lbf·ft}

A 56-84 {571-856, 42-62}	C 41-61 {418-622, 30-45}
B 49-61 {500-622, 36-50}	

EN04-6

EXHAUST SYSTEM (J08E)

MUFFLER UNIT



SAPH011060400006

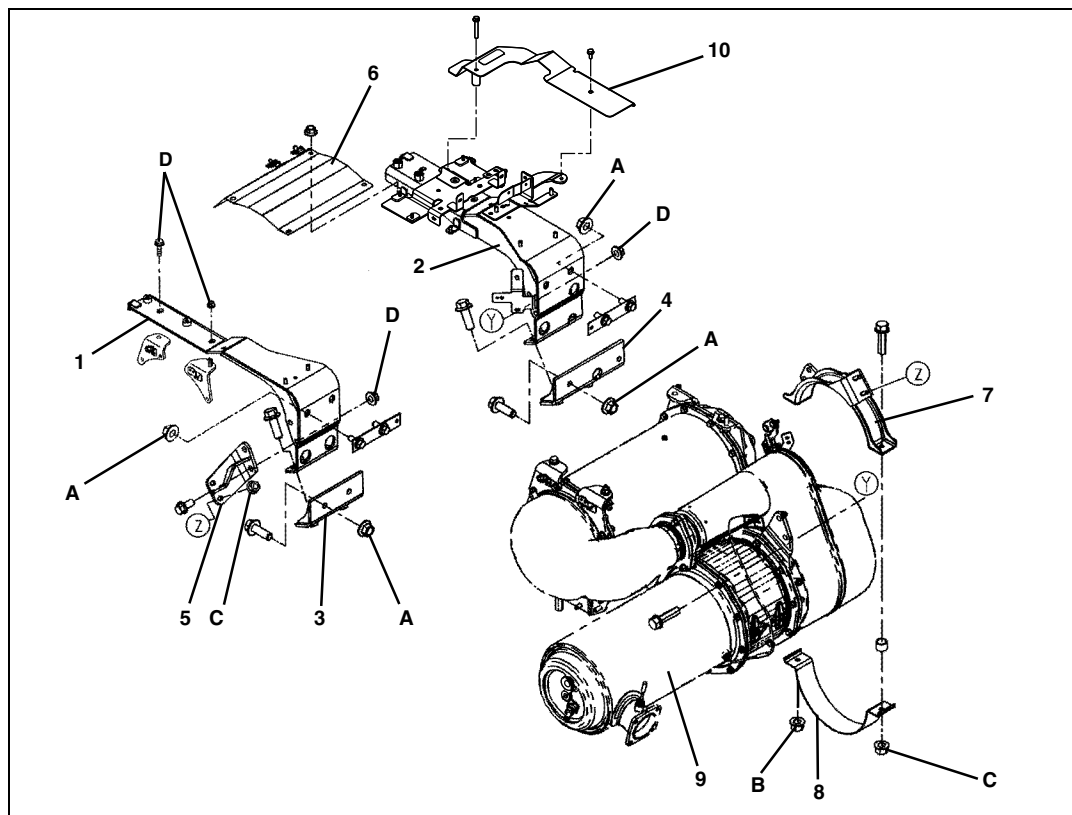
1	Combustion chamber	8	Outlet chamber sub assembly
2	Gasket	9	Flange
3	Particulate filter assembly	10	Support (Front)
4	Chamber sub assembly (Rear)	11	Support (Rear)
5	Gasket	12	Bracket (Front)
6	Chamber sub assembly (Front)	13	Bracket (Rear)
7	Monolithic converter assembly	14	Pipe sub assembly

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	64 {653, 47}	M8: 18-26 {184-265, 14-19}
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MUFFLER SUPPORT



1	Support sub assembly (Front)	6	Insulator
2	Support sub assembly (Rear)	7	Clamp sub assembly
3	Support sub assembly (Front, lower)	8	Lifting clamp
4	Support sub assembly (Rear, lower)	9	Muffler unit
5	Bracket	10	Protector

Tightening torque

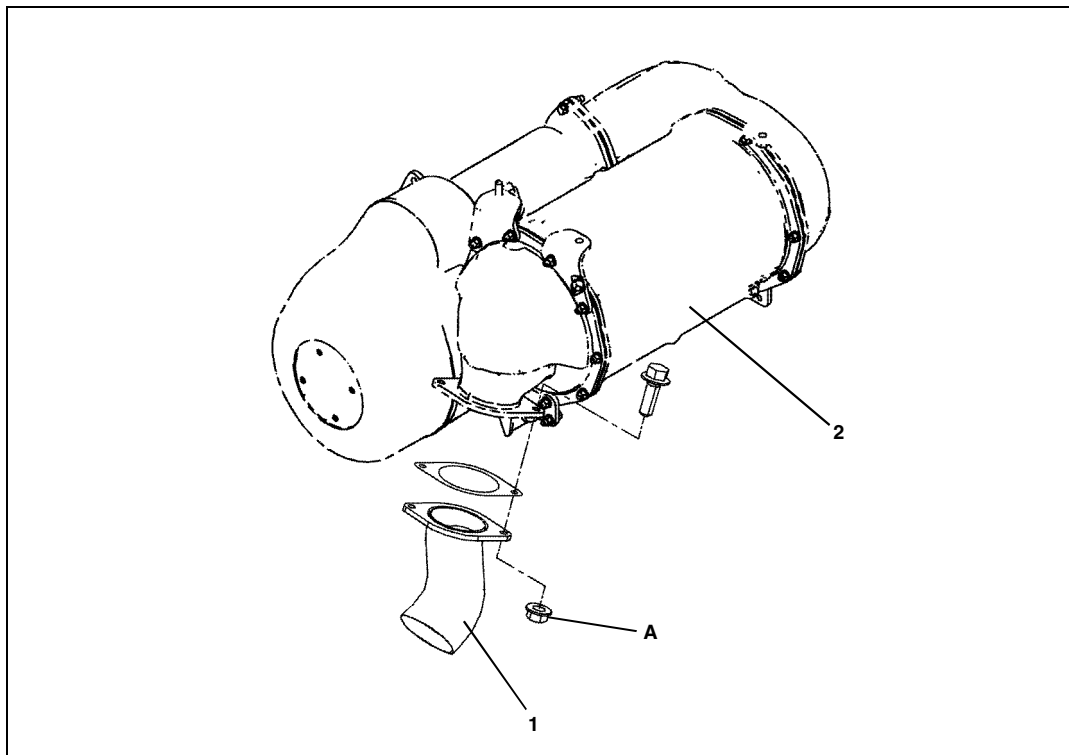
Unit: N·m {kgf·cm, lbf·ft}

A	80-120 {816-1,223, 59-88}	D	69-103 {704-1,050, 51-76}
B	34-44 {347-448, 25-32}	M8:	18-26 {184-265, 14-19}
C	41-61 {418-622, 30-45}		

EN04-8

EXHAUST SYSTEM (J08E)

TAIL PIPE (SHORT TAIL TYPE)



SAPH011060400008

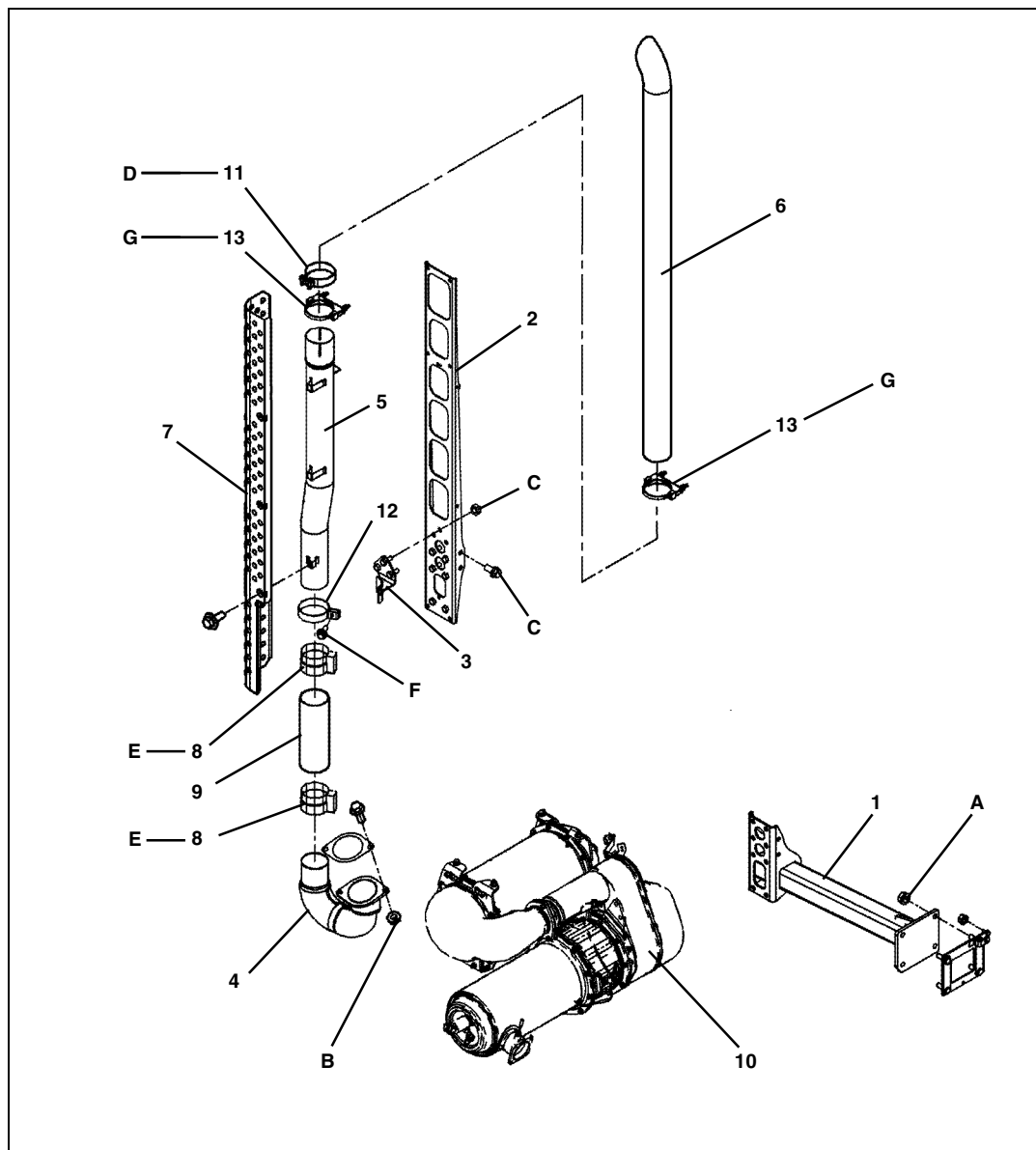
1 Tail pipe	2 Muffler unit
-------------	----------------

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 108-132 {1,101-1,346, 80-97}	
--------------------------------	--

TAIL PIPE (STACK TYPE)



SAPH011060400009

EN04-10

EXHAUST SYSTEM (J08E)

1	Bracket sub assembly	8	Clamp *
2	Exhaust pipe bracket	9	Exhaust flexible pipe
3	Bracket	10	Muffler unit
4	Tail pipe sub assembly	11	Clamp *
5	Tail pipe sub assembly	12	Clamp
6	Tail pipe	13	U-bolt
7	Insulator		

*: Nonreusable. Be sure to use new parts.

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	104-126 {1,060-1,284, 77-92}	E	60-80 {612-815, 45-59}
B	108-132 {1,102-1,346, 80-97}	F	20.4-30.4 {208-310, 15-22}
C	130-158 {1,326-1,611, 96-116}	G	36-44 {367-448, 27-32}
D	37-50 {378-509, 28-36}	M8:	18-26 {184-265, 14-19}

OVERHAUL

EN0110604H200002

IMPORTANT POINT - DISMOUNTING

⚠ WARNING

Do not touch the exhaust manifold when it could be hot. You can be severely burned.

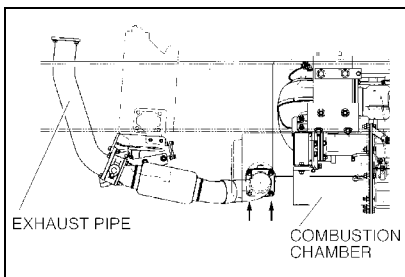
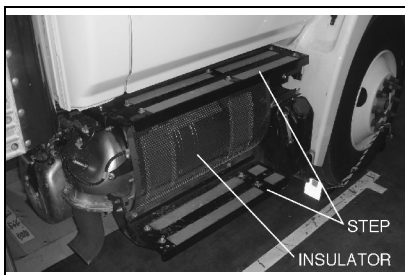
1. DISMOUNTING

- (1) Disconnect the battery ground terminal.

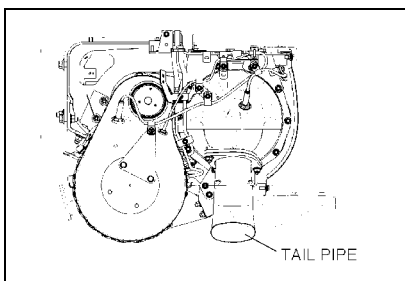
⚠ CAUTION

Be sure to disconnect the battery terminals from the battery in accordance with the procedures in this manual and never use the battery disconnect switch when it is necessary to break the supply of electricity completely. Otherwise, electricity may remain supplied from the battery by the circuit that bypasses the battery disconnect switch and you may get burns or injury from the electricity.

- (2) Dismount the steps (top and bottom) and the insulator on the right side of the vehicle.



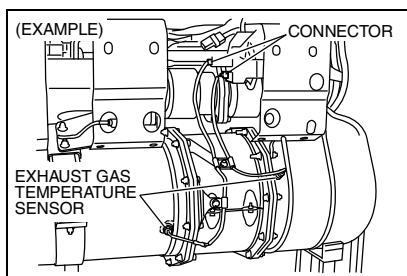
- (3) Remove the bolts and nuts on the flange on the combustion chamber side.



- (4) Remove the tail pipe mounting bolts and then the tail pipe

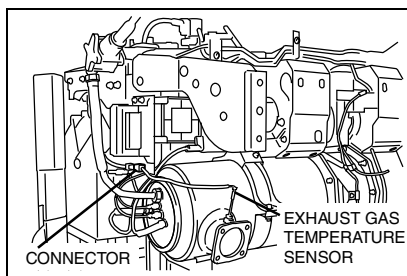
EN04-12

EXHAUST SYSTEM (J08E)



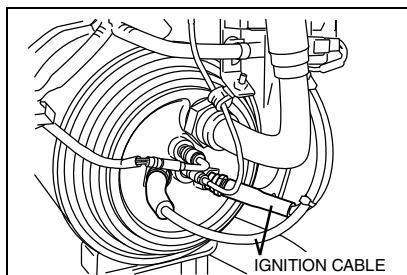
SAPH011060400013

- (5) Disconnect the DPR filter front/rear exhaust gas temperature sensor connector.



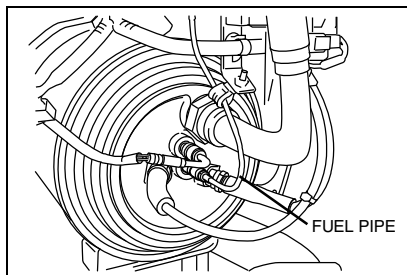
SAPH011060400014

- (6) Disconnect the combustion chamber exhaust gas temperature sensor connector.



SAPH011060400015

- (7) Remove the front ignition cable of the combustion chamber.

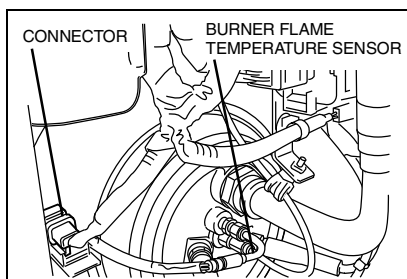


SAPH011060400016

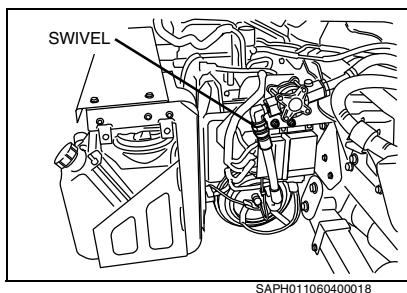
- (8) Remove the front atomized fuel pipe of the combustion chamber.

NOTICE

After removal, do not allow foreign objects to get into the pipe and nozzle.



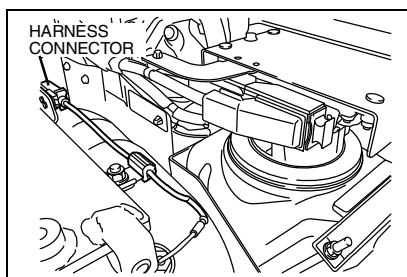
(9) Disconnect the burner flame temperature sensor connector.



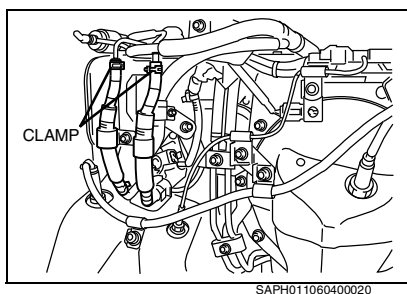
(10) Remove the burner burning air hose.

NOTICE

- When removing, be sure to remove the swivel on the vehicle upper side.
- After removal, do not allow foreign objects to get into the pipe.



(11) Disconnect the SCR catalyst front exhaust gas temperature sensor connector.



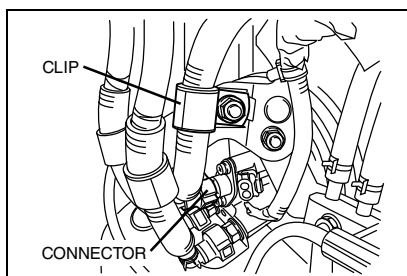
(12) Remove the coolant hose connecting to the injector.

NOTICE

When removed, coolant will flow out. Drain coolant beforehand or plug the end of the pipe.

EN04-14

EXHAUST SYSTEM (J08E)



SAPH011060400021

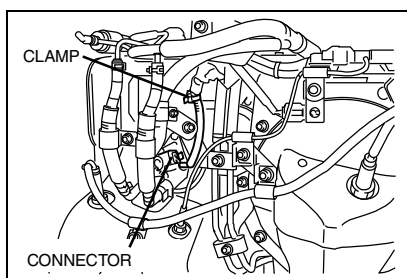
(13) Remove the DEF hose connecting to the injector.

NOTICE

After removal, do not allow foreign objects to get into the pipe.

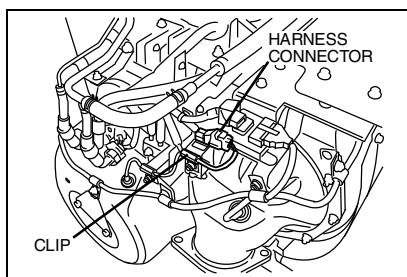
HINT

Remove it by pushing inward the 2 white knobs of the connector.



SAPH011060400022

(14) Remove the clamp of the harness connecting to the injector and the injector connector.

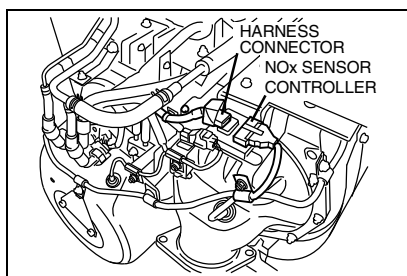


SAPH011060400023

(15) Disconnect the DOC rear exhaust gas temperature sensor connector and remove the clip.

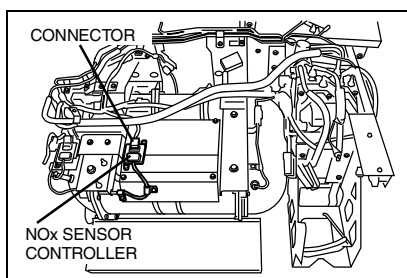
EXHAUST SYSTEM (J08E)

EN04-15



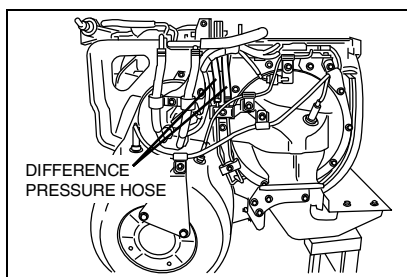
SAPH011060400024

- (16) Disconnect the NOx sensor 1 connector and remove the NOx sensor controller.



SAPH011060400025

- (17) Disconnect the NOx sensor 2 connector and remove the NOx sensor controller.

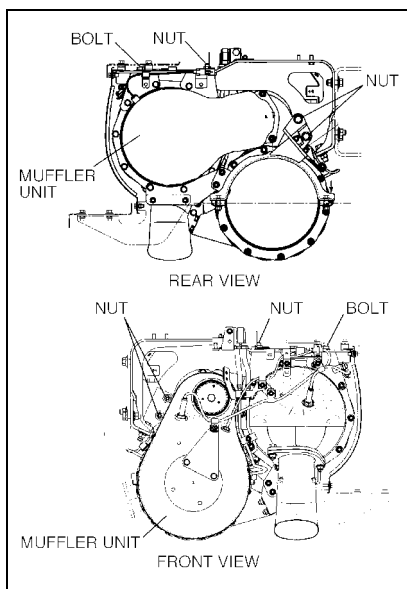


SAPH011060400026

- (18) Remove the differential pressure hose.

EN04-16

EXHAUST SYSTEM (J08E)

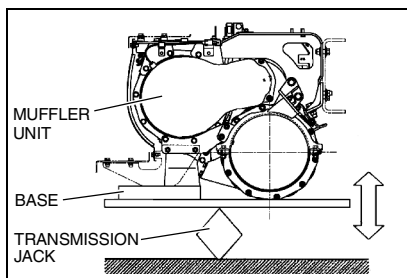


SAPH011060400027

(19) Remove the muffler unit mounting bolts or nuts (4 pcs each in the top and inside the vehicle) and then the muffler unit.

NOTICE

Do not apply heavy load or impact to the muffler unit when mounting and dismounting.



SAPH011060400028

NOTICE

Be extremely careful when handling the heavy muffler unit.

HINT

The jack can be operated easily by placing a base as shown in the figure at left.

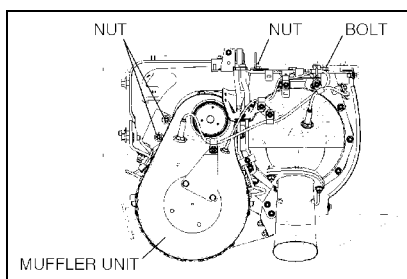
IMPORTANT POINT -MOUNTING

1. MOUNTING

- (1) Mount the muffler unit with bolts or nuts.

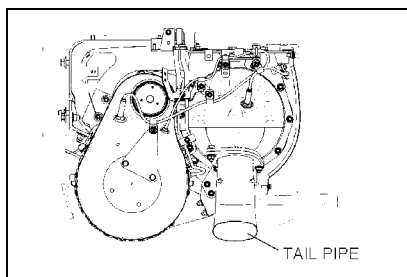
NOTICE

Do not apply heavy load or impact to the muffler unit when mounting and dismounting.



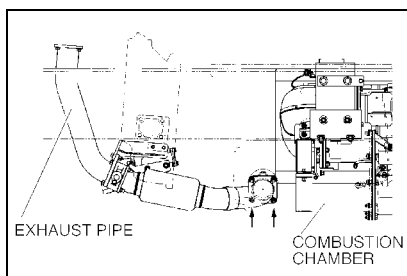
SAPH011060400029

- (2) Mount the tail pipe.



SAPH011060400030

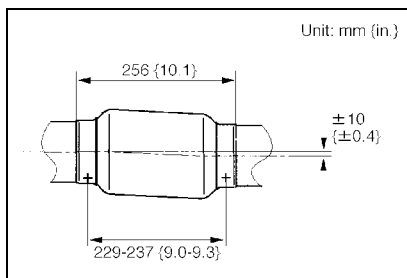
- (3) Connect the combustion chamber and the exhaust pipe.



SAPH011060400031

NOTICE

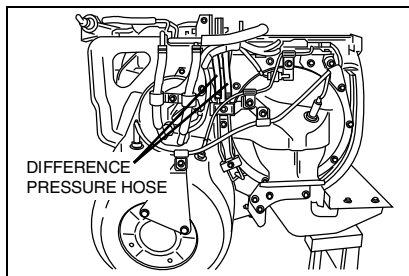
If the exhaust pipe is removed, make sure to mount the bellows tube of the exhaust pipe as in the figure to secure durability.



SAPH011060400032

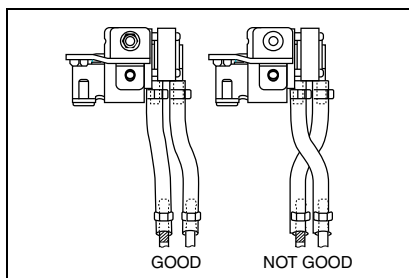
EN04-18

EXHAUST SYSTEM (J08E)



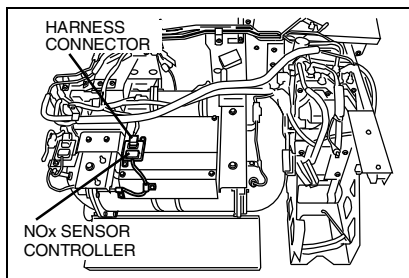
SAPH011060400033

- (4) Install the differential pressure hose.



SAPH011060400034

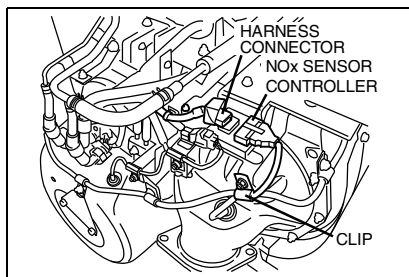
NOTICE
Assemble without crossing hoses.



SAPH011060400035

- (5) Install the NOx sensor 2 and connect the harness connector.

Tightening Torque:
3.9-7.1 N·m {40-72 kgf·cm, 2.9-5.2 lbf·ft}



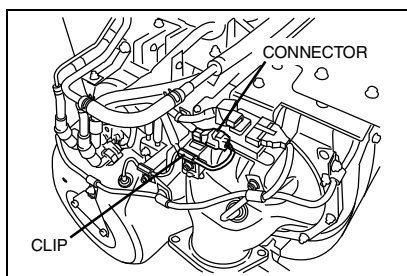
SAPH011060400036

- (6) Install the NOx sensor 1 and connect the harness connector.

Tightening Torque:
3.9-7.1 N·m {40-72 kgf·cm, 2.9-5.2 lbf·ft}

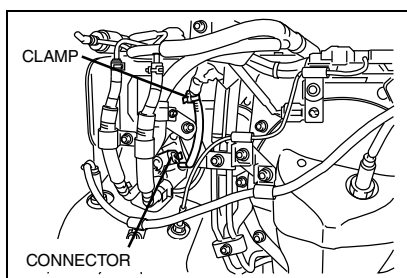
EXHAUST SYSTEM (J08E)

EN04-19



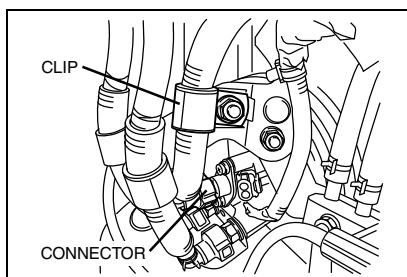
SAPH011060400037

- (7) Connect the DOC rear exhaust gas temperature sensor connector and install the clip.



SAPH011060400038

- (8) Install the clamp of the harness connecting to the injector and the injector connector.

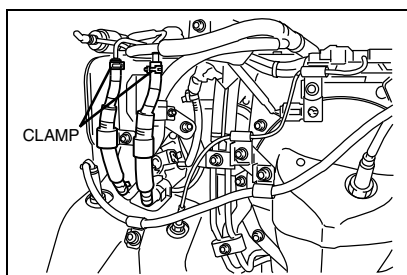


SAPH011060400039

- (9) Install the DEF hose connecting to the injector.

NOTICE

Before reassembling, wash away crystallized DEF on the connector with water.

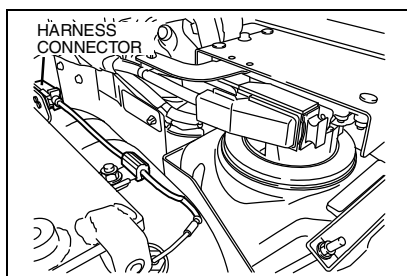


SAPH011060400040

- (10) Install the coolant hose connecting to the injector.

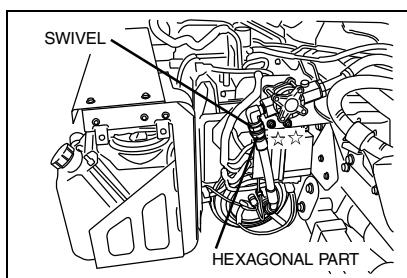
EN04-20

EXHAUST SYSTEM (J08E)



SAPH011060400041

(11) Connect the harness connector.

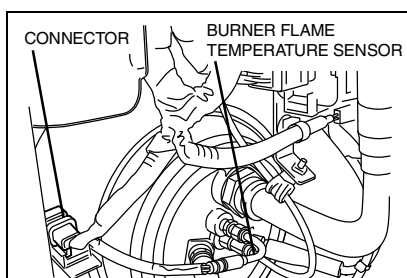


SAPH011060400042

(12) Install the burner burning air hose.

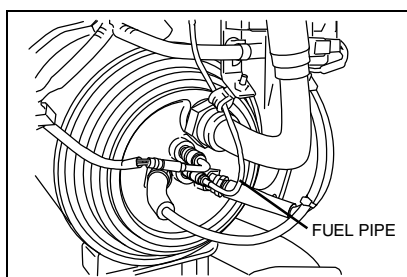
NOTICE

- When tightening, fix the hexagonal part under the swivel with the wrench.
- Before reassembling, remove the combustion air valves (☆ 2 places) without bending the hose so that the valves will be free.



SAPH011060400043

(13) Connect the burner flame temperature sensor connector.

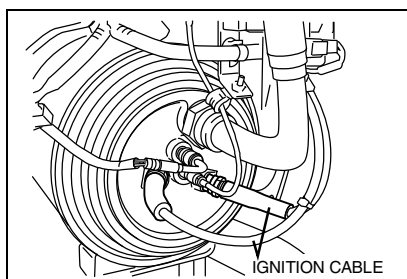


SAPH011060400016

(14) Install the front atomized fuel pipe.

EXHAUST SYSTEM (J08E)

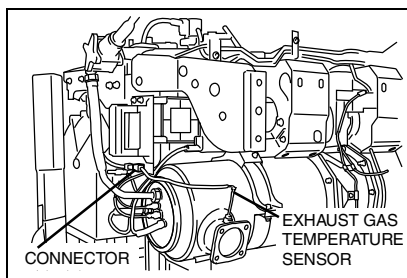
EN04-21



IGNITION CABLE

SAPH011060400044

- (15) Install the front ignition cable of the combustion chamber.

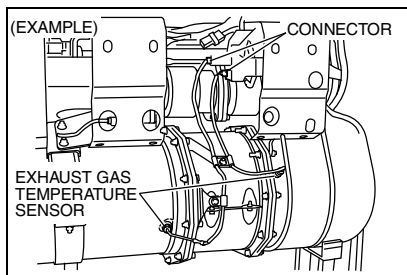


CONNECTOR

EXHAUST GAS TEMPERATURE SENSOR

SAPH011060400045

- (16) Connect the combustion chamber exhaust gas temperature sensor connector.

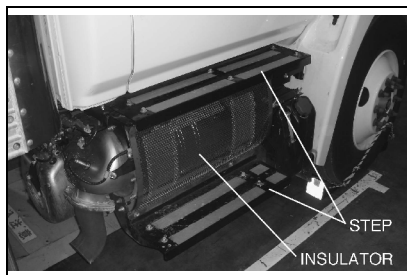


CONNECTOR

EXHAUST GAS TEMPERATURE SENSOR

SAPH011060400046

- (17) Connect the DPR filter front/rear exhaust gas temperature sensor connector.



STEP

INSULATOR

SAPH011060400047

- (18) Mount the steps (top and bottom) and the insulator on the right side of the vehicle.

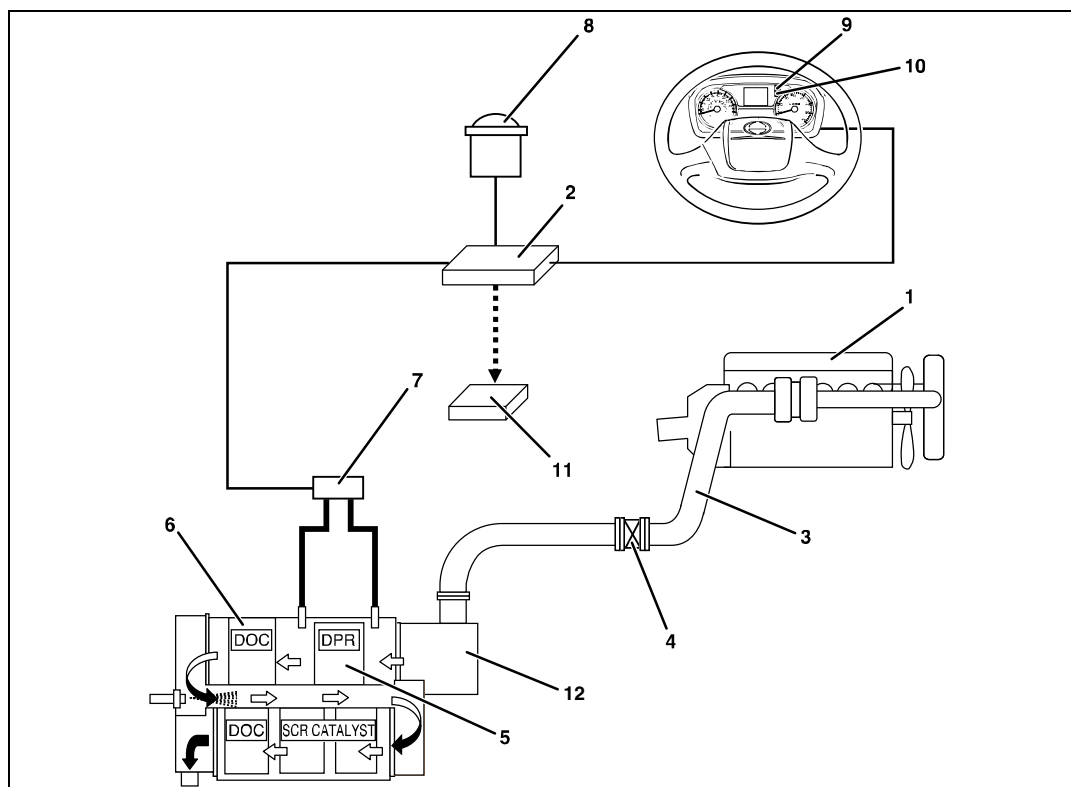
Tightening Torque:
18-26 N·m {184-265 kgf·cm, 14-19 lbf·ft}

- (19) Connect the battery ground terminal.

DPR (DIESEL PARTICULATE REDUCTION SYSTEM)

SYSTEM CONFIGURATION

EN0110604D100003

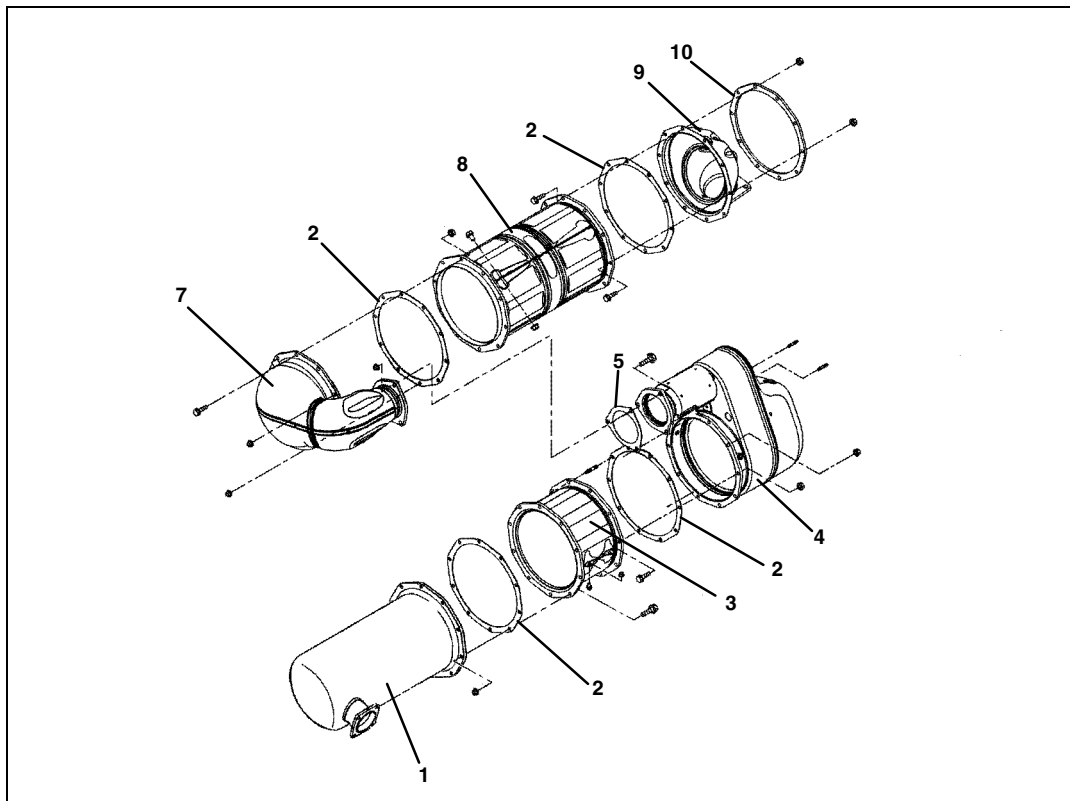


SAPH011060400048

1	Engine	7	Differential pressure sensor
2	Engine ECU	8	DPR-manual regeneration switch
3	Exhaust pipe	9	DPR indicator light
4	Exhaust control valve	10	Check engine light
5	Catalyst coated filter	11	Burner control unit
6	Oxidation catalyst	12	Combustion chamber

STRUCTURE OF DPR-CLEANER

EN0110604D100004



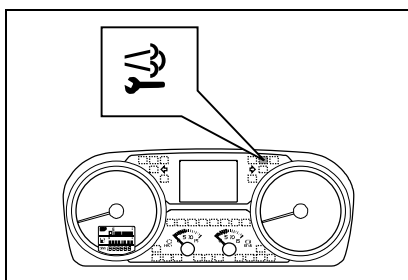
SAPH011060400049

1	Combustion chamber	6	Chamber sub assembly (Front)
2	Gasket	7	Monolithic converter assembly
3	Particulate filter assembly	8	Outlet chamber sub assembly
4	Chamber sub assembly (Rear)	9	Flange
5	Gasket		

DPR MAINTENANCE

EN0110604H200003

- If "DPR maintenance" is displayed on the information display, DPR maintenance is required.
Check the DPR backpressure and determine whether maintenance is required.
If the DPR backpressure value is below the specified value, no maintenance is required.
If the DPR backpressure value exceeds the specified value, clean or replace the filter.



1. NOTIFICATION TO DRIVER

- (1) It informs with the DPR maintenance light.

DPR INSPECTION

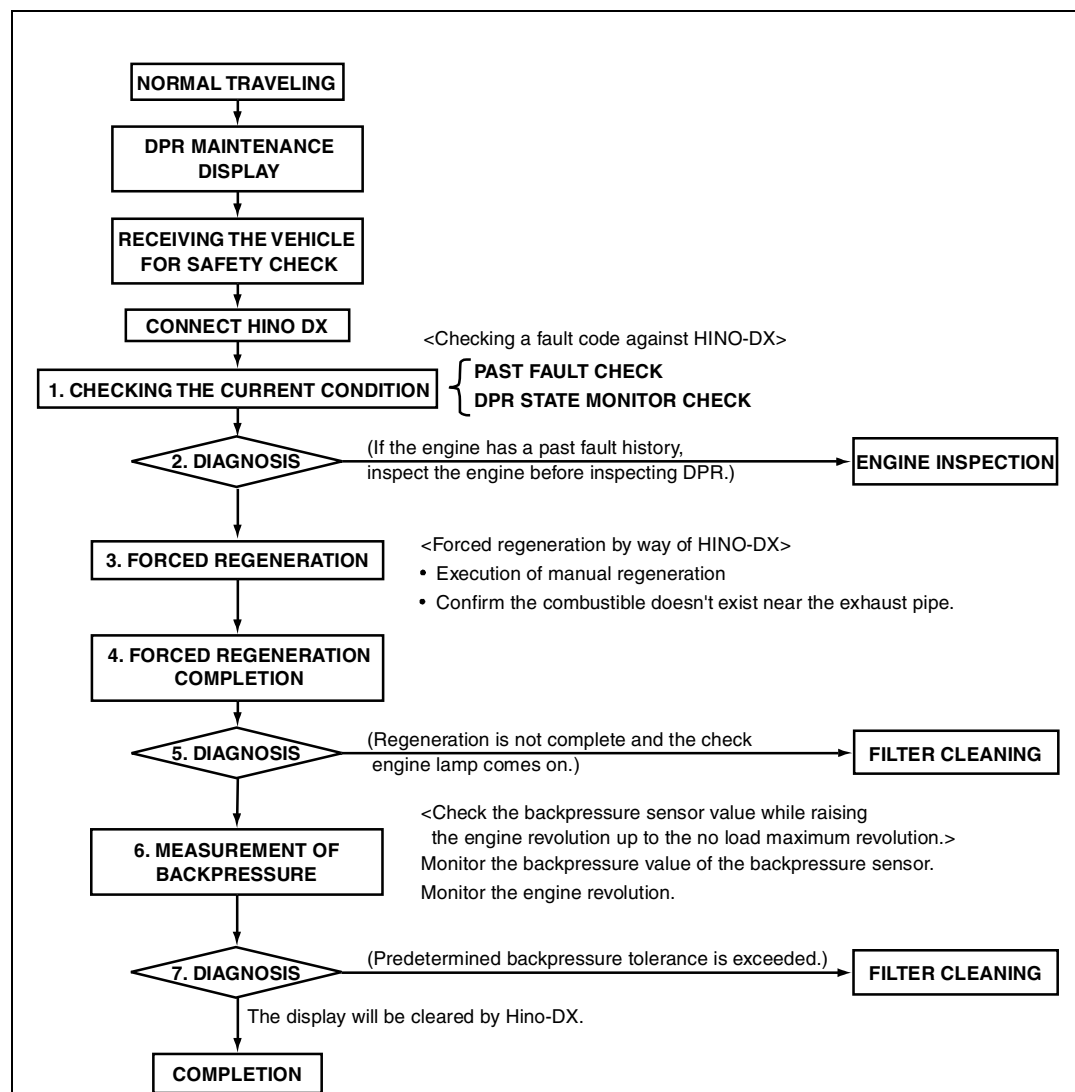
EN0110604H200004

1. ROUTINE INSPECTION ITEMS

- (1) Check the exhaust system tightening portions (exhaust pipe, main unit flange) for looseness or exhaust leakage.
- (2) Check external appearance of the harness of the exhaust temperature sensor for trouble (cracks in coating or missing clip).
- (3) Inspect the hose of the backpressure sensor and check the hose for deterioration or cracks. Replace a hose which has been used for three years or more with a new one.
- (4) Check for a blown indicator lamp or wire break in the DPR-cleaner switch and meter. (Stop the engine, turn ON the starter switch, and press the DPR-cleaner switch. If both the lamp in the switch and indicator lamp in the meter illuminate, the lamps are normal.)

INSPECTION PROCEDURE FOLLOWED WHEN "DPR MAINTENANCE" IS DISPLAYED ON THE INFORMATION DISPLAY

EN0110604H300001



SAPH011060400051

INSPECTION BY WAY OF HINO-DX

EN0110604H200005

1. DPR status check

- (1) Select the "DPR Reset confirmation" in the "Check function" menu of HINO-DX.
- (2) Confirm Data View of the "DPR Status" display (monitor), if the status for all the items are "OFF", DPR functions normally. Then "Manual Incineration" and "DPR backpressure check" can be done.
- (3) In case "ON" is displayed in Data View of the "DPR Status" display (monitor), check according to the procedure on page EN04-32, "DETERMINATION BY WAY OF DPR STATE DETERMINATION MONITOR OF HINO-DX".

DPR Status

Data View

Item	Status
DPR missing substrate flag	OFF
DPR over temperature flag by rear exh...	OFF
DPR over temperature flag by front exh...	OFF
DPR excessive backpressure flag	OFF
DPR clogged warning level flag	OFF
DPR clogged danger level flag	OFF
DPR manual regeneration failure flag	OFF
DPR active regeneration failure flag	OFF

Reset All DPR Status(R)

Forced regeneration(E)

Differential Pressure Check(D)

Explanation

Normal

Attention

To reset all DPR status, Turn-off the engine, shift transmission gear in to neutral position, and turn the starter key to the "ON" position.

Help(E1) **Close(C)**

SAPH011060400052

2. Forced regeneration

- (1) Forced regeneration is done by the "Forced regeneration" screen.

⚠ CAUTION

- **Confirm safety of the surrounding area, then press DPR regeneration switch inside the cabin to execute the regeneration.**
 - **Confirm the PTO switch is OFF.**
- (2) When the "manual regeneration failure flag" status is ON, inspection of burner system and wash or replace the filter.
When the status is OFF, DPR functions normally.

Item	Status	Units
Engine speed	0	r/min
Manual regeneration status flag	OFF	
Exhaust Temperature (IN)	0	°C
Exhaust Temperature (OUT)	0	°C
Injection quantity	0.00	mm ³ /st
DPR Backpressure	16777211.0	KPa

Start(E)

1st: Click

Explanation

Confirm safety of the surrounding area, then press DPR regeneration switch inside the cabin to execute the regeneration process.

Attention

Park the vehicle in a secure position. Then idle the engine.

Help(F1) **Close(C)**

2nd: Push manual regeneration switch in cabin

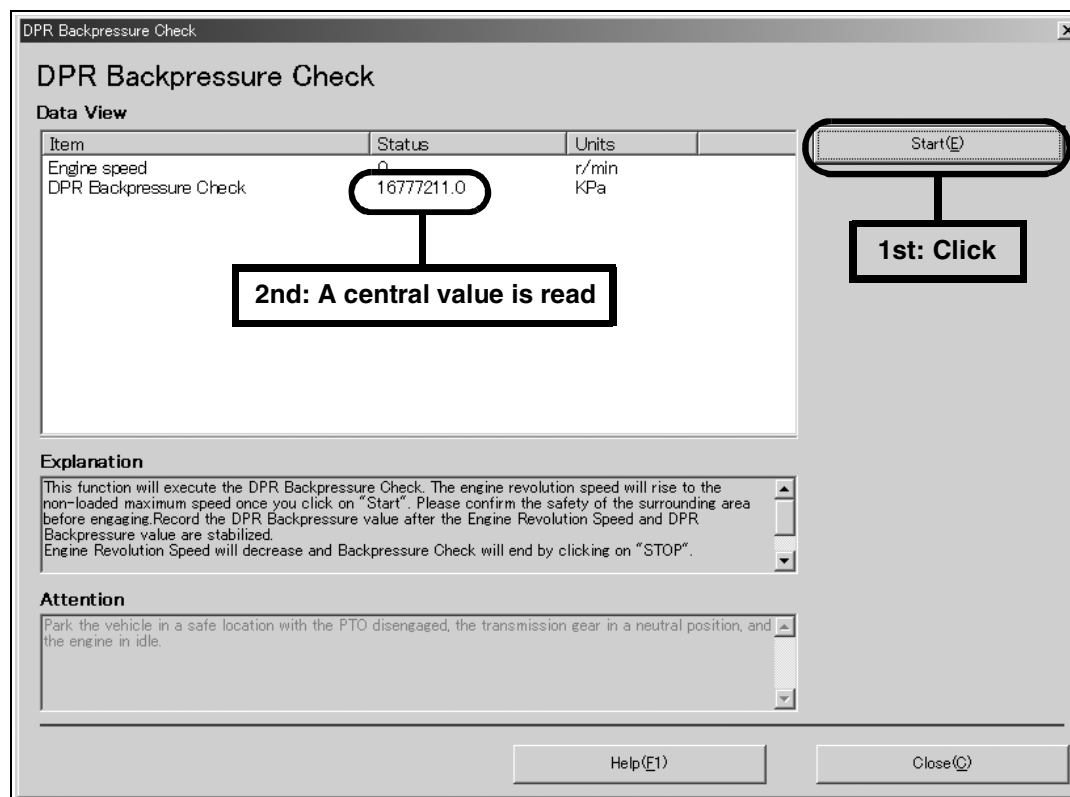
3. DPR backpressure check

- (1) Check the DPR backpressure through the "DPR Status" display.
- (2) Confirm the exhaust gas temperature (in and out) is less than 200°C {392°F}.
- (3) Engine revolution will rise automatically, then record the indicated maximum DPR backpressure.
- (4) In case the central value of the recorded DPR backpressure value exceeds the specific value, clean or replace the filter.
Then "Stop" the DPR backpressure check.

Specific value

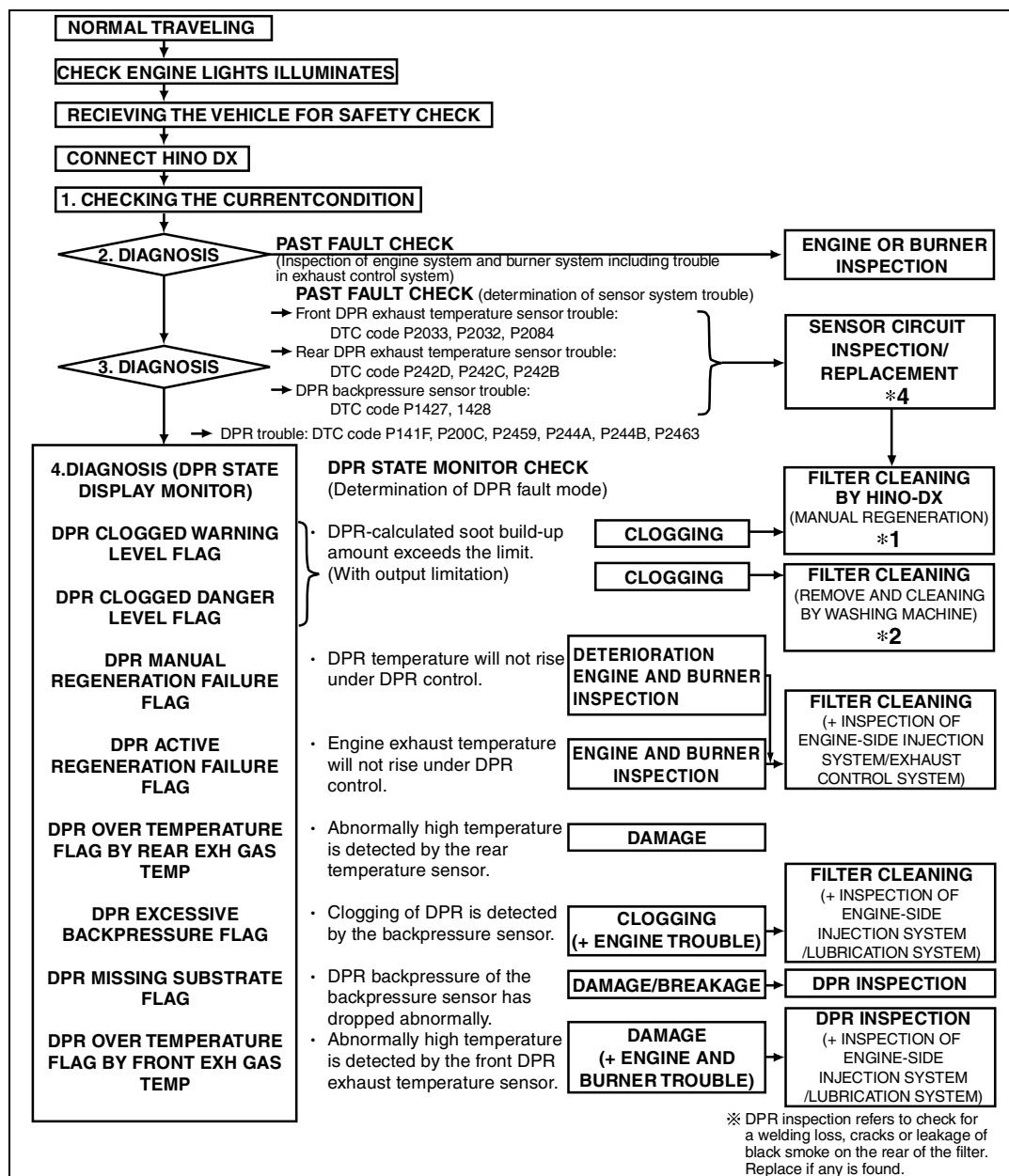
Engine speed (no load maximum revolution)	Backpressure inspection standard value (kPa {kgf/cm ² , lbf/in. ² })
2,800 r/min.	5.0 {0.05, 0.7}

- (5) When the backpressure is unchanged check the following.
If the following are normal, the backpressure sensor should be replaced.
 - a. Confirm backpressure hose for cracks or hole openings.
 - b. Confirm that the hose clamp is neither loose nor disconnected.
 - c. Confirm whether there is clogging in the backpressure pipe (DPR cleaner side).
Use compressed air from one end of the pipe to check for clogging. If the air passes to the other side easily, it is clear.



INSPECTION PROCEDURE FOLLOWED WHEN CHECK ENGINE LIGHT ILLUMINATES (ABNORMAL)

EN0110604H300002



*1 Additional information for inspections with HINO-DX

Light cases of DPR clogging can be treated without removing the housing.
The procedure is shown below.

The "DPR STATUS" can be checked with the HINO-DX, and when only the "DPR clogged warning level flag" is "ON", regeneration processing can be performed with the DPR SW or the tool.

Confirmation method:

Use the HINO-DX, perform System Fix, then open screens in the order of Check function (E) → DPR Reset Confirmation (D) → DPR Status, and confirm that "status" is "ON" for the item "DPR clogged warning level flag" of the DPR Status. Only when this is "ON" can manual regeneration by pressing the DPR manual regeneration switch or manual regeneration by HINO-DX setting be performed.

1. Press the DPR Manual regeneration switch. When manual regeneration has started, wait until regeneration has been completed and confirm that the engine check lamp has gone out.
2. If the operation by means of the DPR SW is not accepted, connect the HINO-DX to the vehicle, record the "HINO-DX Report", erase the trouble code, and then perform manual regeneration according to the following procedure. When manual regeneration has started, wait until regeneration has been completed and confirm that the engine check lamp has gone out.

Confirmation method:

Use the HINO-DX, perform System Fix, and then continue in the order of Check Function (E) → DPR Reset Confirmation (D) → Manual regeneration (E).

Recording method for the "HINO-DX Report":

- a. Connect the HINO-DX to the vehicle and execute System Fix.
- b. Click the Equipment DTC button and then click Load (L).
- c. Click System Fix (W) after the DTC code has been put out.
- d. Enter Work memorandum (information), Customer Name, License Plate, and Mileage information at the pop-up screen.
- e. Click the OK button.
- f. Click the Close Work (C) button of the pull-down menu File (F) for Close Work.
- g. Click Past work information (O) of the File (F) pull-down menu.
- h. Select the files when System Fix was performed in items d and e from the pop-up screen and click the Print button.
- i. Click the Print button on the pop-up screen.
- j. When the HINO-DX Report image screen appears, click the Print button.
- k. Click the Printer Name pull-down button on the Print pop-up screen.
- l. Select Microsoft Office Document Image Writer from the Printer pull-down menu.
- m. Click the OK button.
- n. Save the data in any folder (example: Save to the desktop).
- o. When the folder is clicked, the contents of the HINO-DX Report can be confirmed and sent by e-mail or can be printed out.
3. After completion of manual regeneration by (1) or (2), keep the engine running and wait for the exhaust temperature (IN side) to drop. Confirm a drop to 200 degrees or lower and then inspect the exhaust gas backpressure according to the following procedure.

Confirmation method:

Execute in the order of DPR Reset Confirmation → Backpressure Check (D) → Start (E).

4. Confirm that the values of the exhaust gas backpressure are at or below the standard.

Standard:

Engine model	DPR Backpressure (Units: KPa {kgf/cm ² , lbf/in. ² })
J08E	5.0 {0.05, 0.7}

5. When the confirmation result in (4) is at or below the standard, DPR manual regeneration and the confirmation work have been completed. Click "Stop" on the DPR Backpressure Check screen to end the work with the HINO-DX.
6. If the exhaust gas backpressure with the inspection in (5) exceeds the standard, repeat the steps (2), (3), (4), and (5).

7. If the exhaust gas backpressure with the work in (6) is within the standard, DPR manual regeneration and the confirmation work have been completed. Click "Stop" on the DPR Backpressure Check screen to end the work with the HINO-DX.
8. If the exhaust gas backpressure still exceeds the standard with the second manual regeneration, the DPR filter is defective and must be replaced.

***2 Additional information for filter cleaning with a washing machine**

Confirm the following for filter cleaning with a washing machine.

Use a washing machine from a manufacturer recommended by Hino Motors.

Perform cleaning with correct installation of the attachment for DPR filters made by Hino Motors.

In the following instances the filter cannot be cleaned. In these cases, the filter must be replaced.

1. Cleaning is not possible for filters where soot has escaped and the surroundings have turned black when the filter body is seen from the gas flow outlet side.
2. Cleaning is not possible when a large quantity of oil adheres to the filter body as seen from the gas flow inlet side.
3. Cleaning is not possible when the filter or the catalyst shows cracks or damage seen from any side.
When cleaning has been completed and the filter has been installed again, perform the following inspections.
4. Use the HINO-DX to perform DPR forced regeneration, then confirm normal completion.
5. In this condition, wait for the exhaust gas temperature to drop to 200°C or lower, perform the backpressure inspection, and confirm that the inspection value is at or below the standard.
6. If the backpressure value is high, the filter is defective and must be replaced.

***3 Check for sensor coupler disconnection even when DPR and burner DTC code is displayed.**

***4 Pay attention to the following when the temperature sensor is inspected because of DPR and burner DTC code or a temperature sensor DTC code.**

1. Replace if the tip is bent.
2. Do not bend the tip when it is normal.
3. When the sensor tip is bent, normal control may not be possible and this can lead to DPR trouble.
4. When disconnecting the sensor, remove the sensor body from the muffler after completely removing the harness fixing clips. If this is not done, the sensor tip could get damaged.

DETERMINATION BY WAY OF DPR STATE DETERMINATION MONITOR OF HINO-DX

EN0110604H200006

1. CHECK THAT THE CHECK ENGINE LIGHT COMES ON.
2. CONNECT HINO-DX.
3. CHECK PAST FAULTS.
 - (1) Check past faults by way of HINO-DX. In case a general engine fault such as a trouble of an exhaust control system is displayed, inspect and repair the pertinent section.
 - (2) Inspect and repair general engine faults and check past faults again. In case a code indicating a sensor system trouble is displayed, inspect and replace the sensor circuit.

	DTC code
Front DPR exhaust temperature sensor trouble	P2033, P2032, P2084
Rear DPR exhaust temperature sensor trouble	P242D, P242C, P242B
DPR backpressure sensor trouble	P1426, P1427, P1428

- (3) Check past faults. In case DPR trouble (DTC code: P141F, P200C, P2459, P244A, P244B, P2463) is displayed, check the DPR state monitor.

CHECKING THE DPR STATE

EN0110604H200007

1. CHECK THE DPR STATE MONITOR.
 - (1) Refer to "INSPECTION BY WAY OF HINO-DX" and check the DPR state monitor. Perform inspection as per the procedure under "INSPECTION BY WAY OF HINO-DX".

REPLACEMENT OF DPR FILTER

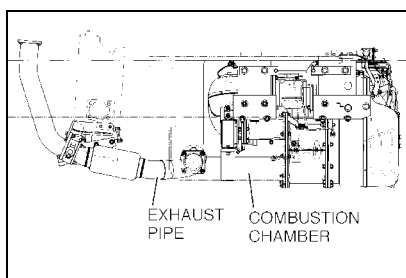
EN0110604H200008

⚠ WARNING

Do not touch the muffler unit when it could be hot. You can be severely burned.

1. REMOVE THE DPR FILTER.

- (1) Remove the bolts and nuts on the flanges on the exhaust pipe.

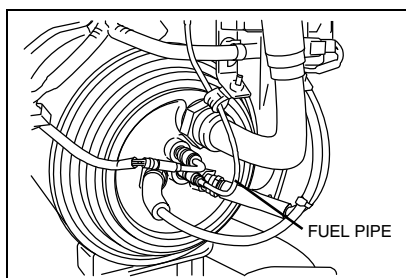


SAPH011060400056

- (2) Remove the front atomized fuel pipe of the combustion chamber.

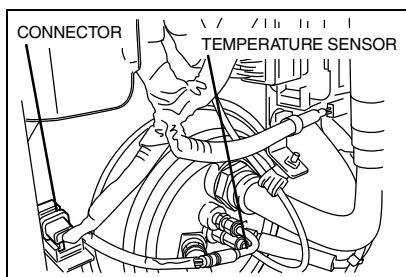
NOTICE

After removal, do not allow foreign objects to get into the pipe and nozzle.



SAPH011060400057

- (3) Disconnect the burner flame temperature sensor connector.

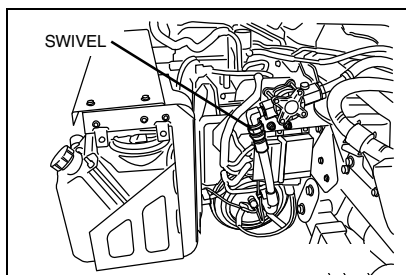


SAPH011060400058

- (4) Remove the burner burning air hose.

NOTICE

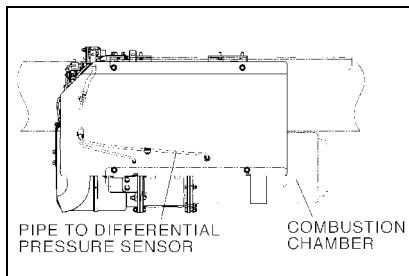
- When removing, be sure to remove the swivel on the vehicle upper side.
- After removal, do not allow foreign objects to get into the pipe.



SAPH011060400059

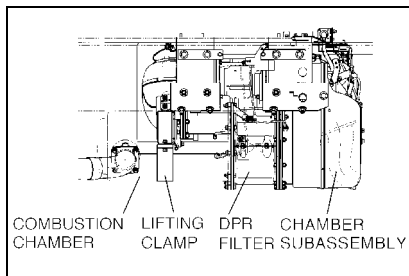
EN04-34

EXHAUST SYSTEM (J08E)



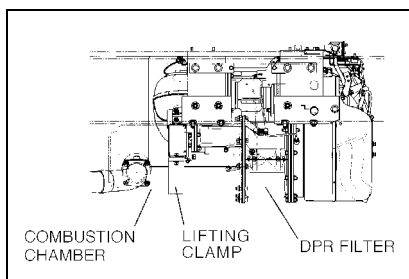
SAPH011060400060

- (5) Dismount the pipe between the combustion chamber and the differential pressure sensor.



SAPH011060400061

- (6) Remove the lifting clamp.
 (7) Remove the fastening bolt secured to the DPR filter and then the combustion chamber.
 (8) Remove the combustion chamber.
 (9) Remove the fastening bolt secured to the chamber subassembly and then the DPR filter.
 (10) Remove the DPR filter.



SAPH011060400062

2. INSTALL THE DPR FILTER.

- (1) Install the DPR filter to the chamber subassembly.

NOTICE

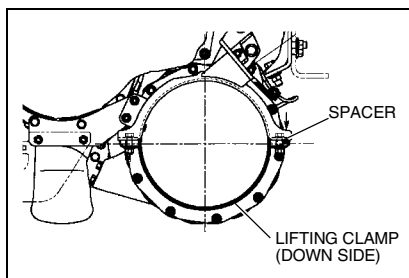
- Replace with a new gasket.
- Tighten the fastening bolts in the diagonal order.

- (2) Install the combustion chamber to the DPR filter.

NOTICE

- Replace with a new gasket.
- Tighten the fastening bolts in the diagonal order.

- (3) Install the lower side of the lifting clamp.



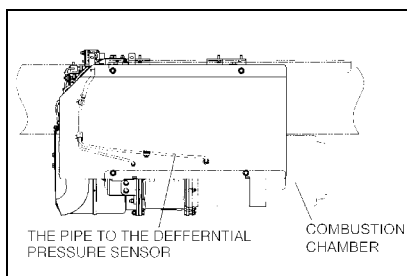
SAPH011060400063

NOTICE

When installing the lower side of the lifting clamp, do not forget to place the spacer.

EXHAUST SYSTEM (J08E)

EN04-35



SAPH011060400064

- (4) Install the pipe between the combustion chamber and the differential pressure sensor.

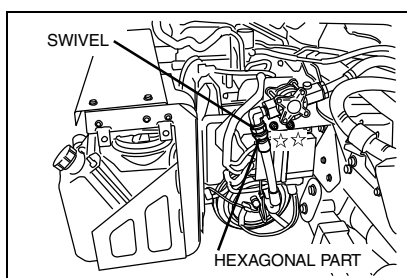
NOTICE

When installing the differential pressure sensor pipe, wipe off the old anti-seizure lubricant on the flare nut and apply new anti-seizure lubricant.

Recommended anti-seizure lubricant: NEVER-SEEZ Pure Nickel Special (Bostic inc.)

Tightening Torque:

25-35 N·m {255-356 kgf·cm, 19-25 lbf·ft} (Flare nut)

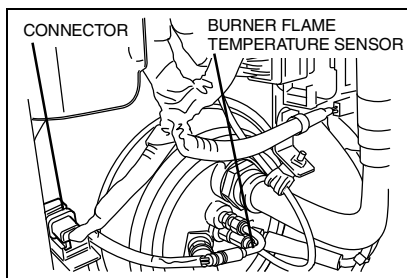


SAPH011060400065

- (5) Install the burner burning air hose.

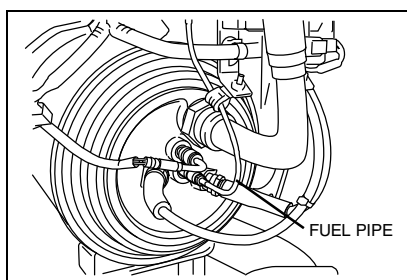
NOTICE

- When tightening, fix the hexagonal part under the swivel with the wrench.
- Before reassembling, remove the combustion air valves (☆ 2 places) without bending the hose so that the valves will be free.



SAPH011060400066

- (6) Connect the burner flame temperature sensor connector.

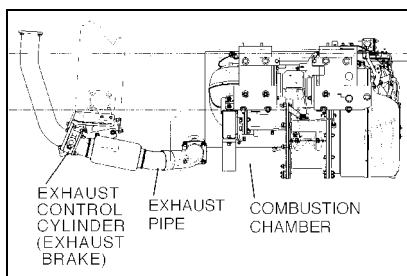


SAPH011060400067

- (7) Install the front atomized fuel pipe of the combustion chamber.

EN04-36

EXHAUST SYSTEM (J08E)



SAPH011060400068

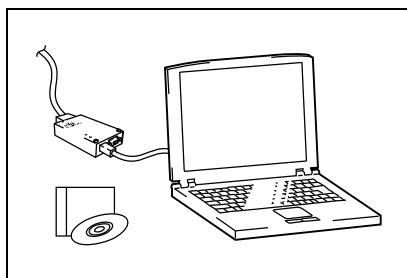
- (8) Install the exhaust pipe to the flanges on the exhaust brake side and the combustion chamber side.

OVERALL OPERATION FLOW

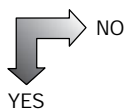
EN0110604H100002

1. VEHICLE RECEIPT FOR INSPECTION

- (1) Check the malfunction code with the Hino-DX.
Standard value: No malfunction code



SAPH011060400069

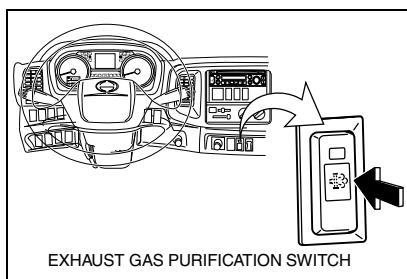


- 4. For P141F, P200C, P244B, P244A, P2459, P2463
- 5. For others than above

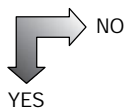
2. MANUAL REGENERATION

2. MANUAL REGENERATION

- (1) After a manual regeneration, check the differential pressure with the Hino-DX.

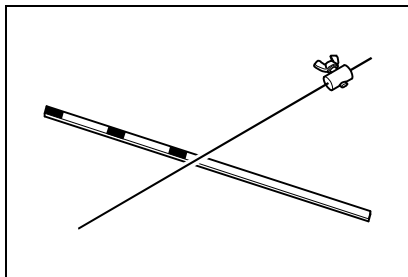
Standard value:
Refer to "LIST OF STANDARD VALUES FOR DIFFERENTIAL PRESSURE INSPECTION" on page EN04-40.


SAPH011060400070



3. INSPECT THE DPR FILTER.

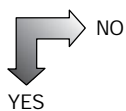
No clean up necessary
 Vehicle delivery



SAPH011060400071

3. INSPECT THE DPR FILTER.

- (1) Dismount the DPR filter from the vehicle.
Refer to "1. REMOVE THE DPR FILTER" on page EN04-33.
- (2) Inspect the status of the DPR filter rear surface.
Refer to "INSPECT INSIDE THE DPR FILTER" on page EN04-41.
Standard value: No soot escape



Replace with a new DPR filter and install it on the vehicle.

Refer to "2. INSTALL THE DPR FILTER" on page EN04-34.

NOTICE

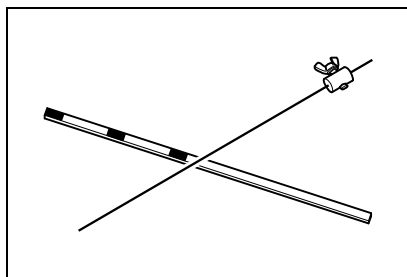
Recheck the differential pressure after the installation. Make sure it is within the standard value and deliver the vehicle.

Perform ash cleaning to the DPR filter and then install it on the vehicle.

Refer to "2. INSTALL THE DPR FILTER" on page EN04-34.

NOTICE

Recheck the differential pressure after the installation. Make sure it is within the standard value and deliver the vehicle.

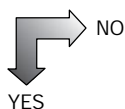


SAPH011060400072

4. IN CASE THAT DPR AND BURNER DTC CODE IS DISPLAYED

- (1) Dismount the DPR filter from the vehicle.
Refer to "1. REMOVE THE DPR FILTER" on page EN04-33.
- (2) Inspect the status of the DPR filter rear surface.
Refer to "INSPECT INSIDE THE DPR FILTER" on page EN04-41.

Standard value: No soot escape



Replace with a new DPR filter and install it on the vehicle.

Refer to "2. INSTALL THE DPR FILTER" on page EN04-34.

NOTICE

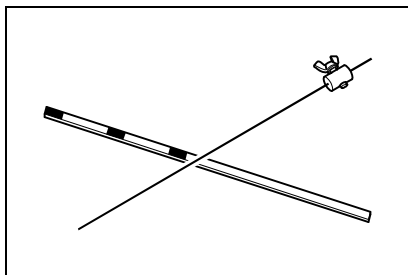
After the installation, regenerate the DPR filter manually and recheck the differential pressure. Make sure it is within the standard value and deliver the vehicle.

Perform soot cleaning to the DPR filter and then install it on the vehicle.

Refer to "2. INSTALL THE DPR FILTER" on page EN04-34.

NOTICE

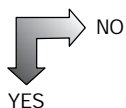
After the installation, regenerate the DPR cleaner manually and recheck the differential pressure. Make sure it is within the standard value and deliver the vehicle.



SAPH011060400072

5. FOR OTHERS THAN DPR AND BURNER DTC CODE IS DISPLAYED

- (1) Check the engine body and repair or replace defective parts if any.
- (2) Dismount the DPR filter from the vehicle.
Refer to "1. REMOVE THE DPR FILTER" on page EN04-33.
- (3) Inspect the status of the DPR filter rear surface.
Refer to "INSPECT INSIDE THE DPR FILTER" on page EN04-41.

Standard value: No soot escape

Replace with a new DPR filter and install it on the vehicle.

Refer to "2. INSTALL THE DPR FILTER" on page EN04-34.

NOTICE

After the installation, regenerate the DPR cleaner manually and recheck the differential pressure. Make sure it is within the standard value and deliver the vehicle.

Perform soot cleaning to the DPR filter and then install it on the vehicle.

Refer to "2. INSTALL THE DPR FILTER" on page EN04-34.

NOTICE

- After the installation, regenerate the DPR cleaner manually and recheck the differential pressure. Make sure it is within the standard value and deliver the vehicle.
- If the differential pressure is out of the standard value, perform ash cleaning.

LIST OF STANDARD VALUES FOR DIFFERENTIAL PRESSURE INSPECTION

Engine type	Engine no-load maximum revolution speed	Differential pressure (kPa {kgf/cm ² , lbf/in. ² })
J08E	2,800	5.0 {0.05, 0.7}

INSPECT INSIDE THE DPR FILTER.

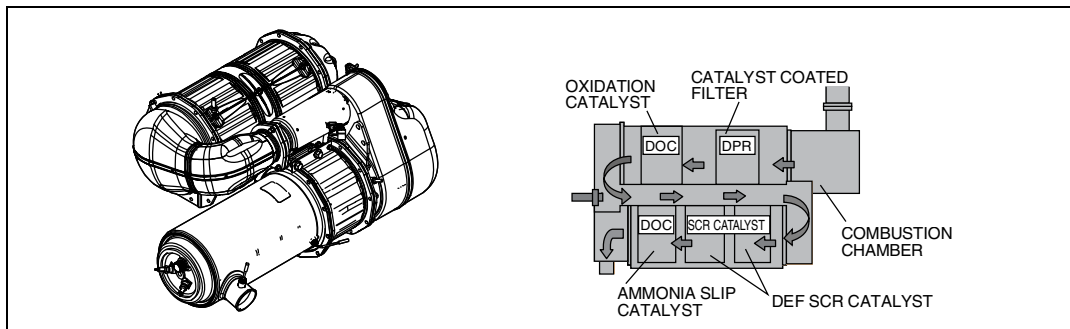
HINT

This is for detecting abnormalities inside the DPR filter.

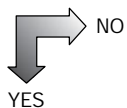
1. VISUALLY INSPECT THE FILTER REAR SURFACE.

- (1) Visually inspect the filter rear surface to detect soot escapes (black part).

Standard value: No soot escape



SAPH011060400073

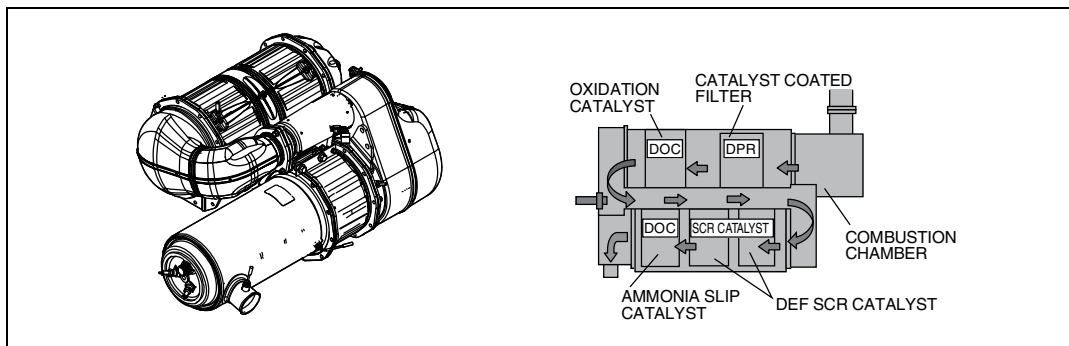


3. INSPECT THE DPR FILTER WITH THE DEDICATED CHECK PROBE.

2. VISUALLY INSPECT THE CASE EDGE.

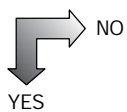
2. VISUALLY INSPECT THE CASE EDGE.

- (1) Visually inspect the case edge to detect soot escapes (black part).



SAPH011060400074

Standard value: No soot escape

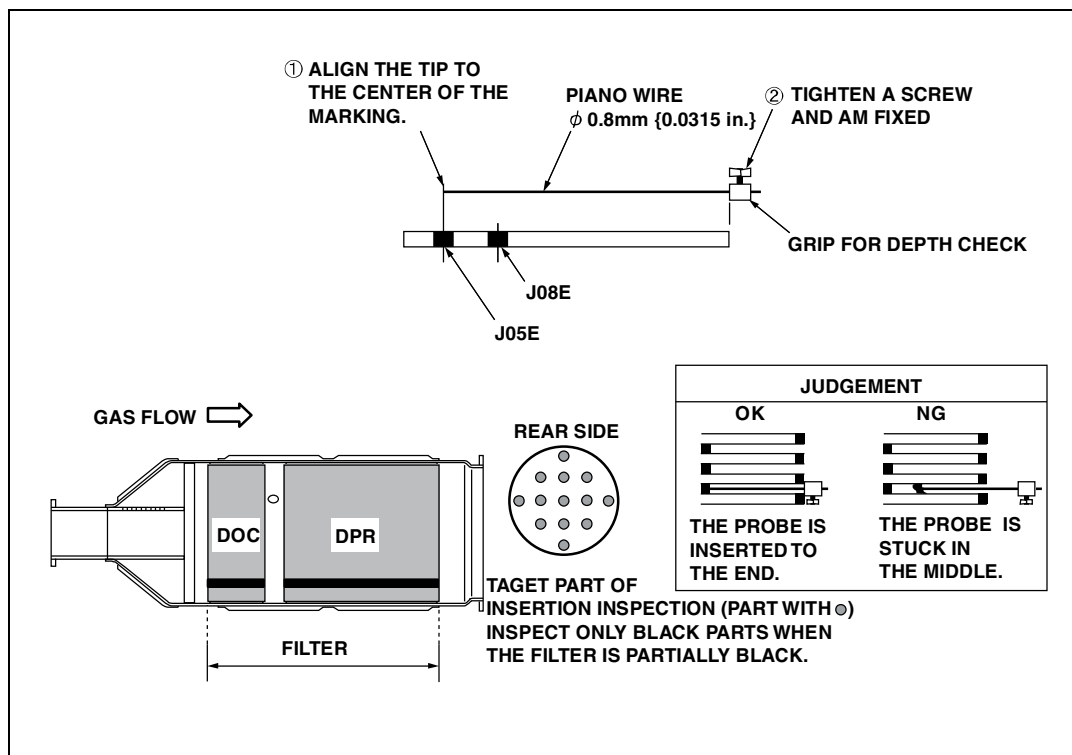


3. INSPECT THE DPR FILTER WITH THE DEDICATED CHECK PROBE.

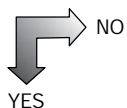
The DPR filter is normal.

3. INSPECT THE DPR FILTER WITH THE DEDICATED CHECK PROBE.

- (1) Insert the check probe from the rear surface to inspect the inside.
SST: FILTER GAGE ASSEMBLY (09992-E4010)



SAPH011060400075

Standard value: Insert the check probe to the specified position.

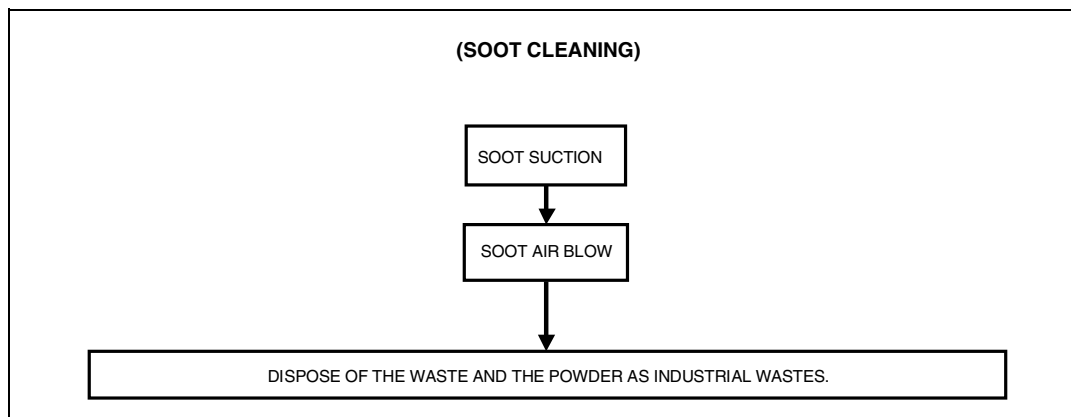
Replace with a new DPR filter and install it on the vehicle.
Refer to "2. INSTALL THE DPR FILTER" on page EN04-34.

Clean it and then install it on the vehicle.
Refer to "2. INSTALL THE DPR FILTER" on page EN04-34.

EN04-44

EXHAUST SYSTEM (J08E)

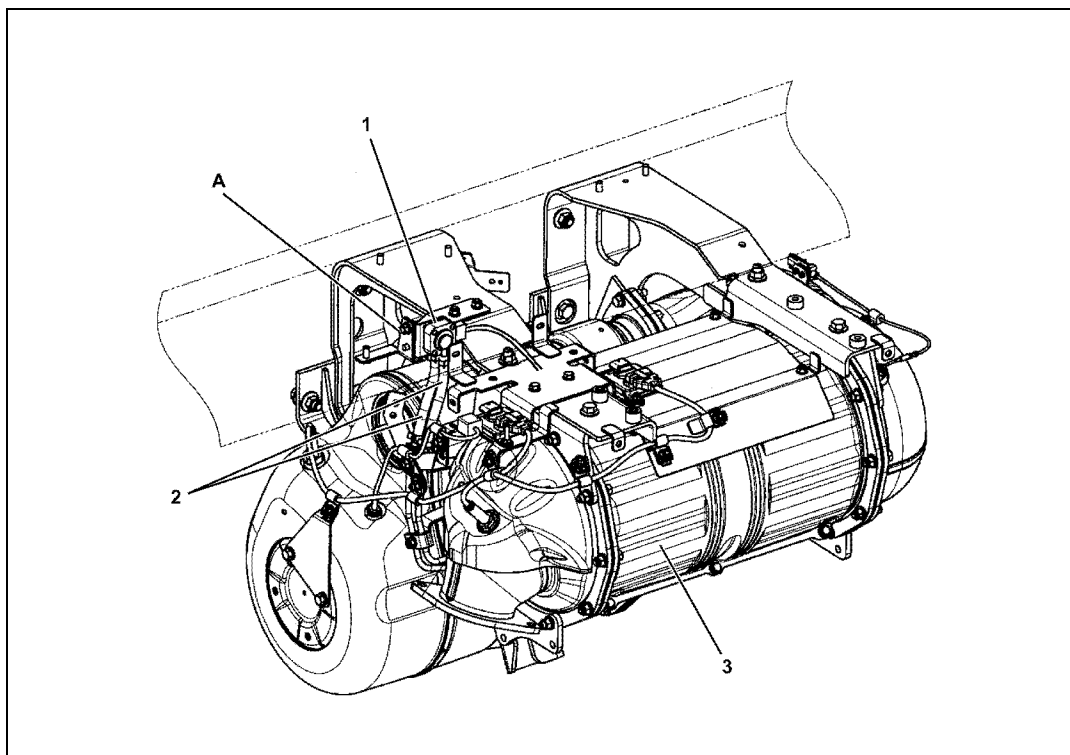
AIR CLEANING FLOW



SAPH011060400076

DIFFERENTIAL PRESSURE SENSOR COMPONENT LOCATOR

EN0110604D100005



SAPH011060400077

1	Differential pressure sensor	3	Muffler unit
2	Hose		

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	18-26 {183-265, 13-19}		
---	------------------------	--	--

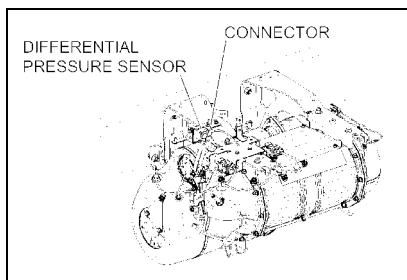
DISMOUNTING AND MOUNTING

EN0110604H100003

REMOVAL OF THE DIFFERENTIAL PRESSURE SENSOR

1. REMOVE THE HARNESS.

- (1) Disconnect the connector attached to the differential pressure sensor.

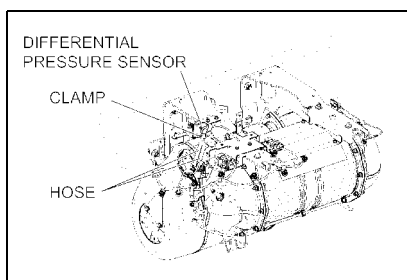


2. DISCONNECT THE HOSE.

- (1) Remove the clamps and disconnect the hose from the differential pressure sensor.

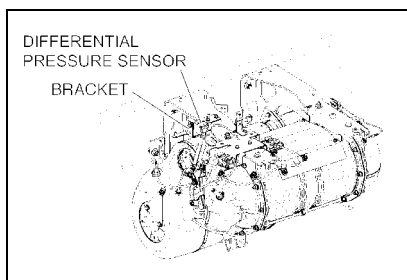
NOTICE

Do not allow foreign objects to get into the differential pressure pipe and hose.



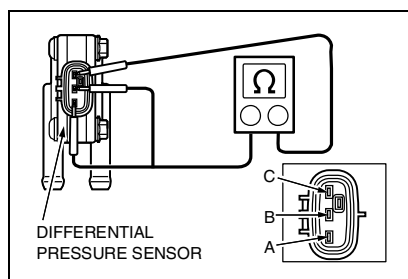
3. REMOVE THE DPR DIFFERENTIAL PRESSURE SENSOR.

- (1) Remove the nut and the differential pressure sensor from the bracket.



UNIT CHECK**1. RESISTANCE CHECK**

- (1) Measure the resistance of the differential pressure sensor with a circuit tester. If the value exceeds the standard value, replace it.



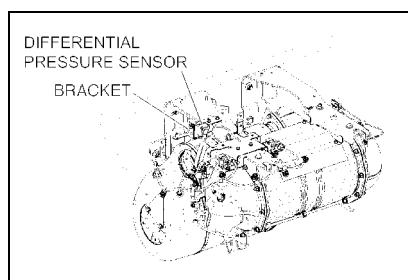
SAPH011060400081

Measurement item	Standard value (k Ω)
A \longleftrightarrow B	15
B \longleftrightarrow C	15

INSTALL THE DIFFERENTIAL PRESSURE SENSOR.**1. INSTALL THE DIFFERENTIAL PRESSURE SENSOR.**

- (1) Install the differential pressure sensor to the bracket with a nut.

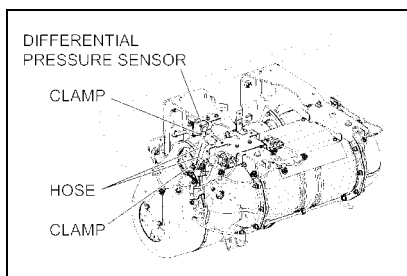
Tightening Torque: 18-26 N·m {183-265 kgf·cm, 13-19 lbf·ft}



SAPH011060400082

EN04-48

EXHAUST SYSTEM (J08E)



SAPH011060400083

2. CONNECT THE HOSE.

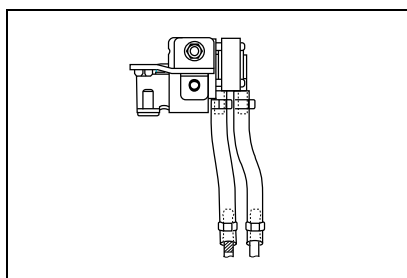
- (1) Install the hose to the differential pressure sensor with clamps (4 pcs).

NOTICE

If the differential pressure sensor hose is inserted incorrectly, the DPR will not operate properly.

⚠ CAUTION

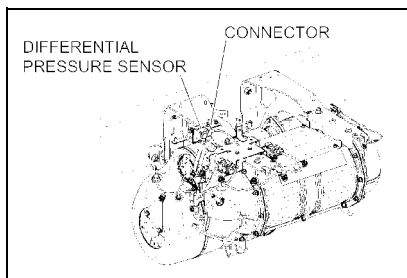
- Connect the white marks of the sensor and the pipe.
- Insert the hoses certainly against the sensor body.
- Insert the hoses certainly against the sensor spool.



SAPH011060400084

3. INSTALL THE HARNESS.

- (1) Connect the connector to the differential pressure sensor.

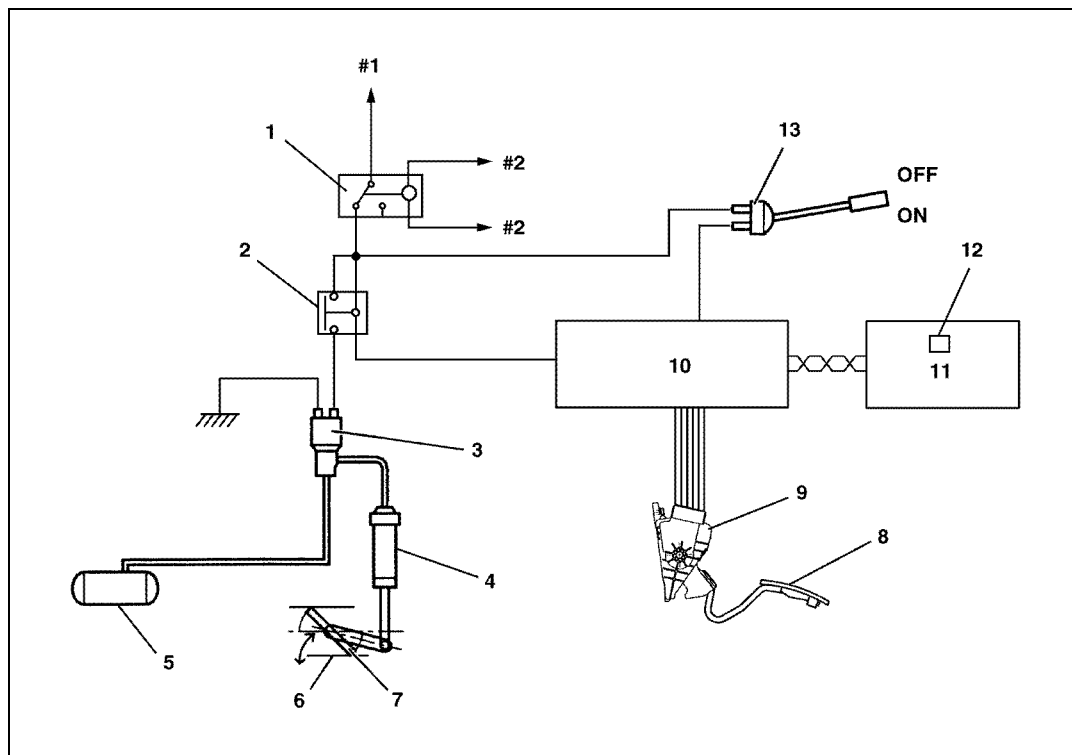


SAPH011060400085

EXHAUST CONTROL CYLINDER

SYSTEM CONFIGURATION

EN0110604D100006



SAPH011060400086

1	ABS exhaust cut relay	9	Accelerator sensor
2	Exhaust relay	10	Engine ECU
3	Magnetic valve	11	Combination meter ECU
4	Exhaust control cylinder (Exhaust brake)	12	Exhaust brake light
5	Air tank	13	Exhaust brake switch
6	Exhaust pipe	#1	To actuator power relay
7	Butterfly valve	#2	To ABS ECU
8	Accelerator pedal		

EN04-50

EXHAUST SYSTEM (J08E)

DPR INSPECTION CHECK SHEET

EN0110604D100007

HINT After the inspection, enter check marks into the empty check boxes.								
Step	1		2		3		4	
Inspection part	Fuel tank, Filter		Air intake system parts		Engine ECM		VNT turbocharger	
Inspection items	<input type="checkbox"/> Dirty or clogged fuel filter element <input type="checkbox"/> Entry of foreign matter or water into the fuel tank <input type="checkbox"/> Use of bad fuel		<input type="checkbox"/> Air filter element dirty, clogged, etc. <input type="checkbox"/> Damage to air cleaner body or air intake stack <input type="checkbox"/> Damaged or bent air hose <input type="checkbox"/> Damaged inter cooler body or hose		<input type="checkbox"/> Most recent program No.?		<input type="checkbox"/> Following characteristic at the time of inspection (Error within $\pm 5\%$)	
	OK	NG	OK	NG	OK	NG	OK	NG
Handling in case of "NG" judgment	<ul style="list-style-type: none"> • Element replacement • Fuel sampling → Investigation *Sampling from the fuel tank		<ul style="list-style-type: none"> • Element replacement • Inspection of body and air intake stack • Replacement of intercooler body or hose 		<ul style="list-style-type: none"> • Updating to the most recent software version (**). 		<ul style="list-style-type: none"> • Replacement in case of bad following 	

(**)As long as the injection quantity is normal at the time of exhaust control valve is operating, there is no problem.

EXHAUST SYSTEM (J08E)

EN04-51

EN0110604D100008

HINT After the inspection, enter check marks into the empty check boxes.							
5		6		7		8	
EGR valve		Supply pump, Injector		Fuel injection quantity		Manual regeneration	
<input type="checkbox"/> Following characteristic at the time of inspection (Error within $\pm 5\%$)		<input type="checkbox"/> Stability of the pump electrical current value *Standard = Refer to the supply pump inspection. <input type="checkbox"/> Injector correction value *Guide value = "Correction value for the correction injection quantity between cylinders" at the time of idle speed within ± 5 mm ³ /st		<input type="checkbox"/> Injection quantity 1. At the time of idle 2. At the time of exhaust control valve is in operation <input type="checkbox"/> Exhaust control valve operation (No clinging or air leakage etc.?) *At the time of exhaust control valve opening adjustment, refer to the standard value table shown blow left. *Confirm the injection quantity at the time of exhaust control valve is operating when the exhaust temperature has stabilized.		*To be performed with all auxiliary equipment load off. <input type="checkbox"/> Gas leakage at the time of regeneration <input type="checkbox"/> Discharge of white or black smoke at the time of regeneration <input type="checkbox"/> Exhaust gas temperature at the time of regeneration *Peak temperature: 500 °C or more (guide value) <input type="checkbox"/> Regeneration time *Guide value: Approximately 20 min	
OK	NG	OK	NG	OK	NG	OK	NG
<ul style="list-style-type: none"> Replacement in case of bad following 		<ul style="list-style-type: none"> Supply pump replacement when the inspection result is NG Injector replacement when the injector correction value is not within ± 5 mm³/st 		Repair or replacement the exhaust control valve in case of problems with exhaust control valve operation. (***)		White smoke means excessively closed exhaust control valve → Readjustment. Black smoke requires DPR filter confirmation. → Replace if the rear part is black. <ul style="list-style-type: none"> If the temperature rise is bad although injector, VNT, and EGR all are OK, inspect the temperature sensor and the front of the DPR. → Clean if the front is clogged. 	

(*) Caution items before inspection of the fuel injection quantity**

1. Connect the HINO-DX and perform warm-up until the engine temperature becomes 82°C {180°F} or higher.
2. Set the gear to neutral and pull the parking brake lever sufficiently.
3. Switch off the air conditioner and the headlights.
4. Confirm that charging of the air compressor has been completed.
5. Switch off all other auxiliary equipment loads. (Refrigeration compressor, PTO, etc.)

EN04-52

EXHAUST SYSTEM (J08E)

Injection quantity and engine speed standard value table (value with all auxiliary equipment loads off)

Idling (normal)	Speed (rpm)	750
	Injection quantity (q)	7 - 16
At the time of manual regeneration (guide value)	Speed (rpm)	980
Backpressure standard	Speed (rpm)	2,800
	Backpressure (kPa {kgf/cm ² , lbf/in. ² })	5.0 {0.05, 0.7}

LUBRICATING SYSTEM (J08E)

EN05-001

LUBRICATING SYSTEMEN05-2

DIAGRAM EN05-2

OIL PUMP AND OIL STRAINEREN05-4

COMPONENT LOCATOR..... EN05-4

OVERHAUL EN05-5

INSPECTION AND REPAIR EN05-6

OIL FILTER AND OIL COOLEREN05-8

COMPONENT LOCATOR..... EN05-8

SPECIAL TOOL EN05-9

DISMOUNTING AND MOUNTING EN05-10

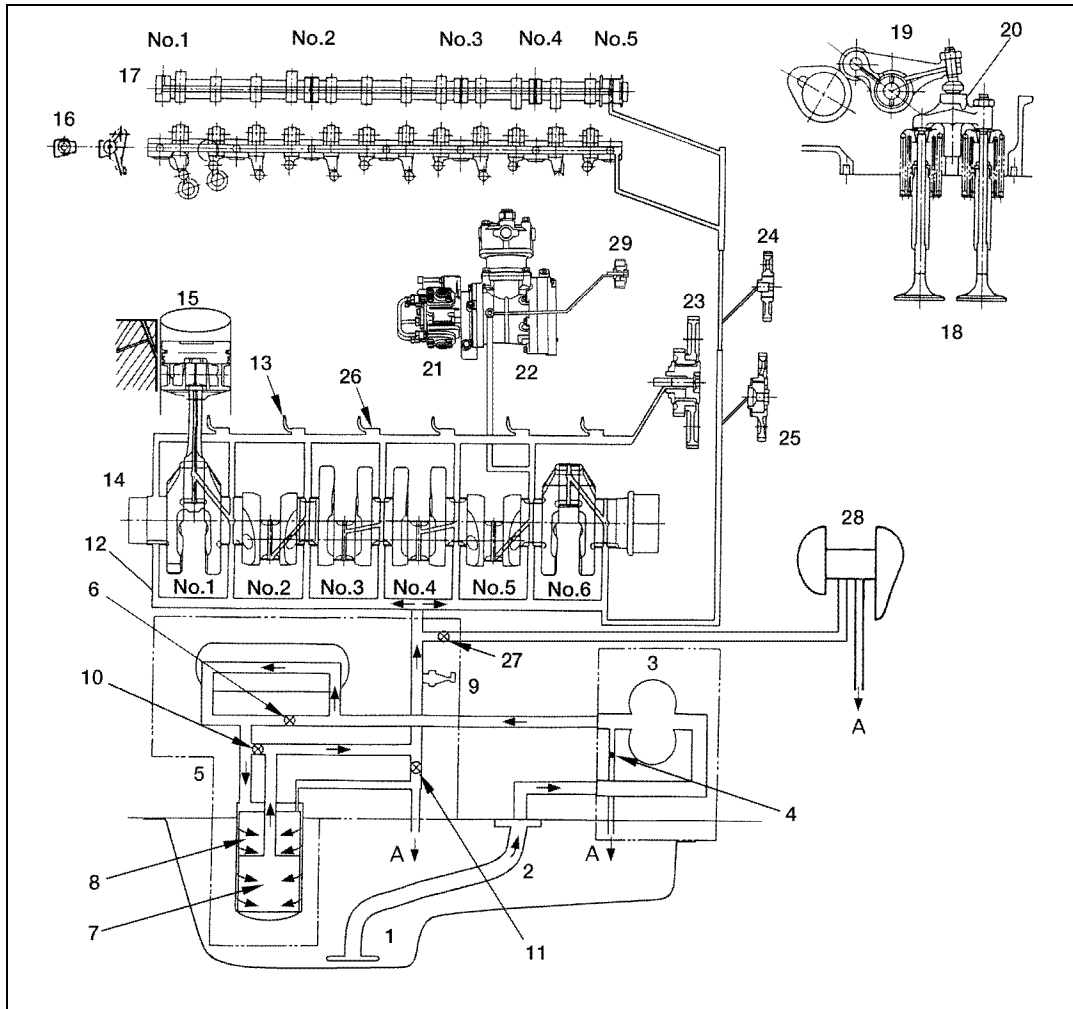
INSPECTION AND REPAIR EN05-11



LUBRICATING SYSTEM

DIAGRAM

EN0110605J100001



SHTS011060500001

LUBRICATING SYSTEM (J08E)

EN05-3

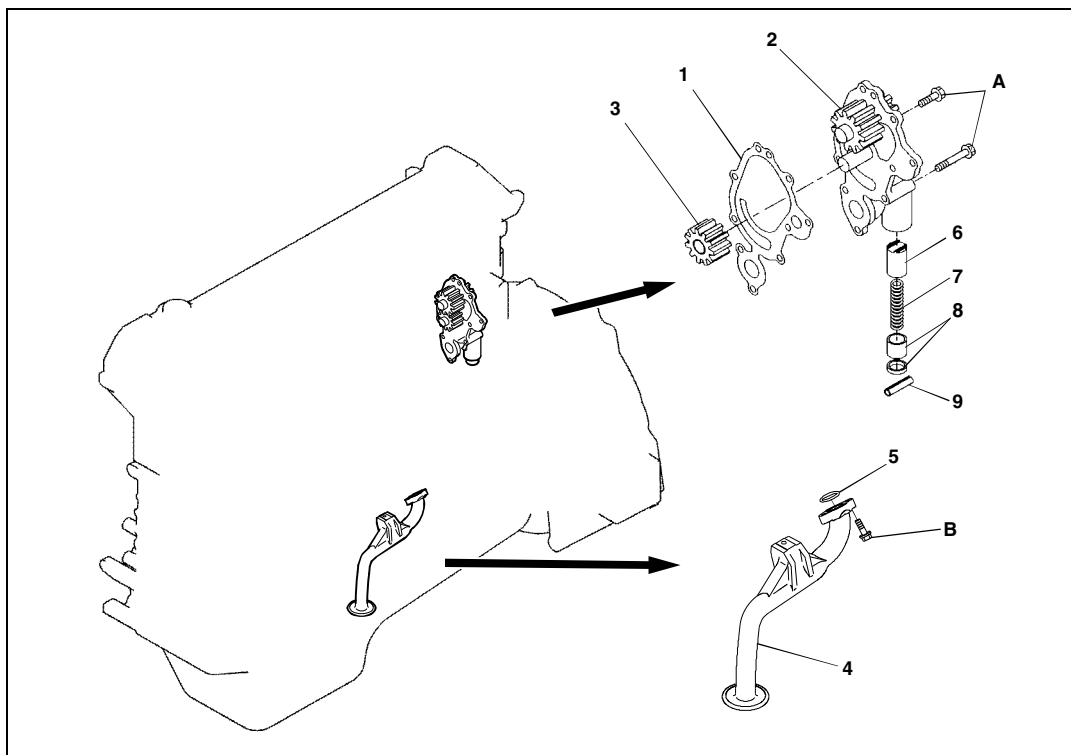
Unit: kPa {kgf/cm², lbf/in.²}

1	Oil pan	15	Piston
2	Oil strainer	16	Valve rocker shaft
3	Oil pump	17	Camshaft
4	Oil pump safety valve 1,648-1,746 {16.8-17.8, 239-253}	18	Valve
5	Oil cooler and oil filter	19	Rocker arm
6	Oil cooler safety valve 352-432 {3.6-4.4, 52-62}	20	Cross head
7	Oil filter (full flow)	21	Supply pump
8	Oil filter (by-pass)	22	Air compressor
9	Pressure switch	23	Main idle gear
10	Oil filter safety valve 137-157 {1.3-1.6, 20-23}	24	Cam idle gear
11	Regulator valve 490-570 {5.0-5.8, 72-82}	25	Sub idle gear
12	Main oil hole	26	Check valve 245 {2.5, 36}
13	Piston cooling jet	27	Check valve for turbocharger
14	Crankshaft	28	Turbocharger
		29	Idle gear
		A	To oil pan

OIL PUMP AND OIL STRAINER

COMPONENT LOCATOR

EN0110605D100001



SHTS011060500002

1 Gasket	6 Safety valve
2 Oil pump	7 Relief spring
3 Driven gear	8 Spring seat
4 Oil strainer	9 Cotter pin
5 O-ring	

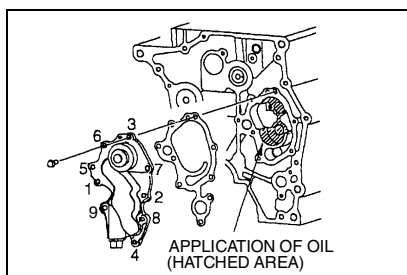
Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 28.5 {291, 21}	B 30 {306, 22}
------------------	----------------

OVERHAUL

EN0110605H200001



SHTS011060500003

IMPORTANT POINTS - ASSEMBLY

1. INSTALLING THE OIL PUMP.

- (1) Apply oil to the pump case and bearings of the block (hatched area) before installing the oil pump.

NOTICE

Not applying oil may cause oil suction failure at start-up, resulting in seizure and abnormality.

- (2) To prevent misalignment of the gasket, apply grease to the gasket matching face of the block. Then, place and fix the gasket.

NOTICE

If you change with the gasket misaligned, the seal will be defective and cause all the oil in the oil pump to flow out when the engine is stopped. The defective seal may also result in an insufficient oil suction quantity in the initial rotation when restarting the engine and cause seizure or abnormal wear.

- (3) Tighten the oil pump mounting bolts provisionally in the order as shown in the figure. Tighten them to the specified torque.

NOTICE

- Note that failure to observe the tightening order may result in damage to the oil pump.
- After tightening, check that the gear can be turned easily by hand.

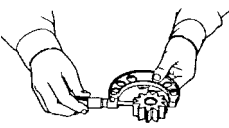
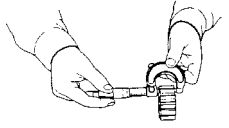
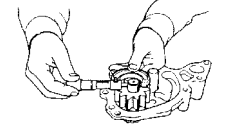
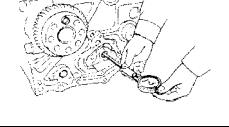
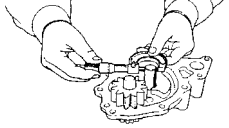


EN05-6

LUBRICATING SYSTEM (J08E)

INSPECTION AND REPAIR

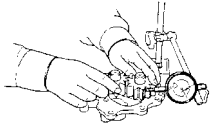
EN0110605H300001

Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Gear outside diameter		54 {2.126}	—	—	Measure 
Block side pump body inside diameter		54 {2.126}	—	—	
Tip clearance		0.093-0.252 {0.0037-0.0099}	0.30 {0.0118}	Replace oil pump.	
Gear width		43 {1.693}	—	—	Measure 
Block side pump body inside depth		43 {1.693}	—	—	
End play	With gasket	0.047-0.150 {0.0019-0.0059}	0.15 {0.0059}	Replace oil pump.	
	Without gasket	-0.013-0.050 {-0.0005-0.0020}	—	—	
Drive gear	Shaft outside diameter	18 {0.709}	—	—	Measure  
	Block side bushing inside diameter	18 {0.709}	—	—	
	Clearance	0.040-0.099 {0.0016-0.0039}	—	Replace oil pump.	
Driven gear	Shaft outside diameter	18 {0.709}	—	—	Measure   
	Block hole diameter	18 {0.709}	—	—	
	Clearance	0.030-0.075 {0.0012-0.0030}	—	Replace oil pump.	
	Gear bushing inside diameter	18 {0.709}	—	—	
	Clearance	0.040-0.083 {0.0016-0.0033}	0.15 {0.0059}	Replace driven gear or oil pump.	

LUBRICATING SYSTEM (J08E)

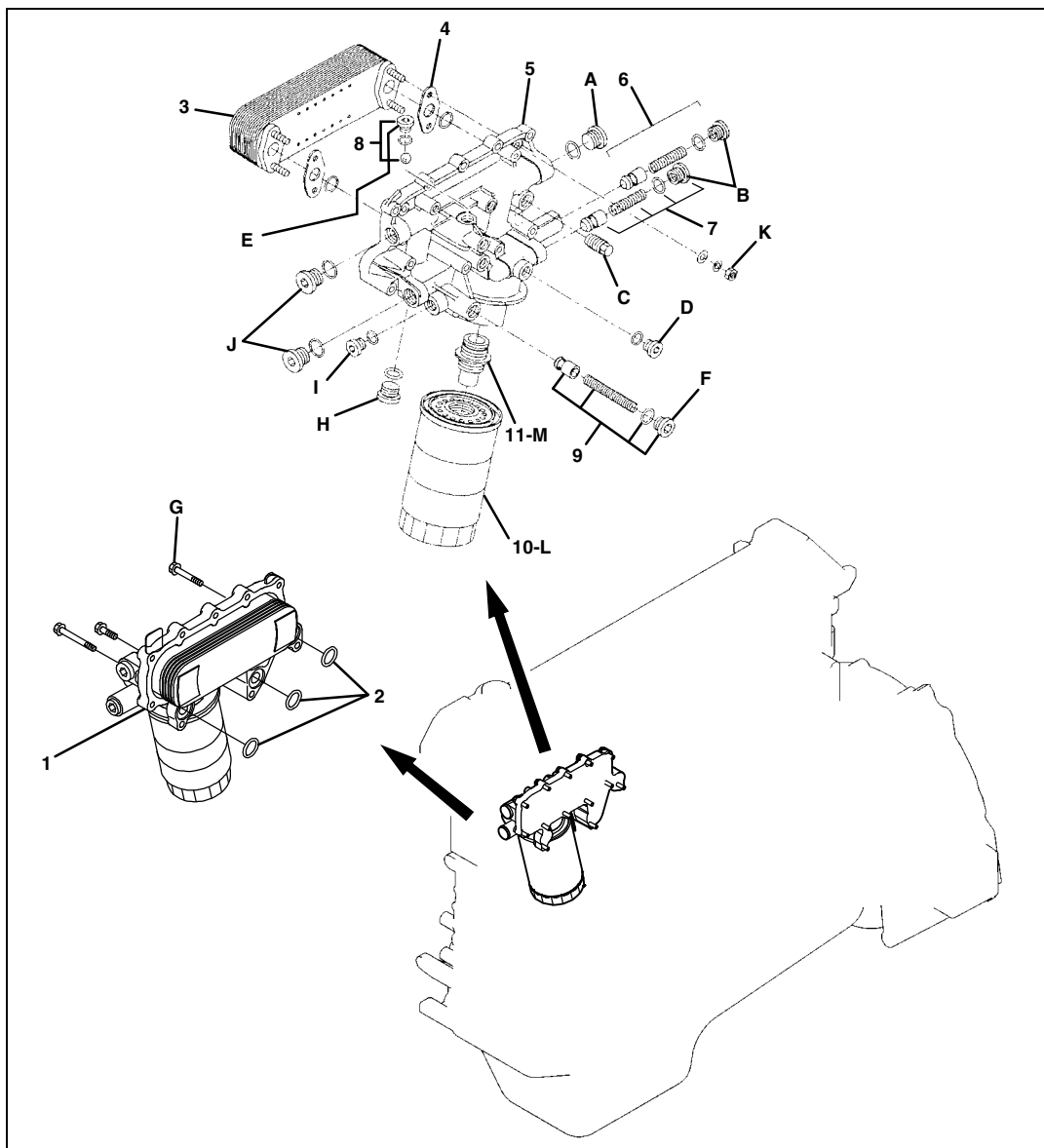
EN05-7

Inspection item	Standard	Limit	Remedy	Inspection procedure
Gear backlash	0.073-0.207 {0.0029-0.0082}	0.30 {0.0118}	Replace pump.	Measure 

OIL FILTER AND OIL COOLER

COMPONENT LOCATOR

EN0110605D100002



SHTS011060500009

LUBRICATING SYSTEM (J08E)

EN05-9

1 Oil cooler with filter assembly	7 Oil filter safety valve
2 O-ring	8 Check valve
3 Oil cooler element	9 Oil cooler safety valve
4 Gasket	10 Oil filter element
5 Oil cooler case	11 Insert
6 Regulator valve	

Tightening torque

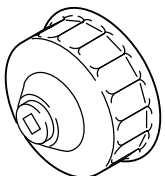
Unit: N·m {kgf·cm, lbf·ft}

A 29.4-39.2 {300-400, 22-28}	H 29.4-39.2 {300-400, 22-28}
B 24.5-34.3 {250-350, 19-25}	I 19.6-29.4 {200-300, 15-21}
C 39.2-49 {400-500, 29-36}	J 29.4-39.2 {300-400, 22-28}
D 19.6-29.4 {200-300, 15-21}	K 19.6-29.4 {200-300, 15-21}
E 19.6-29.4 {200-300, 15-21}	L 39.2-49 {400-500, 29-36}
F 24.5-34.3 {250-350, 19-25}	M 98-117 {1,000-1,190, 72-86}
G 28.4 {290, 21}	

SPECIAL TOOL

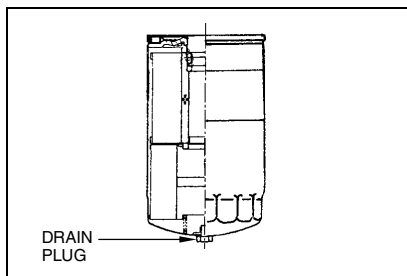
EN0110605K100001

Prior to starting an engine overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0950-31110	OIL FILTER WRENCH	

DISMOUNTING AND MOUNTING

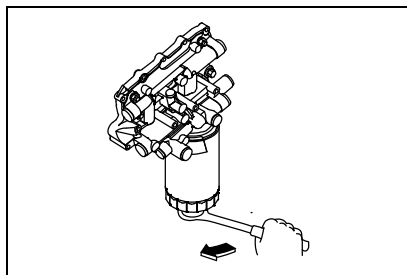
IMPORTANT POINTS - DISMOUNTING



SHTS011060500011

1. REMOVE THE OIL FILTER.

- (1) Remove the drain plug from bottom of the oil filter and drain the engine oil.



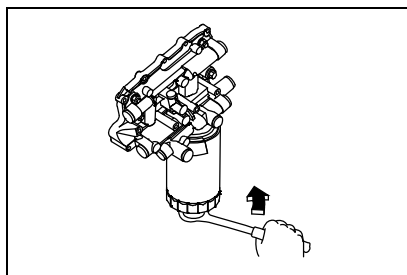
SHTS011060500012

- (2) Using the special tool, remove the oil filter.

SST: Oil filter wrench (S0950-31110)

NOTICE

Make sure that O-rings are not on the oil cooler case side.



SHTS011060500013

IMPORTANT POINT - MOUNTING

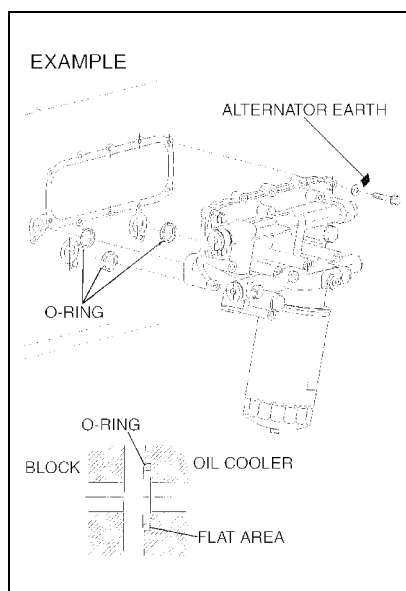
1. INSTALL THE OIL FILTER.

- (1) Remove the dust on installation surface of oil cooler case side.
- (2) Apply the engine oil to the O-ring on new oil filter.
- (3) Install the oil filter by turning it lightly to the right by hand until it comes in contact with the surface of the oil cooler. Then using the special tool, tighten the oil filter about 270°-360° (3/4-1 turn).

SST: Oil filter wrench (S0950-31110)

NOTICE

- Do not reuse the O-ring.
- Attention to damage of O-ring to damage.



2. INSTALL THE OIL COOLER AND OIL FILTER ASSEMBLY.

- (1) Insert the O-ring into the O-ring groove of the oil cooler.

NOTICE

Face the flat area of the O-ring toward the oil cooler for installation.

- (2) Apply liquid gasket to the oil cooler case and install it onto the cylinder block, then tighten the bolt to the specified torque.

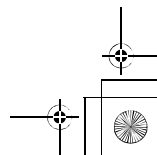
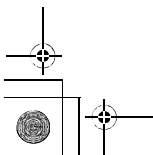
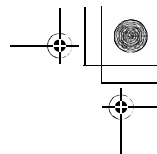
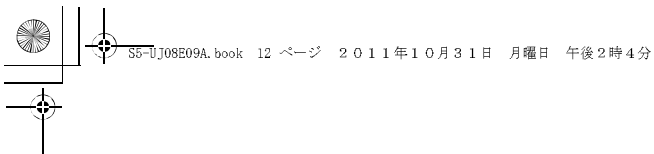
Tightening Torque:

28.4 N·m {290 kgf·cm, 21 lbf·ft}

INSPECTION AND REPAIR

EN0110605H300002

Inspection item	Standard	Limit	Remedy	Inspection procedure
Oil cooler air leakage Air pressure: 588 kPa {6 kgf/cm ² , 85 lbf/in. ² }	0 mL	—	Replace, if necessary.	Visual check
Wear or damage to valve spring of oil cooler and oil filter	—	—	Replace, if necessary.	1. Damage to sliding face of valve 2. Valve movement (smoothness)



COOLING SYSTEM (J08E)

EN06-001

COOLING SYSTEM EN06-2

DIAGRAM EN06-2

COOLANT PUMP..... EN06-3

COMPONENT LOCATOR..... EN06-3

THERMOSTAT EN06-4

COMPONENT LOCATOR..... EN06-4

OVERHAUL EN06-5

RADIATOR AND INTERCOOLER EN06-7

COMPONENT LOCATOR..... EN06-7

OVERHAUL EN06-7

RADIATOR EN06-9

COMPONENT LOCATOR..... EN06-9

SPECIAL TOOL EN06-10

OVERHAUL EN06-10

INSPECTION AND REPAIR EN06-14

COOLING FAN..... EN06-15

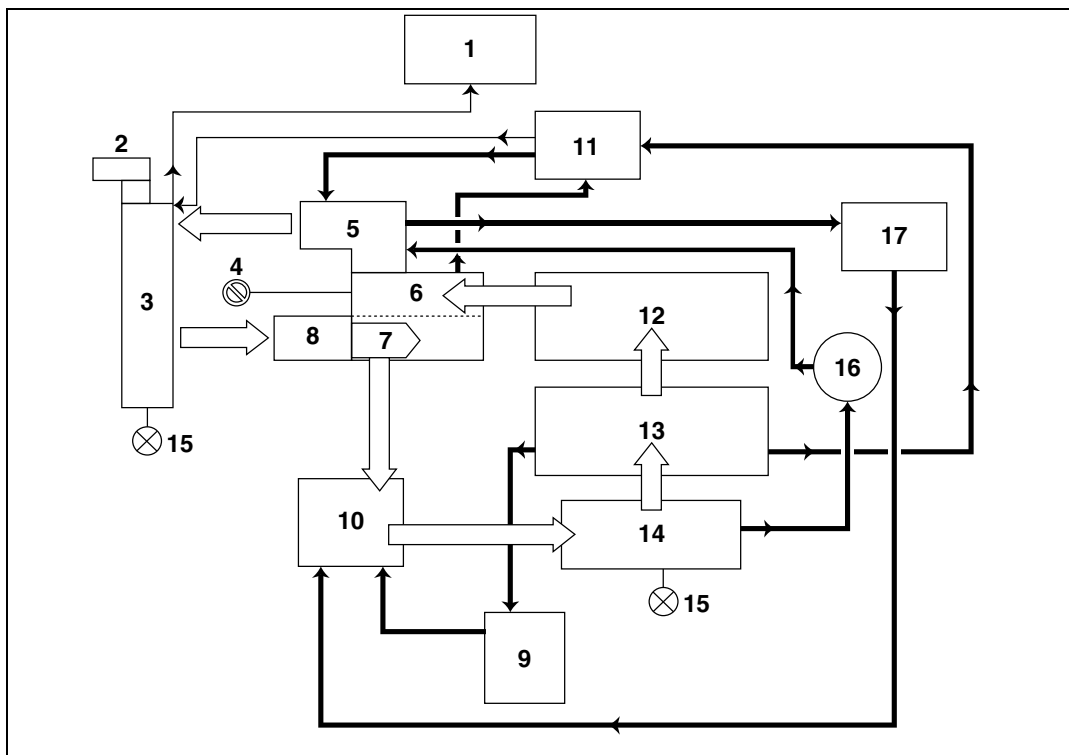
COMPONENT LOCATOR..... EN06-15

INSPECTION AND REPAIR EN06-16

COOLING SYSTEM

DIAGRAM

EN0110606J100001



SHTS011060600001

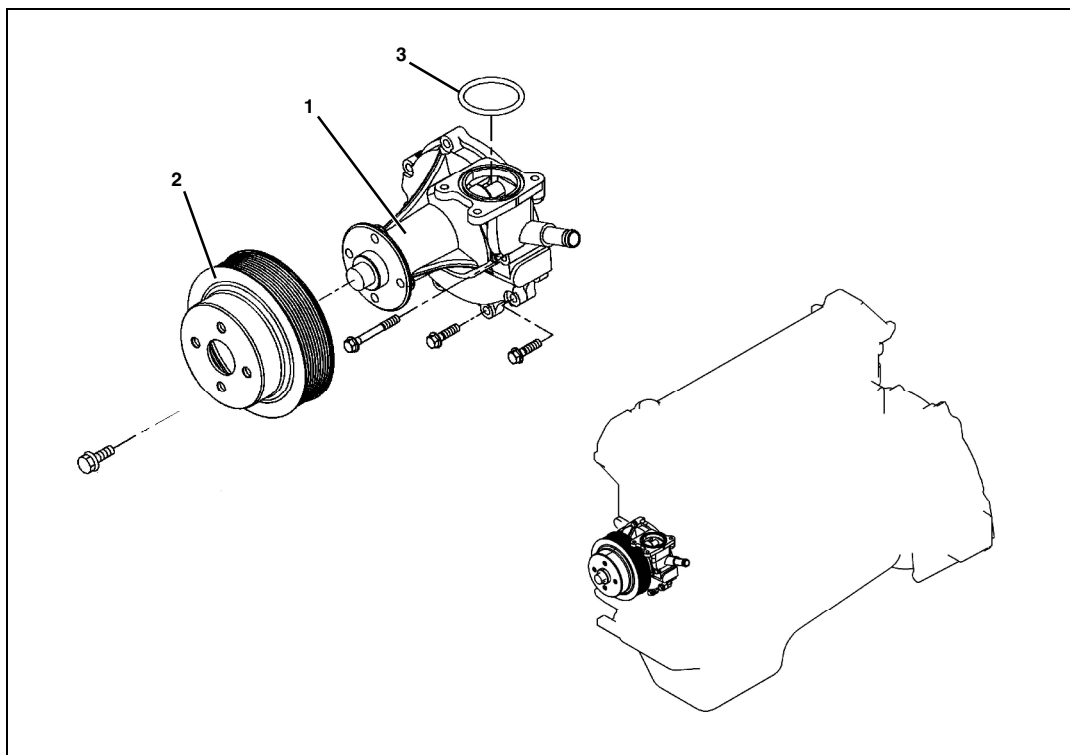
- 1 Reservoir tank
- 2 Radiator cap
- 3 Radiator
- 4 Coolant temperature gauge
- 5 Thermostat case cover (Outlet)
- 6 Thermostat case
- 7 Thermostat
- 8 Thermostat case cover (Inlet)
- 9 Air compressor

- 10 Coolant pump
- 11 EGR cooler
- 12 Cylinder head
- 13 Cylinder block
- 14 Oil cooler
- 15 Drain plug
- 16 Turbocharger
- 17 Car heater

COOLANT PUMP

COMPONENT LOCATOR

EN0110606D100001



SHTS011060600002

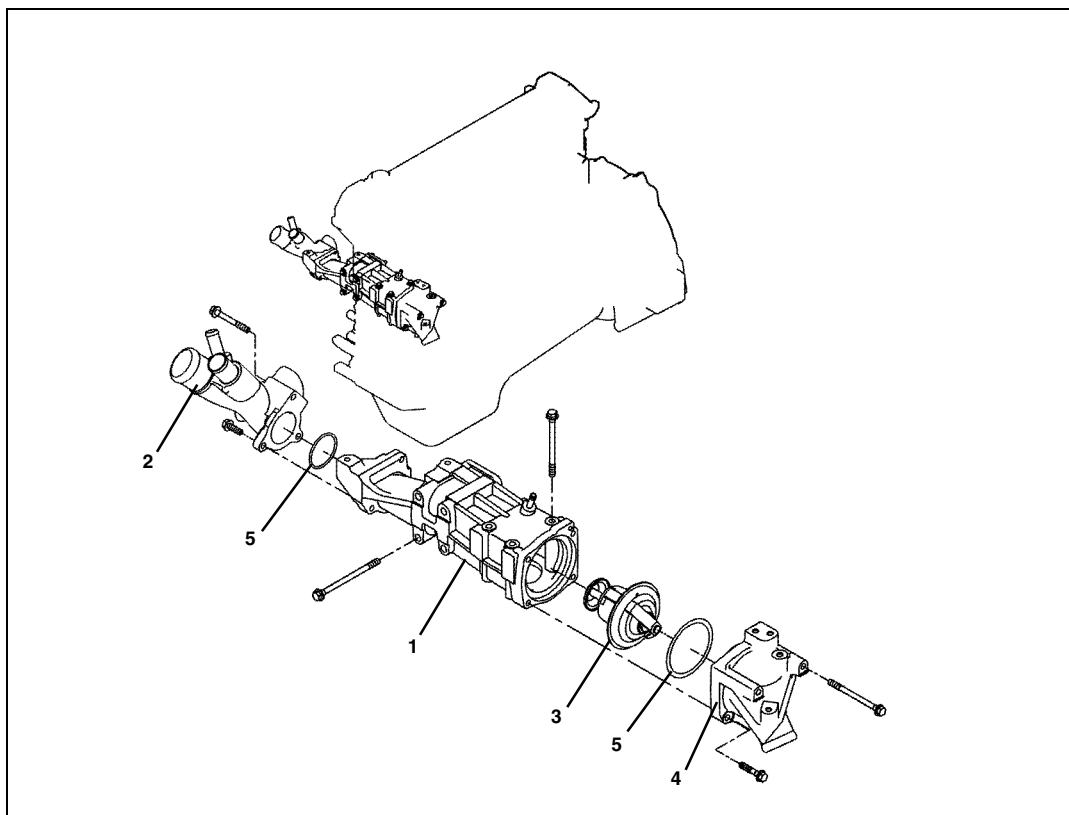
- | | |
|---|-----------------------|
| 1 | Coolant pump assembly |
| 2 | Pulley |

- | | |
|---|--------|
| 3 | O-ring |
|---|--------|

THERMOSTAT

COMPONENT LOCATOR

EN0110606D100002

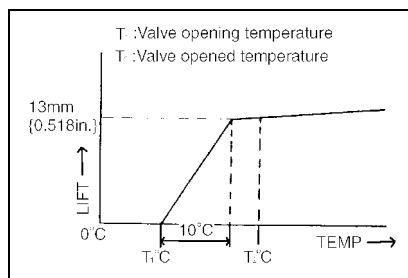


SHTS011060600003

1	Thermostat case	4	Water inlet
2	Water outlet	5	O-ring
3	Thermostat		

OVERHAUL

EN0110606H200001



SHTS011060600004

IMPORTANT POINTS - INSPECTION AND REPAIR

1. INSPECT THE THERMOSTAT FUNCTION.

- (1) Place the thermostat in hot water and check the valve opening temperature and the valve lift.

Thermostat valve opening temperature:

Thermostat valve opening temperature. (T ₁)	Service standard
82°C {180°F}	80-84°C {176-183°F}

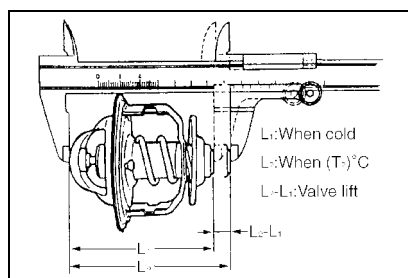
NOTICE

Check that the thermostat valve opening temperature (T₁) is engraved on the thermostat seat.

Thermostat valve lift:

Thermostat valve opening temp. (T ₁)	Measuring temp. (T ₂)	Valve lift (L ₂ -L ₁)
82°C {180°F}	95°C {203°F}	13 mm {0.512 in.} or more

- (2) Immerse the opened thermostat in water at normal temperature. If it completely closes within 5 minutes, it is satisfactory. If it remains slightly open, it is defective and must be replaced.



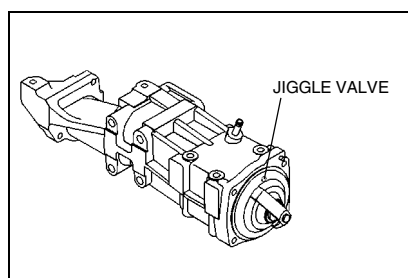
SHTS011060600005

IMPORTANT POINTS - ASSEMBLY

1. ASSEMBLE THE THERMOSTAT CASE.

NOTICE

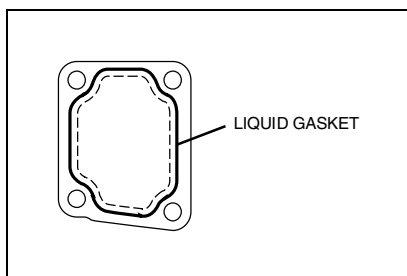
- Remove water or dirt adhering to the thermostat case.
- Be sure to replace the gasket if it is corroded, damaged or flattened.
- Before installing the hose, apply liquid gasket to the hose installation part of the thermostat case cover.
- To prevent clogging of the radiator, do not use a large amount of liquid gasket.
- Be sure that the jiggle valve faces upward when installing it.



SHTS011060600006

EN06-6

COOLING SYSTEM (J08E)

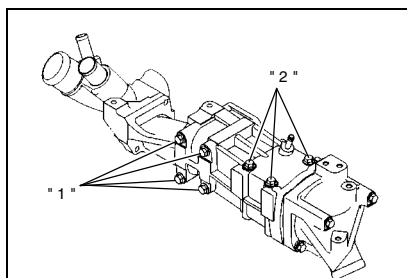


SHTS011060600007

IMPORTANT POINTS - MOUNTING

1. INSTALL THE THERMOSTAT CASE ASSEMBLY.

- (1) Apply liquid gasket to the thermostat case.
- (2) Install the o-ring into the groove of the coolant pump.



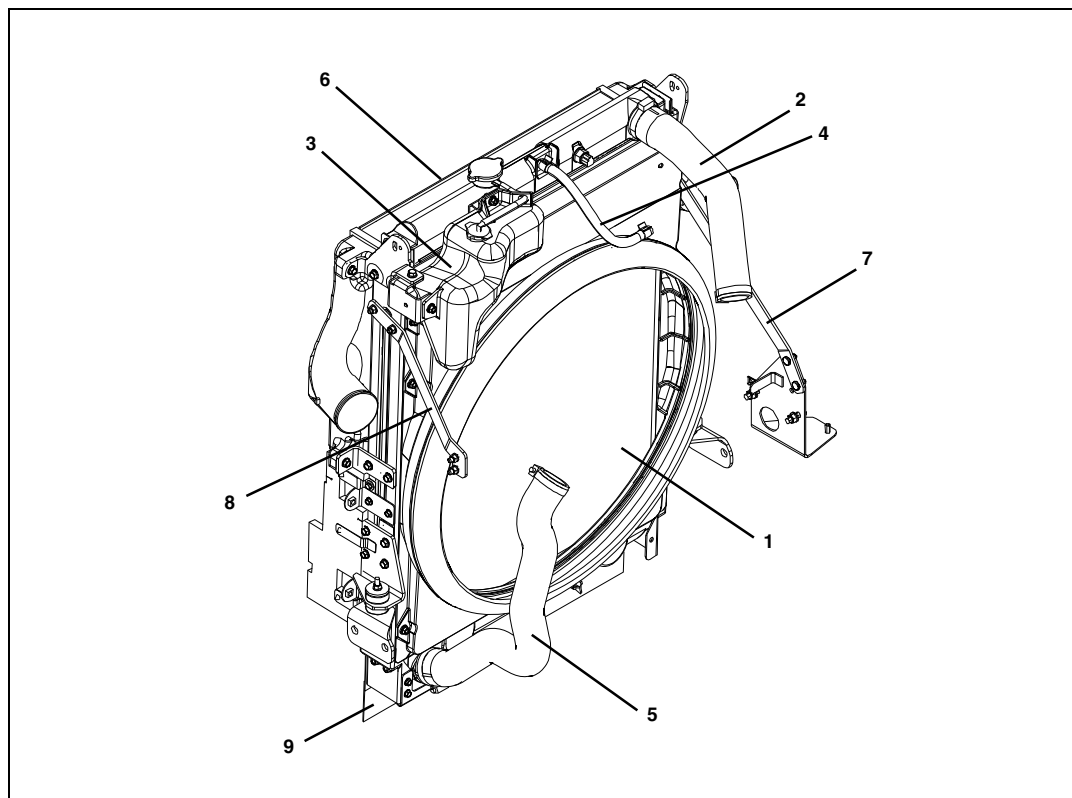
SHTS011060600008

- (3) Temporarily tighten the bolts "1" and bolts "2" in that order, and securely contact the fitting surface.
- (4) Tighten the bolts in numeral order.

RADIATOR AND INTERCOOLER

COMPONENT LOCATOR

EN0110606D100003



SHTS011060600009

1 Radiator	6 Inter cooler
2 Inlet hose	7 Radiator stay, RH
3 Reservoir tank	8 Radiator stay, LH
4 Hose	9 Baffle plate
5 Outlet hose	

OVERHAUL

EN0110606H200002

IMPORTANT POINTS - DISMOUNTING

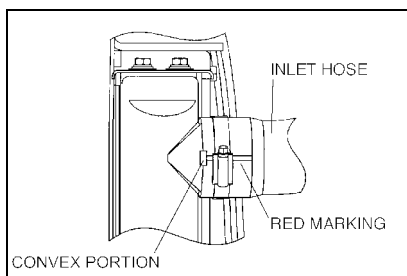
1. DISMOUNT THE RADIATOR.

⚠ WARNING

Do not drain the coolant while the engine and radiator are still hot to avoid burns and scalds.

NOTICE

When dismantling and mounting the radiator, do not damage the radiator core.



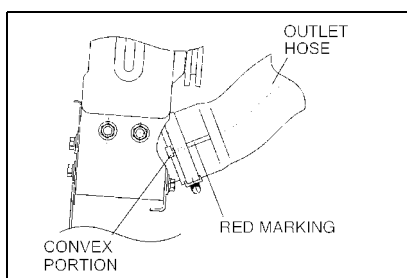
SHTS011060600010

IMPORTANT POINTS - MOUNTING

1. INSTALL THE RADIATOR INLET HOSE.

NOTICE

- Install the radiator hose against the convex portion of the radiator.
- Match the red mark of the radiator hose and match mark (convex portion) of the radiator.



SHTS011060600011

2. INSTALL THE RADIATOR OUTLET HOSE.

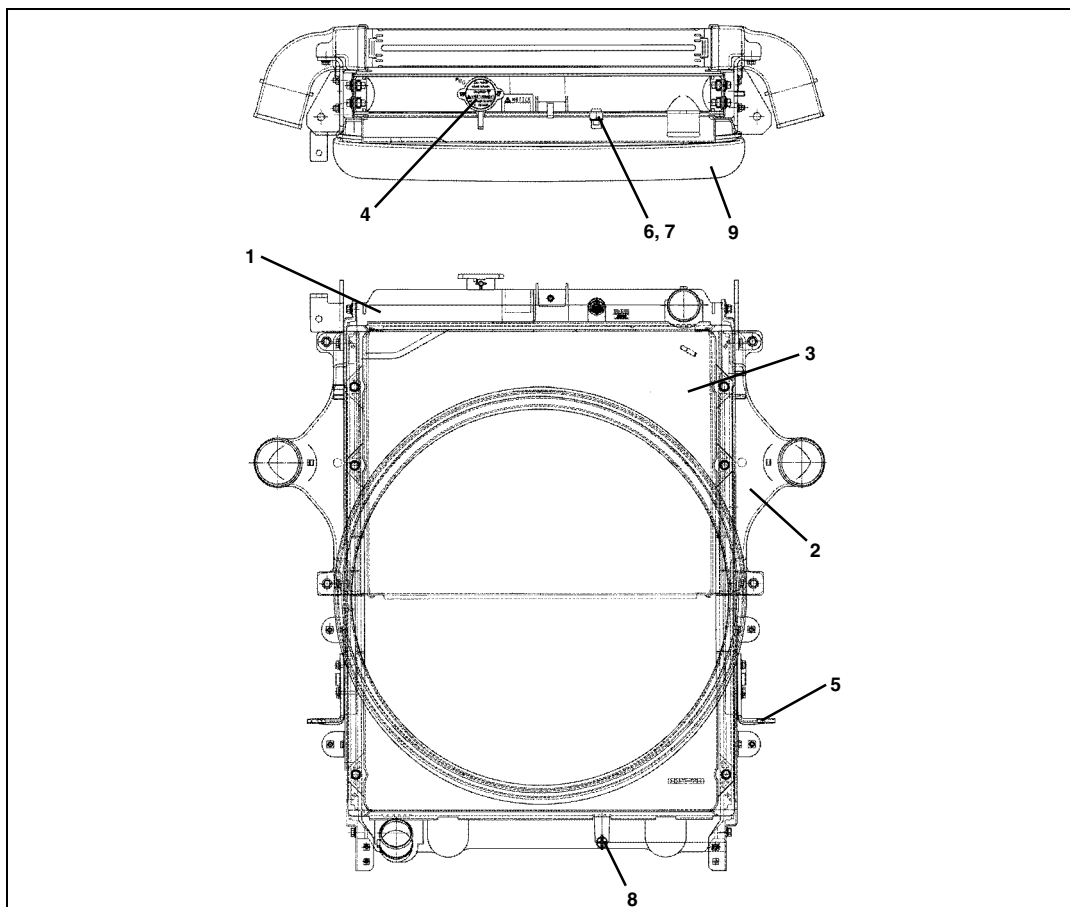
NOTICE

- Install the radiator hose against the convex portion of the radiator.
- Match the red mark of the radiator hose and match mark (convex portion) of the radiator.

RADIATOR

COMPONENT LOCATOR

EN0110606D100004



SHTS011060600012

1 Radiator assy	6 Sensor
2 Intercooler assy	7 Packing
3 Fan shroud	8 Drain plug
4 Radiator cap	9 Seal
5 Bracket	

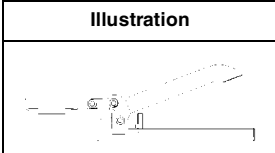
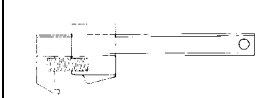
EN06-10

COOLING SYSTEM (J08E)

SPECIAL TOOL

EN0110606K100001

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0976-01030	RADIATOR TOOL	TOOL FOR UNCAULKING
	S0976-01040	RADIATOR TOOL	TOOL FOR CAULKING (USED WITH S0976-01030)

OVERHAUL

EN0110606H200003

IMPORTANT POINTS - DISMOUNTING

1. DISMOUNT THE RADIATOR.

⚠ WARNING

Do not drain the coolant while the engine and radiator are still hot to avoid burns and scalds.

NOTICE

When dismantling and mounting the radiator, do not damage the radiator core.

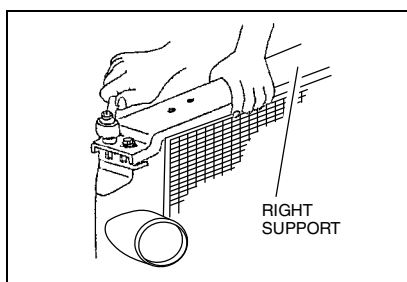
IMPORTANT POINTS - DISASSEMBLY

NOTICE

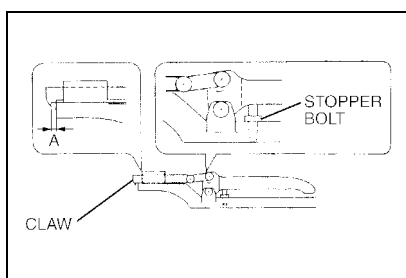
Recaulking should be limited to twice.

1. DISASSEMBLE THE UPPER TANK, LOWER TANK AND RADIATOR CORE.

- (1) Remove the left support and right support.



SHTS011060600015



SHTS011060600016

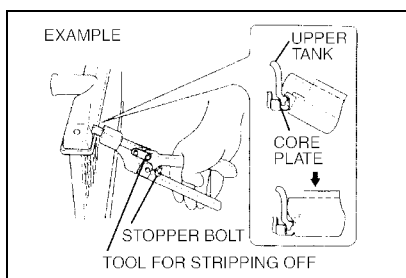
- (2) Grip the handle until it hits to the stopper bolt, then adjust the dimensions A with stopper bolt.

Dimension A: 0.2-0.3 mm (0.0079-0.0118 in.)

SST: Radiator tool (S0976-01030)

NOTICE

Be sure to adjust the dimension to prevent damage of the claw.

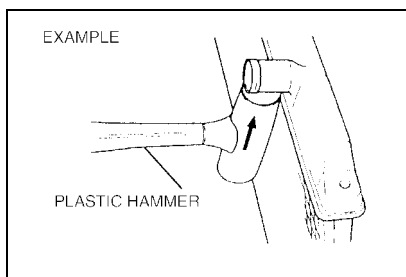


SHTS011060600017

- (3) Using a special tool, lift the staked part.

NOTICE

Do not lift up tanks more than 90°.

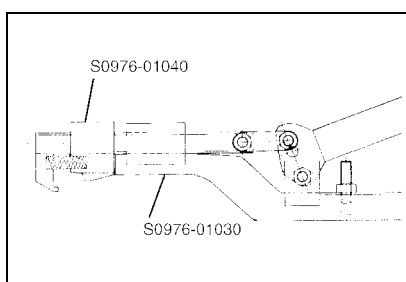


SHTS011060600018

- (4) Remove the upper tank and lower tank from the radiator core by tapping lightly with plastic hammer.

NOTICE

Do not remove the tank by forcing or prying.



SHTS011060600019

IMPORTANT POINTS - ASSEMBLY

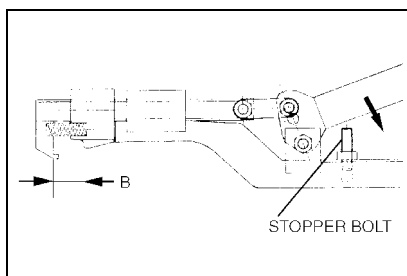
1. **ASSEMBLE THE UPPER TANK, LOWER TANK AND RADIATOR CORE.**

- (1) Exchange the crow of the radiator tool (S0976-01030) for the radiator tool (S0976-01040) as shown in the figure.

SST:

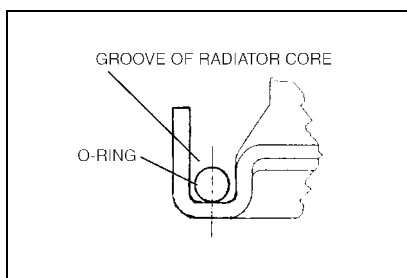
Radiator tool (S0976-01030)

Radiator tool (S0976-01040)



SHTS011060600020

- (2) Grip the handle of the radiator tool until it hits the stopper bolt, then adjust the dimension B with stopper bolt.
Dimension B: 9.5mm {0.374 in.}



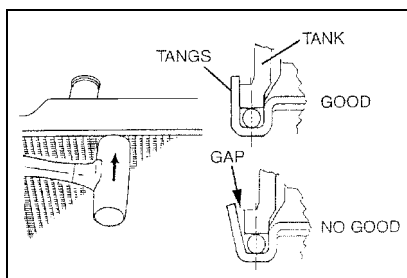
SHTS011060600021

- (3) Install the new O-ring into the groove of the radiator core (upper and lower) in such away that it will not be twisted.

NOTICE

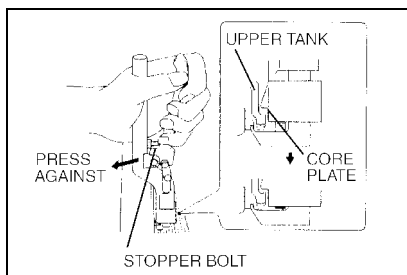
Be sure to clean the fitting portion before installing. When cleaning, lightly rub the inside portion of the groove with the emery paper.

- (4) Install the upper tank and lower tank into the groove of the radiator core.



SHTS011060600022

- (5) Tap the tangs to obtain a tight contact with the upper tank and lower tank.

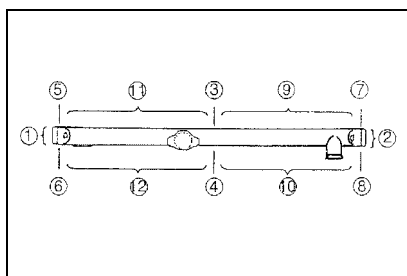


SHTS011060600023

- (6) Press the radiator tool (caulking tool) against the side portion. Temporarily caulk the tangs several times, then proceed to the final caulking by gripping the handle until it hits the stopper bolt.

NOTICE

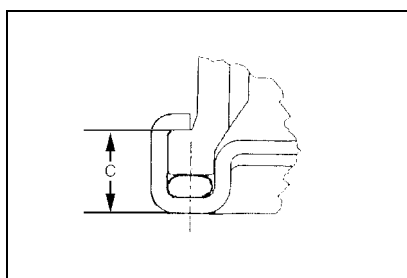
For the positions where the radiator tool is not usable, perform the caulking with pliers.



SHTS011060600024

NOTICE

Perform the caulking according to the sequence as shown in the figure.



SHTS011060600025

- (7) Check the dimension C.

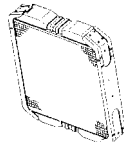
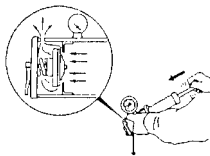
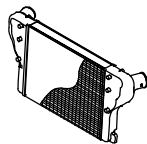
Assembly standard: 8.2-8.8 mm {0.323-0.346 in.}

If the dimension is out of the standard value, adjust the stopper bolt of the handle once again and perform the caulking again.

INSPECTION AND REPAIR

EN0110606H300001

Unit: MPa {kgf/cm², lbf/in.²}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Air leakage (When the air pressure of 100 {1,14} is applied.)		—	—	Replace radiator.	Visual check 
Clogging of the fins		—	—	Clean.	
Radiator cap valve opening pressure	Mark 0.5	40-58 {0.4-0.6, 5.7-8.5}	—	Replace.	Measure 
Intercooler					
• Air leakage test (when the air pressure of 490 {5.0, 71} is applied.)		0 mL	—	Replace the inter-cooler.	
• Clogging of the fins		—	—		

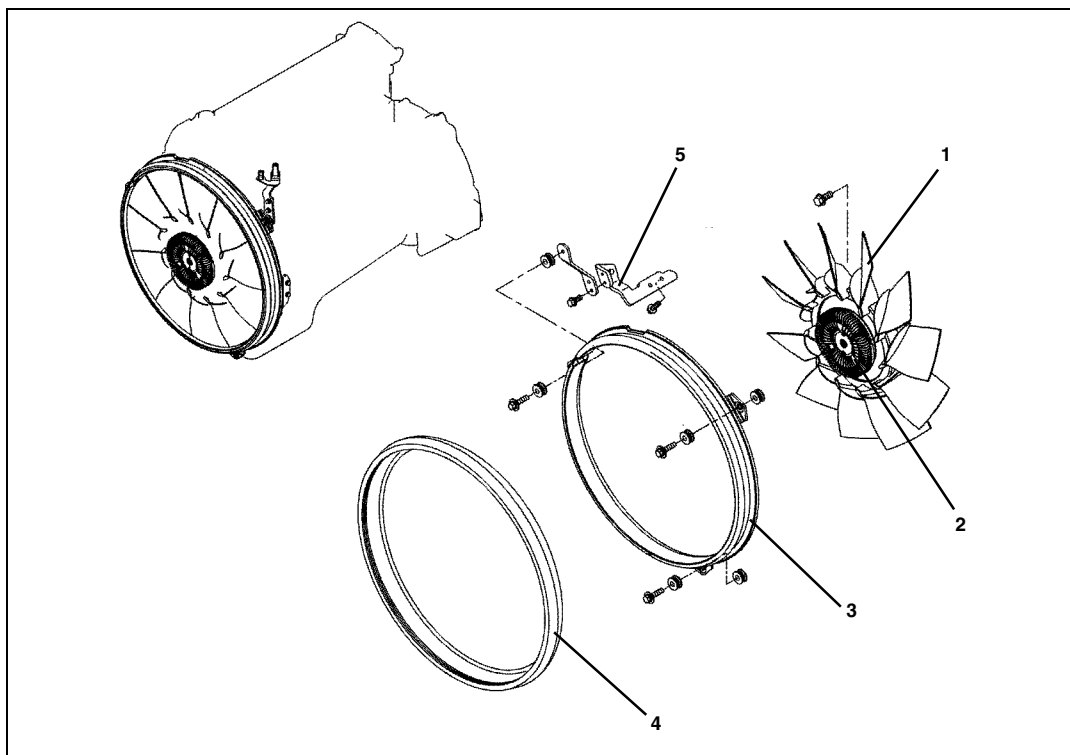
NOTICE

- The coolant filler cap valve opening pressure is indicated on the cap and it should be confirmed. If the cap pressure is incorrect, there is a risk of abnormally high pressure being generated in the cooling system, which may cause the hose to drop off or burst and may result in the damage of the engine.
- When carrying out high pressure washing to remove fin clogging, do not apply excessive pressure to the fins which may cause deformation and consequent performance deterioration.

COOLING FAN

COMPONENT LOCATOR

EN0110606D100005



SHTS011060600029

1	Cooling fan	4	Seal
2	Fan clutch	5	Bracket
3	Fan shroud		

NOTICE

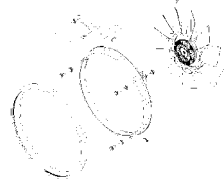
- **Shock to the fan clutch and fan.**
During maintenance and inspection, be careful not to drop or strike the fan clutch or fan itself. The resulting damage may lower the performance of the fan. Also, note that the fan is made of plastic and may become damaged or deformed if force is applied to it.
- **Replace the fan.**
Do not replace the fan unless it is faulty. When replacing the fan, replace with the same type. If the fan is replaced with one of a larger capacity because of overheating or, conversely is replaced with one of a smaller capacity due to overcooling, the performance may in fact be reduced and durability may be jeopardized.
- **Other items**
Check the bimetal to see if there is any mud or dust on it. If the bimetal is covered with mud or dust, the fan performance will be erratic, and may result in overheating or overcooling. In such case, carefully remove mud and dust adhering to the surface of the bimetal, using a wire brush, or the like.
Take particular care not to apply excessive force.
Do not paint the fan or fan clutch. Do not place any paint or other reagents which are likely to dissolve plastic in contact with the fan.

EN06-16

COOLING SYSTEM (J08E)

INSPECTION AND REPAIR

EN0110606H300002

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cooling fan and fan clutch deformation and damage	—	—	Replace if necessary.	Visual check 

FUEL SYSTEM (J08E)

EN07-001

FUEL SYSTEM.....EN07-2

DIAGRAM EN07-2

COMPONENT LOCATOR..... EN07-3

SUPPLY PUMPEN07-4

DESCRIPTION EN07-4

COMPONENT LOCATOR..... EN07-5

SPECIAL TOOL EN07-5

OVERHAUL EN07-6

COMMON RAIL.....EN07-14

DESCRIPTION EN07-14

REPLACEMENT EN07-16

INJECTOR.....EN07-20

DESCRIPTION EN07-20

REPLACEMENT EN07-21

FUEL FILTEREN07-29

DESCRIPTION EN07-29

AIR BLEEDING..... EN07-31

BUBBLE SEPARATOR.....EN07-33

DESCRIPTION EN07-33

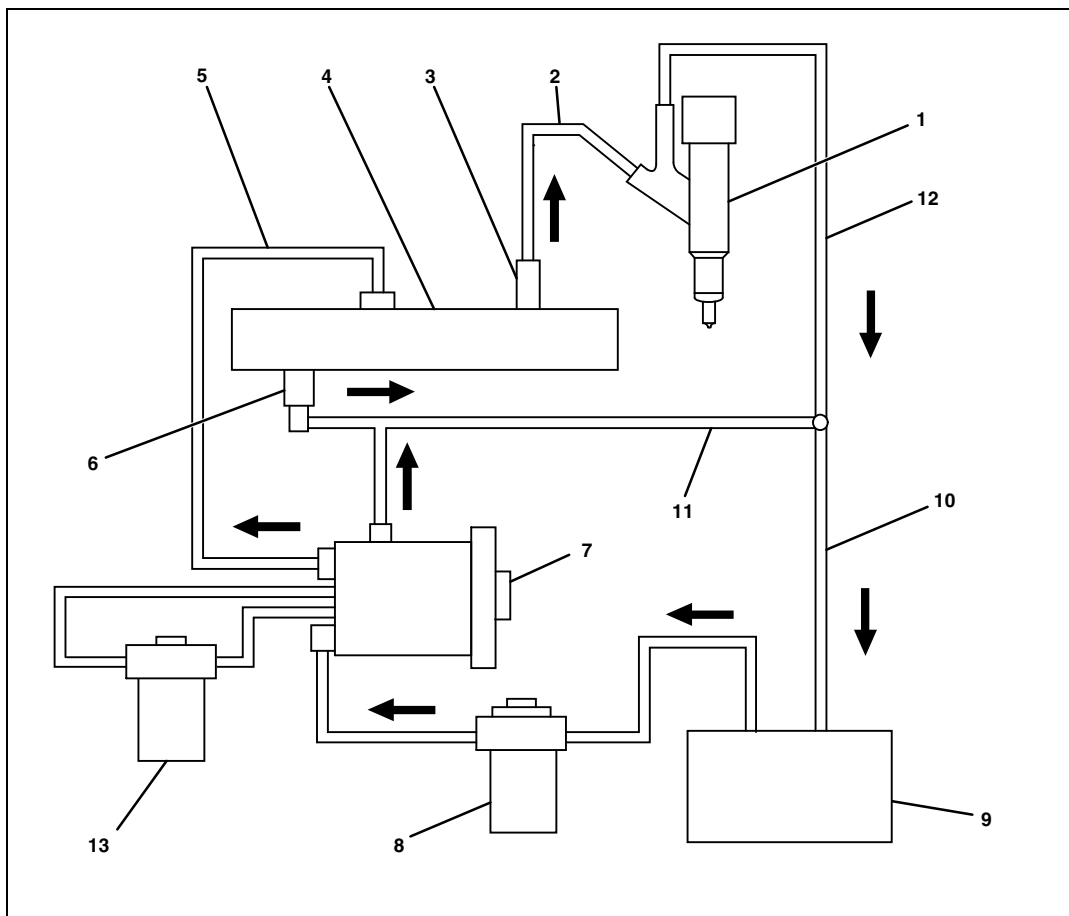
FUEL TANK.....EN07-34

COMPONENT LOCATOR..... EN07-34

FUEL SYSTEM

DIAGRAM

EN0110607J100001

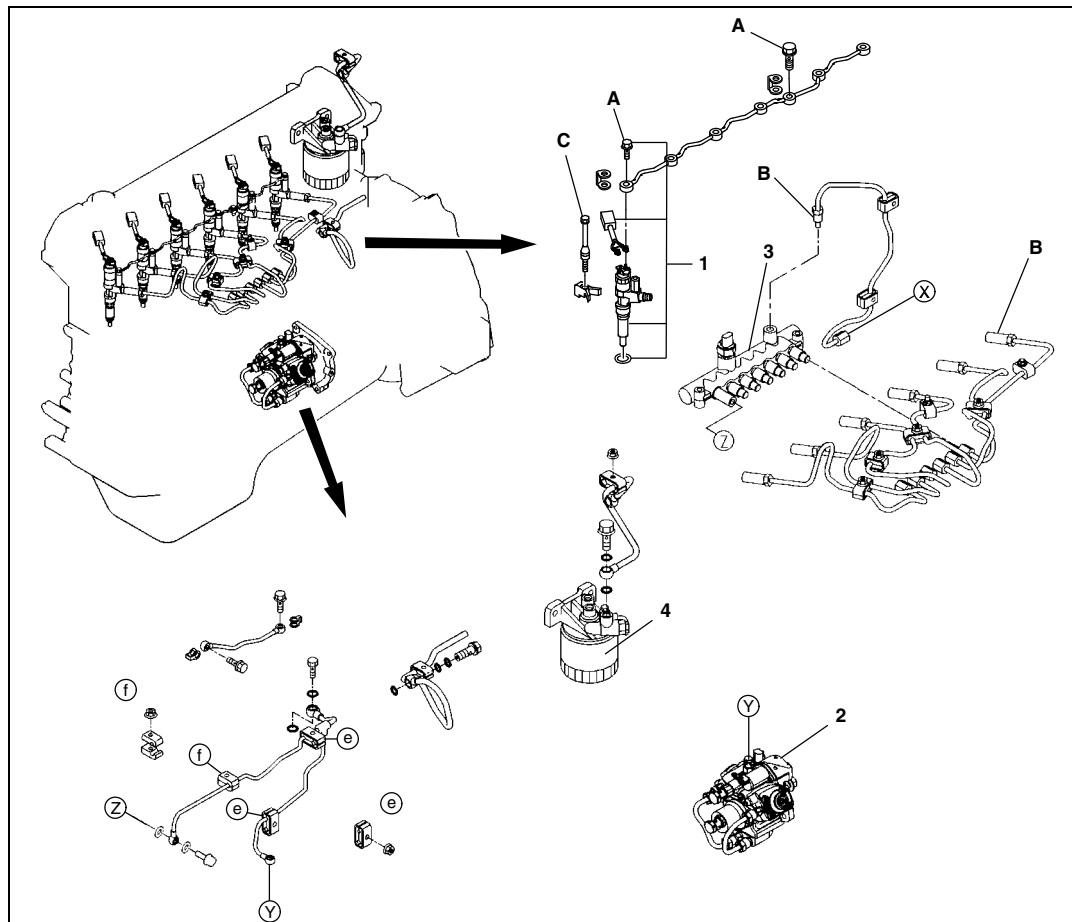


SAPH011060700001

1	Injector	8	Fuel filter
2	Injection pipe	9	Fuel tank
3	Flow damper	10	Through feed pipe
4	Common rail	11	Overflow pipe
5	Pressure feed pipe	12	Leakage pipe
6	Pressure limiter	13	Bubble separator
7	Supply pump		

COMPONENT LOCATOR

EN0110607C100001



SAPH011060700002

1	Injector	3	Common rail
2	Supply pump	4	Bubble separator

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	12.3 {126, 9}	C	25 {250, 18}
B	44 {450, 32.5}		

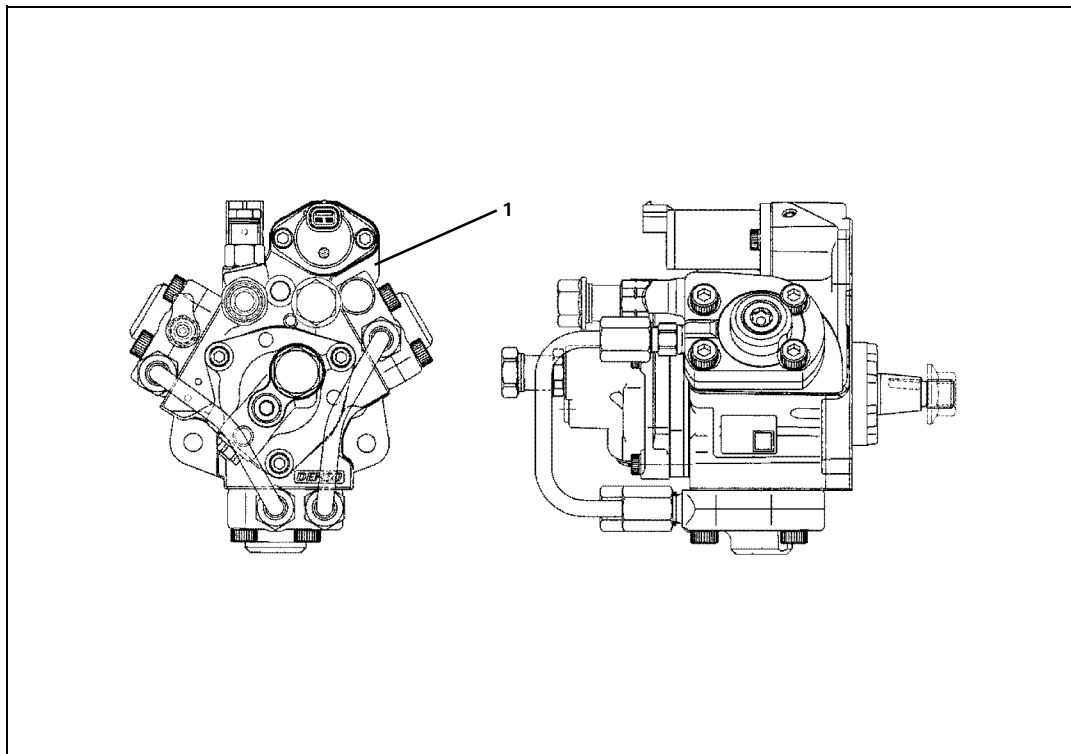
EN07-4

FUEL SYSTEM (J08E)

SUPPLY PUMP

DESCRIPTION

EN0110607J100002

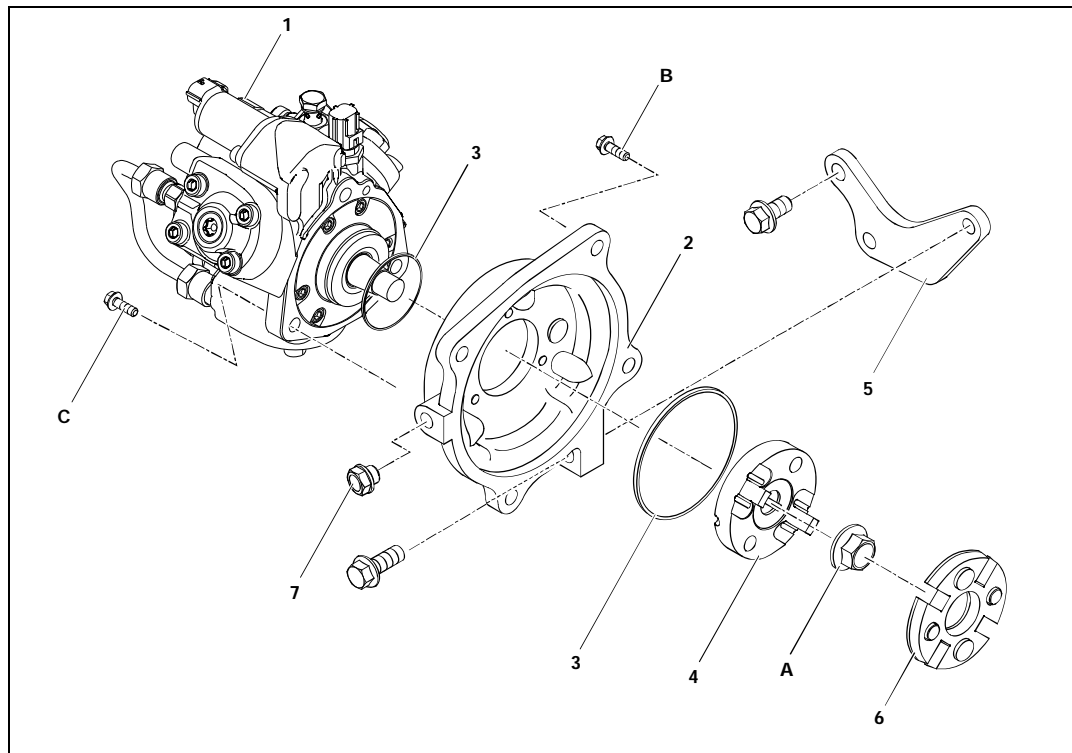


SAPH011060700003

1	Supply pump assembly
---	----------------------

COMPONENT LOCATOR

EN0110607C100002



SAPH011060700004

1 Supply pump assembly	5 Bracket
2 Bearing holder case	6 Coupling assembly
3 O-ring	7 Plug
4 Coupling flange	

Tightening torque

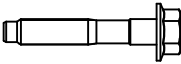
Unit: N·m {kgf·cm, lbf·ft}

A 63.7 {650, 47}	C 28.5 {290, 21}
B 28.5 {290, 21}	

SPECIAL TOOL

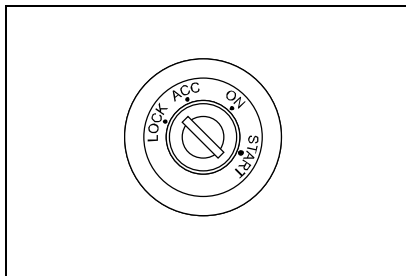
EN0110607K100001

Prior to starting an engine overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	SZ105-08067	GUIDE BOLT	

OVERHAUL

EN0110607H200001



SAPH011060700006

IMPORTANT POINTS - DISMOUNTING

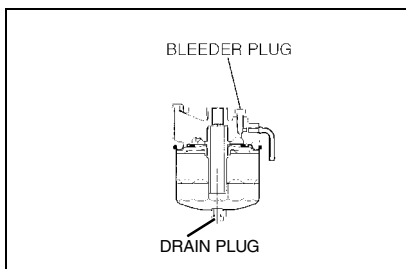
NOTICE

While working, be careful not to make dirt and water enter parts.

1. TURN THE STARTER SWITCH TO THE LOCK POSITION.

⚠ WARNING

Perform the following work after the engine cools off to avoid fire or burning. The fuel in the common rail could have a high temperature (approx. 100°C {212°F}) immediately after driving.



SAPH011060700007

2. FUEL DISCHARGE

- (1) Prepare reservoir under the drain pipe to receive the drained fuel.
- (2) Remove the drain plug of the bubble separator.
- (3) Loosen the bleeder plug of the bubble separator.
- (4) Drain until no more fuel comes out.
- (5) Tighten the drain plug and the bleeder plug of the bubble separator.

Tightening Torque:

Drain plug: 5.9-7.9 N·m {60.2-80.5 kgf·cm, 4.4-5.8 lbf·ft}

Bleeder plug: 5-8.8 N·m {51-89.7 kgf·cm, 3.7-6.5 lbf·ft}

NOTICE

Drain the fuel in accordance with the regulation of disposal specified in each region.

3. REMOVING THE FUEL FILTER

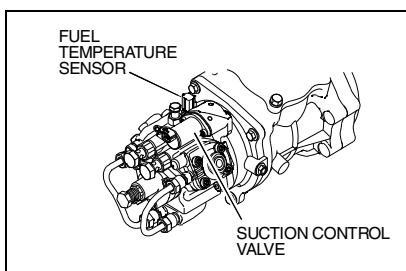
- (1) Remove the fuel filter and the fuel pipe.
Refer to the chapter "AIR INTAKE SYSTEM"

4. REMOVING THE INTAKE PIPE

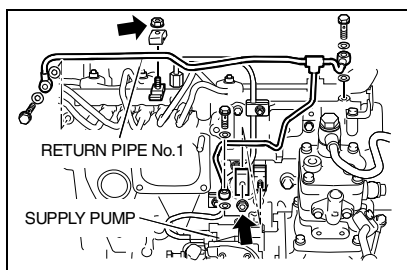
- (1) Remove the intake pipe.
Refer to the chapter "AIR INTAKE SYSTEM"

5. DISCONNECTING THE HARNESS

- (1) Disconnect the connector connected to each of the suction control valve of the supply pump and the fuel temperature sensor.



SAPH011060700008



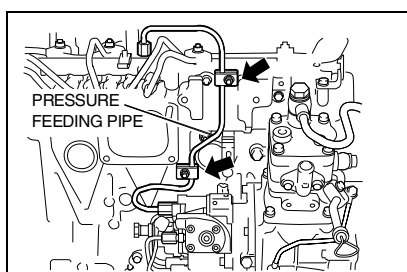
SAPH011060700009

6. REMOVING THE FUEL PIPE

- (1) Unfasten the nuts (2 pcs.) to remove the clips (2 pcs.).
- (2) Unfasten the union bolts (3 pcs.) securing return pipe No.1 to the pressure limiter, the inlet manifold, and the supply pump, and disconnect the return pipe No.1.

HINT

Prepare a reservoir and a waste cloth because fuel spills when disconnecting the fuel pipe.



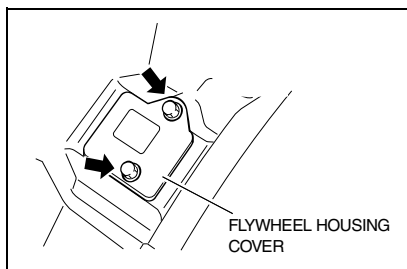
SAPH011060700010

7. REMOVING THE PRESSURE FEEDING PIPE

- (1) Unfasten the nuts (2 pcs.) securing the clips, and remove the clips (2 pcs.).
- (2) Loosen the nut, and remove the pressure feeding pipe.

HINT

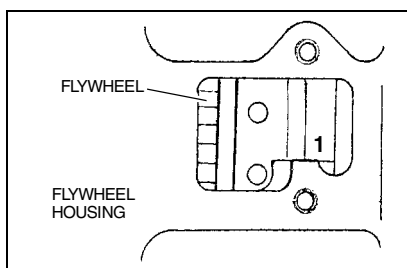
Prepare a reservoir and a waste cloth because fuel spills when removing the pressure feeding pipe.



SAPH011060700011

8. SETTING THE COMPRESSION STROKE TOP DEAD CENTER OF No.1 CYLINDER

- (1) Unfasten the bolts (2 pcs.) securing the flywheel housing cover, and remove the flywheel housing cover from the flywheel housing.

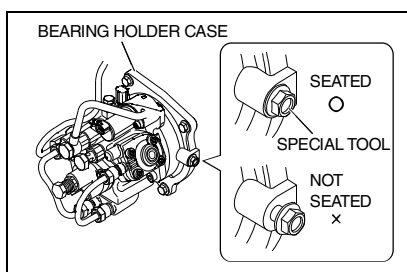


SAPH011060700012

- (2) Turn the flywheel clockwise in the engine direction and align the No.1 cylinder mark to the pointer in the flywheel housing inspection opening.

EN07-8

FUEL SYSTEM (J08E)



SAPH011060700013

(3) Remove the timing check window plug from the bearing holder case of the supply pump.

(4) Mount the special tool specified below to the timing check window of the bearing holder case to see that the bearing surface of the special tool is seated on the supply pump.

SST: Guide bolt (SZ105-08067)

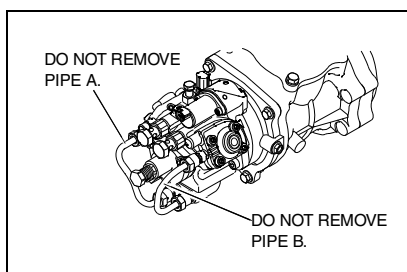
NOTICE

- If the special tool is not seated, it is in contact with a part other than the detent of the coupling flange. Do not forcibly tighten the special tool.
- If the special tool is not seated, the No.1 cylinder is not set at the compression stroke top dead center. In this case, remove the special tool, turn the crankshaft, and install the special tool again to see if it is seated.
- Before turning the crankshaft, do not fail to pull out the special tool.
- Do not perform cranking with the special tool inserted.

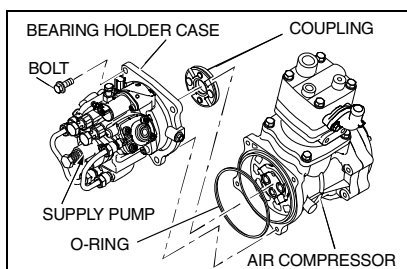
9. REMOVING THE SUPPLY PUMP

NOTICE

- While working, be careful not to make dirt and water enter parts.
- Do not remove pipe A and pipe B.
- Be careful not to apply excessive load on pipe A and pipe B. (Pipe twist will cause fuel leakage.)
- Do not hold pipe A or pipe B when carrying the pump.



SAPH011060700014

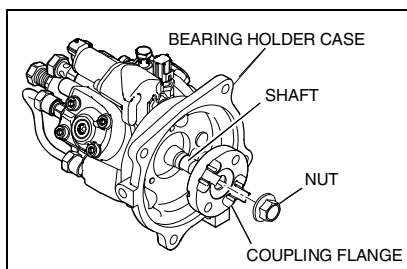


SAPH011060700015

(1) Unfasten the bolts (4 pcs.) securing the supply pump, and remove the supply pump, the coupling, and the O-ring from the air compressor.

NOTICE

Remove the supply pump and the bearing holder case together.

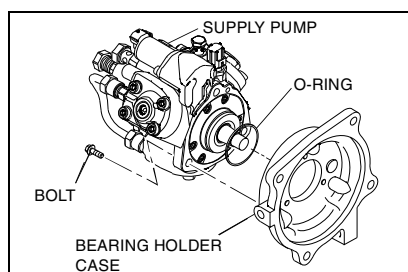


SAPH011060700016

(2) Unfasten the nut with the coupling flange locked with a vise, and remove the coupling flange.

FUEL SYSTEM (J08E)

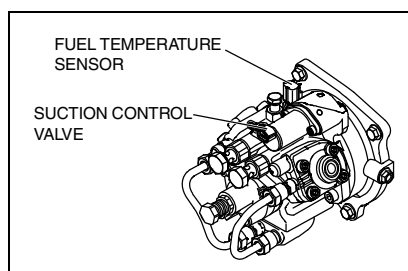
EN07-9



SAPH011060700017

- (3) Unfasten the bolts (3 pcs.) to remove the bearing holder case and the O-ring from the supply pump.

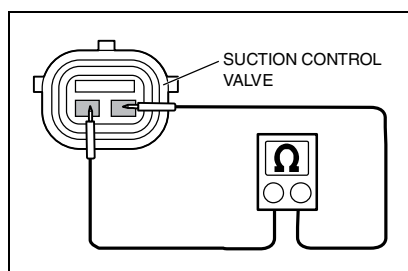
INSPECTING THE COMPONENT PARTS



SAPH011060700018

1. INSPECTING THE SUCTION CONTROL VALVE AND THE FUEL TEMPERATURE SENSOR

- (1) Using Hino-DX, inspect the suction control valve and the fuel temperature sensor. If some abnormalities are found, replace the supply pump.

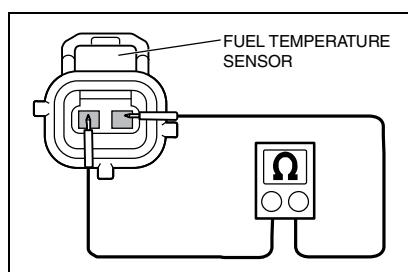


SAPH011060700019

2. INSPECTING THE RESISTANCE OF THE SUCTION CONTROL VALVE

- (1) Using a circuit tester, measure the resistance between the terminals. If the measured value is in excess of the standard value, replace the supply pump.

Standard value (at a temperature of 20°C {68°F})	1.6-2.6 Ω
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SAPH011060700020

3. INSPECTING THE RESISTANCE OF THE FUEL TEMPERATURE SENSOR

- (1) Using a circuit tester, measure the resistance between the terminals. If the measured value is in excess of the standard value, replace the supply pump.

Temperature 20°C {68°F}	Resistance (kΩ)
-20 {-4}	13.84 - 16.33
20 {68}	2.32 - 2.59
80 {176}	0.310 - 0.326
110 {230}	0.1399 - 0.1435

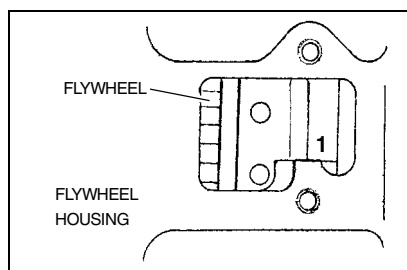
NOTICE

If SCV and fuel temperature sensor need replacements, they should be serviced by Denso Service Dealer.

MOUNTING THE SUPPLY PUMP

NOTICE

- While working, be careful not to make dirt and water enter parts.
- Before mounting parts, make sure that there is no dirt on the connection between them.
- Air enters the fuel pipe in the process of mounting the pre fuel filter case. After mounting is completed, thoroughly purge air from the fuel pipe.



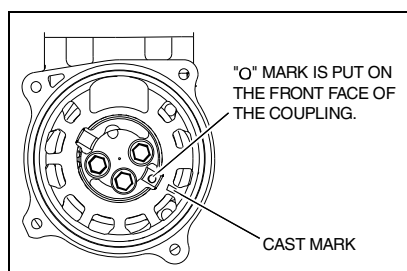
SAPH011060700021

1. COMPRESSION UPPER DEAD CENTER SETTING OF NO.1 CYLINDER

- (1) Turn the flywheel clockwise in the engine direction and align the No.1 cylinder mark to the pointer in the flywheel housing inspection opening.

NOTICE

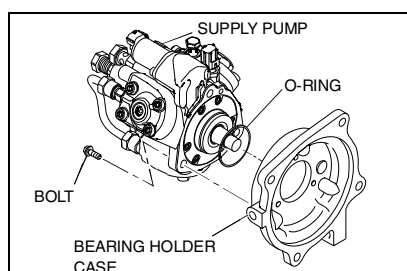
- Refer to the section "ENGINE TUNEUP" in the chapter "ENGINE INTRODUCTION".
- Make sure that the No.1 cylinder is positioned at the top dead center point of the compression stroke.



SAPH011060700022

2. ADJUSTING THE TOP OF THE AIR COMPRESSOR

- (1) Align the cast mark on the air compressor with the "O" mark put on the front face of the coupling.



SAPH011060700023

3. MOUNTING THE SUPPLY PUMP

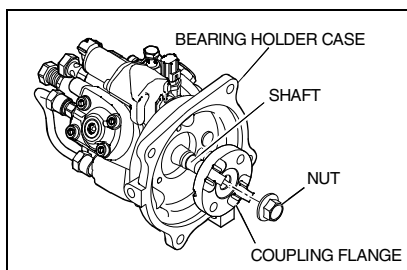
- (1) Replace the O-ring with a new one, and mount the bearing holder case to the supply pump using the bolts (3 pcs.).

Tightening Torque:

28.5 N·m {290 kgf·cm, 21 lbf·ft}

FUEL SYSTEM (J08E)

EN07-11



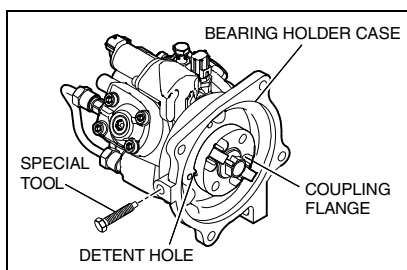
SAPH011060700024

- (2) Install the coupling flange to the shaft.
- (3) Fix the supply pump and tighten the nuts while preventing the coupling flange from rotating using a vise.

Tightening Torque:
63.7 N·m {650 kgf-cm, 47 lbf-ft}

NOTICE

Do not use a special tool to lock the shaft.



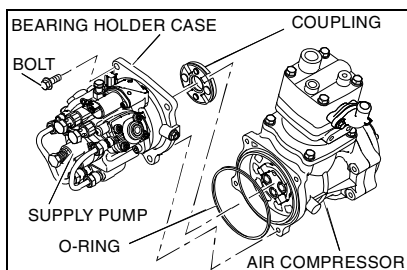
SAPH011060700025

- (4) Insert the special tool specified below into the bearing holder case and bring it into close contact with the detent of the coupling flange.

SST: Guide bolt (SZ105-08067)

NOTICE

- Do not tighten the special tool by applying it to a part other than the detent of the coupling, or do not use a tool other than the special tool for locking.
- The special tool is not designed to allow its tip to come into contact with the end of the detent hole. (The clearance at the tip is 2 mm {0.079 in.}.)



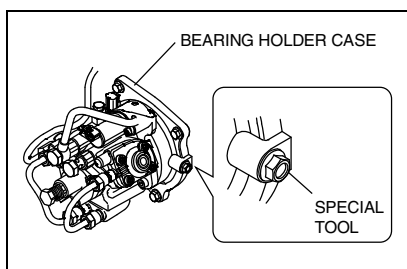
SAPH011060700026

- (5) Replace with a new O-ring, and mount the coupling and the supply pump to the air compressor using the bolts (4 pcs.).

Tightening Torque:
28.5 N·m {290 kgf-cm, 21 lbf-ft}

NOTICE

Mount the coupling and the supply pump to the air compressor with the No.1 cylinder set at the compression stroke top dead center and the cast mark on the air compressor and the "O" mark on the front face of the coupling aligned with each other.



SAPH011060700027

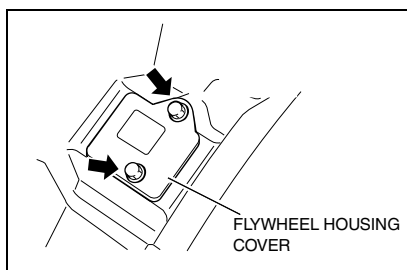
- (6) Make sure that the No.1 cylinder is set at the compression stroke top dead center, and then remove the special tool and mount the timing checking window plug.

NOTICE

- After all parts are assembled, do not fail to remove the special tool and mount the timing checking window plug.
- Before turning the crankshaft, do not fail to pull out the special tool.
- Do not perform cranking with the special tool inserted.

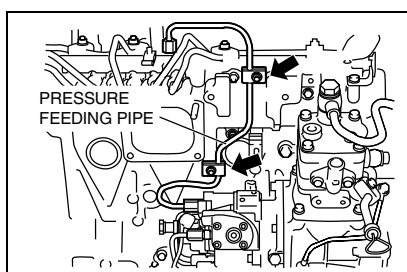
EN07-12

FUEL SYSTEM (J08E)



SAPH011060700028

- (7) Mount the flywheel housing cover to the flywheel housing with the bolts (2 pcs.).



SAPH011060700029

4. MOUNTING THE PRESSURE FEED PIPE

- (1) Mount the pressure feeding pipe.

Tightening torque:

(Supply pump side)

44 N·m {450 kgf·cm, 32.5 lbf·ft}

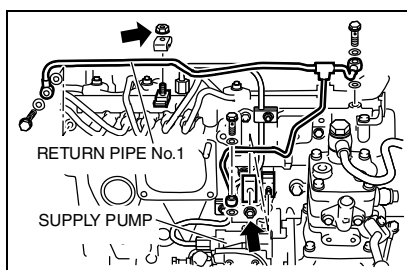
(Common rail side)

44 N·m {450 kgf·cm, 32.5 lbf·ft}

⚠ CAUTION

Always replace the pressure feed pipe by a new one because the pipe is subjected to high pressure; reusing the same pipe may result in a fuel leak.

- (2) Mount the clips (2 pcs.) with the nuts (2 pcs.) and fix the pressure feeding pipe.



SAPH011060700030

5. MOUNTING THE FUEL PIPE

- (1) Replace the gasket with a new one, and mount return pipe No.1 on the supply pump, the inlet manifold, and the pressure limiter with the union bolts (3 pcs.) that secured the return pipe.

Tightening torque:

(Supply pump side)

7.9-12.7 N·m {80-129 kgf·cm, 5.8-9.3 lbf·ft}

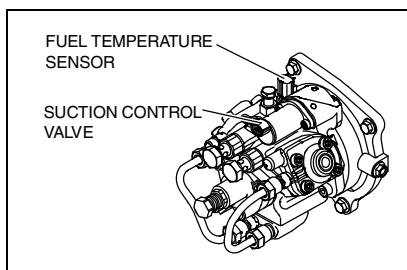
(Inlet manifold side)

30 N·m {305 kgf·cm, 22 lbf·ft}

(Pressure limiter side)

20 N·m {205 kgf·cm, 15 lbf·ft}

- (2) Mount the clips (2 pcs.) with the nuts (2 pcs.) and fix the return pipe.



SAPH011060700031

6. CONNECTING THE HARNESS

- (1) Connect the connector to the fuel temperature sensor and suction control valve of the supply pump.

NOTICE

Before connecting the connectors, make sure that the terminals are free of a spark mark.

7. MOUNTING THE INTAKE PIPE

- (1) Mount the intake pipe.
Refer to the chapter "AIR INTAKE SYSTEM"

8. MOUNTING THE FUEL FILTER CASE

- (1) Mount the fuel filter case and the fuel pipe.
Refer to the chapter "AIR INTAKE SYSTEM"

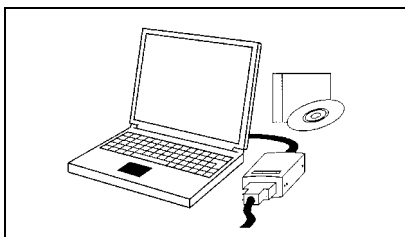
9. AIR BLEEDING OF FUEL SYSTEM

- (1) Air bleeding.
Refer to the chapter "AIR BLEEDING"

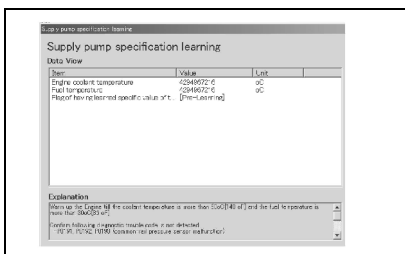
10. RESET THE ECU DEFAULT VALUE.

NOTICE

- It is necessary to reset the ECU default value using the diagnosis tool at the time of supply pump service replacement. In addition, the ECU has a function enabling it to learn the performance of the supply pump at the time of ECU service replacement, so ensure sufficient time (several minutes) is available.
- Diagnosis tool refer to chapter "FUEL CONTROL". ECU default value can be reset by "Supply pump specification learning" in the "Check function" menu.



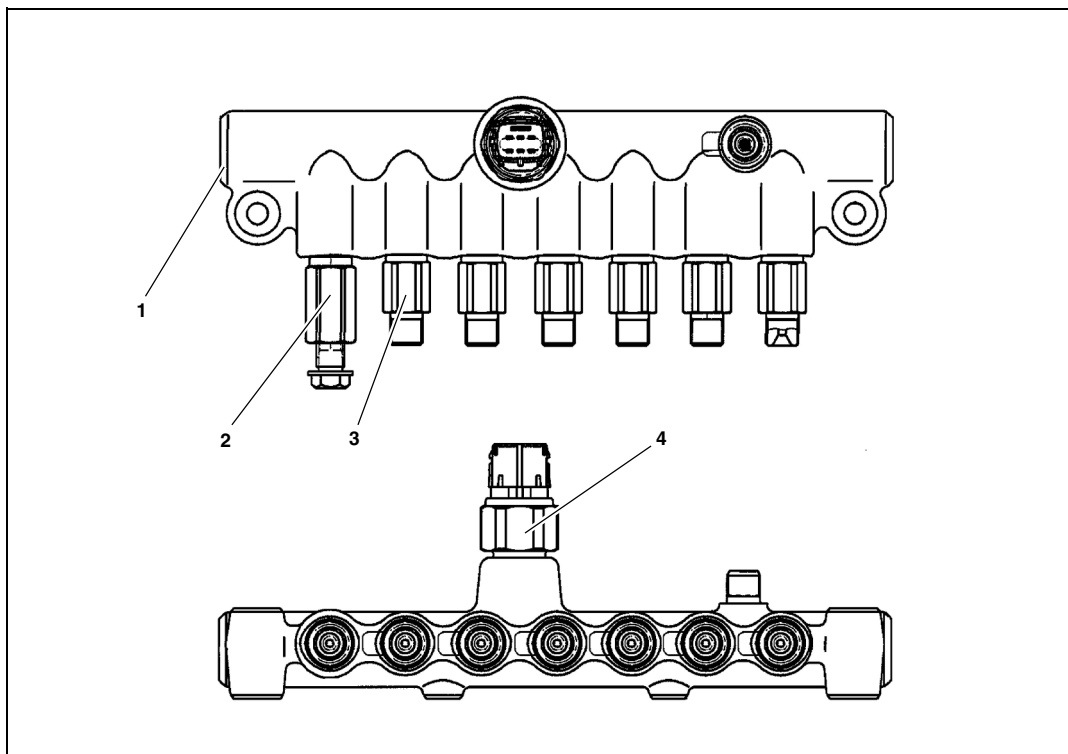
SAPH011060700032



COMMON RAIL

DESCRIPTION

EN0110607J100003



SAPH011060700034

1	Common rail
2	Pressure limiter

3	Flow damper
4	Pressure sensor

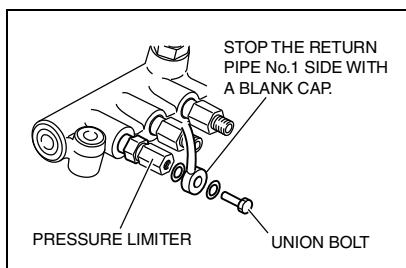
INSPECTION

EN0110607H200002

INSPECTING THE COMMON RAIL

1. INSPECTING THE FLOW DAMPER

- (1) Start the engine and change the engine revolution from idling to full throttle. Use Hino-DX to check the diagnosis code of the "flow damper operation".
- (2) If the diagnosis code of the "flow damper operation" is detected, replace the relevant injector and inspect it again.
- (3) If the same phenomenon occurs even after the injector is replaced, replace the flow damper with a common rail assembly.



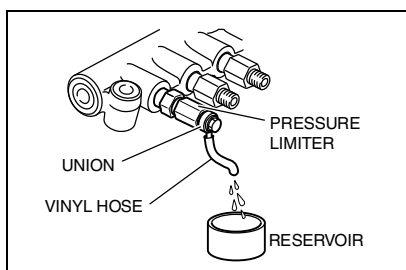
SAPH011060700035

2. INSPECTING THE PRESSURE LIMITER

- (1) Unfasten the union bolt securing the pressure limiter.
- (2) Stop the return pipe No.1 side with a blank cap to prevent the outflow of fuel.

HINT

While working, be careful not to make dirt and water enter parts.

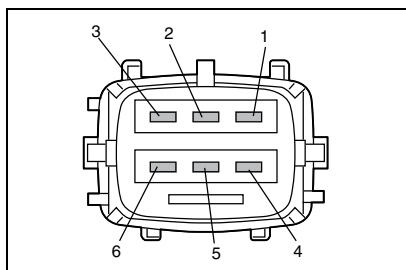


SAPH011060700036

- (3) Mount the union to the pressure limiter, and connect a vinyl hose to the end of the union.
- (4) Place a fuel reservoir under the free end of the vinyl hose.
- (5) Start the engine. If the fuel continuously flows out, replace the pressure limiter with a common rail assembly.

⚠ WARNING

When the pressure limiter is working, fuel flows out at a high temperature and pressure. Serious injury like scalding could result from this hot fuel being blown out under pressure.



SAPH011060700037

3. INSPECTING THE COMMON RAIL PRESSURE SENSOR

- (1) Using a circuit tester, measure the resistance between the terminals. If the measured value is in excess of the standard value, replace the common rail assembly.

Terminal to be measured	Standard value (k Ω) At 20°C {68°F} with the engine turned off
1 \leftrightarrow 2	1.05-3.55
5 \leftrightarrow 6	
2 \leftrightarrow 3	6.7-18.7
4 \leftrightarrow 5	

REPLACEMENT

EN0110607H200003

REMOVING THE COMMON RAIL

⚠ CAUTION

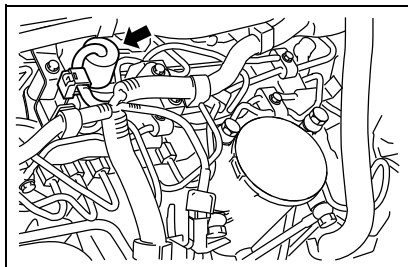
While working, be careful not to make dirt and water enter parts.

NOTICE

Clean off surrounding area of the nozzle and the fuel line connectors.

1. DISCONNECTING THE HARNESS

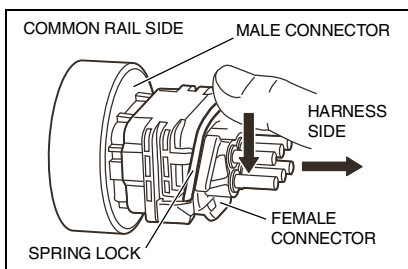
- (1) Disconnect the connector connected to the common rail pressure sensor.



SAPH011060700038

⚠ CAUTION

Pressing the spring lock of the female connector, disengage the female connector from the male connector.



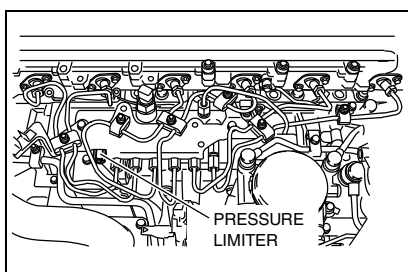
SAPH011060700039

2. DISCONNECTING THE FUEL PIPE

- (1) Unfasten the union bolt securing return pipe No.1, and disconnect the return pipe No.1 from the pressure limiter.

NOTICE

Prepare a reservoir and a waste cloth because fuel spills when disconnecting the fuel pipe.



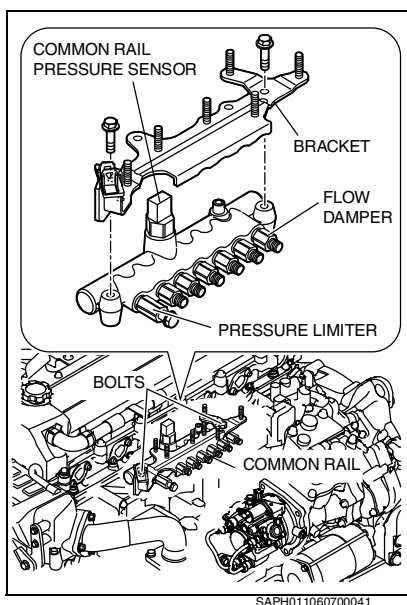
SAPH011060700040

3. REMOVING THE INJECTION PIPE

- (1) Remove the injection pipe from the common rail.

4. REMOVING THE PRESSURE FEEDING PIPE

- (1) Remove the pressure feeding pipe from the common rail and the supply pump.



5. REMOVING THE COMMON RAIL

- (1) Unfasten the bolts (2 pcs.) securing the common rail, and remove the common rail and the bracket from the intake manifold.

⚠ CAUTION

- Protect with clean vinyl to avoid entry of dirt into the common rail.
- Remove dirt from around each part, and detach the common rail.
- Remove the common rail together with the flow damper, the common rail pressure sensor, and the pressure limiter.

NOTICE

Prepare a reservoir and a waste cloth because fuel spills when removing the common rail.

MOUNTING OF THE COMMON RAIL

1. INSTALL THE COMMON RAIL ASSY.

- (1) Install the common rail with 2 bolts.

Tightening Torque:

28.5 N·m {290 kgf·cm, 21 lbf·ft}

⚠ CAUTION

- While working, be careful not to make dirt and water enter parts.
- Before mounting a part, check that there is no dirt on the connection between the parts.

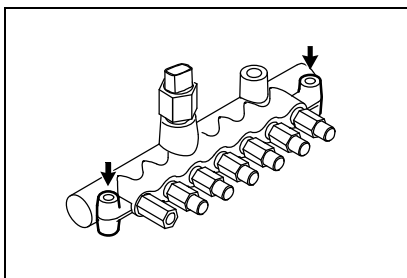
- (2) Connect the connector.

⚠ CAUTION

Before inserting the connector, check that there are no spark traces on the terminals.

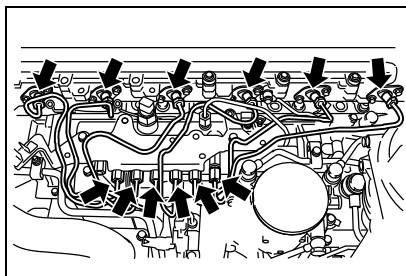
NOTICE

- Be careful to prevent dust from entering inside the common rail and parts when the mounting is performed. Dust and foreign matter must not adhere to the seats of the parts and common rail main unit.
- After mounting is completed, check fuel leak using "Activation Test" menu of HINO DX.



EN07-18

FUEL SYSTEM (J08E)



SAPH011060700043

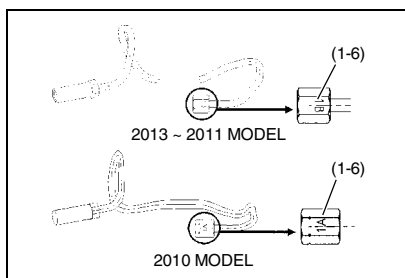
- (3) Tighten the injection pipe nuts to the specified torque.

Tightening Torque:**44 N·m {450 kgf·cm, 32.5 lbf·ft}****CAUTION**

- While working, be careful not to make dirt and water enter parts.
- Before mounting a part, check that there is no dirt on the connection between the parts.
- Air enters the fuel pipe while working. After working, be sure to purge air.

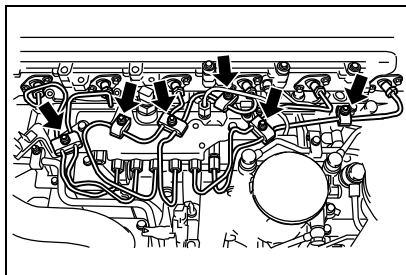
NOTICE

When installing the fuel injection pipe, do not misassemble the 2010 model fuel injection pipe.



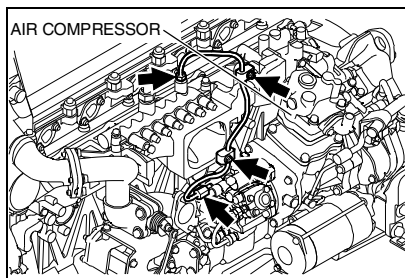
SAPH011060700044

Fuel injection pipe	2013 ~ 2011 Model (J08E-VB, VC)	2010 Model (J08E-TV, TW)
No.1 injector	1B	1A
No.2 injector	2B	2A
No.3 injector	3B	3A
No.4 injector	4B	4A
No.5 injector	5B	5A
No.6 injector	6B	6A



SAPH011060700045

- (4) Fit the clips (6 pcs) and fix the injection pipe.



SAPH011060700046

- (5) Tighten the pressure feed pipe nuts to the specified torque.

- (6) Fit the clips (2 pcs) and fix the pressure feed pipe.

Tightening Torque:**44 N·m {450 kgf·cm, 32.5 lbf·ft}****CAUTION**

- While working, be careful not to make dirt and water enter parts.
- Before mounting a part, check that there is no dirt on the connection between the parts.
- Air enters the fuel pipe while working. After working, be sure to purge air.

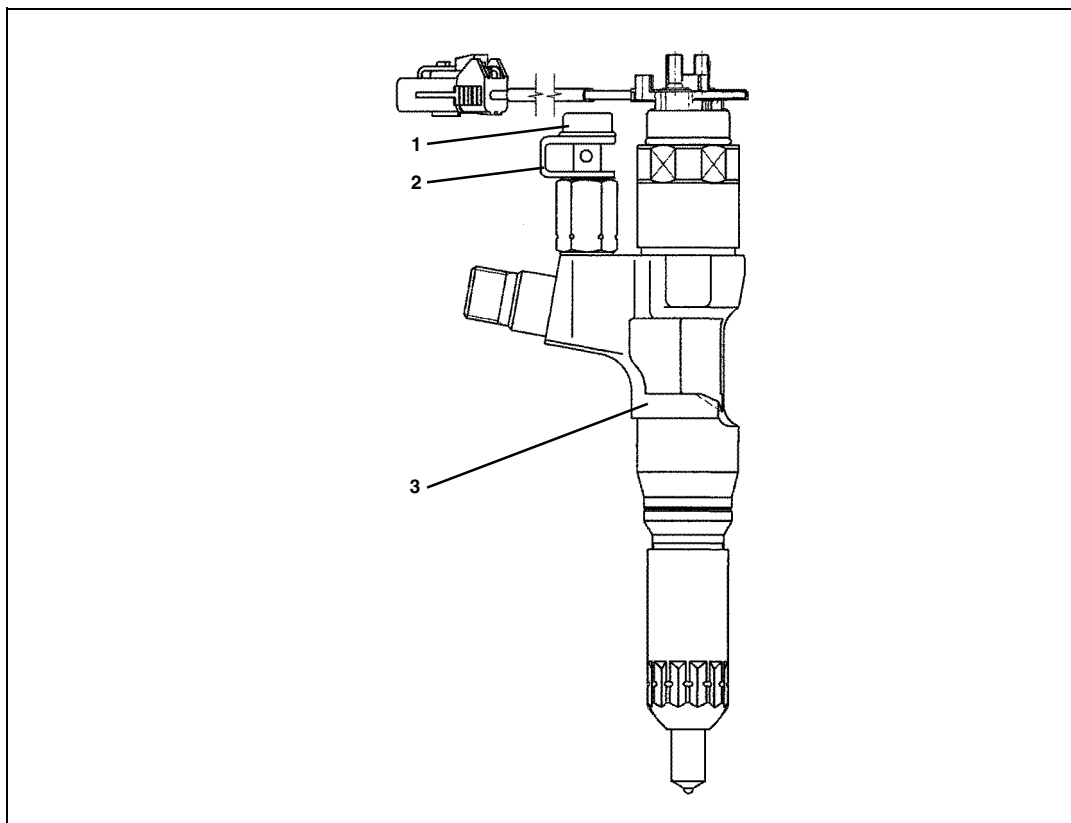
NOTICE

- If the tightening torque of the nuts is less than the specified value, it may cause a fuel leak. If the tightening torque of the nuts is greater than the specified value it may have a negative influence on the engine function. As a result, always perform torque management.
- After mounting is completed, fuel leak check using "check functions" menu of Hino-DX.

INJECTOR

DESCRIPTION

EN0110607C100003



SAPH011060700047

1	Return joint bolt	3	Injector assembly
2	Gasket		

REPLACEMENT

EN0110607H200004

REMOVING THE INJECTOR

⚠ CAUTION

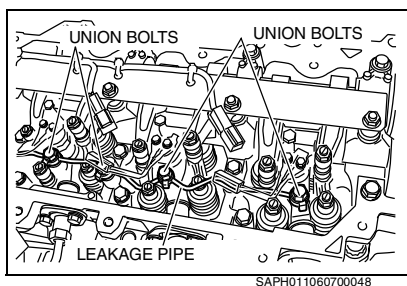
While working, be careful not to make dirt and water enter parts.

NOTICE

Clean off surrounding area of the nozzle and the fuel line connectors.

1. REMOVING THE HEAD COVER

- (1) Remove the head cover.
Refer to the chapter "ENGINE MECHANICAL"



SAPH011060700048

2. REMOVING THE LEAKAGE PIPE

- (1) Unfasten the union bolts (7 pcs.) to remove the leakage pipe and the gaskets (7 pcs.).

NOTICE

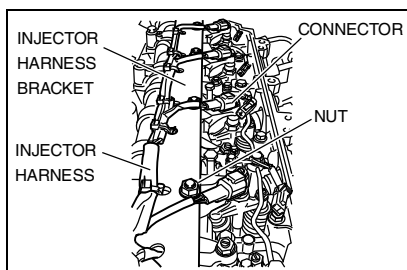
The leakage pipe can be twisted easily. Use care in handling.

3. REMOVING THE INJECTOR HARNESS

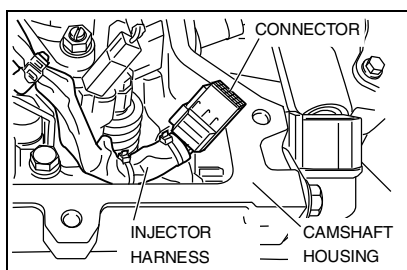
- (1) Disconnect each connector connected to the injector.
- (2) Unfasten the nuts (7 pcs.) securing the injector harness, and remove the injector harness together with the injector harness bracket.

⚠ CAUTION

The injector harness bracket can be twisted easily. Use care in handling.



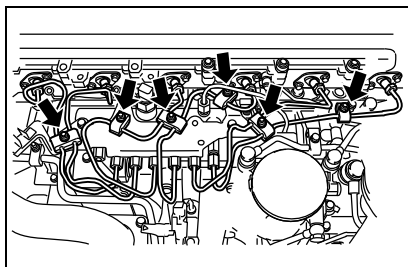
SAPH011060700049



SAPH011060700050

NOTICE

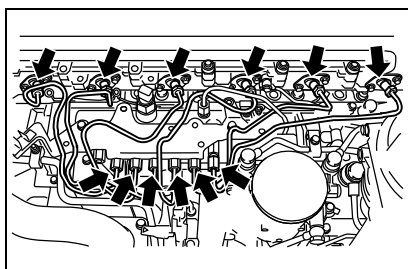
It is easy to disconnect the connectors by last disconnecting the one connected to the camshaft housing.



SAPH011060700045

4. REMOVING THE INJECTION PIPE

- (1) Unfasten the nuts (6 pcs.) securing the clips, and remove the clips.

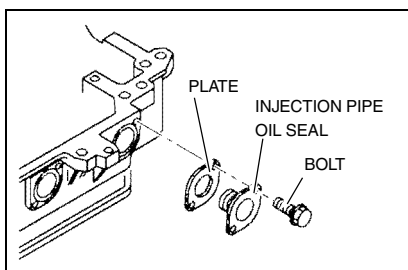


SAPH011060700043

- (2) Loosen the nuts securing the injection pipes (6 pcs.) to remove them from the injector and the common rail.

CAUTION
Do not reuse the injection pipes.

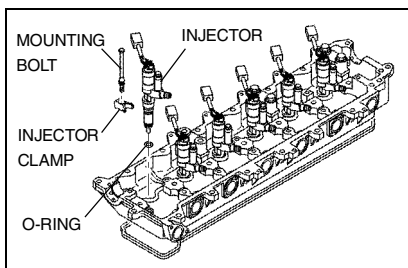
NOTICE
Prepare a reservoir and a waste cloth because fuel spills when removing the injection pipes.



SAPH011060700051

5. REMOVING THE INJECTOR

- (1) Unfasten the bolts (2 pcs.) to remove the injection pipe oil seals (6 pcs.) and plates (6 pcs.) from the cylinder head.



SAPH011060700052

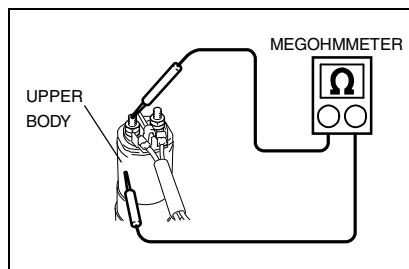
- (2) Unfasten the injector clamp mounting bolts to remove the injector and injector clamp.

- (3) Remove the O-ring.

NOTICE
Replace the O-ring with new one.

INSPECTION

1. INSPECTING THE RESISTANCE

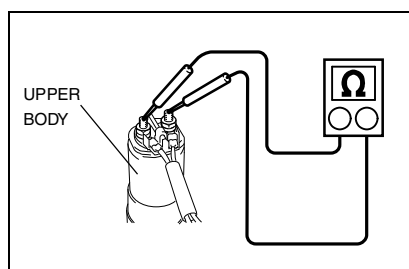


- (1) Using a 1,000V megohmmeter, measure the insulation resistance between either of the 2 terminals (no polarity) to which the injector harness is connected and the upper body of the injector.

⚠ CAUTION

Never measure between the terminals, or the injector will be damaged.

Standard value (Normal temperature)	10 MΩ or more (Use a 1,000V megohmmeter.)
--	--



- (2) Using a circuit tester, measure the resistance between terminals.

Standard value (at a temperature of 20°C {68°F})	0.37-0.57 Ω
---	-------------

- (3) The resistance values of (1) and (2) exceed the standard value, replace the injector.

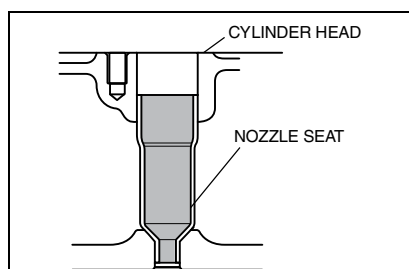
2. CLEANING THE INJECTOR

- (1) Use clean clothes to remove sludge adhered to the terminal part and its perimeter.

⚠ CAUTION

- Use clean clothes to wipe off sludge without using any detergent.
- Use of detergent causes it to penetrate, which may lead to electric failure.

3. CLEANING THE INSIDE OF THE NOZZLE SEAT



- (1) If sludge sticks to the inside of the nozzle seat, spray a detergent over it, wipe it off with a waste cloth, and wash it out with the detergent.

NOTICE

- If sludge sticks hard to the inside of the nozzle seat, remove it with brush and a detergent.
 - It is advisable to perform a contact check using red lead primer.
- (2) Make sure that the inside of the nozzle seat is free of sludge or foreign matters.

MOUNTING THE INJECTOR

⚠ CAUTION

- While working, be careful not to make dirt and water enter parts.
- Before mounting parts, make sure that there is no dirt on the connection between them.
- Air enters the fuel pipe in the process of mounting the pre fuel filter case. After mounting is completed, thoroughly purge air from the fuel pipe.

1. MOUNTING THE INJECTOR AND THE INJECTION PIPE

- (1) Apply engine oil to a new O-ring and mount it to the injector. Then temporarily fit the injector clamp and injector at the same time.

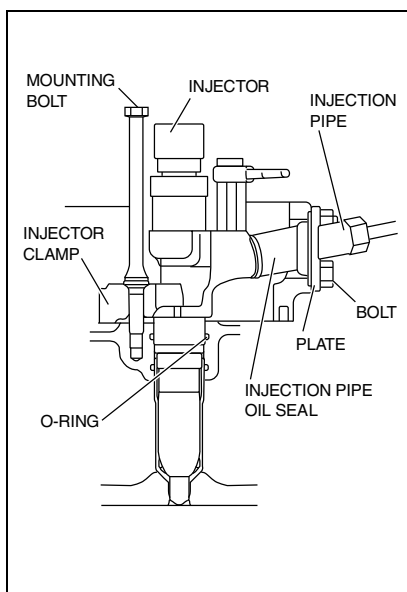
⚠ CAUTION

- Apply engine oil to the O-ring. Use care not to get the O-ring jammed when inserting it.
- Note that if the O-ring is damaged, fuel will leak out and the engine will fail to start to run.
- Do not fix the injector clamp until the injection pipe is fit temporarily.

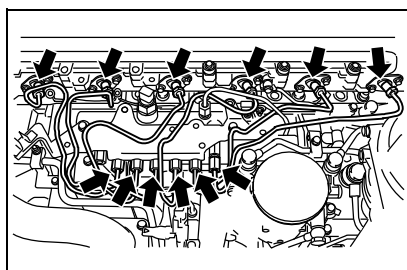
- (2) Slip a new injection pipe oil seal on the injector, and mount the plate with the bolts (2 pcs.) that secured it.

⚠ CAUTION

Mount the injection pipe oil seal so that excessive force will not be applied to the injection nozzle. (If the injection pipe oil seal and the injection nozzle are out of position, oil leakage or improper assembly of the injection pipe will result.)



SAPH011060700056

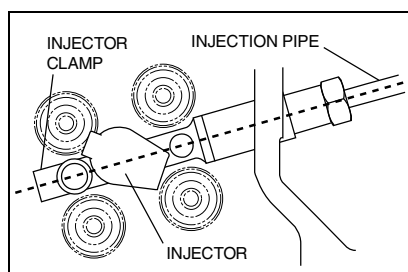


SAPH011060700043

- (3) Temporarily mount new injection pipes (6 pcs.) on the injector and the common rail.

⚠ CAUTION

- Do not fail to replace the injection pipes with new ones because they are subjected to high pressure and may cause fuel leakage.
- Fuel will leak out if the injection pipes are not properly connected. Follow the procedure.
- Fuel leakage will cause damage to the engine.

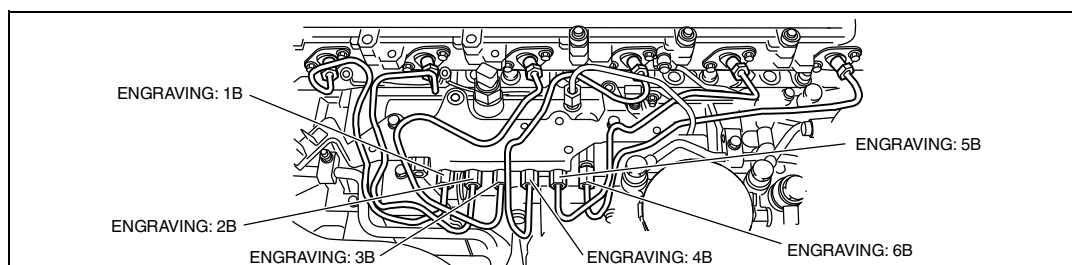


SAPH011060700057

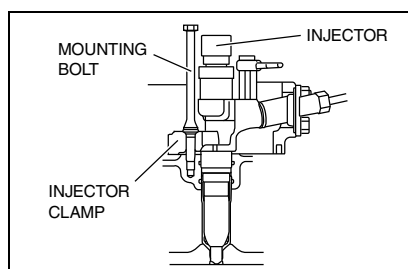
- Arrange the injector and the injection pipes in a straight line.

NOTICE

Mount the injection pipes so that the flare tightening nuts of the injection pipes will be arranged in the order of the numbers engraved on the nuts shown in the figure below.



SAPH011060700058



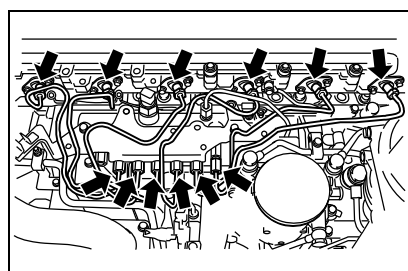
SAPH011060700059

- (4) Tighten the injector clamp mounting bolt.

Tightening Torque:
25 N·m {250 kgf·cm, 18 lbf·ft}

CAUTION

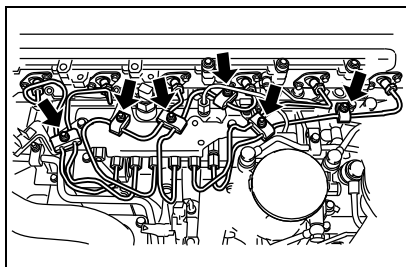
Insufficient tightening will cause gas leakage, which will result in the seizure of the nozzle.



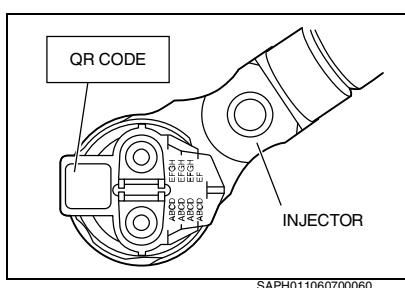
SAPH011060700043

- (5) Tighten the injection pipe to the specified torque.

Tightening Torque:
44 N·m {450 kgf·cm, 32.5 lbf·ft}



(6) Mount the clips with the nuts (6 pcs.), and fix the injection pipes.



2. WRITING AN INJECTOR COMPENSATION VALUE TO THE ENGINE ECU (WRITING BY MEANS OF RE-PROGRAMMING)

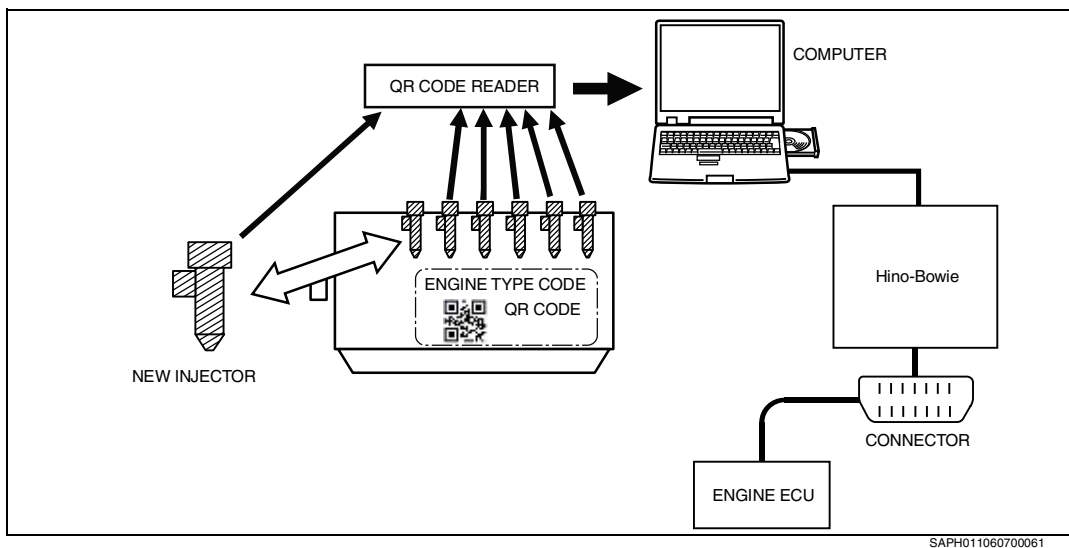
⚠ CAUTION

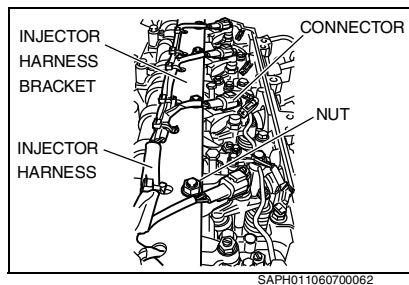
- If an injector is replaced, write an injector compensation value (QR code) indicated on a new injector in the engine ECU.
- Writing an incorrect compensation value may cause engine troubles.

NOTICE

Injector compensation value can be written by means of a combined use of the PC tool and QR code reader.

- (1) Read the QR code of the injector by using the scanner of the QR code reader to create a compensation data file.
- (2) Write the injector compensation value in the engine ECU from a computer.



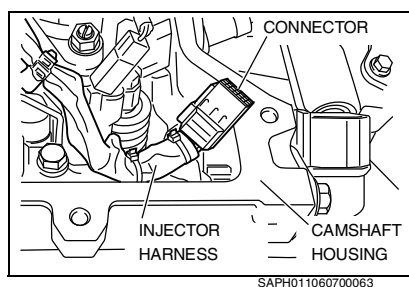


3. MOUNTING THE INJECTOR HARNESS

- (1) Mount the injector harness together with the injector bracket with the bolts (7 pcs.) that secured them.
- (2) Connect each connector of the injector harness.

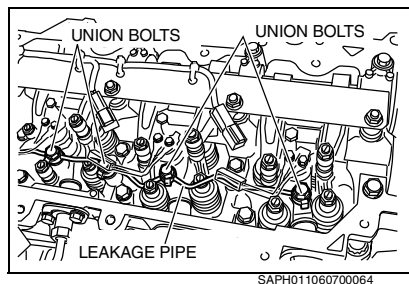
⚠ CAUTION

Before connecting the connectors, make sure that the terminals are free of a spark mark.



NOTICE

It is easy to connect the connectors by first connecting the one to the camshaft housing.



4. MOUNTING THE LEAKAGE PIPE

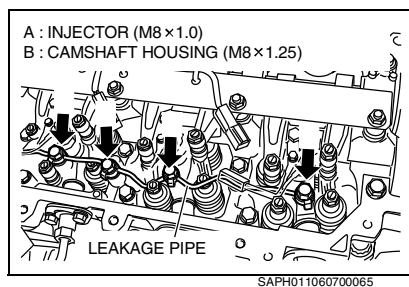
- (1) Remove dirt or foreign matters from the gasket mounting surface.
- (2) Replace the gasket with a new one, and mount the leakage pipe on the injector and the camshaft housing with the union bolts (7 pcs.) that fastened them.

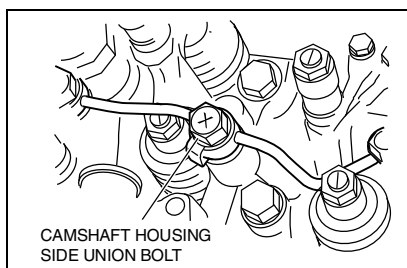
Tightening Torque:

12.3 N·m {126 kgf-cm, 9 lbf-ft}

⚠ CAUTION

- Do not reuse the old gasket.
- The leakage pipe can be twisted easily. Use care in handling.
- Note that the thread pitch is different between the union bolts (6 pcs.) for the injector and the union bolt for the camshaft housing.





SAPH011060700066

- An "X" mark is put on the union bolt for the camshaft housing.

5. MOUNTING THE HEAD COVER

- (1) Mount the head cover.
Refer to the chapter "**ENGINE MECHANICAL**"

6. AIR BLEEDING OF FUEL SYSTEM

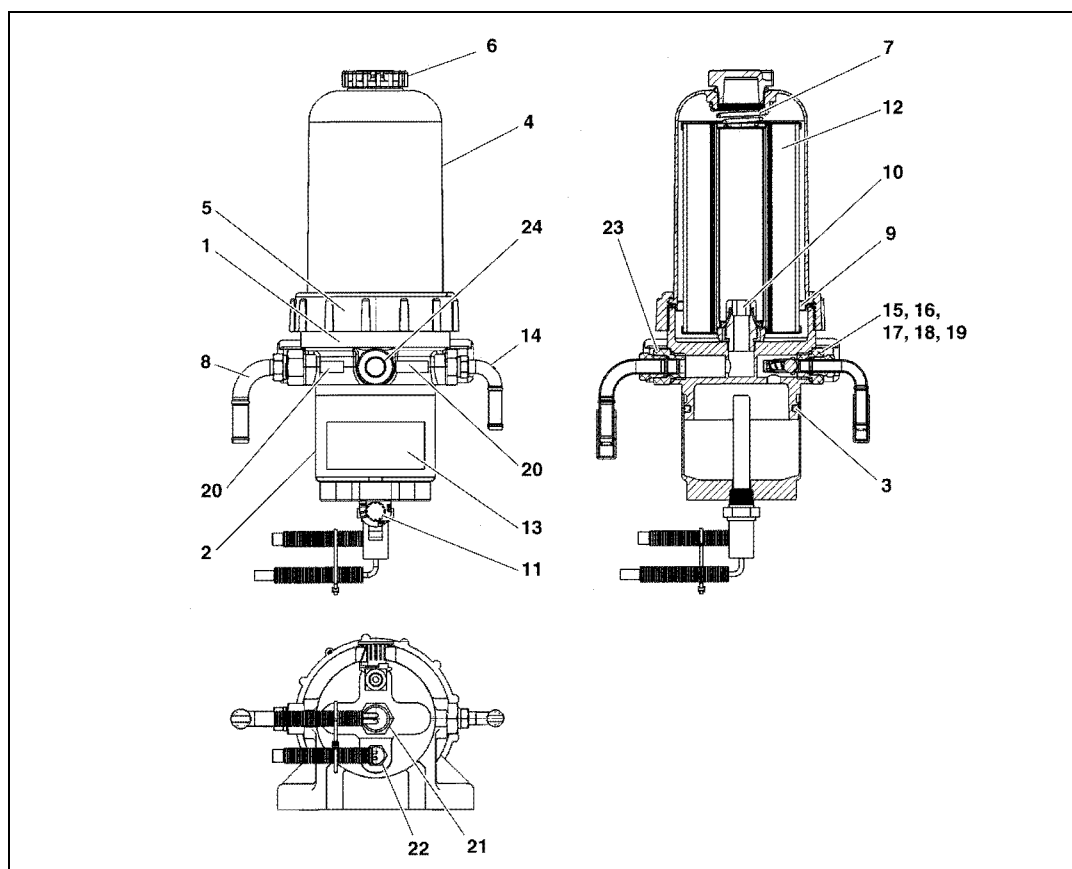
- (1) Operate the priming pump to purge air from the fuel system.
Refer to the chapter "**AIR BLEEDING**"

FUEL FILTER

DESCRIPTION

EN0110607J100004

TYPE: DP233



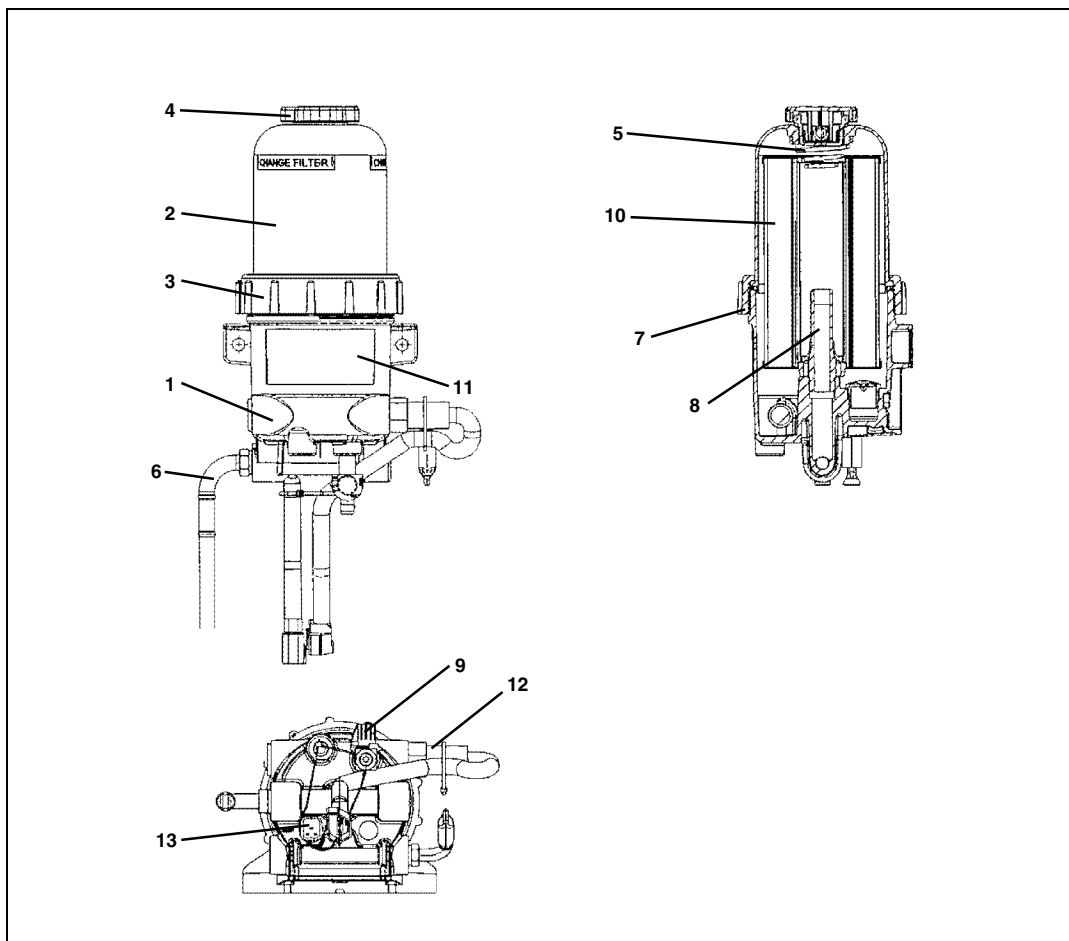
SAPH011060700067

1	Head	13	Label
2	Body	14	Fuel pipe (In)
3	Seal	15	Check valve body fitting
4	Cover	16	Retainer
5	Collar	17	Seal
6	Vent cap	18	Ball
7	Spring	19	Spring
8	Pipe	20	Label
9	Seal	21	Heater
10	Stud	22	Water level sensor
11	Drain valve	23	Adapter
12	Filter	24	Plug

EN07-30

FUEL SYSTEM (J08E)

TYPE:DP240




SAPH011060700068

1	Body	8	Stud
2	Cover	9	Drain valve
3	Collar	10	Filter
4	Vent cap	11	Label
5	Spring	12	Heater
6	Fuel pipe (Out)	13	Water level sensor
7	Seal		

SPECIAL TOOL

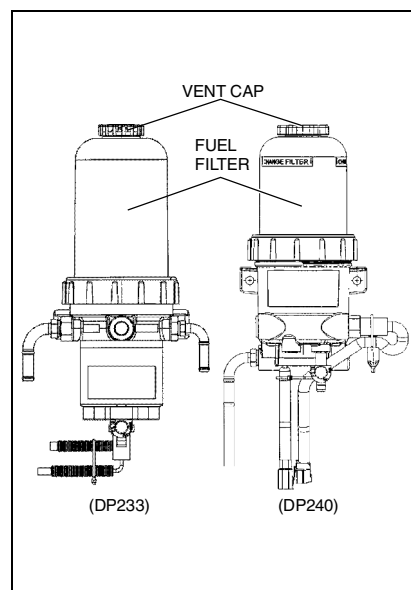
EN0110607K100002

Prior to starting an engine overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0955-31040	FILTER WRENCH	For DP233 fuel filter

AIR BLEEDING

EN0110607H200005



SAPH011060700070

1. AIR BLEEDING

- (1) Remove the vent cap from the top of the cover by turning the vent cap counterclockwise. Fill the cover full of clean fuel. Reinstall the cap and tighten.

[DP233]**SST: Filter wrench (S0955-31040)****Tightening Torque:****4.5 N·m {45.9 kgf·cm, 3.3 lbf·ft}****[DP240]****By hand only**

- (2) Start the engine. When the lubrication system reaches its normal operating pressure, increase engine speed to high for 2 to 3 minutes.
- (3) After the air is purged, and the engine is running, loosen the vent cap. When the fuel level fills to following position, quickly tighten the vent cap. (In case of DP240, tighten the vent cap until the vent cap run idle with click sounds.)

Fuel level:**DP233: 51-76 mm {2-3 in.} Above top of collar.****DP240: 12.7-38 mm {0.5-1.5 in.} Above top of collar.**

NOTICE

- Thoroughly wipe off any spilled fuel.
- Start the engine and check the fuel system for leaks.

⚠ WARNING

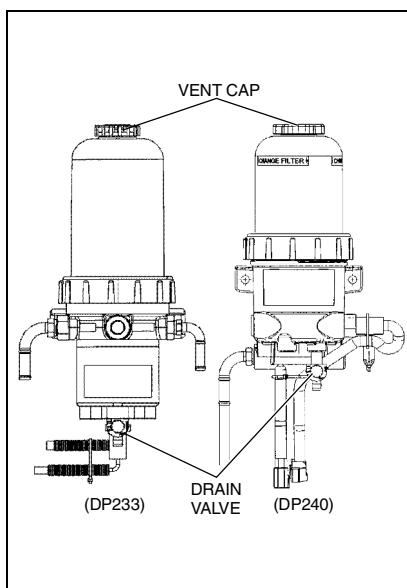
- Always drain the fuel into a container and dispose of it properly. Be careful not to spill any of the fuel.
- If fuel is spilled on engine parts, wipe it off entirely. It is dangerous since it can cause a fire which can result in serious personal injury or death.
- Do not smoke when performing maintenance on the fuel system.
- Keep flame and heat away from the fuel system since the fuel is flammable and can cause a fire resulting in serious personal injury or death.
- Any of these can result in personal injury and/or property damage due to fire.
- Use the designated special tool and fuel filter wrench to tighten the fuel filter. Use of an ordinary tool (for example, chain-type tool) can scratch or dent the peripheral surface of the fuel filter. If the fuel filter is damaged, it can cause fuel to leak, thus resulting

in a fire or other serious accidents and can result in serious personal injury or death.

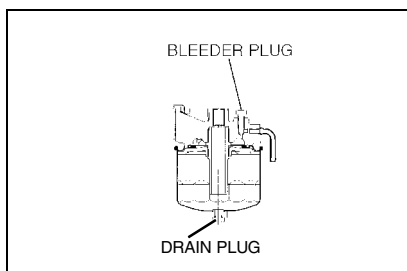
- After replacing the filter, inspect the external surface of the fuel filter for checking scratches and dents. It is dangerous to use a scratched or dented fuel filter, since it can cause fuel to leak and lead to a fire or other serious accidents and can result in serious personal injury or death.
- After replacement of the element, operate the engine for trial to check to see if there is any fuel leakage around the fuel filter. Fuel leakage can cause a fire and can result in serious personal injury or death.

2. DRAIN WATER

- (1) Connect specific tube to drain outlet.
To protect steering joint by draining liquids. Specific tube is available at HINO dealer. (Part No. SZ950-61502)
- (2) Loose the vent cap and after open drain valve.
- (3) Collect water in to cup.
- (4) Allow any water to drain out, then close the drain valve and vent cap.
(Drain minimum amount of fuel possible)



SAPH011060700071



SAPH011060700007

- (5) Remove the drain plug of the bubble separator.
- (6) Loosen the bleeder plug of the bubble separator.
- (7) Drain until no more water comes out.
- (8) Tighten the drain plug and the bleeder plug of the bubble separator.

Tightening Torque:

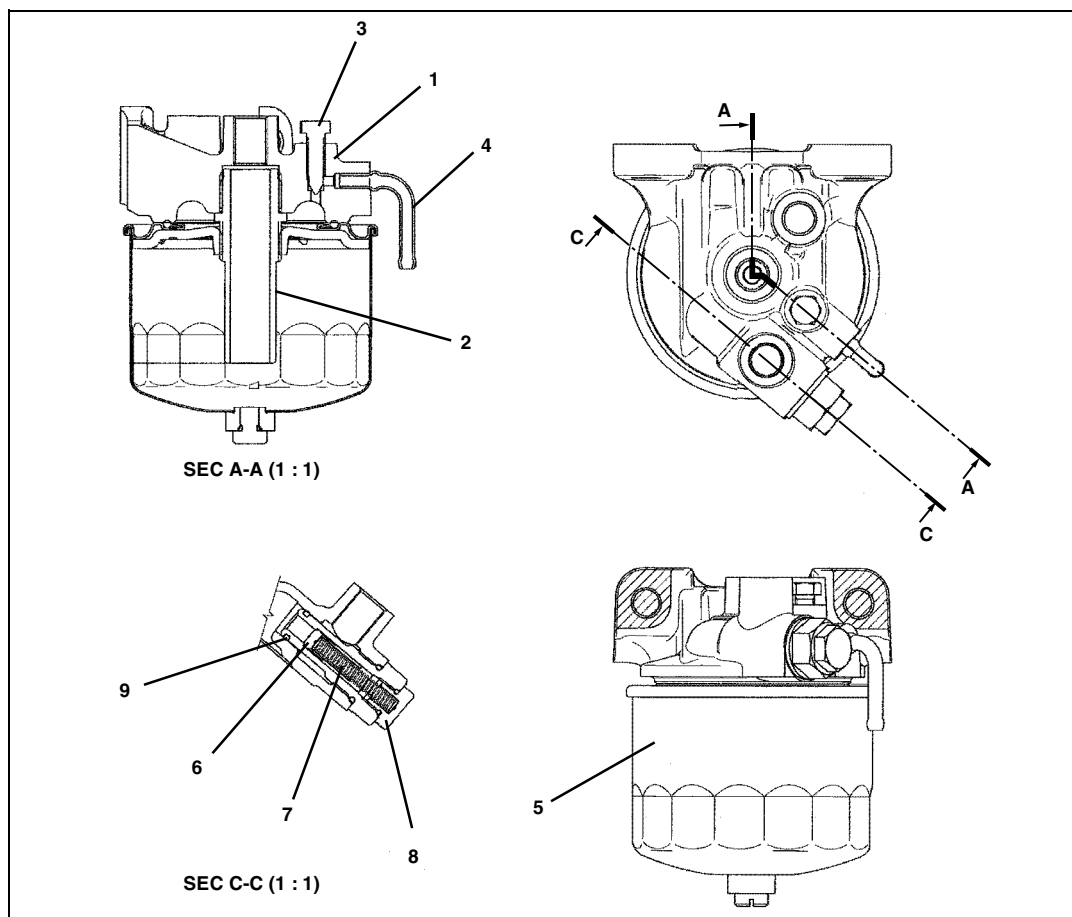
Drain plug: 5.9-7.9 N-m {60.2-80.5 kgf-cm, 4.4-5.8 lbf-ft}

Bleeder plug: 5-8.8 N-m {51-89.7 kgf-cm, 3.7-6.5 lbf-ft}

BUBBLE SEPARATOR

DESCRIPTION

EN0110607J100005



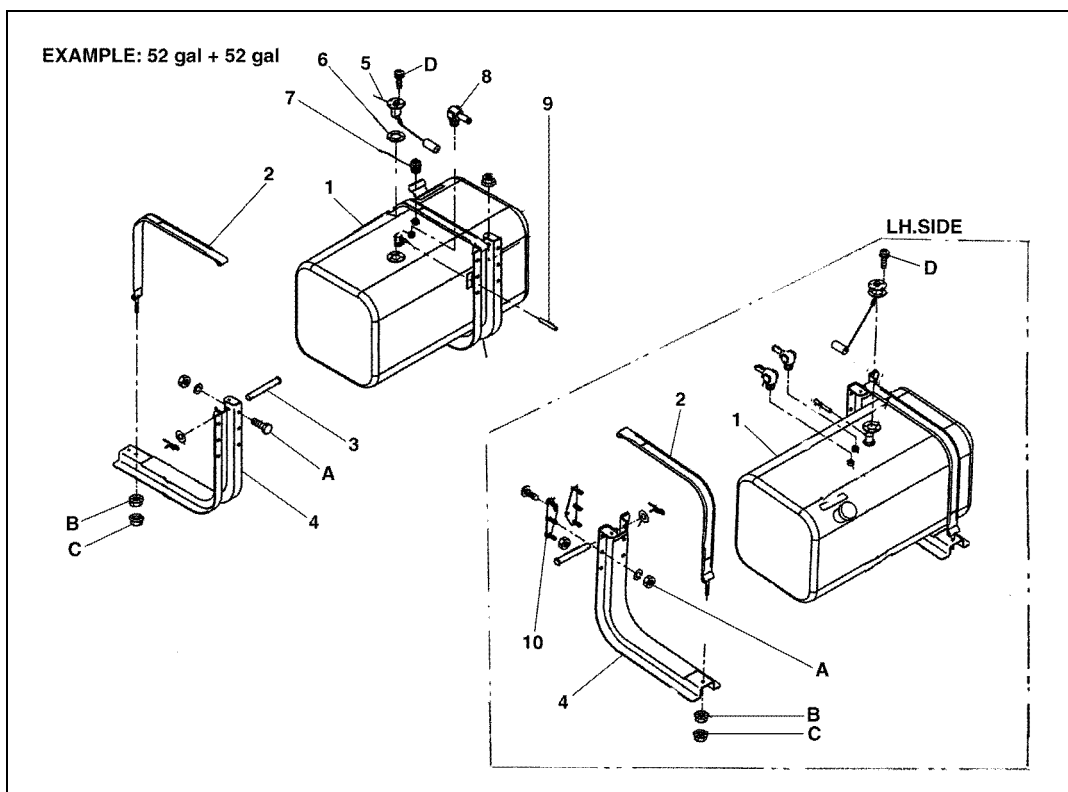
SAPH011060700072

1	Body	6	Valve
2	Insert	7	Spring
3	Plug	8	Plug
4	Pipe	9	O-ring
5	Cartridge		

FUEL TANK

COMPONENT LOCATOR

EN0110607J100006



SAPH011060700073

1	Fuel tank	6	Gasket
2	Fuel tank band	7	Plug
3	Pin	8	Joint
4	Fuel tank support	9	Hose
5	Fuel sender	10	Plate, fuel tank set

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	91.2-136.8 {930-1,396, 67-100}	C	39.4-63 {402-643, 29-46}
B	24.5-31.5 {250-320, 18-23}	D	0.5-0.7 {5-7, 0.362-0.506}



TURBOCHARGER (J08E)

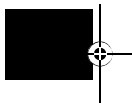
EN08-001

TURBOCHARGER.....EN08-2

DESCRIPTION EN08-2

TROUBLESHOOTING EN08-3

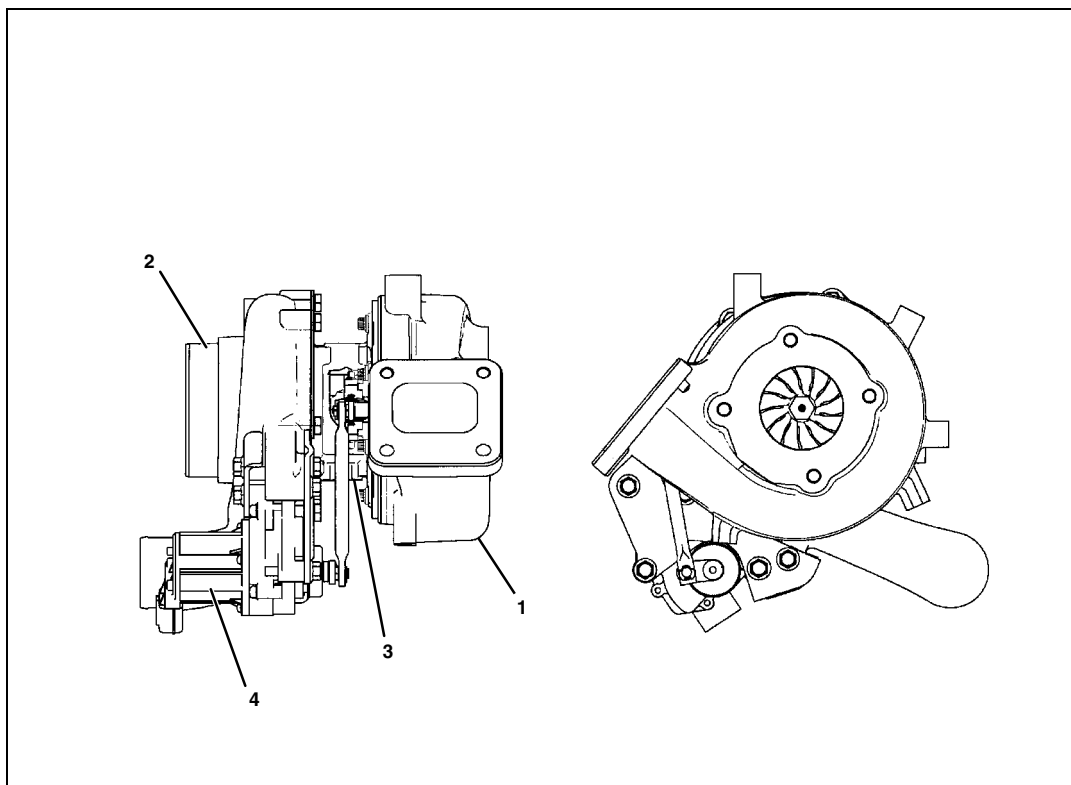
OVERHAUL CRITERIA..... EN08-12



TURBOCHARGER

DESCRIPTION

EN0110608C100001



SHTS011060800001

1	Turbine housing	3	Center housing and rotating assy
2	Compressor housing	4	Actuator assembly

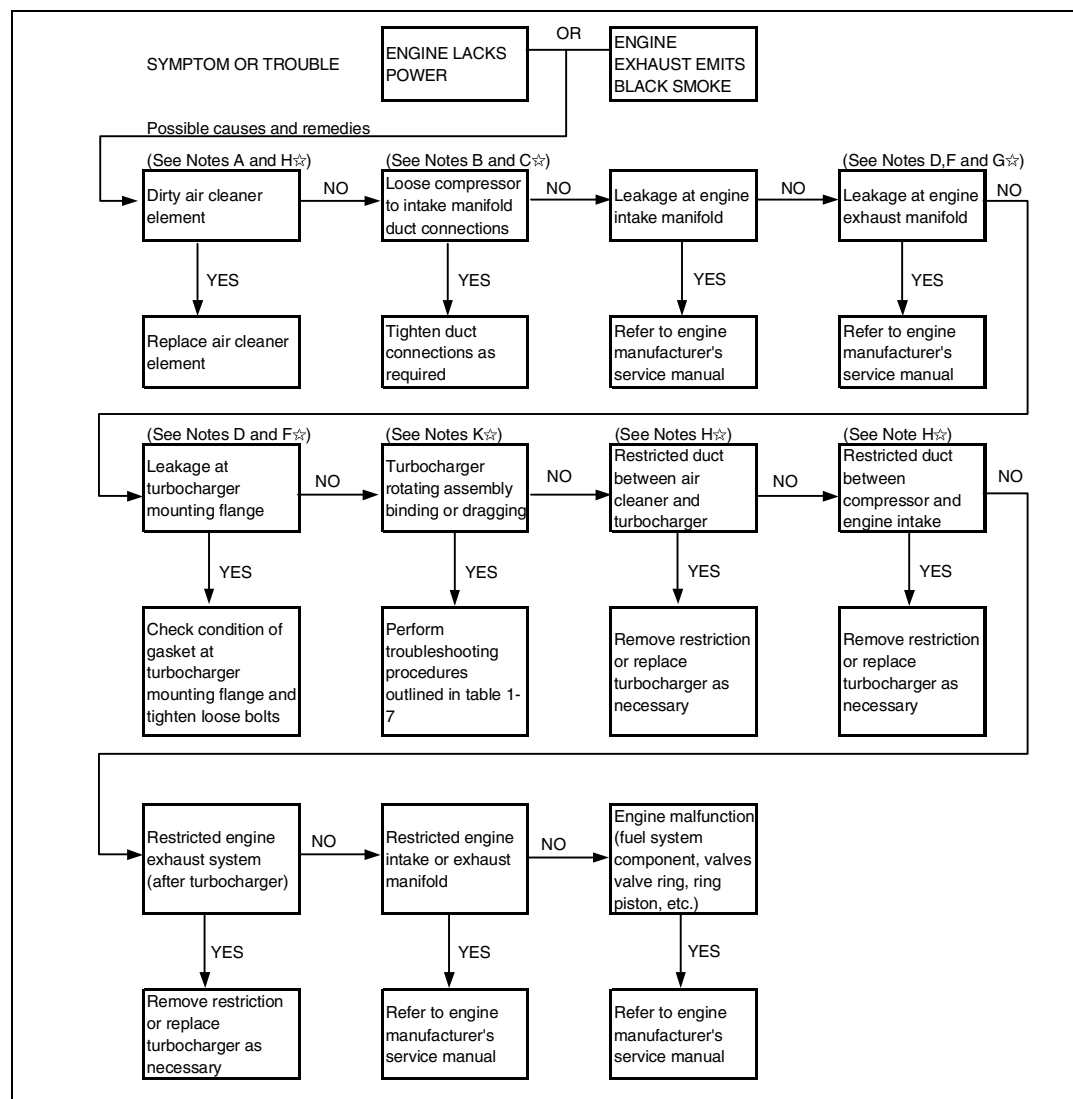
NOTICE

This turbocharger should not be disassembled unless by turbocharger manufacture. The turbocharger parts cannot be replaced.

TROUBLESHOOTING

EN0110608F300001

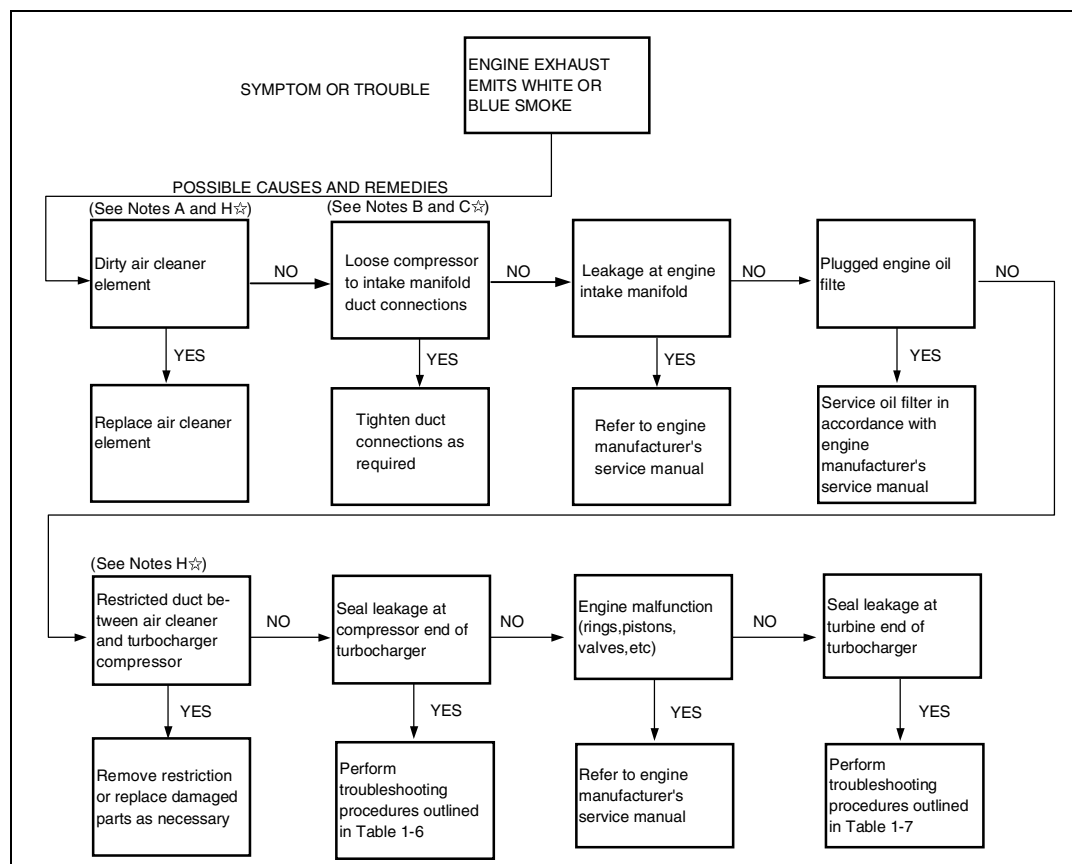
1. Table 1-1 Troubleshooting-Engine Exhaust Lacks Power or Engine Exhaust Emits Black Smoke



SHTS011060800002

☆ Shown on Table 1-9

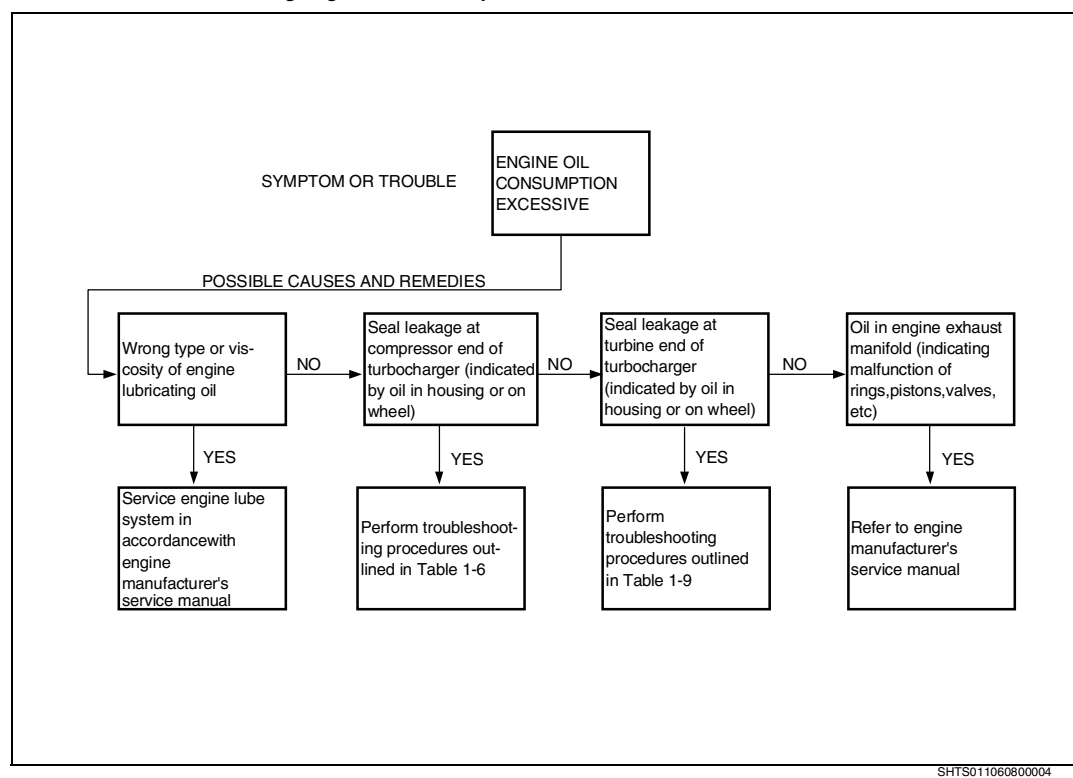
2. Table 1-2 Troubleshooting Engine Exhaust Emits WHITE or BLUE SMOKE



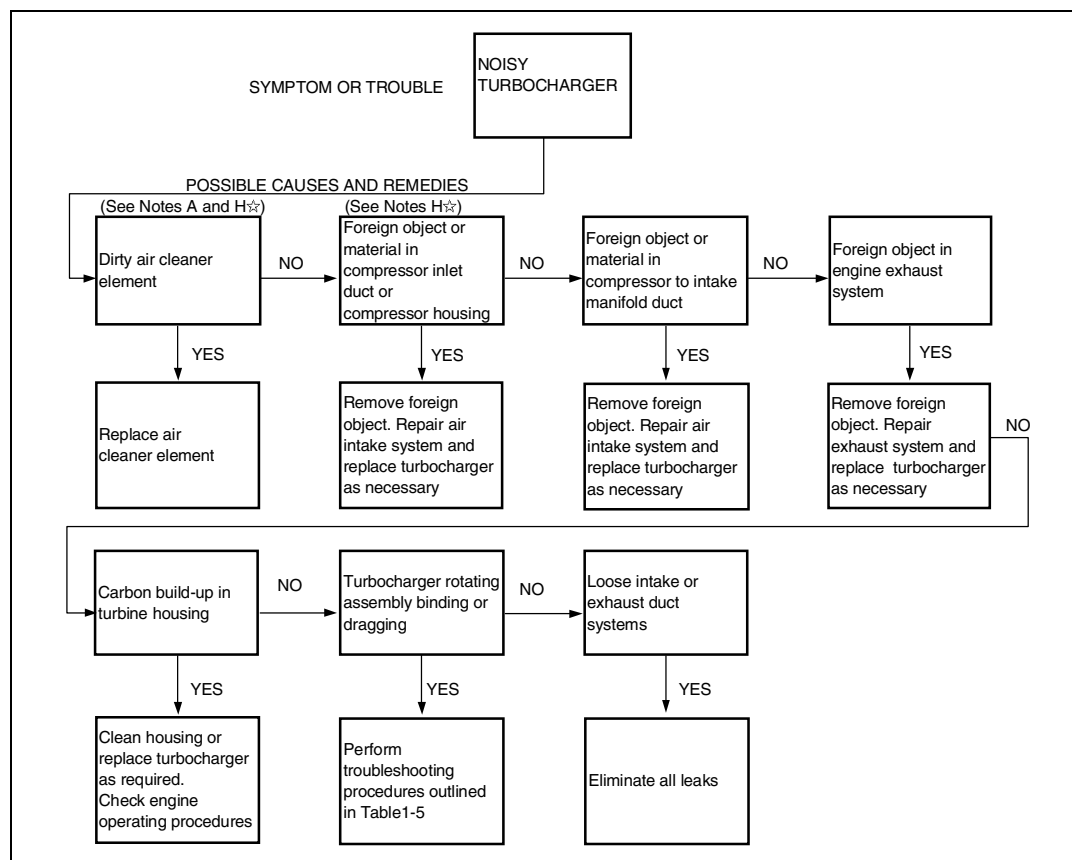
SHTS011060800003

☆ Shown on Table 1-9

3. Table 1-3 Troubleshooting Engine Oil Consumption Excessive



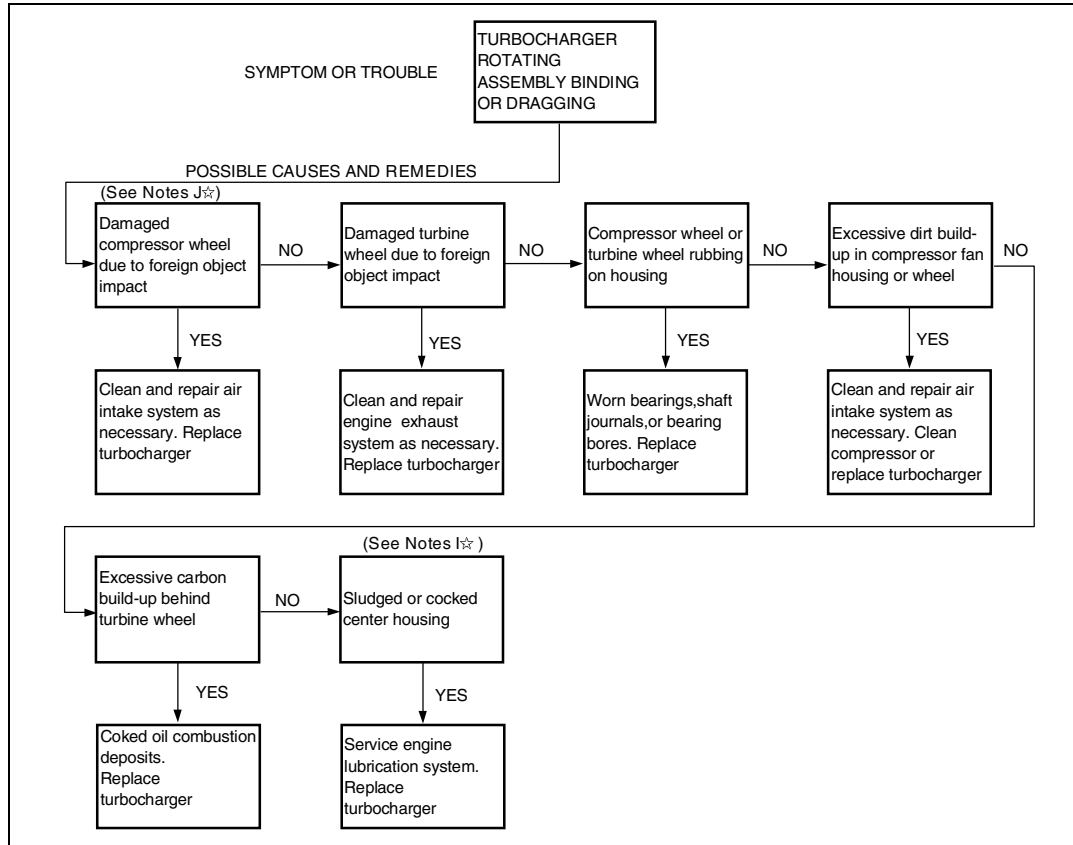
4. Table 1-4 Troubleshooting Noisy Turbocharger



SHTS011060800005

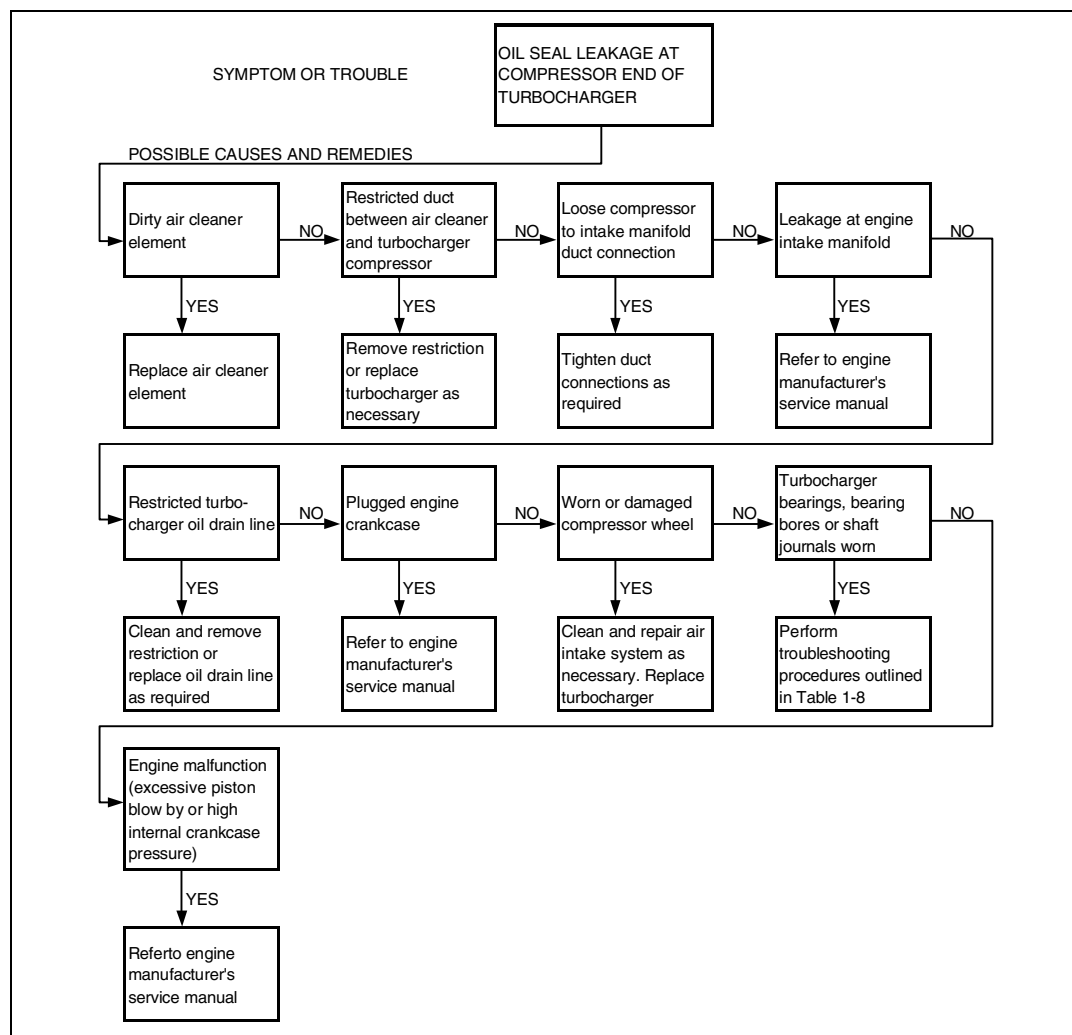
☆ Shown on Table 1-9

5. Table 1-5 Troubleshooting Turbocharger Rotating Assembly Binding or Dragging



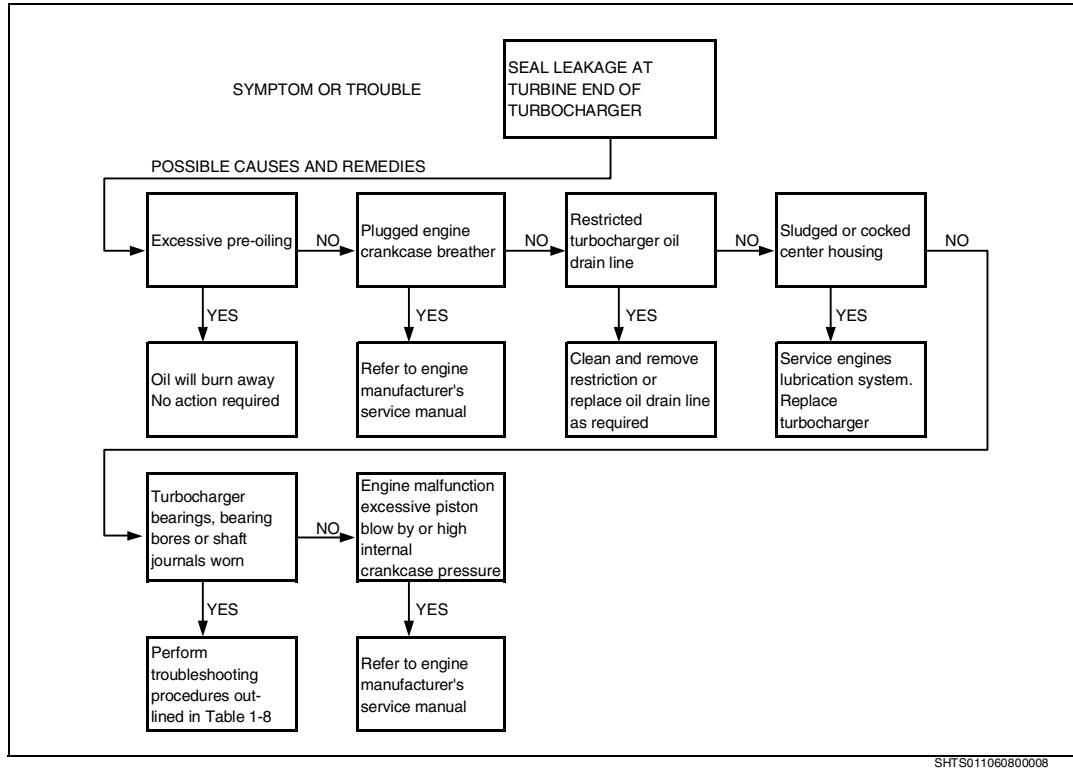
☆ Shown on Table 1-9

6. Table 1-6.Troubleshooting-Seal Leakage at Compressor End of Turbocharger

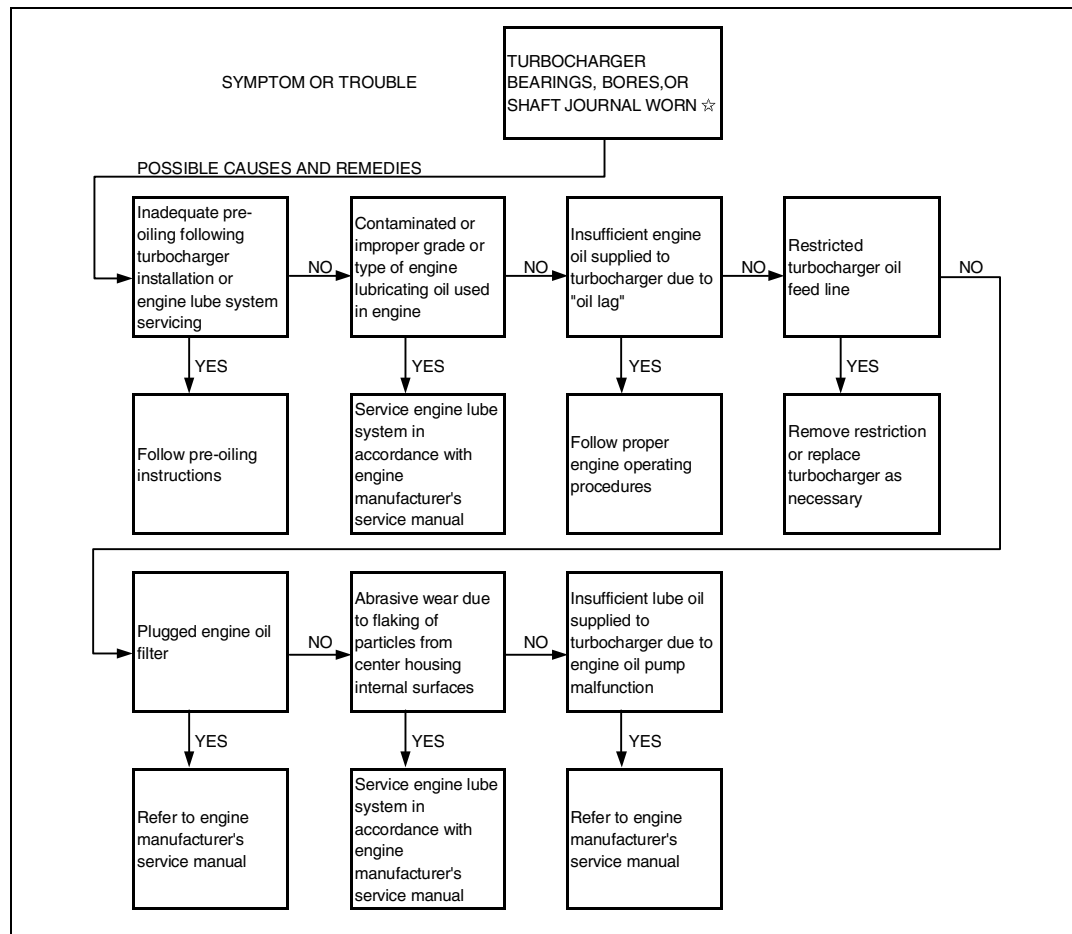


SHTS011060800007

7. Table 1-7.Troubleshooting-Seal Leakage at Turbine End of Turbocharger



8. Table 1-8.Troubleshooting-Turbocharger Bearings, Bores, or Journals are Worn



SHTS011060800009

☆ Replace turbocharger, then use this table to determine cause of failure.

9. Table 1-9. Troubleshooting Procedures Notes

A	Refer to engine manufacturer's service manual for inspection requirements and replacement specifications.
B	With engine stopped, check duct clamping devices for tightness.
C	With engine running at idle speed, lightly spray duct connections with starting fluid. Leaks at connections will be indicated by an increase in engine speed due to the starting fluid being drawn into the compressor and pumped into the engine combustion chambers.
D	With engine running at idle speed, check duct connections for leaks by applying lightweight oil or liquid soap to areas of possible leakage and checking for bubbles. Exhaust gas leakage between the engine block and the turbocharger inlet will also create a noise level change.
E	With engine running at idle speed, check for unusual noise and vibration. If either condition is noted, shut down the engine immediately to protect the turbocharger and engine from further damage. With the engine stopped, check the turbocharger shaft wheel assembly for damage as outlined Note I, below.
F	With engine running, a change in the noise level to a higher pitch can indicate air leakage between the air cleaner and the engine or a gas leak between the engine block and the turbocharger inlet.
G	Exhaust gas leakage may be indicated by hat discoloration in the area of the leak.
H	With the engine running, noise level cycling from one level to another can indicate a plugged air cleaner, a restriction in the air-cleaner to compressor duct, or a heavy build-up of dirt in the compressor housing or on the compressor wheel.
I	Internal inspection of the center housing can be accomplished by removing the oil drain line and looking through the oil drain opening. When a slugged or cocked condition exists, a heavy sludge build-up will be seen on the shaft between the bearing journals and in the center housing from the oil drain opening back to the turbine end.
J	Thorough cleaning of the air intake system is essential following compressor wheel damage due to foreign object impact. In many cases, metal pieces from the wheel become imbedded in the air cleaner element. If the element is not changed, these metal pieces can be drawn into the replacement turbocharger and cause it to fail in the same manner as the original unit.
K	With the air inlet and exhaust gas ducting removed from the turbocharger, examine both the compressor and turbine wheels for blade damage. Examine the outer blade tip edges for evidence of rubbing on housing surfaces.

- Turn the rotating assembly by hand and feel for dragging or binding. Push the rotating assembly side-ways while rotating to feel for wheel rub. If there is any indication of rubbing, perform the bearing clearance inspection procedure. If the rotating assembly rotates freely and there is no evidence of binding or rubbing, it can be assumed that the turbocharger is serviceable.

OVERHAUL CRITERIA

EN0110608H300001

1. CONDITIONS WHICH DETERMINE WHEN A TURBOCHARGER OVERHAUL MAY BE NEEDED ON ENGINE TROUBLESHOOTING.

The most common symptoms of turbocharger failure are related to engine performance:

- Lack of power
- Excessive exhaust smoke
- Unusual noise
- Excessive oil or fuel consumption.

NOTICE

Any of these symptoms could be the result of an internal engine problem, and might not involve the turbocharger at all.

2. EXAMINE THE TURBOCHARGER EXTERIOR AND INSTALLATION.

⚠ WARNING

Do not work on the turbocharger while it could be still hot. This can result in personal injury.

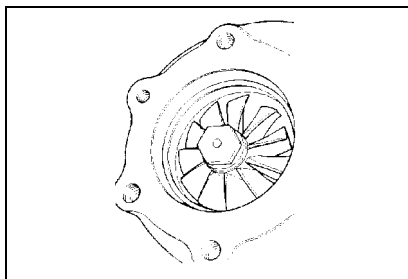
Visually check for:

- Missing or loose nuts and bolts.
- Loose or damaged intake and exhaust pipe.
- Damaged oil supply and drain lines.
- Cracked or deteriorating turbocharger housings.
- External oil or coolant leakage.

Correct any installation problems. If turbocharger parts are damaged, the unit should be overhauled after completion of the remainder of this troubleshooting procedure.

⚠ WARNING

Operation of the turbocharger without the intake pipe and air cleaner connected can result in personal injury and damage to equipment from foreign objects entering the turbocharger.



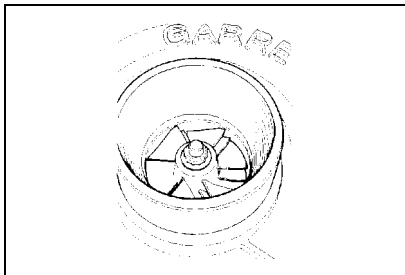
SHTS011060800010

3. INSPECTION TURBINE WHEEL AND HOUSING.

Remove the duct from the turbine outlet. Using a flash-light, check the turbine for wheel to housing rub, evidence of oil leakage or foreign object damage. Foreign object damage to the turbine is not usually visible through the turbine outlet unless the damage is severe.

- (1) Wheel to housing rub
 - a. If wheel rub is found, and the housing attaching hardware is secure, then the turbocharger is probably damaged internally and must be overhauled.
- (2) Oil leakage
 - a. If oil deposits are found, determine whether the oil has come from, the engine exhaust or from the turbocharger center housing.
 - b. If the oil has come from the engine, consult the chapter "**ENGINE MECHANICAL**" and correct the problem. If oil deposits on the wheel are heavy, the turbocharger should be disassembled, cleaned, and overhauled if necessary.

- (3) Foreign object damage
 - a. If foreign object damage to the turbine is visible, the turbocharger must be overhauled. Such damage destroys the wheel's balance and causes internal damage to the seal bores and journal bearings. Be sure to find the source of the foreign object. In many cases, the object has come out of the engine, and there may be engine damage as well.



SHTS011060800011

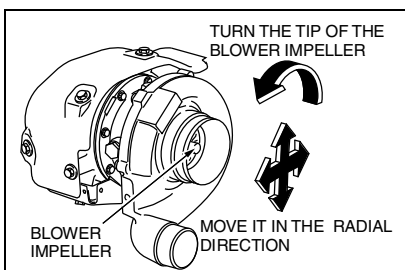
4. EXAMINE COMPRESSOR WHEEL AND HOUSING.

Remove the duct from the compressor inlet. Using a flashlight, check the compressor for wheel to housing rub, evidence of oil leakage, or foreign object damage.

- (1) Wheel to housing rub
If wheel rub is found, and the housing attaching hardware is secure, then the turbocharger is probably damaged internally and must be overhauled.
- (2) Oil leakage
Oil leakage into the compressor can be caused by:
 - a. Long periods of idling on a restricted oil drain line.
 - b. Oil leakage into the compressor can also be caused by a restricted air intake system.
 - c. Oil leakage into the compressor can be caused by frequent use of the engine as a brake. In this case, nothing is wrong with either the engine or the turbocharger, but frequent compressor wheel and housing clean-up is recommended.
- (3) Foreign object damage
If the compressor wheel has been damaged by a foreign object, the turbocharger must be overhauled.

5. SIMPLE INSPECTION OF THE TURBINE SHAFT

- (1) Holding the blower impeller tip, inspect for rotating condition by lightly rotating the turbine shaft by hand.
- (2) If the turbine shaft does not rotate or does not rotate smoothly, or the blower impeller contacts with the blower case, replace the turbocharger assembly.



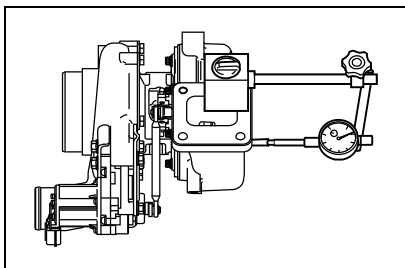
SHTS011060800012

6. INSPECTING THE TURBINE SHAFT PLAY IN THE AXLE (THRUST) DIRECTION

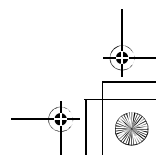
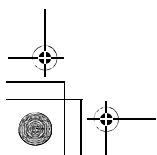
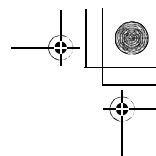
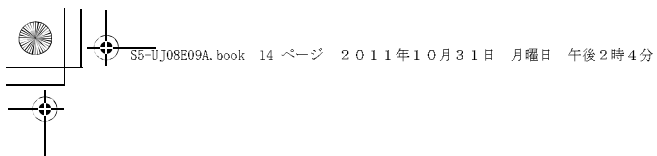
- (1) Inspect the turbine shaft play on the exhaust side.
- (2) If a measurement reading exceeds the standard value, replace the turbocharger assembly.
Standard value: 0.165 mm {0.0036 in.} or less

⚠ CAUTION

Turbocharger is replaced as assembly. Do not overhaul.



SHTS011060800013



EMISSION CONTROL (J08E)

EN10-001

EGR VALVE AND EGR PIPE.....EN10-2

COMPONENT LOCATOR..... EN10-2

EGR VALVE.....EN10-3

DESCRIPTION EN10-3

DISMOUNTING AND MOUNTING EN10-4

CLOSED VENTILATOREN10-7

DESCRIPTION EN10-7

REPLACEMENT OF CLOSED VENTILATOR . EN10-7

SELECTIVE CATALYTIC

REDUCTION (SCR)EN10-8

GENERAL DESCRIPTION EN10-8

COMPONENT LOCATOR..... EN10-10

DISMOUNTING AND MOUNTING EN10-11

INSPECTION AND REPAIR EN10-26

BURNER SYSTEM.....EN10-27

COMPONENT LOCATOR..... EN10-27

BURNER SYSTEM WARNING AND

CAUTION EN10-28

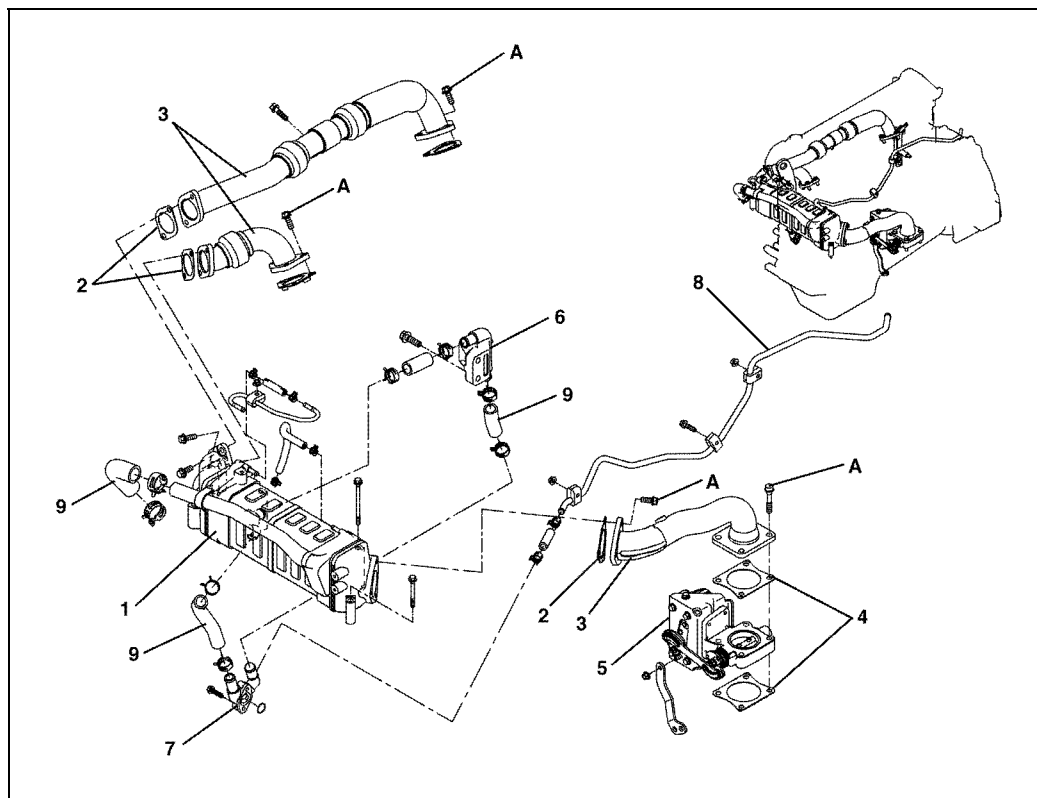
DISMOUNTING AND MOUNTING EN10-29

INSPECTION AND REPAIR EN10-38

EGR VALVE AND EGR PIPE

COMPONENT LOCATOR

EN0110610J100001



SHTS011061000001

1	EGR cooler sub assembly	6	Water pipe sub assembly
2	Gasket	7	Water pipe sub assembly
3	EGR pipe assembly	8	Water pipe
4	Gasket	9	Water hose
5	EGR valve		

Tightening torque

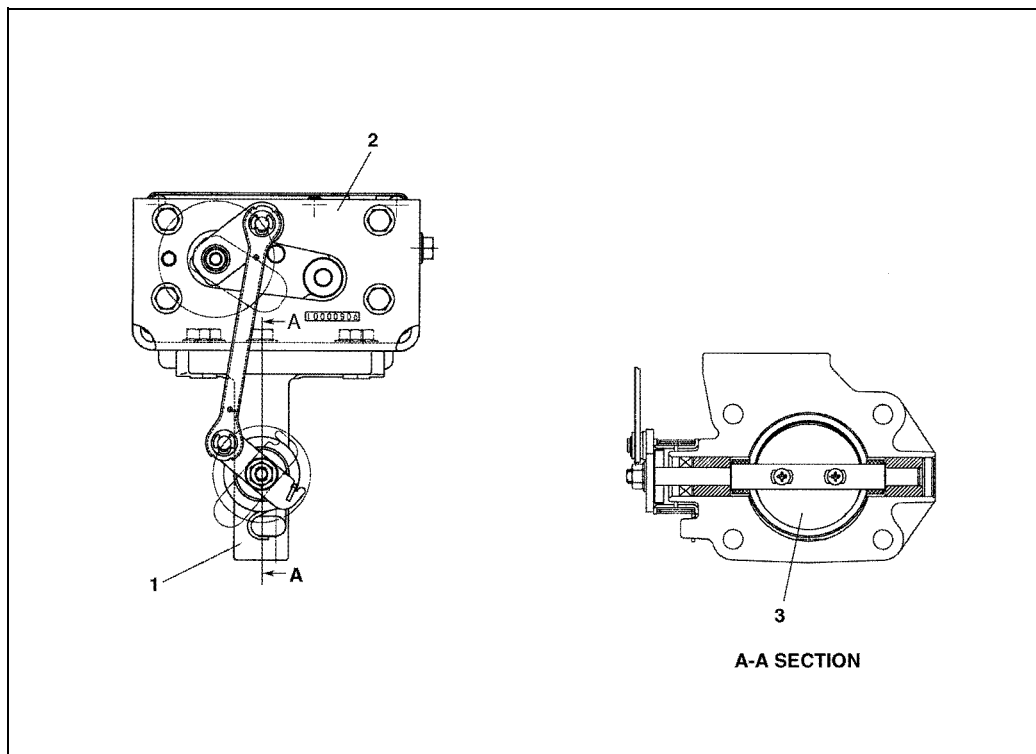
Unit: N·m {kgf·cm, lbf·ft}

A	55 {560, 40}
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EGR VALVE

DESCRIPTION

EN0110610J100002

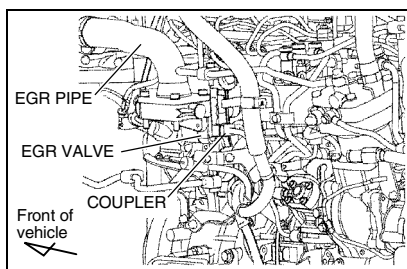


SHTS011061000002

1 EGR valve assembly	3 Butterfly valve
2 DC Motor	

DISMOUNTING AND MOUNTING

EN0110610H200001



SHTS011061000003

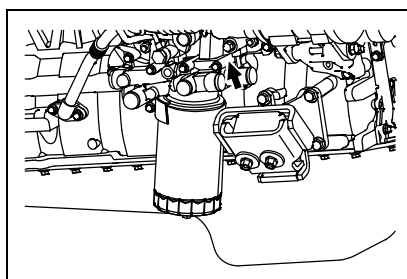
IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE EGR VALVE AND EGR COOLER.

NOTICE

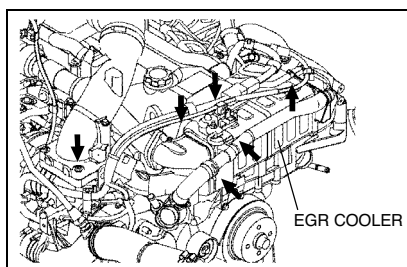
To prevent burns ensure the engine is cold before changing the valve.
(At least 30 minutes after switching off the engine)

- (1) Disconnect the harness coupler.



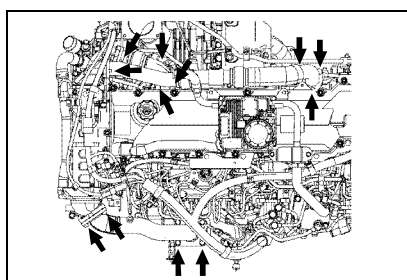
SHTS011061000004

- (2) Drain the coolant out of the drain plug of oil cooler situated on the right side of the engine.



SHTS011061000005

- (3) Disconnect and remove all pipes connected to the EGR pipe as well as coolant hose and related parts.



SHTS011061000006

- (4) Remove EGR pipe.
- (5) Remove EGR cooler sub assembly.
- (6) Remove EGR valve from intake pipe.

NOTICE

- If you have to place your feet on the engine while working on it, be careful not to fall off the engine or get your foot caught in the engine parts.
- Be careful not to step on the EGR valve when servicing the engine.
- Do not loosen or tighten the bolts and nuts securing the EGR valve components; otherwise, the valve will not perform properly. If you remove the nuts and bolts and dismantle a component, do not re-assemble it; instead, replace the valve with a new one.
- Be careful not to hit the EGR valve lever with a tool when you are removing or installing the valve.

2. INSPECT THE EGR COOLER.

- (1) Visually inspect cracks or clogging in the main body gas passage and sub-coolant piping. In case a trouble is found, replace the EGR cooler with a new one.

IMPORTANT POINTS - MOUNTING

1. INSTALL THE EGR VALVE.

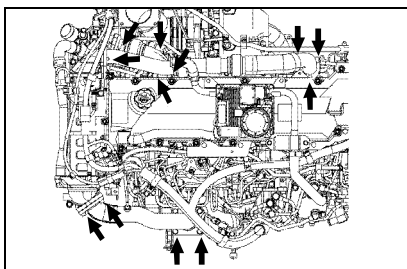
- (1) Install the EGR valve to the intake pipe.
- (2) Install the EGR cooler.
- (3) Install the EGR pipe.

Tightening Torque:

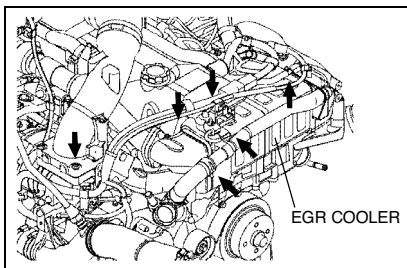
55 N·m {560 kgf-cm, 40 lbf-ft}

NOTICE

Fit the exhaust manifold gasket with the claw of the gasket facing down.



SHTS011061000007



SHTS011061000008

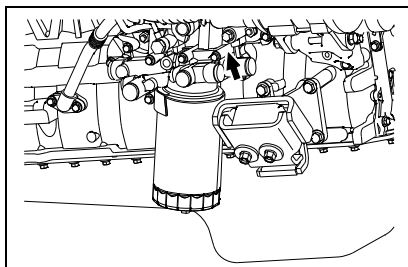
- (4) Connect and install all pipes connected to the EGR pipe as well as coolant hose and related parts.

NOTICE

Install all pipes with new gasket.

EN10-6

EMISSION CONTROL (J08E)

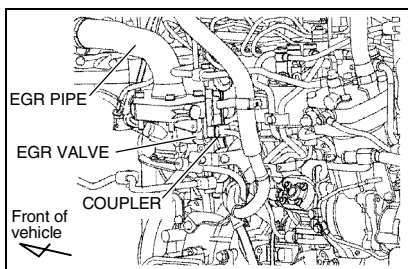


SHTS011061000009

- (5) Close the coolant plug of the oil cooler situated on the right side of the engine.

NOTICE

Fit the exhaust manifold gasket with the claw of the gasket facing down.



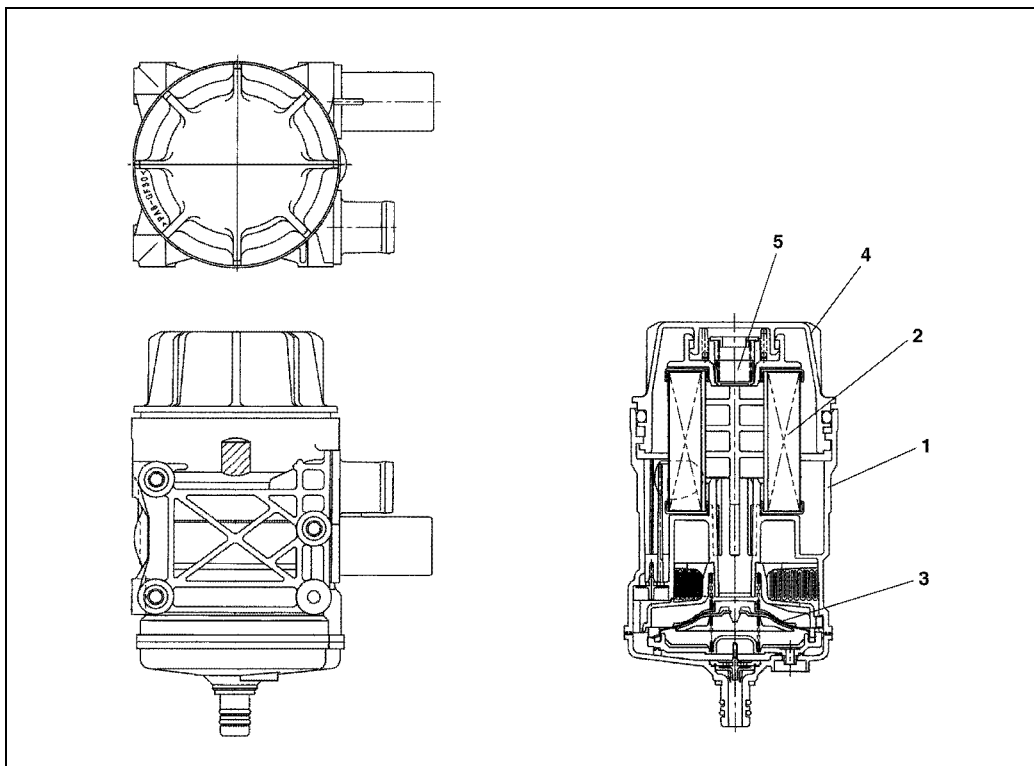
SHTS011061000010

- (6) Connect the harness coupler.

CLOSED VENTILATOR

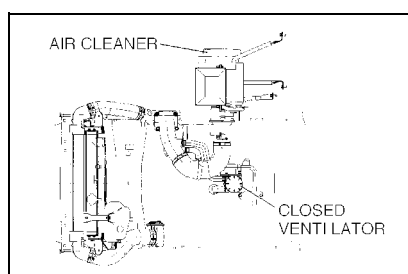
DESCRIPTION

EN0110610C100001



SHTS011061000011

1	Body	4	Cap
2	Filter	5	Safety valve
3	PCV valve		



SHTS011061000012

REPLACEMENT OF CLOSED VENTILATOR

EN0110610H200002

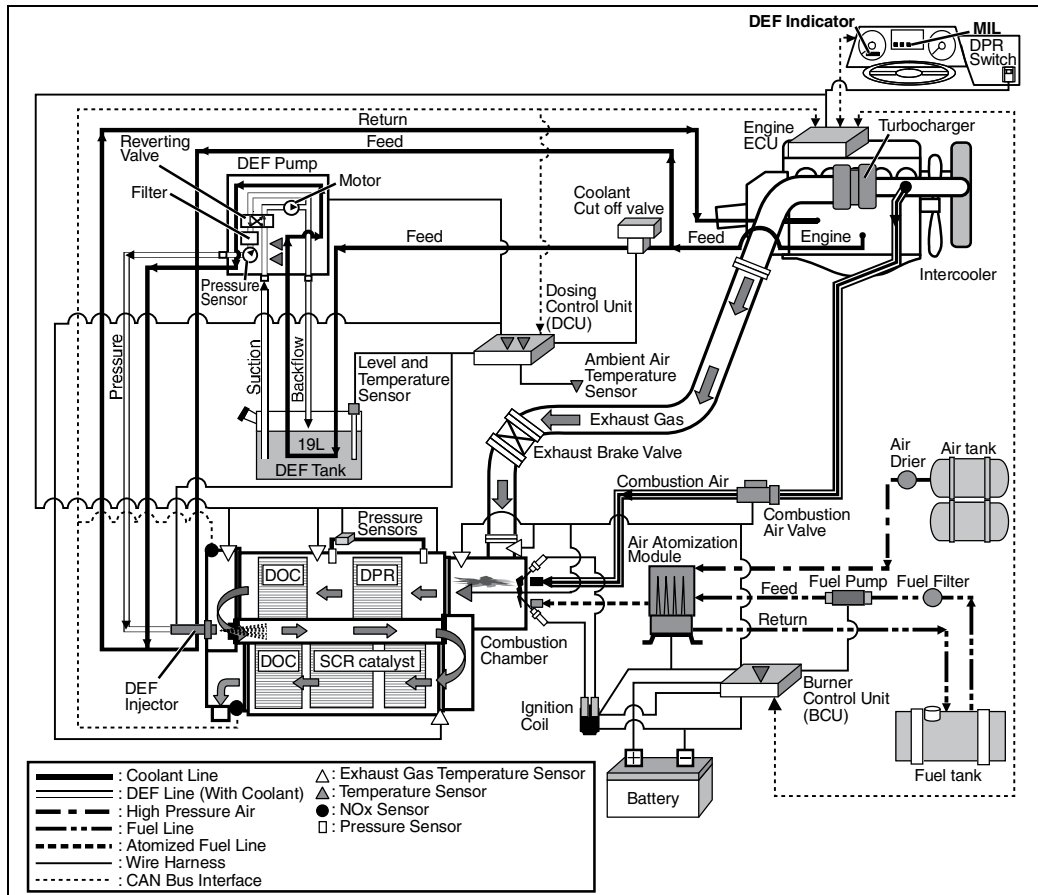
1. **REMOVE THE CLOSED VENTILATOR.**
 - (1) Remove the hoses and then the closed ventilator.
2. **INSTALL THE CLOSED VENTILATOR.**
 - (1) Connect the hoses and install the closed ventilator.

SELECTIVE CATALYTIC REDUCTION (SCR)

GENERAL DESCRIPTION

EN0110610C100002

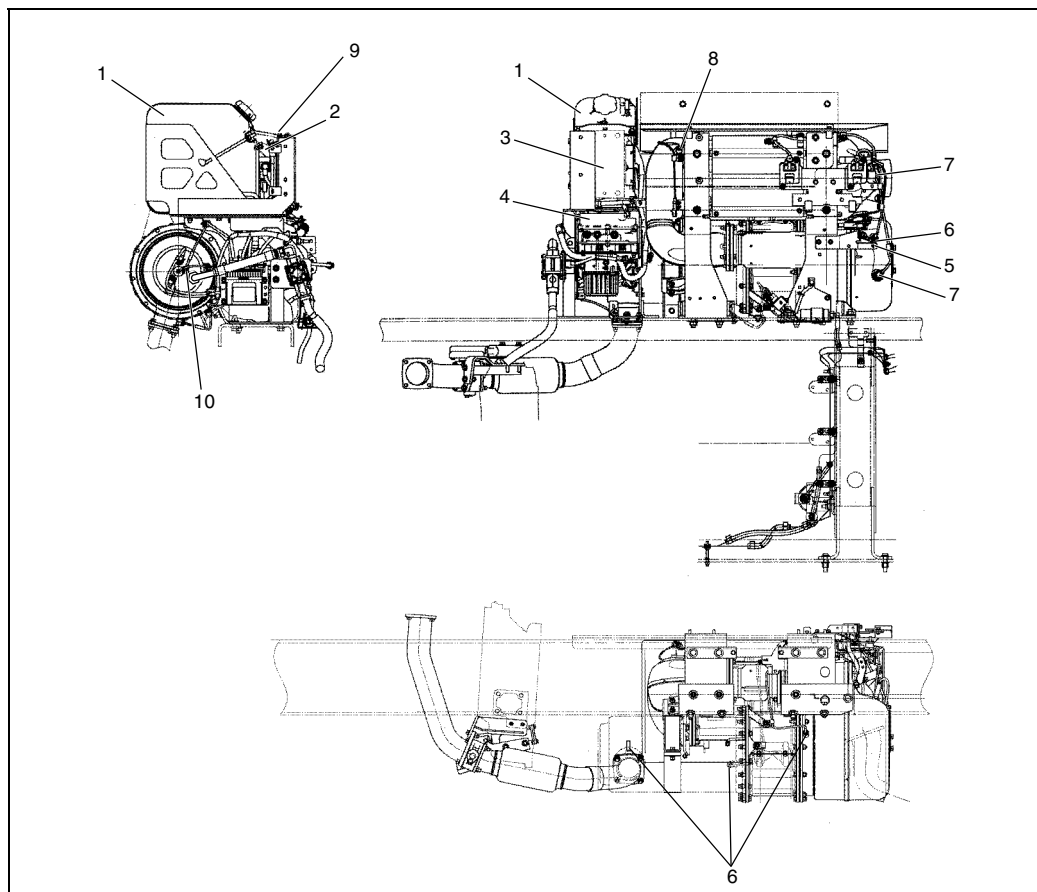
- What is SCR?
SCR is an abbreviation of "Selective Catalytic Reduction", a general term for aftertreatment equipment which promotes a chemical reaction by using a catalyst for eliminating or detoxifying particular chemical ingredients. To meet the EPA2010 regulation the vehicle out NOx level will be extremely close to zero (0.2 Grams per brake horsepower). By mixing the NOx with the ammonia contained in DEF, it will be separated it to harmless water and nitrogen. It is an extremely effective, dependable efficient and economical selection.
- What is DEF?
DEF is an abbreviation for "Diesel Exhaust Fluid", a solution made from 67.5% purified water and 32.5% automotive-grade urea that serves as a carrying agent for the ammonia needed to reduce nitrogen oxide (NOx) emissions from diesel engines. When DEF is injected into the engine exhaust gas downstream of the DPF, it will be rapidly hydrolyzed producing the oxidizing ammonia needed by the SCR catalyst to complete NOx emissions reductions.
- The system consists of the DEF adding device and its accessories, SCR (Selective Catalytic Reduction) catalyst, DCU, and sensors.



SHTS011061000013

COMPONENT LOCATOR

EN0110610J100003



SHTS011061000014

1	DEF tank	6	Exhaust gas temperature sensor
2	DEF level sensor	7	NOx sensor
3	DCU (Dosing control unit)	8	SCR catalyst inlet temperature sensor
4	DEF pump	9	Ambient temperature sensor
5	DEF injector	10	Burner flame temperature sensor

DISMOUNTING AND MOUNTING

EN0110610H100001

1. PREPARATION

WARNING

Do not touch the exhaust pipe and muffler unit when it could be hot. You can be severely burned.

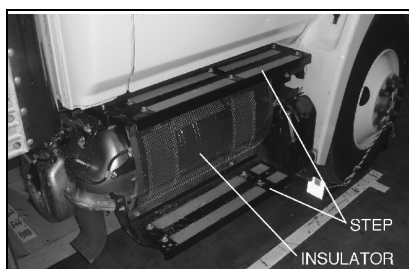
NOTICE

- If the quick joint used in DEF piping is once removed, DEF powder will precipitate on the seal surface and leakage may occur after reconnection. Before reconnecting, thoroughly check the crystallize (=urea) for deposition of crystallized urea and foreign matter. If deposition of crystallized urea is found, wash it with hot water.
- If you perform work with after-run not finished, an DEF filled in the pipe will flow out when the quick connector is disconnected. Be sure that after-run is finished.
- What is after-run?
Remained DEF in the DEF injector, DEF pump and plumbing is returned to DEF tank after engine off in order to prevent DEF frozen in the plumbing and crystallization.
- If you perform work immediately after the engine is stopped, hot coolant may spout and you may get burned.
Before performing work, be sure that engine coolant is thoroughly cooled.
- Formed tubes are used for DEF plumbing. Do not apply an excessive force to tubes when working. If a tube is bent, must to be replaced.
- Do not directly touch an DEF or coolant flowing out from the plumbing. If you have touched it, thoroughly rinse it out.
- After removal, place a plastic cover to avoid entry of foreign matter into the pipe.
- Place a cover immediately after removing the joint to avoid entry of foreign matter into the DEF tank, DEF pump, and DEF injector.
- When covering, use separate covers to avoid mixing of DEF and coolant.
- If removed by forcing, the quick connector may be damaged. If removal is difficult to do, do not apply an excessive force but remove dust attached around the joint.
- The coolant pipe and DEF pipe are assembled for piping. Do not disassemble them.
- Do not use tools when disconnecting the quick connector.
- Perform work with all the harness connectors fitted. If you perform work with connectors removed, rusting may result. Cover the connectors to avoid splashing of coolant and DEF.

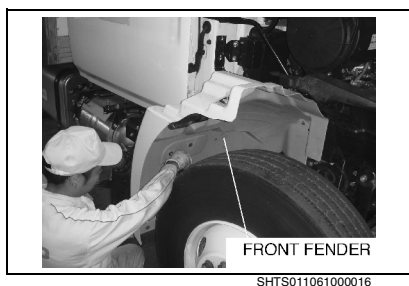
- (1) Disconnect the battery ground terminal.

CAUTION

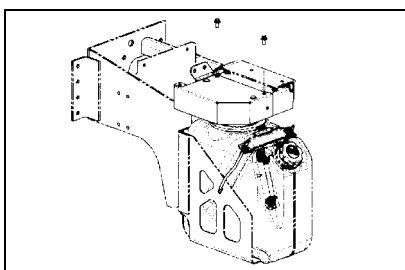
- **Be sure to disconnect the battery terminals from the battery in accordance with the procedures in this manual and never use the battery disconnect switch when it is necessary to break the supply of electricity completely. Otherwise, electricity may remain supplied from the battery by the circuit that bypasses the battery disconnect switch and you may get burns or injury from the electricity.**



- (2) Dismount the steps (top and bottom) and insulator on the right side of the vehicle.



- (3) Dismount the front fender.



SHTS011061000017

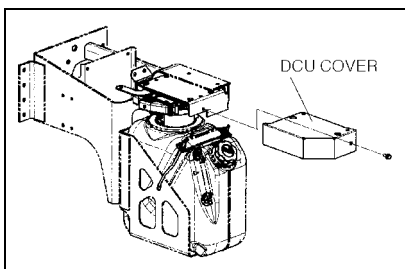
2. DOSING CONTROL UNIT (DCU)

(1) IMPORTANT POINT - DISMOUNTING

- a. Remove the bolt and then the DCU cover.

⚠ CAUTION

When dismantling/mounting the DCU, wear the glove to avoid injury.

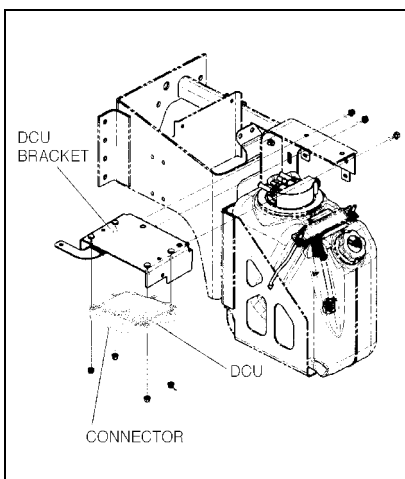


SHTS011061000018

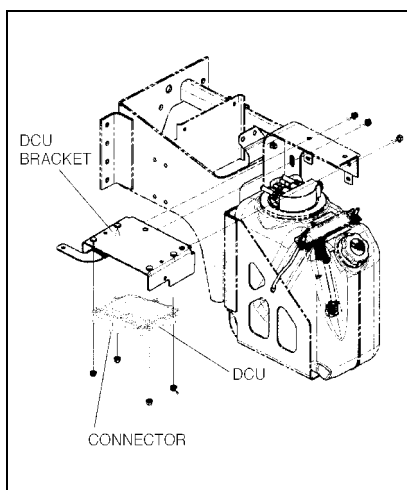
- b. Disconnect the harness connectors (53 pin and 86 pin) from the DCU.

NOTICE

- Pull the tab on the connector side surface to remove the connector.
 - Do not touch the connector pin with bare hand.
 - Do not have an impact on DCU. If dropping the DCU, do not reuse it because of concern that inside of DCU is damaged.
 - Protect the removed connectors from dirt and dust.
- c. Remove the DCU bracket mounting nut. Dismount the DCU along with the bracket.
 - d. Remove the nut and then dismount the DCU from the bracket.



SHTS011061000019



SHTS011061000020

(2) IMPORTANT POINT - MOUNTING

- a. Mount the DCU to the DCU bracket and then mount the assembly to the vehicle.

Tightening Torque:

8-12 N·m {82-122 kgf·cm, 6-8 lbf·ft} (DCU)

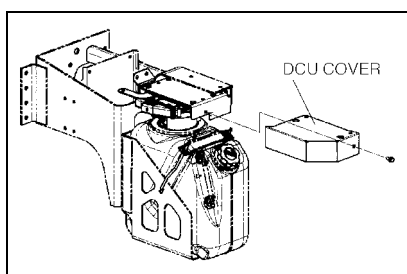
Tightening Torque:

18-26 N·m {184-265 kgf·cm, 14-19 lbf·ft} (DCU bracket)

- b. Connect the harness connectors (53 pin and 86 pin) to the DCU.

NOTICE

Press the tab on the connector side surface until a "click" is heard.

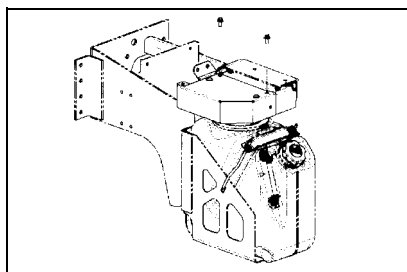


SHTS011061000021

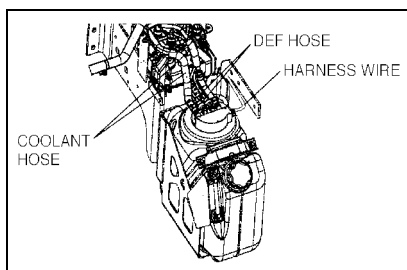
- c. Mount the DCU cover.

Tightening Torque:

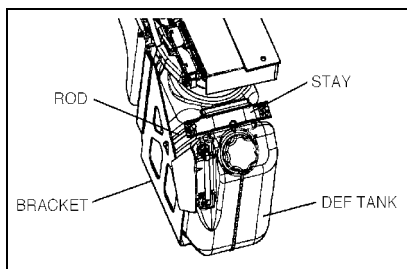
18-26 N·m {184-265 kgf·cm, 14-19 lbf·ft}



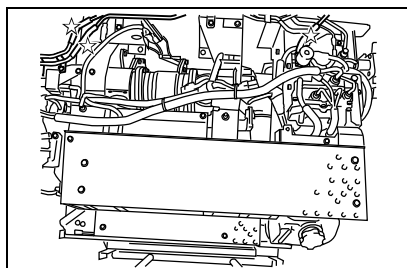
SHTS011061000022



SHTS011061000023



SHTS011061000024



SHTS011061000025

3. DEF TANK

(1) IMPORTANT POINT - DISMOUNTING

- a. Dismount the DCU.
Refer to "DOSING CONTROL UNIT (DCU)" for details.
- b. Remove the drain plug from the DEF tank to drain the DEF.

- c. Remove the nut and then the stay and rod from the bracket.

- d. Move the DEF tank toward outside the vehicle and remove the coolant and DEF hoses.

NOTICE

Remove the coolant hose first to prevent the coolant residue in the hose from entering the DEF tank via the DEF hose connection when removing it.

HINT

Coolant will spout if the coolant hose is removed. Drain coolant beforehand or block the hose with the vice grip plier. If you use the vice grip at the ☆ area as shown in the figure below, you can minimize leakage of coolant.

- e. Disconnect the harness connector and then remove the DEF tank.

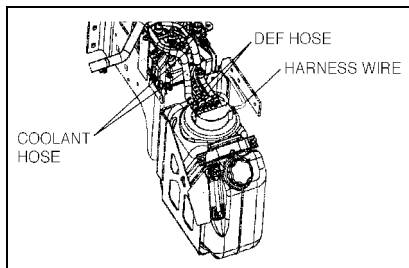
NOTICE

- Remove the harness connector last to prevent the coolant and DEF residues in the coolant and DEF hoses from wetting the harness connector terminal.
- Protect the removed connector from dirt and dust.

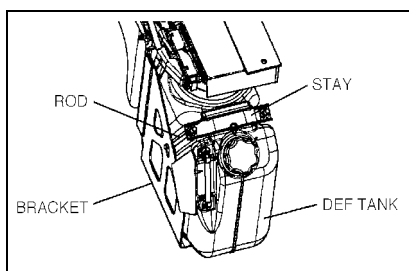
- (2) IMPORTANT POINT - MOUNTING
- Set the DEF tank on the bracket.
 - Mount the coolant and DEF hoses.
 - Connect the harness connector.

NOTICE

Tighten clockwise the connector connecting to the DEF sensor until a "click" is heard.



SHTS011061000026



SHTS011061000027

- Fix the DEF tank with the rod, stay and nut.
- Tightening Torque:**
21.7-30.3 N·m {222-308 kgf·cm, 16-22.3 lbf·ft}
- Mount the drain plug to the DEF tank. Pour the DEF.

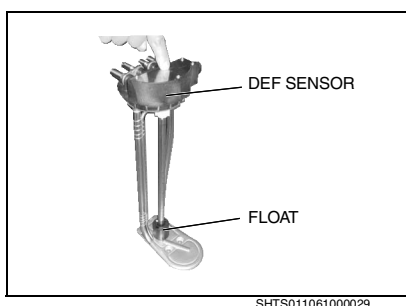
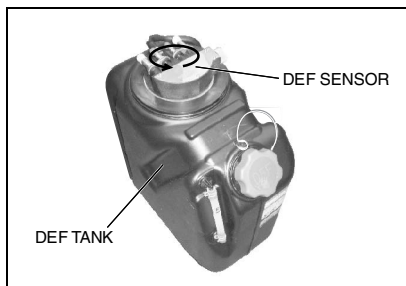
(3) MOUNTING/DISMOUNTING AND INSPECTING DEF SENSOR

⚠ WARNING

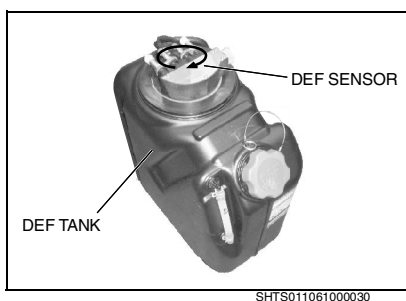
- If the DEF is frozen, do not mount or dismount the DEF sensor.
- Do not allow foreign objects to enter the DEF tank from the opening.
 - a. Dismount the DEF tank.
Refer to "DEF TANK" for details.
 - b. Remove the DEF sensor by turning it counterclockwise.

NOTICE

- When removing, be careful not to bend the DEF sensor pipe.
- When taking out the sensor from inside the tank, be careful not to damage the sensor by hitting the tank edge.



- c. Check if the DEF sensor float moves smoothly.



- d. Insert the DEF sensor to the DEF tank. Rotate it to mount.

NOTICE

- Replace the O-ring between the tank and sensor with a new one.
- Thoroughly wipe off crystals of DEF precipitating on the mounting surface with a clean cloth.
- Check that the tank center and DEF sensor pipe center are assembled in parallel to each other.

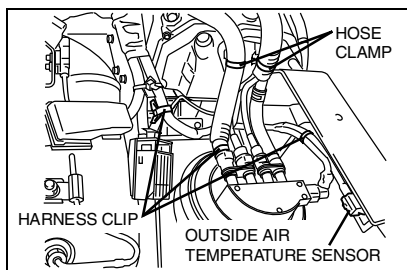
4. DEF PUMP

(1) IMPORTANT POINT - DISMOUNTING

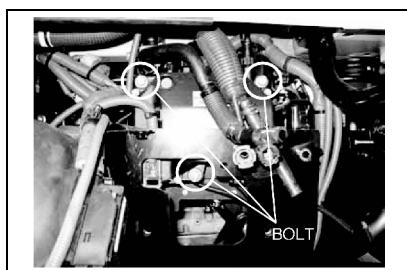
- a. Dismount the DCU.
Refer to "DOSING CONTROL UNIT (DCU)" for details.
- b. Dismount the DEF tank.
Refer to "DEF TANK" for details.
- c. Remove the ambient air temperature sensor, hose clamp and harness clip.
Remove the DEF tank bracket.
- d. Release the lock of the harness wire connector. Disconnect it from the DEF pump.

NOTICE

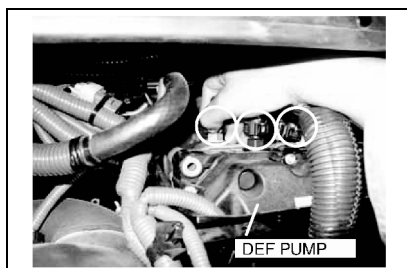
- Be careful to prevent the coolant and DEF residues in the coolant and DEF hoses from wetting the harness connector terminal.
- Protect the removed connector from dirt and dust.



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SHTS011061000033

- e. Remove the mounting bolt of the DEF pump.

- f. Remove the coolant and DEF hoses connected to the DEF pump.

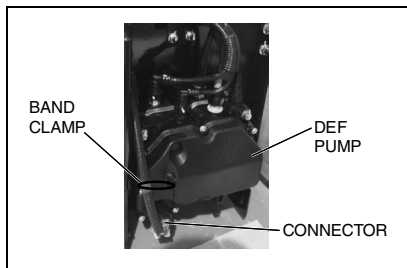
HINT

Lower the DEF pump to secure working space.

- g. Dismount the DEF pump.

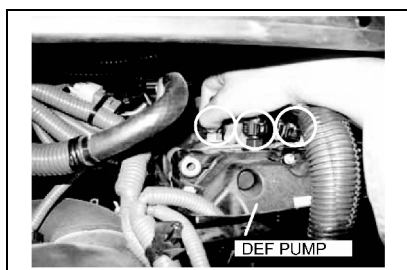
(2) IMPORTANT POINT - MOUNTING

- a. Set the DEF pump at the mounting position.
- b. Connect the harness wire connector to the DEF pump.



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- c. Mount the coolant and DEF hoses to the DEF pump.

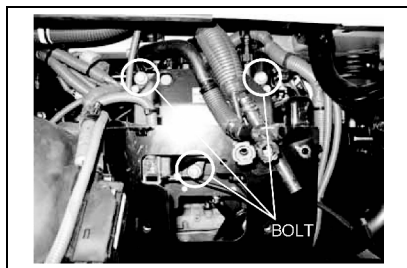


SHTS011061000035

- d. Mount the DEF pump to the specified position.

Tightening Torque:

15.2-22.8 N·m {155-232 kgf·cm, 11.2-16.8 lbf·ft}



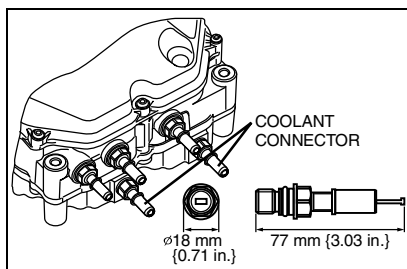
SHTS011061000036

(3) REPLACE THE COOLANT CONNECTOR OF THE DEF PUMP.

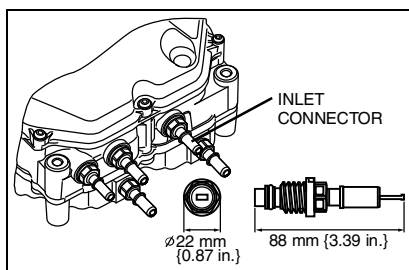
- a. When the connector is exchanged, the O-ring must not be used two times.

NOTICE

- All sealing surface must be clean, contamination or particles are not acceptable.
- Mounting torque for connector: 5.0-6.0 N·m {51-61 kgf·cm, 3.7-4.4 lbf·ft}
- Wrench size: 15 mm {0.59 in.}
- For the mounting process, oil the O-ring with Mobil velocyte oil No.61



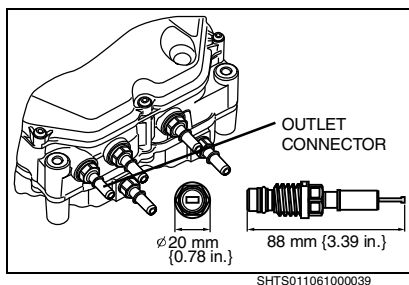
SHTS011061000037



- (4) REPLACE THE DEF INLET CONNECTOR OF THE DEF PUMP.
- When the connector is exchanged, the O-ring must not be used two times.

NOTICE

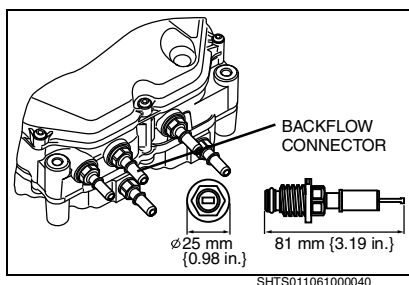
- All sealing surface must be clean. Contamination or particles are not acceptable.
- Mounting torque for connector: 4.0-5.0 N·m {41-51 kgf·cm, 3.0-3.6 lbf·ft}
- Wrench size: 17 mm {0.67 in.}
- For the mounting process, oil the O-ring with Mobil velocite oil No.61



- (5) REPLACE THE DEF OUTLET CONNECTOR OF THE DEF PUMP.
- When the connector is exchanged, the O-ring must not be used two times.

NOTICE

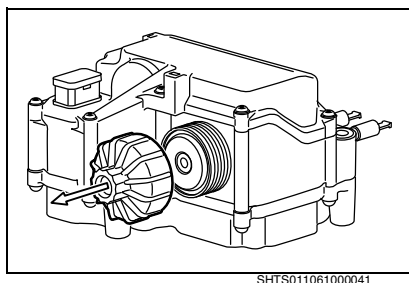
- All sealing surface must be clean. Contamination or particles are not acceptable.
- Mounting torque for connector: 4.0-5.0 N·m {41-51 kgf·cm, 3.0-3.6 lbf·ft}
- Wrench size: 17 mm {0.67 in.}
- For the mounting process, oil the O-ring with Mobil velocite oil No.61



- (6) REPLACE THE DEF BACKFLOW CONNECTOR OF THE DEF PUMP.
- When the connector is exchanged, the O-ring must not be used two times.

NOTICE

- All sealing surface must be clean. Contamination or particles are not acceptable.
- Mounting torque for connector: 4.0-5.0 N·m {41-51 kgf·cm, 3.0-3.6 lbf·ft}
- Wrench size: 17 mm {0.67 in.}
- For the mounting process, oil the O-ring with Mobil velocite oil No.61

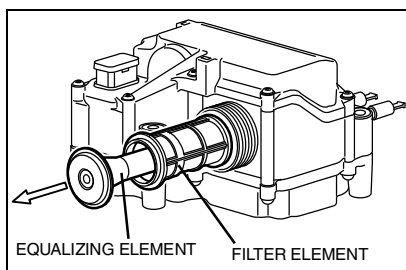


- (7) REPLACE THE DEF PUMP FILTER.
- Remove the filter cover.

NOTICE

Contamination or damage of the sealing surface on the housing is not acceptable.

Wrench size: 27 mm {1.063 in.}

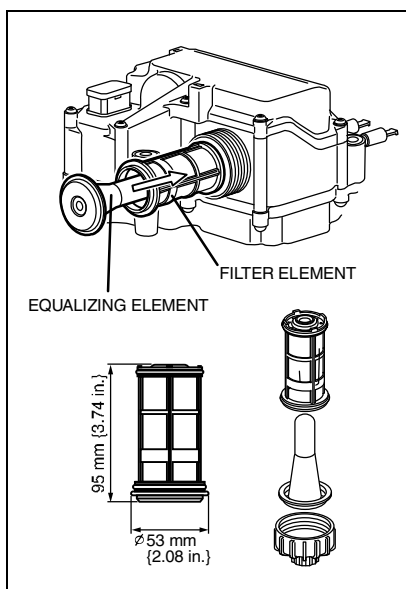


SHTS011061000042

b. Remove the equalizing element and the filter element.

NOTICE

Protect filter area in the housing from contamination.



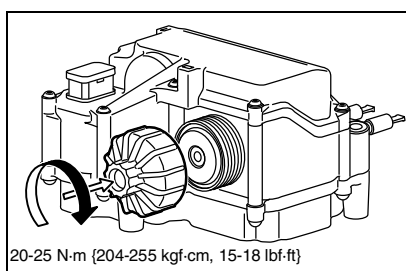
SHTS011061000043

c. Replace the filter element and the equalizing element.

NOTICE

The sealing surface on the housing must be clean.

No contamination or particles acceptable.

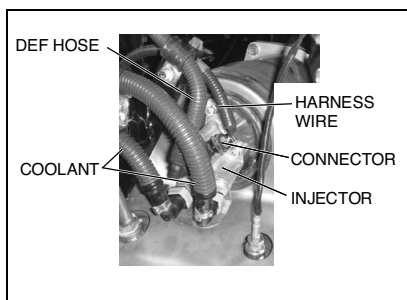


SHTS011061000044

d. Mount the filter cover.

NOTICE

- All sealing surface must be clean. Contamination or particles are not acceptable.
- It must be checked if there are cracks around the area of the filter cover. No cracks in the material are allowed. If there are cracks in the housing the entire supply module must be exchanged. If there are cracks in the filter cover, the filter cover must be exchanged.
- Wrench size: 27 mm {1.06 in.}
- Mounting torque for connector: 20-25 N-m {204-255 kgf-cm, 15-18 lbf-ft}



SHTS011061000045

5. DEF INJECTOR

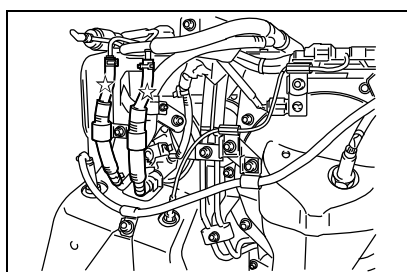
(1) IMPORTANT POINT - DISMOUNTING

- a. Disconnect the harness wire connector from the DEF injector.

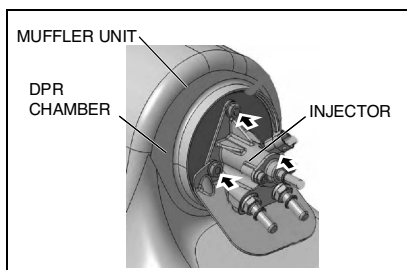
- b. Disconnect the DEF and coolant hoses connected to the DEF injector.

HINT

Coolant will spout if the coolant hose is removed. Drain coolant beforehand or block the hose with the vice grip. If you use the vice grip at the ☆ area as shown in the figure below, you can minimize leakage of coolant.

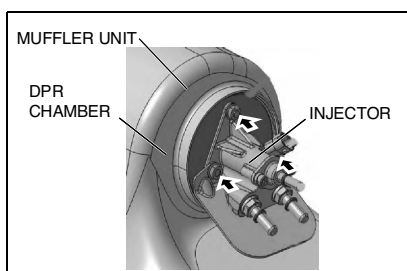


SHTS011061000046



SHTS011061000047

- c. Remove the nut and then dismount the DEF injector and gasket from the muffler unit.



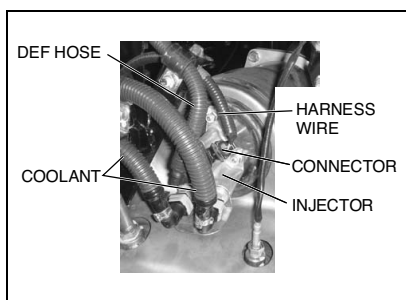
SHTS011061000048

(2) IMPORTANT POINT - MOUNTING

- a. When the DEF injector is reused, must to replace with a new gasket and attach the DEF injector to the muffler unit with the nut.

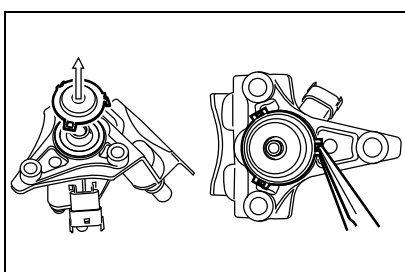
Tightening Torque:

6-10 N·m {61-102 kgf·cm, 4.4-7.4 lbf·ft}



SHTS011061000049

- b. Connect the DEF and coolant hoses to the DEF injector.
- c. Connect the harness wire connector to the DEF injector.

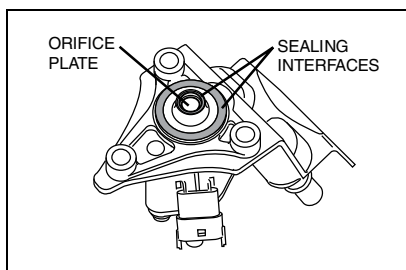


SHTS011061000050

- (3) REPLACE THE DEF INJECTOR GASKET.
 - a. Remove the gasket.

NOTICE

- Use pliers, no sharp tools permitted.
- Disassembling of the gasket is only allowed at the 3 clips.

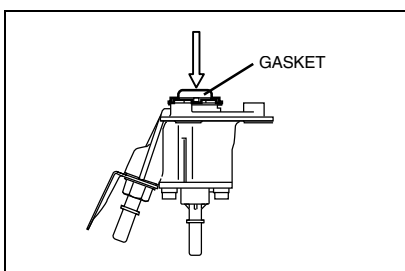


SHTS011061000051

- b. Clean the sealing surface on the cooling body (if necessary).

NOTICE

Take care when cleaning the sealing interfaces (avoid scratches). Do not touch the orifice plate.



SHTS011061000052

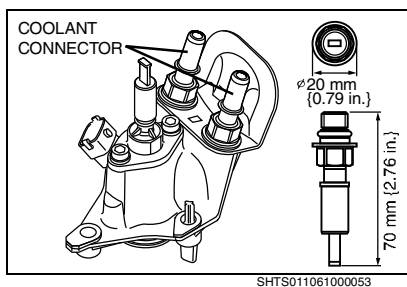
- c. Mount new gasket.

NOTICE

- The sealing interfaces must be clean.
- Place the gasket on the interface and press on.
- Avoid any damages or scratches on the gasket.
- Dosing module with fully mounted gasket see figure.

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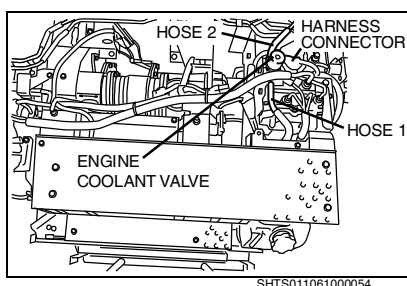
EMISSION CONTROL (J08E)



- (4) REPLACE THE DEF INJECTOR COOLANT PIPE.
- When the connector is exchanged, The O-ring must not be used two times.

NOTICE

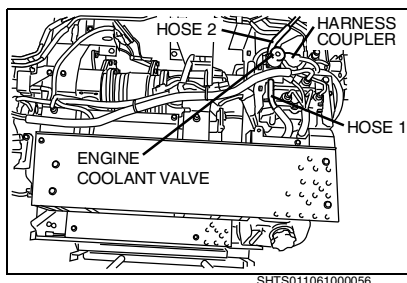
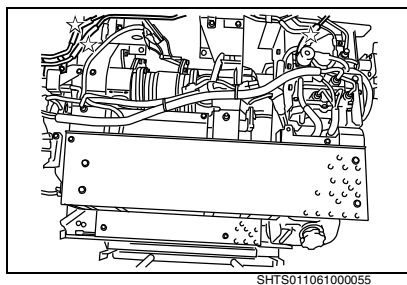
- All sealing surface must be clean.
- Contamination or particles are not acceptable.
- Mounting torque for connector: 5.0-6.0 N·m {51-61 kgf·cm, 3.7-4.4 lbf·ft}
- Wrench size: 15 mm {0.59 in.}
- For the mounting process, oil the O-ring with Mobil velocyte oil No.61


6. ENGINE COOLANT VALVE
(1) IMPORTANT POINT - DISMOUNTING

- Dismount the DCU.
Refer to "DOSING CONTROL UNIT (DCU)" for details.
- Remove the hose 1 clamp and remove the hose 1 (engine coolant valve side only).
- Disconnect the harness connector.
- Remove the engine coolant valve mounting bolt.
- Remove the hose 2 clamp and remove the hose 2 (engine coolant valve side only).

NOTICE

Coolant will spout if the coolant hose is removed. Drain coolant beforehand or block the hose with the vice grip. If you use the vice grip at the ☆ area as shown in the figure below, you can minimize leakage of coolant.


(2) IMPORTANT POINT - MOUNTING

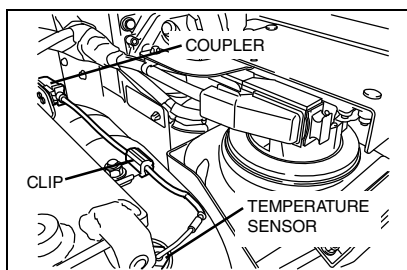
- Connect the hose 2 to the engine coolant valve and fix it with clamp.

- Mount the engine coolant valve.

Tightening Torque:

18-26 N·m {184-265 kgf·cm, 14-19 lbf·ft}

- Connect the harness coupler.
- Connect the hose 1 to the engine coolant valve and fix it with clamp.
- Mount the DCU.
Refer to "DOSING CONTROL UNIT (DCU)" for details.



SHTS011061000057

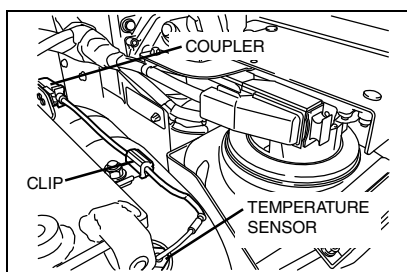
7. SCR FRONT TEMPERATURE SENSOR

(1) IMPORTANT POINT - DISMOUNTING

- Remove the clips.
- Disconnect the harness coupler.
- Remove the temperature sensor.

NOTICE

After removing the sensor, check that there is no entry of foreign matters inside the muffler.



SHTS011061000058

(2) IMPORTANT POINT - MOUNTING

- Mount the temperature sensor.

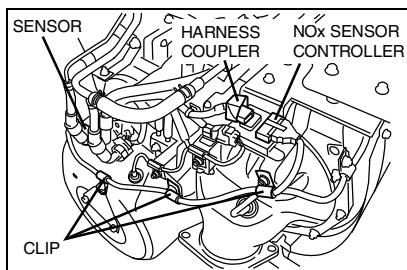
Tightening Torque:

25-40 N·m {255-407 kgf·cm, 19-29 lbf·ft}

- Connect the harness coupler.
- Mount the clips.

NOTICE

When reassembling, apply anti-seizure lubricant to the temperature sensor.



SHTS011061000059

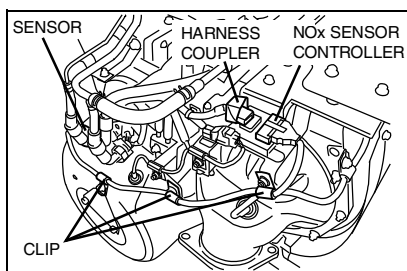
8. NOx SENSOR 1

(1) IMPORTANT POINT - DISMOUNTING

- Remove the clips.
- Disconnect the harness coupler.
- Remove the NOx sensor controller.
- Remove the sensor.

NOTICE

After removing the sensor, check that there is no entry of foreign matters inside the muffler.



SHTS011061000060

(2) IMPORTANT POINT - MOUNTING

- Mount the sensor.

Tightening Torque:

40-60 N·m {407-611 kgf·cm, 29-44 lbf·ft} (Sensor)

Tightening Torque:

3.9-7.1 N·m {40-72 kgf·cm, 2.9-5.2 lbf·ft} (Controller)

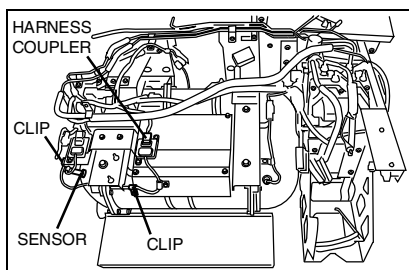
- Mount the NOx sensor controller.
- Connect the harness coupler.
- Mount the clips.

NOTICE

When reassembling, apply anti-seizure lubricant to the temperature sensor.

EN10-26

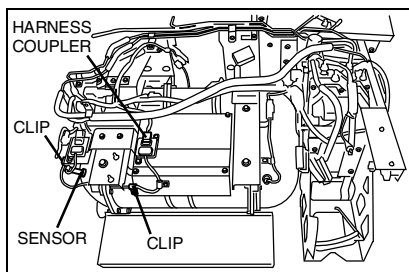
EMISSION CONTROL (J08E)

**9. NOx SENSOR 2****(1) IMPORTANT POINT - DISMOUNTING**

- a. Remove the clips.
- b. Disconnect the harness coupler.
- c. Remove the NOx sensor controller.
- d. Remove the sensor.

NOTICE

After removing the sensor, check that there is no entry of foreign matters inside the muffler.

**(2) IMPORTANT POINT - MOUNTING**

- a. Mount the sensor.

Tightening Torque:

40-60 N·m {407-611 kgf·cm, 29-44 lbf·ft} (Sensor)

Tightening Torque:

3.9-7.1 N·m {40-72 kgf·cm, 2.9-5.2 lbf·ft} (Controller)

- b. Mount the NOx sensor controller.
- c. Connect the harness coupler.
- d. Mount the clips.

NOTICE

When reassembling, apply anti-seizure lubricant to the temperature sensor.

INSPECTION AND REPAIR

EN0110610H300001

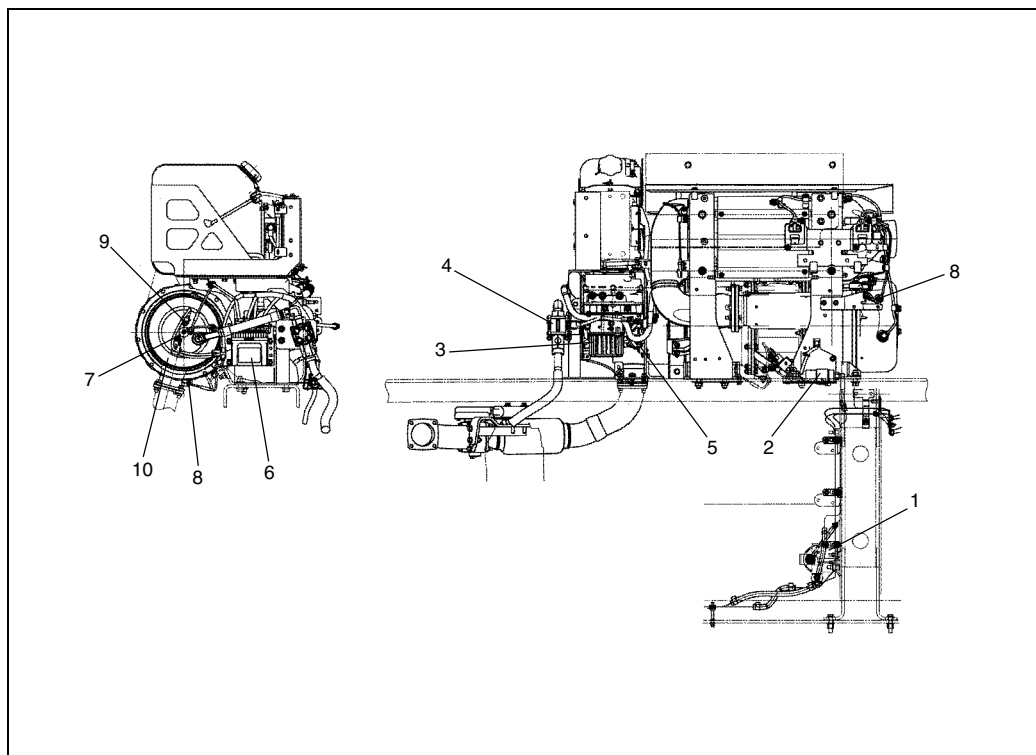
Inspect the SCR-related components in accordance with the table below and perform a repair or replacement if necessary.

Item	Content	Action	Travel distance
DEF filter element (& equalizing element)	Replacement	Replacement	60,000 mile

BURNER SYSTEM

COMPONENT LOCATOR

EN0110610J100004



SHTS011061000063

1	Fuel filter	6	Burner control unit
2	Fuel pump	7	Nozzle
3	Atomizer	8	Flame temperature sensor
4	Combustion air valve	9	Ignition plug
5	Ignition coil	10	Combination chamber

BURNER SYSTEM WARNING AND CAUTION

EN0110610A100001

BEFORE YOU BEGIN

Read and understand all instructions and procedures before you begin to service components.

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

Follow your company's maintenance and service, installation, and diagnostics guidelines.

Use special tools when required to help avoid serious personal injury and damage to components.

HAZARD ALERT MESSAGES

WARNING

A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury and damage to components.

CAUTION

A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components.

HAZARD ALERT MESSAGES

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

DANGER

During engine "ON", the burner system may use an ignition coil to increase voltage to 40,000-50,000 volts. Do not touch the ignition coil during engine "ON". Death or serious personal injury, and damage to components can result.

The burner system uses a high voltage arc to ignite the injected fuel. A coil located near the muffler unit provides extremely high voltage. Two ignition cables connect the coil to two ignition plugs. Turn the vehicle OFF and disconnect the battery before you service these components to prevent death or serious personal injury, and damage to components.

The burner system oxidizes and releases heat into the exhaust outlet.

Depending on the amount of soot, exhaust outlet temperatures during regeneration can exceed 1,290°F (700°C). Do not touch the exhaust outlet. Do not park a vehicle under objects, such as trees and awnings, which can ignite from the extremely high exhaust outlet temperature. Death or serious personal injury, and damage to components can result.

If your vehicle has the stack tail pipe. Do not park a vehicle on ignitable objects, such as grass.

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service procedures.

The burner system operates at an extremely high temperature of about 1,832°F (1,000°C) inside the combustion chamber. The skin temperature of a unit can reach 572°F (300°C) during operation. Even higher temperatures can occur at the flange; the exhaust outlet; and the filter, which remains hot for a longer period of time than other system components. Before you service the burner unit, all system components must be at ambient temperature to prevent serious personal injury.

An original equipment-mounted exhaust outlet is not insulated. The skin temperature of a non-insulated exhaust outlet can exceed 1,292°F (700°C) during operation. Before you service the thermal regenerator unit, all system components must be at ambient temperature to prevent serious personal injury.

When you work on an electrical system, the possibility of electrical shock exists, and sparks can ignite flammable substances. You must always disconnect the battery ground cable before you work on an electrical system to prevent serious personal injury and damage to components.

DISMOUNTING AND MOUNTING

EN0110610H100002

1. PREPARATION

⚠ WARNING

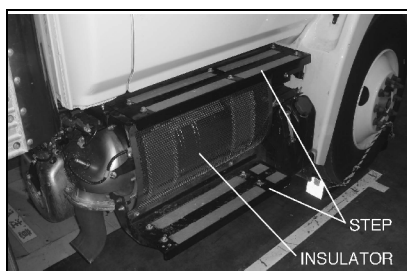
Do not touch the exhaust pipe and muffler unit when it could be hot.
You can be severely burned.

- (1) Disconnect the battery ground terminal.

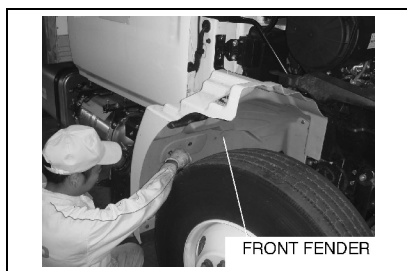
⚠ CAUTION

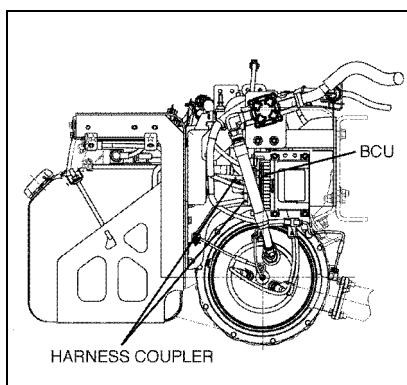
- Be sure to disconnect the battery terminals from the battery in accordance with the procedures in this manual and never use the battery disconnect switch when it is necessary to break the supply of electricity completely. Otherwise, electricity may remain supplied from the battery by the circuit that bypasses the battery disconnect switch and you may get burns or injury from the electricity.

- (2) Dismount the steps (top and bottom) and insulator on the right side of the vehicle.

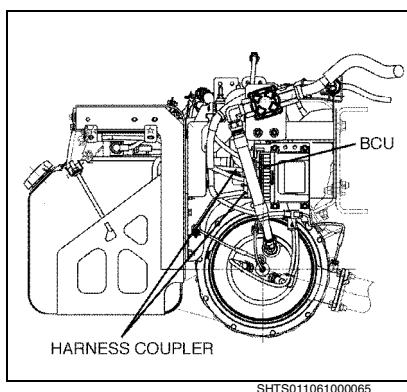


- (3) Dismount the front fender.

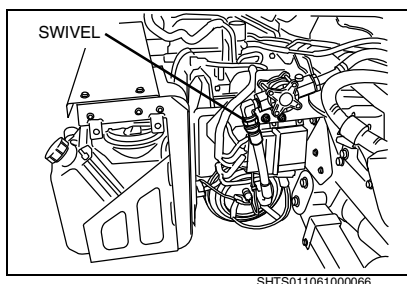




- 2. BURNER CONTROL UNIT (BCU)**
(1) IMPORTANT POINT - DISMOUNTING
 a. Disconnect the harness coupler.
 b. Remove the BCU.



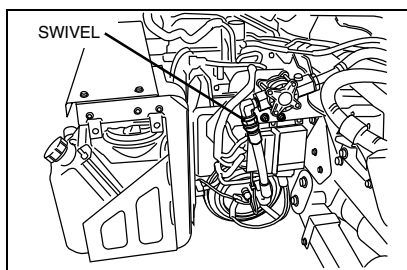
- (2) IMPORTANT POINT - MOUNTING**
 a. Mount the BCU.
Tightening Torque:
6 N·m {62 kgf·cm, 4.4 lbf·ft}
 b. Connect the harness coupler.



- 3. COMBUSTION AIR VALVE**
(1) IMPORTANT POINT - DISMOUNTING
 a. Disconnect the harness wire connector from the combustion air valve.
 b. Remove the air hose on the engine side.
 c. Remove the air hose on the combustion chamber side.
 d. Remove the bolts and then dismount the combustion air valve.

NOTICE

- When removing, be sure to remove the swivel on the vehicle upper side.
- After removal, be careful to avoid entry of foreign matter into the pipe.



SHTS01106100067

(2) IMPORTANT POINT - MOUNTING

- a. Connect the air hose on the combustion chamber side.

NOTICE

- Mount it without bending the hose with the combustion air valve free.
- When tightening, fold the hexagonal part under the swivel with the wrench.

- b. Mount the combustion air valve.

Tightening Torque:

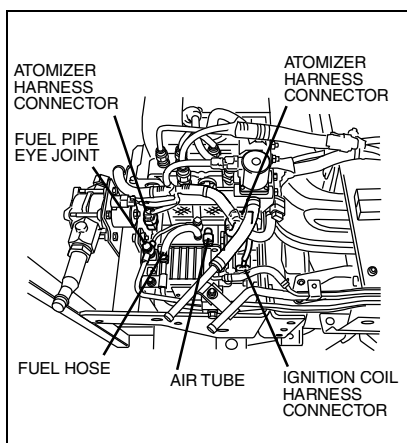
41-61 N·m {418-622 kgf·cm, 31-45 lbf·ft}

- c. Connect the air hose on the engine side.
- d. Connect the harness wire connector to the combustion air valve.

4. ATOMIZER

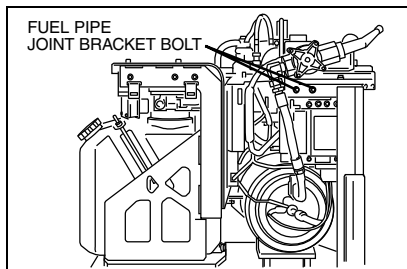
(1) IMPORTANT POINT - DISMOUNTING

- a. Disconnect the BCU harness connector.
- b. Remove the solenoid valve.
Refer to "SOLENOID VALVE" for details.
- c. Disconnect the atomizer harness connectors (2 places).
- d. Disconnect the ignition coil harness connector.
- e. Remove the fuel pipe eye joint.
- f. Disconnect the fuel hose.
- g. Disconnect the air tube.
- h. Remove the atomized fuel line on the front of the combustion chamber.
- i. Detach the ignition cable on the front of the combustion chamber.



SHTS01106100068

- j. Remove the fuel pipe joint bracket bolts (2 places).

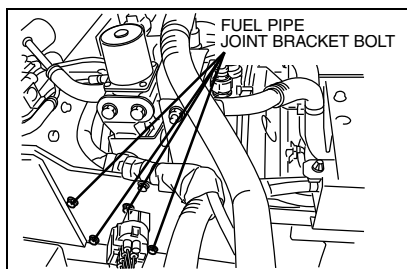


SHTS01106100069

- k. Remove the atomizer mounting bolt from the burner accessory module bracket (atomizer back, 4 places) and remove the atomizer.

NOTICE

After removal, be careful to avoid entry of foreign matter into the removed pipe and harness connector.

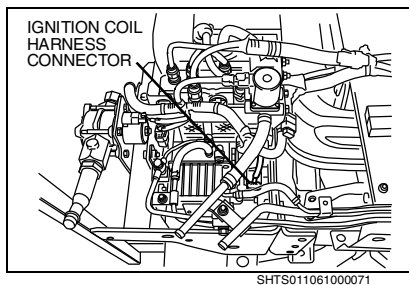


SHTS01106100070

- (2) IMPORTANT POINT - MOUNTING
 a. Its installation is the reversal of the removal.
Tightening Torque:
18-26 N·m {184-265 kgf·cm, 14-19 lbf·ft} (Atomizer)

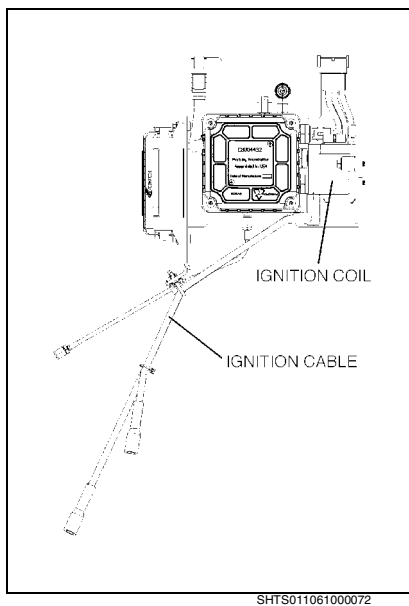
NOTICE

When reassembling the ignition cable, apply grease.

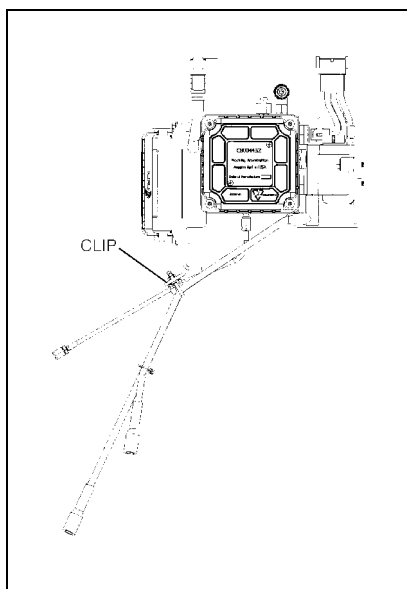


5. IGNITION COIL

- (1) IMPORTANT POINT - DISMOUNTING
- Remove the solenoid valve.
Refer to "SOLENOID VALVE" for details.
 - Disconnect the ignition coil harness connector.
 - Disconnect the ignition cable.
- d. Remove the ignition coil mounting bolt from the burner accessory module bracket (2 places) and remove the ignition coil.



- (2) IMPORTANT POINT - MOUNTING
 a. Installation is the reversal of the removal.
Tightening Torque:
9 N·m {92 kgf·cm, 6.6 lbf·ft} (Ignition coil)

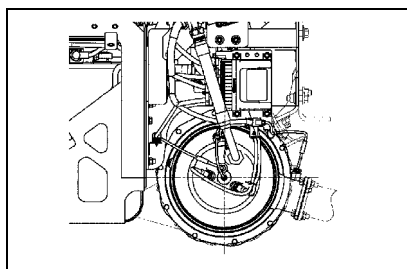


SHTS011061000073

6. ATOMIZED FUEL PIPE

(1) IMPORTANT POINT - DISMOUNTING

- a. Remove the clip.
- b. Remove the pipe (use the wrench to avoid looseness of the base connector).



SHTS011061000074

NOTICE

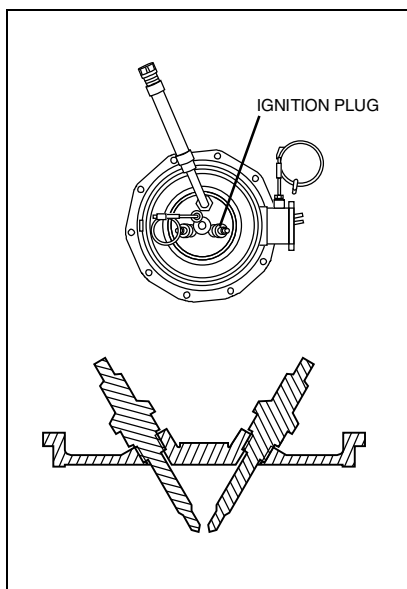
- After removal, be careful to avoid entry of foreign matter into the removed pipe.
- If rust is gathered around the nut on the front of the combustion chamber, blow air before removal to avoid rust from getting into the combustion chamber.

(2) IMPORTANT POINT - MOUNTING

- a. Installation is the reversal of the removal.

Tightening Torque:

6 N·m {62 kgf·cm, 4.4 lbf·ft} (Fuel pipe clip)



7. IGNITION PLUGS

(1) IMPORTANT POINT - DISMOUNTING

- Disconnect the ignition cable on the ignition plug side.
- Remove the ignition plug.

NOTICE

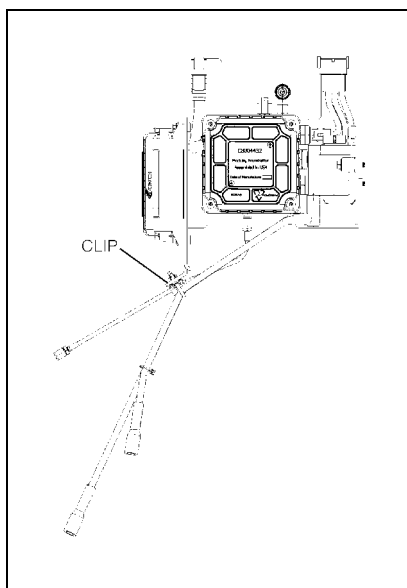
- After removal, be careful to avoid entry of foreign matter into the ignition cable and combustion chamber.
- If rust is gathered around the nut on the front of the combustion chamber, blow air before removal to avoid rust from getting into the combustion chamber.

(2) IMPORTANT POINT - MOUNTING

- Installation is the reversal of the removal.

NOTICE

- When reassembling, apply anti-seizure lubricant.
- Ignition plug gap range: 4.0-5.0mm {0.16-0.19in}
- Use ignition plug gap checking tool to confirm gap.



8. IGNITION CABLES

(1) IMPORTANT POINT - DISMOUNTING

- Remove the clip.
- Disconnect the ignition cable by twisting, pulling motion.

NOTICE

After removal, be careful to avoid entry of foreign matter into the removed ignition cable.

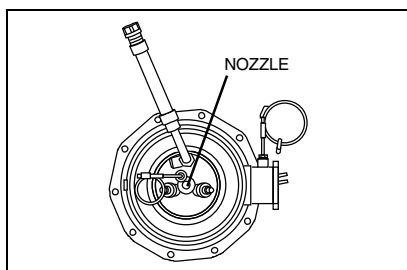
(2) IMPORTANT POINT - MOUNTING

- Connect the ignition cable.
- Mount the clip.

NOTICE

When reassembling, apply the following grease to the ignition cable insertion area.

SILKON 1000 or equivalent (by Superior industries)



SHTS011061000077

9. NOZZLE

(1) IMPORTANT POINT - DISMOUNTING

- a. Remove the atomized fuel pipe.
- b. Remove the nozzle.

NOTICE

- After removal, be careful to avoid entry of foreign matter into the removed pipe and combustion chamber.
- If rust is gathered around the nut on the front of the combustion chamber, blow air before removal to avoid rust from getting into the combustion chamber.

(2) IMPORTANT POINT - MOUNTING

- a. Mount the nozzle.

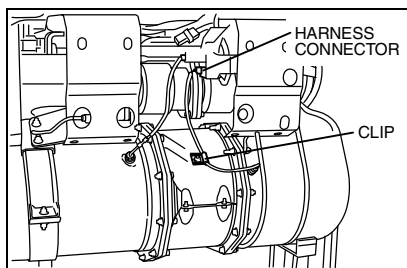
Tightening Torque:

25.5-28.7 N·m {260-292 kgf·cm, 18.8-21.1 lbf·ft}

- b. Install the atomized fuel pipe.

NOTICE

- When reassembling, replace with a new washer.
- When reassembling, apply anti-seizure lubricant.



SHTS011061000078

10. TEMPERATURE SENSOR (DPR INLET PORT)

(1) IMPORTANT POINT - DISMOUNTING

- a. Disconnect the harness connector.
- b. Remove the clips.
- c. Remove the temperature sensor.

NOTICE

- After removal, be careful to avoid entry of foreign matter into the removed harness connector and combustion chamber.
- If rust is gathered around the nut on the front of the combustion chamber, blow air before removal to avoid rust from getting into the combustion chamber.

(2) IMPORTANT POINT - MOUNTING

- a. Mount the temperature sensor.

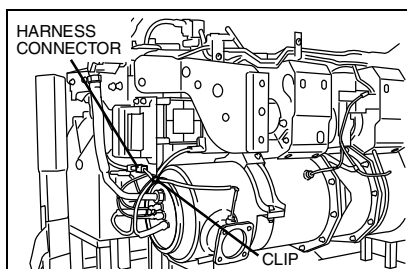
Tightening Torque:

42.3-47.7 N·m {432-486 kgf·cm, 32-35 lbf·ft}

- b. Mount the clips.
- c. Connect the harness connector.

NOTICE

When reassembling, apply anti-seizure lubricant.



SHTS011061000079

11. TEMPERATURE SENSOR (COMBUSTION CHAMBER INLET PORT)

(1) IMPORTANT POINT - DISMOUNTING

- a. Disconnect the harness connector.
- b. Remove the clips.
- c. Remove the temperature sensor.

NOTICE

- After removal, be careful to avoid entry of foreign matter into the removed harness connector and combustion chamber.
- If rust is gathered around the nut on the front of the combustion chamber, blow air before removal to avoid rust from getting into the combustion chamber.

(2) IMPORTANT POINT - MOUNTING

- a. Mount the temperature sensor.

Tightening Torque:

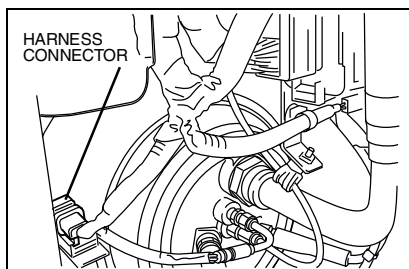
42.3-47.7 N·m {432-486 kgf·cm, 32-35 lbf·ft}

- b. Mount the clips.

- c. Connect the harness connector.

NOTICE

When reassembling, apply anti-seizure lubricant.



SHTS011061000080

12. FLAME TEMPERATURE SENSOR

(1) IMPORTANT POINT - DISMOUNTING

- a. Disconnect the harness connector.

- b. Remove the temperature sensor (fix the base connector with the wrench so that it will not also turn).

NOTICE

- After removal, be careful to avoid entry of foreign matter into the removed harness connector and combustion chamber.
- If rust is gathered around the nut on the front of the combustion chamber, blow air before removal to avoid rust from getting into the combustion chamber.

(2) IMPORTANT POINT - MOUNTING

- a. Mount the temperature sensor.

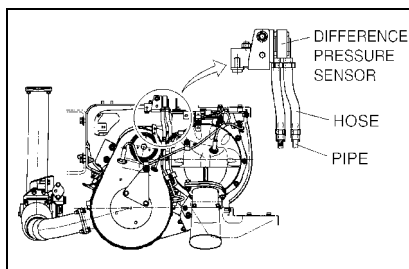
Tightening Torque:

5.3-5.9 N·m {54-60 kgf·cm, 3.9-4.3 lbf·ft}

- b. Connect the harness connector.

NOTICE

When reassembling, apply anti-seizure lubricant.



SHTS011061000081

13. DIFFERENCE PRESSURE SENSOR

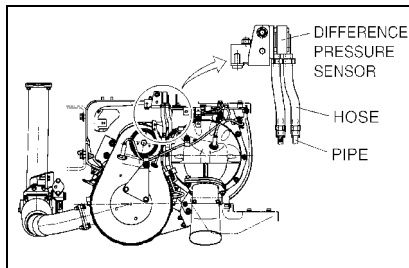
(1) IMPORTANT POINT - DISMOUNTING

- a. Remove the clip. Remove the hose between the pipe and differential pressure sensor.

- b. Remove the nut and then dismount the differential pressure sensor along with the bracket.

NOTICE

After removal, be careful to avoid entry of foreign matter into the difference pressure sensor and hose.

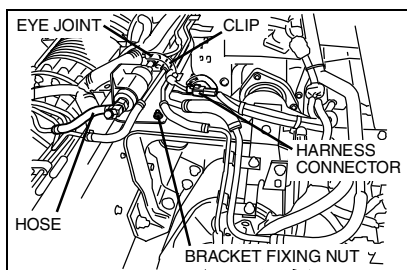


SHTS011061000082

(2) IMPORTANT POINT - MOUNTING

- a. Mount the differential pressure sensor.

- b. Mount the hose between the pipe and differential pressure sensor and fix it with the clip.



SHTS011061000083

14. FUEL PUMP

(1) IMPORTANT POINT - DISMOUNTING

- Disconnect the harness connector.
- Remove the bracket fixing nut.
- Remove the fuel pipe fixing clip.
- Disconnect the hose on the pump inlet port side.
- Remove the eye joint (fix the base connector with the wrench so that it will not also turn).
- Remove the fuel pump.

NOTICE

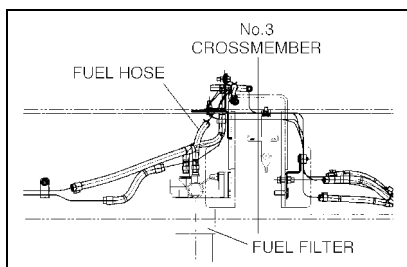
- After removal, be careful to avoid entry of foreign matter into the removed harness connector, pump and pipe.
- If rust is gathered around the eye joint, blow air before removal to avoid rust from getting into the pump and pipe.

(2) IMPORTANT POINT - MOUNTING

- Its installation is the reversal of the removal.

NOTICE

After reassembling, operate the pump for 40 seconds before starting the engine.



SHTS011061000084

15. FUEL FILTER

(1) IMPORTANT POINT - DISMOUNTING

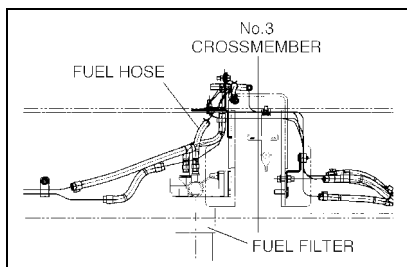
- Remove the clip and then the fuel hose.
- Dismount the fuel filter from the No. 3 crossmember.

NOTICE

After removal, be careful to avoid entry of foreign matter into the removed filter and hose.

CAUTION

While working, be careful not to make dirt and water enter parts.



SHTS011061000085

(2) IMPORTANT POINT - MOUNTING

- Mount the fuel filter to the No. 3 crossmember.
- Connect the fuel hose to the fuel filter and fix them with the clip.

CAUTION

- While working, be careful not to make dirt and water enter parts.
- Before mounting a part, check that there is no dirt on the connection between the parts.
- Air enters the fuel pipe while working. After working, be sure to purge air.
- Use a Hino genuine part for the fuel filter element.

INSPECTION AND REPAIR

EN0110610H300002

Inspect the BURNER SYSTEM-related components in accordance with the table below and perform a repair or replacement if necessary.

Item	Content	Action	Travel distance
DPR filter	Ash deposition	Clean-up	200,000 mile
Hose for difference pressure sensor	Replacement	Replacement	3 years
Burner fuel injection nozzle	Replacement	Replacement	150,000 mile
Burner flame temperature sensor	Replacement	Replacement	150,000 mile
Fuel filter element for burner	Replacement	Replacement	2 years

ALTERNATOR (J08E: REMY 12V-130A,135A,180A)

EN11-001

ALTERNATOR..... EN11-2

DATA AND SPECIFICATIONS	EN11-2
TROUBLESHOOTING	EN11-2
COMPONENT LOCATOR.....	EN11-3
OVERHAUL	EN11-4
INSPECTION AND REPAIR	EN11-7

ALTERNATOR

DATA AND SPECIFICATIONS

EN0110611I200001

Nominal voltage	12V
Nominal output	12V-130A/135A/180A
Max. output	126A/130A/176A at 13.5V, 5,000 r/min
Max. rotating	10,000 r/min
Rotating direction	Right (seen from pulley side)
Regulator	Mount-on

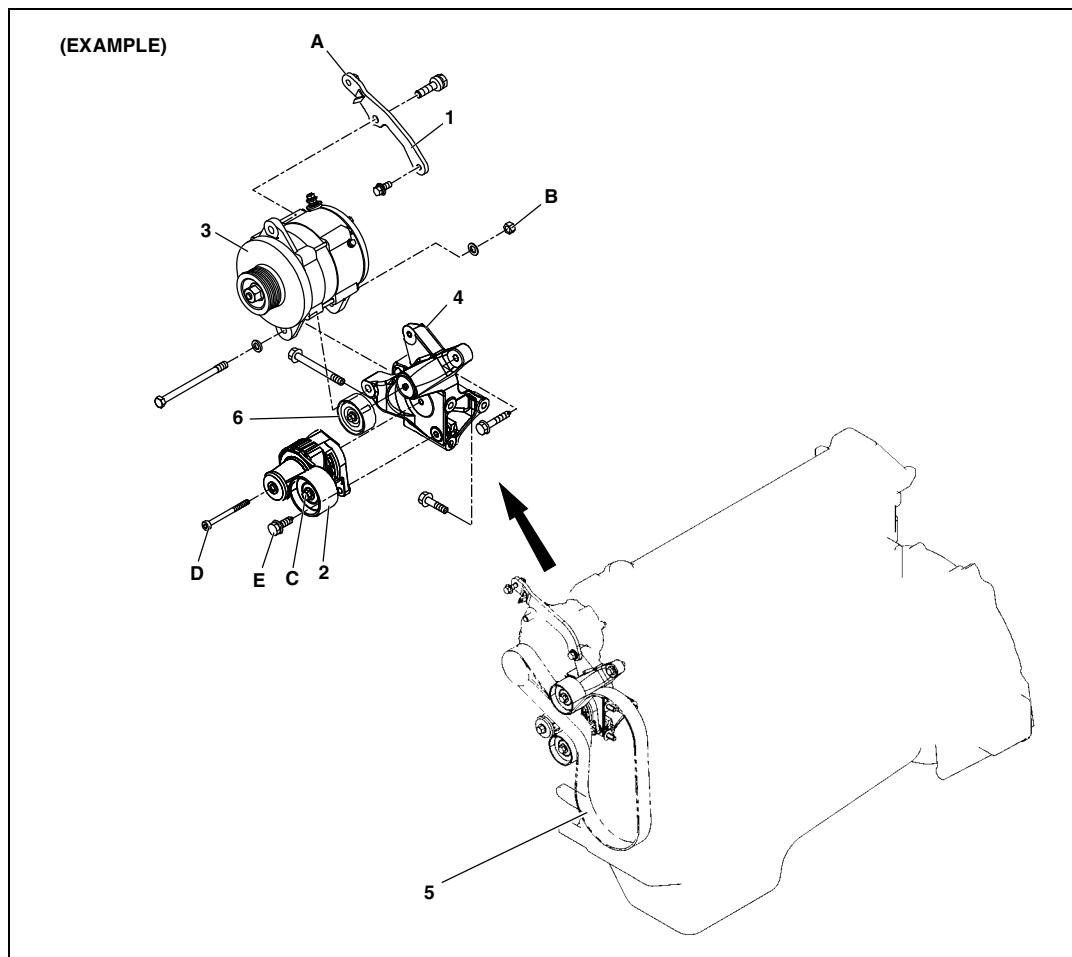
TROUBLESHOOTING

EN0110611F300001

Symptom	Possible cause	Remedy/Prevention
Charge warning light does not light with starter switch ON and engine off	Fuse blown	Determine cause and replace fuse
	Light burned out	Replace light
	Wiring connection loose	Tighten loose connections
	IC regulator faulty	Replace IC regulator
Charge warning light does not go out with engine running (Battery requires frequent recharging)	Drive belt loose or worn	Adjust or replace drive belt
	Battery cables loose, corroded or worn	Repair or replace cables
	Fuse blown	Determine cause and replace fuse
	Fusible link blown	Replace fusible link
	IC regulator or alternator faulty	Check charging system
	Wiring faulty	Repair wiring

COMPONENT LOCATOR

EN0110611D100001



SHTS011061100001

1 Brace	4 Bracket
2 Tensioner pulley	5 V-belt
3 Alternator	6 Idler pulley

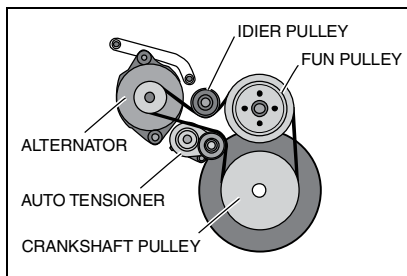
Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

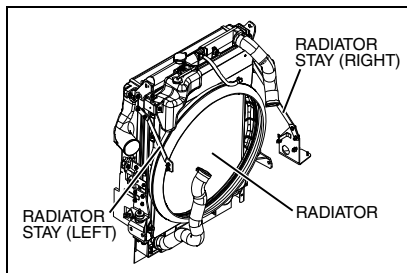
A 88 {897, 65}	D 68.5 {700, 51}
B 93 {948, 69}	E 68.5 {700, 51}
C 80-95 {816-968, 59-70}	

OVERHAUL

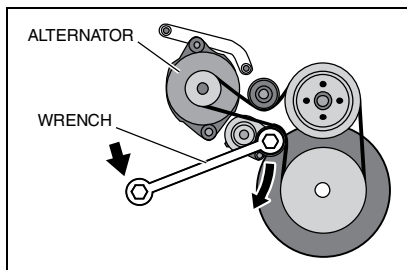
EN0110611H200001



SHTS011061100002



SHTS011061100003



SHTS011061100004

IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE ALTERNATOR.

- (1) Remove the drive belt.
- (2) Remove the through bolt and the fixing belt.

NOTICE

To remove the belt, turn the nut of the tension pulley with a wrench in counterclockwise direction to turn the tension pulley in arrow direction. Then the belt becomes loose and can be removed.

⚠ CAUTION

- As the belt is under tension, take care not to get your hand caught at the time of removal.
- Remove the following parts because your hand might be stuck when replacing the belt.
 - a. Engine side cover
 - b. Suction hose
 - c. Fun shroud bracket (Engine side)
 - d. Radiator stay
 - e. Radiator stay bracket

Failure to disconnect negative battery cable at battery before removing or attaching alternator "BAT" terminal lead may result in an injury. If a tool is shorted at alternator "BAT" terminal, the tool can quickly heat enough to cause a skin burn.

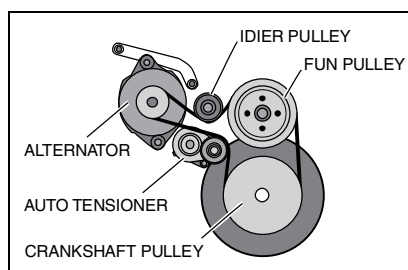
NOTICE

Always reinstall fasteners at original location. If necessary to replace fasteners, use only correct part number or equivalent.

- If correct part number is not available, use only equal size and strength. For alternator internal fasteners, refer to Delco Remy America Standard Hardware Fasteners section in Service Parts Catalog.
- Fasteners that are not to be reused will be noted in procedure.
- Fasteners requiring thread locking compound will be noted in procedure.
- Use specified torque values when shown.

Using or replacing fasteners in any other manner could result in part or system damage.

If diagnosis determines that alternator repair is needed, remove alternator from engine according to manufacturer's instructions.



SHTS011061100005

IMPORTANT POINTS - MOUNTING

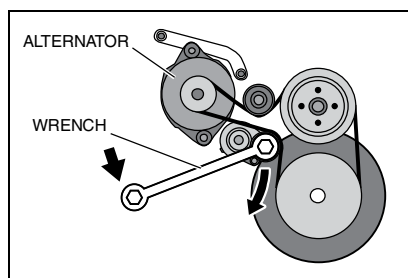
1. INSTALL THE ALTERNATOR.

- (1) Install the alternator with through bolt and fixing bolt.

Tightening Torque:

Through bolt: 93 N·m {948 kgf·cm, 69 lbf·ft}

Fixing bolt: 88 N·m {897 kgf·cm, 65 lbf·ft}

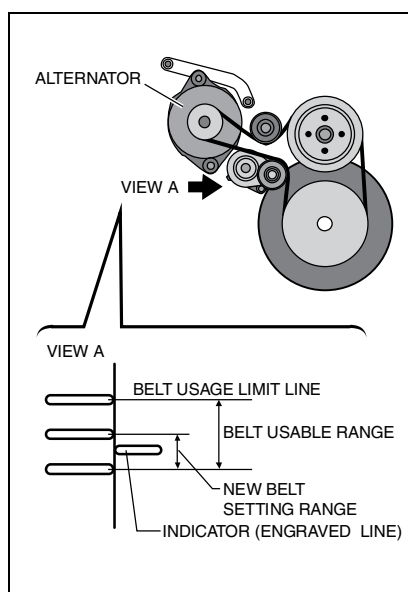


SHTS011061100006

- (2) Install the drive belt.

NOTICE

Turn the tension pulley in the same way as for the belt removal and install the belt.



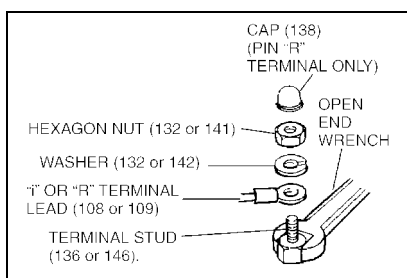
SHTS011061100007

NOTICE

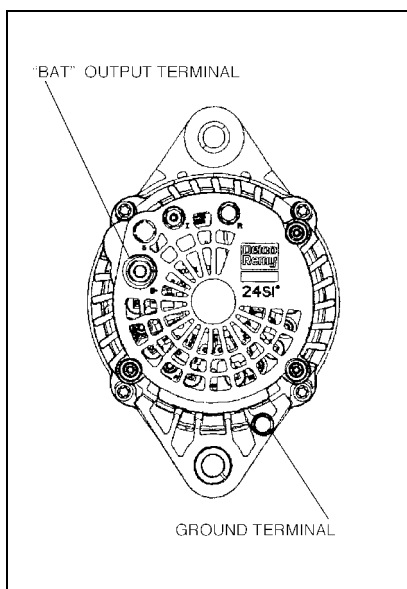
When installing the drive belt, use the gauge on the belt tensioner (1) to confirm that the tensioner arm is correctly positioned. (View from A.)

EN11-6

ALTERNATOR (J08E: REMY 12V-130A, 135A, 180A)



SHTS011061100008



SHTS011061100009

2. INSTALL OR CONNECT

- (1) "I" and/or "R" terminal lead(s) (108 or 109), if used, to threaded terminal stud(s) (136 and/or 146), washer(s) and hexagon nut(s) (131 and/or 141).

NOTICE

Use suitable open end wrench to hold nut portion of terminal stud(s) (125, 136 and/or 146).

Tightening Torque:

2.0 N·m {20 kgf·cm, 20 lbf·in}

- (2) Cap (138) to the "R" (or "Relay") pin terminal stud (146A) if necessary.
- (3) Ground lead (110) to "GRD" hole in SRE housing (1), with screw assembly (159).

Tightening Torque:

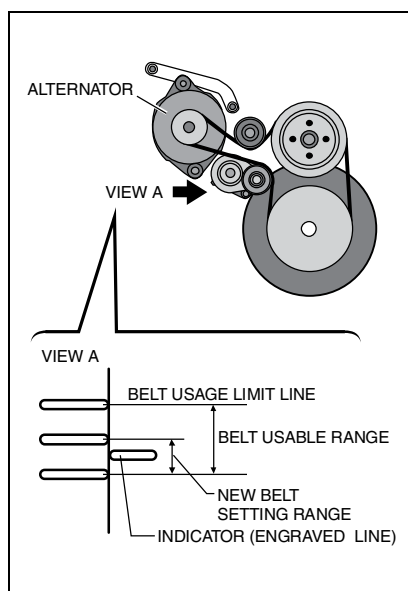
6 N·m {61 kgf·cm, 55 lbf·in}

- (4) "BAT" output lead (111), washer (122) and nut (121) to "BAT" terminal stud (125).

Tightening Torque:

130A/180A: 11 N·m {112 kgf·cm, 100 lbf·in}

135A: 9 N·m {83 kgf·cm, 75 lbf·in}



SHTS011061100010

IMPORTANT POINTS - ON - VEHICLE INSPECTION**1. INSPECT THE DRIVE BELT**

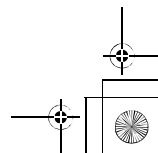
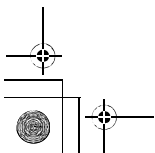
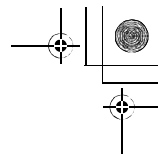
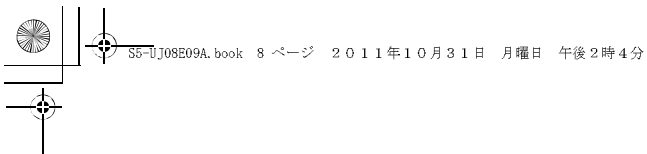
If the indicator (engraved line) is out of the belt usage limit line, or if the belt is damaged, replace the belt.

INSPECTION AND REPAIR

EN0110611H300001

Inspect the alternator-related components in accordance with the table below and perform a repair or replacement if necessary.

Item	Content	Action	Travel distance
130A/180A Alternator	Replacement	Replacement	250,000 mile
135A Alternator	Replacement	Replacement	350,000 mile



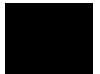


STARTER (J08E)

EN12-001

STARTER EN12-2

DATA AND SPECIFICATIONS	EN12-2
DESCRIPTION	EN12-2
TROUBLESHOOTING	EN12-3
COMPONENT LOCATOR	EN12-4
OVERHAUL	EN12-5
INSPECTION AND REPAIR	EN12-9



STARTER

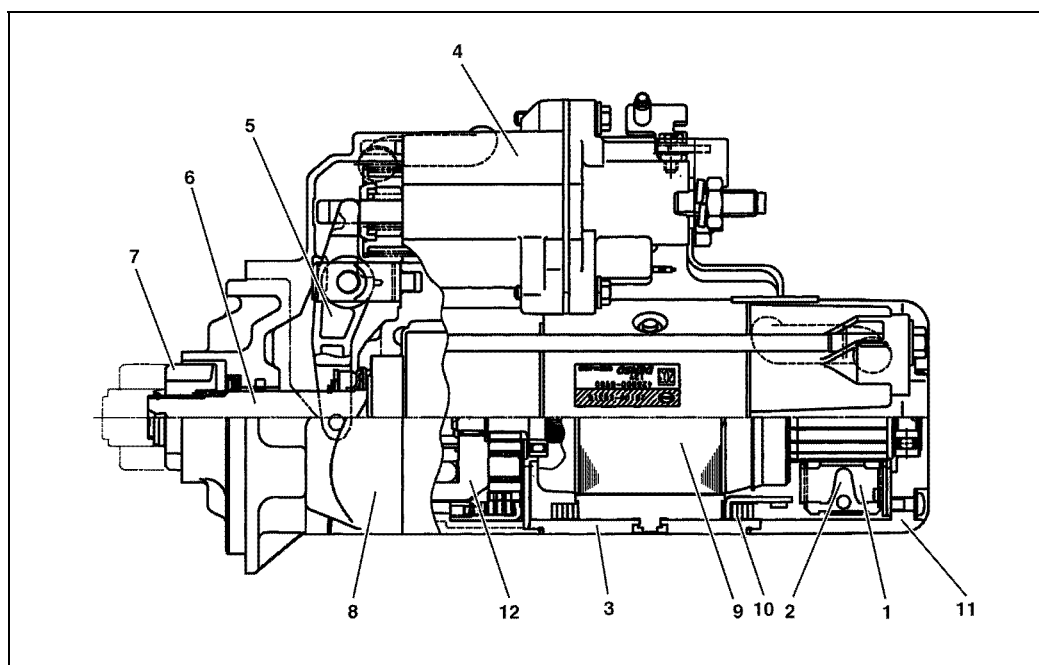
DATA AND SPECIFICATIONS

EN0110612I200001

Type	Planetary reduction gear type
Rated output	12 V, 4.8 kW
Number of teeth of pinion	11
Module	3
Rotating direction	Clockwise (Seen from pinion side)

DESCRIPTION

EN0110612C100001



SHTS011061200001

1 Holder assembly	7 Pinion gear
2 Brush	8 Drive housing assembly
3 Yoke assembly	9 Armature assembly
4 Magnetic switch assembly	10 Field coil
5 Lever	11 Commutator end frame
6 Drive shaft	12 Clutch assembly

TROUBLESHOOTING

EN0110612F300001

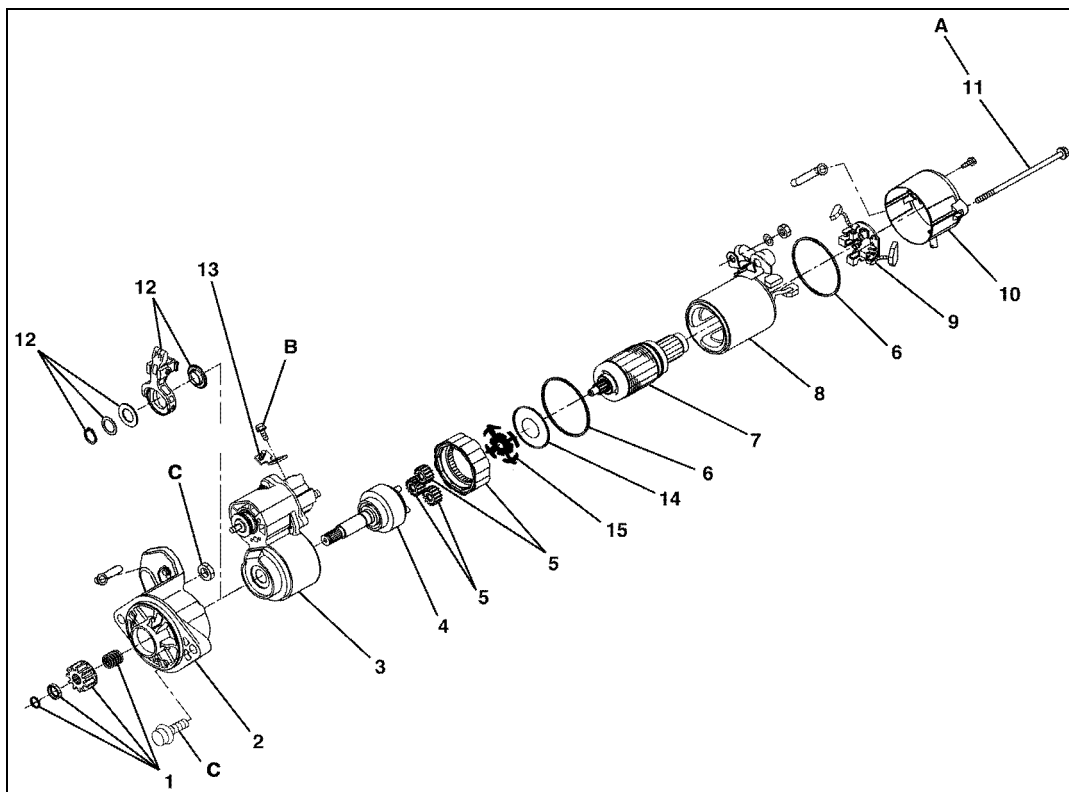
Symptom	Possible cause	Remedy/Prevention
Engine does not crank, or cranks slowly. (Starter switch)	Poor contact	Replace the starter switch.
Engine does not crank, or cranks slowly. (Battery)	Discharged battery	Charge.
	Short circuited between electrodes	Replace battery.
	Poor contact at battery terminal	Clean or retighten.
Engine does not crank, or cranks slowly. (Engine oil)	Improper viscosity oil	Change oil.
Engine does not crank, or cranks slowly. (Magnetic switch)	Poor contact caused by burnt contact plate	Replace the magnetic switch assembly.
	Contact plate worn out	
	Holding coil disconnected (Overrunning clutch moves back and forth)	
	Pull-in coil disconnected or short circuited	
Engine does not crank, or cranks slowly. (Starter relay)	Defective or poor contact	Repair or replace the starter relay.
Engine does not crank, or cranks slowly. (Starter)	Brush worn out	Replace.
	Commutator burnt out	Replace the armature assembly.
	Commutator worn out	
	Field winding shorted or grounded	Replace the yoke assembly.
	Armature winding shorted or grounded	Replace the armature assembly.
	Insufficient brush spring tension	Replace the brush spring.
	Poor contact between magnetic switch and field windings	Repair.
	Armature contact pole core because of worn bearing bushing or bent armature shaft	Replace the end frame or armature assembly.
	Overrunning clutch malfunction	Replace.
Engine does not crank while starter is running in good condition. (Overrunning clutch)	Overrunning clutch malfunction	Replace.
	Pinion teeth worn out	Replace.
	Poor sliding of spline teeth	Remove foreign particles, dirt or replace.
Starter does not stop running. (Starter switch)	Contacts keep closing	Replace.
	Key switch sticks	Replace.
	Overrunning clutch sticks to armature	Repair or replace overrunning or armature.
Starter does not stop running. (Starter relay)	Contacts keep closing	Repair or replace.

EN12-4

STARTER (J08E)

COMPONENT LOCATOR

EN0110612D100001



SHTS011061200002

1 Pinion gear	9 Brush holder
2 Drive housing assembly	10 End frame
3 Main switch assembly	11 Through bolt
4 Clutch assembly	12 Lever assembly
5 Internal gear assembly	13 Terminal
6 O-ring	14 Cover
7 Armature assembly	15 Plate
8 Yoke assembly	

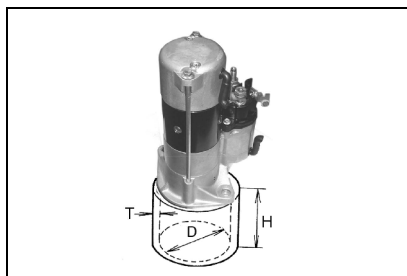
Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 17 {173, 121}	C 139-169 {1,418-1,723, 103-124}
B 21 {214, 15}	

OVERHAUL

EN0110612H200001



SHTS011061200003

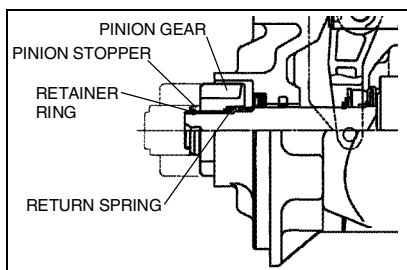
IMPORTANT POINTS - DISASSEMBLY

When disassembling the starter, prepare a work stand as shown in the figure.

D: Diameter = 110 mm {4.331 in.}

T: Thickness = 10 mm {0.394 in.}

H: Height = 120 mm {4.724 in.}



SHTS011061200004

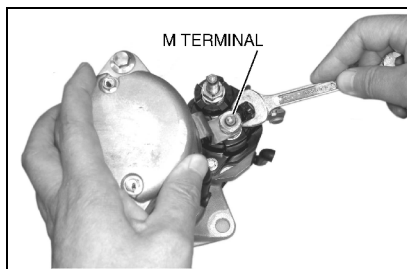
1. REMOVE THE PINION GEAR.

- (1) Remove the retainer ring.

⚠ CAUTION

Wear a pair of safety goggles, because the retainer ring may spring out the groove at the time of removal.

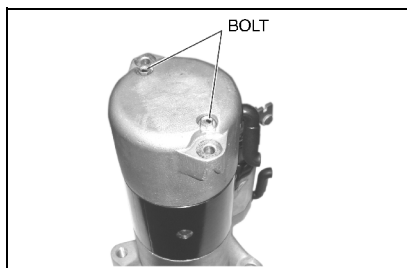
- (2) Remove the pinion stopper.
- (3) Remove the pinion gear.
- (4) Remove the return spring.



SHTS011061200005

2. REMOVE THE TERMINAL LEAD.

- (1) Remove the nut, disconnect the "M" terminal lead.



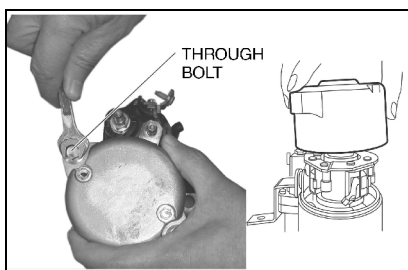
SHTS011061200006

3. REMOVE THE COMMUTATOR END FRAME.

- (1) Remove the bolt.

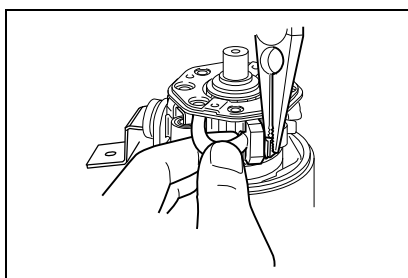
EN12-6

STARTER (J08E)



SHTS011061200007

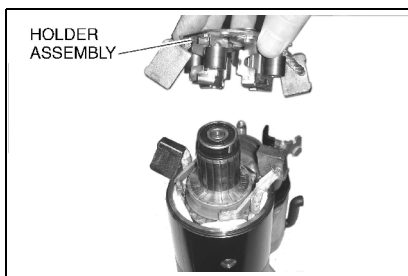
- (2) Remove the through bolt, remove the commutator end frame.



SHTS011061200008

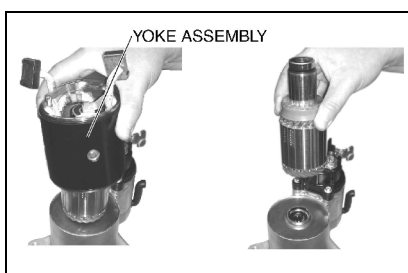
4. REMOVE THE HOLDER ASSEMBLY.

- (1) Using a long nose plier, remove the brush of the yoke from the holder.



SHTS011061200009

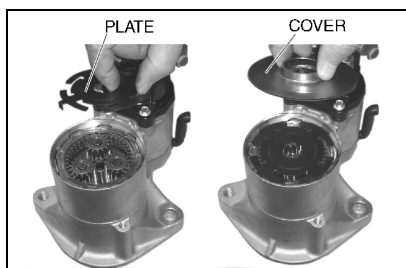
- (2) Remove the holder assembly from the armature.



SHTS011061200010

5. REMOVE THE YOKE ASSEMBLY AND ARMATURE ASSEMBLY.

- (1) Remove the yoke assembly and armature assembly from the center bracket assembly.



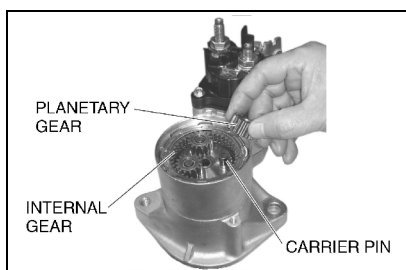
SHTS011061200011

6. REMOVE THE GEAR.

- (1) Remove the cover and plate.

NOTICE

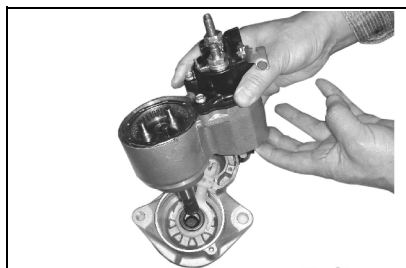
Remember the assembled position and direction of the plate.



SHTS011061200012

- (2) Remove the planetary gear.

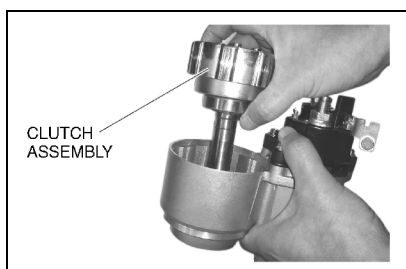
- (3) Remove the internal gear.



SHTS011061200013

7. REMOVE THE DRIVE HOUSING ASSEMBLY.

- (1) Remove the bolt, remove the drive housing assembly.



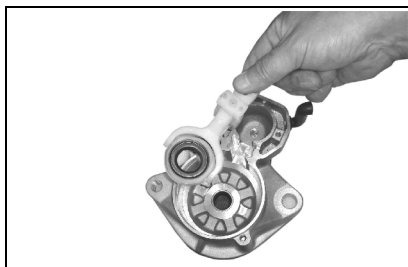
SHTS011061200014

8. REMOVE THE CLUTCH ASSEMBLY.

- (1) Remove the retainer ring.
- (2) Pushing the clutch assembly toward yoke assembly.
- (3) Remove the clutch assembly.

EN12-8

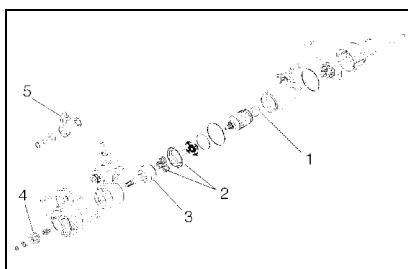
STARTER (J08E)



SHTS011061200015

9. REMOVE THE LEVER.

- (1) Remove the lever assembly.



SHTS011061200016

IMPORTANT POINTS - ASSEMBLY

NOTICE

Reverse the order of disassembly to reassemble the starter.

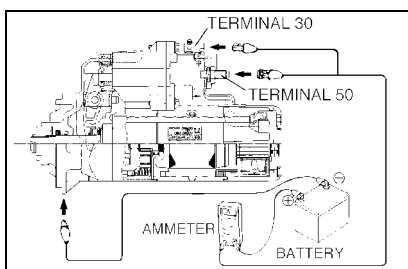
1. LUBRICATION

- (1) Before reassembling, apply the recommended grease to the following:
[Apply Nippondenso No. HL50 grease (Shin-nisseki U3311 grease)] or equivalent.
 - (1) Front bearing
 - (2) Internal gear assembly
 - (3) Clutch assembly (Excluding the clutch roller.)
 - (4) Pinion gear
 - (5) Lever assembly

IMPORTANT POINTS - INSPECTION

NOTICE

These tests must be performed within 3 to 5 seconds to avoid burning out the coil.



SHTS011061200017

1. PERFORM NO-LOAD PERFORMANCE TEST.

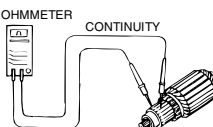
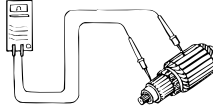
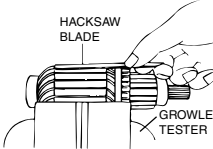
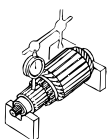
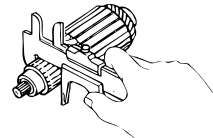
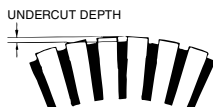
- (1) Connect battery and ammeter to the starter as shown.
- (2) Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check the reading on the ammeter.

Standard amperage:
220 A or less/11 V

INSPECTION AND REPAIR

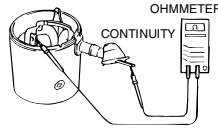
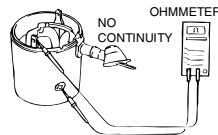
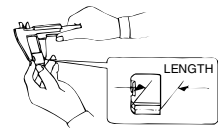

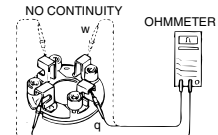

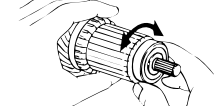
EN0110612H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Continuity between the segments of the commutator	1 Ω or less	1 Ω	Replace.	Measure 
No continuity between the connector and armature coil core.	10 k Ω or more	10 k Ω	Replace.	Measure 
Armature short circuit test (Using a growler tester)	If the iron piece does not vibrate, the armature is good.	—	Replace.	Measure 
Measure the circle run-out	—	0.05 {0.0020}	Replace.	Measure 
Outside diameter of the commutator	34.0 {1.338}	33.0 {1.299}	Replace.	Measure 
Depth between the mica and the commutator (Under cut depth)	0.7 {0.028}	0.2 {0.008}	Replace or repair.	Measure 

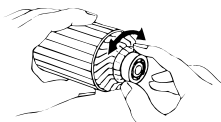
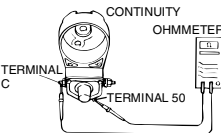
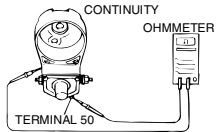
EN12-10

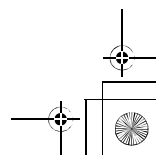
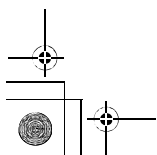
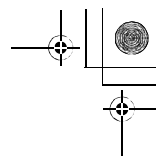
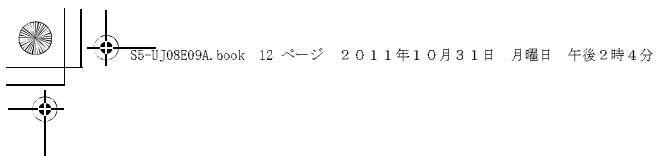
STARTER (J08E)

Inspection item	Standard	Limit	Remedy	Inspection procedure
Continuity between the field coil end and the read wire.	1 Ω or less	1 Ω	Replace.	Measure 
No continuity between the field coil end and yoke out side	10 k Ω or more	10 k Ω	Replace.	Measure 
Brush length	20.5 {0.807}	11 {0.433}	Replace.	Measure 
Brush spring load	45 N {162 oz}	17 N {61.20 oz}	Replace.	Measure 
Insulation between the brush and brush holder	10 k Ω or more	10 k Ω	Replace.	Measure 
Rotating of pinion	—	—	Replace.	Visual check 
Rotating of needle roller front bearing	—	Sticks or does not rotate	Replace.	Visual check 

STARTER (J08E)

EN12-11

Inspection item	Standard	Limit	Remedy	Inspection procedure
Rotating of needle roller rear bearing	—	Sticks or does not rotate	Replace.	Visual check 
Continuity between terminals 50 and C	1 Ω or less	1 Ω	Replace.	Measure 
Continuity between terminal 50 and the switch body	2 Ω or less	2 Ω	Replace.	Measure 



AIR COMPRESSOR (J08E: 340 cm³)

EN13-001

AIR COMPRESSOR.....EN13-2

DATA AND SPECIFICATIONS	EN13-2
DESCRIPTION	EN13-3
TROUBLESHOOTING	EN13-4
COMPONENT LOCATOR.....	EN13-5
SPECIAL TOOL	EN13-6
OVERHAUL	EN13-6
INSPECTION AND REPAIR	EN13-14



EN13-2

AIR COMPRESSOR (J08E: 340 cm³)



AIR COMPRESSOR

DATA AND SPECIFICATIONS

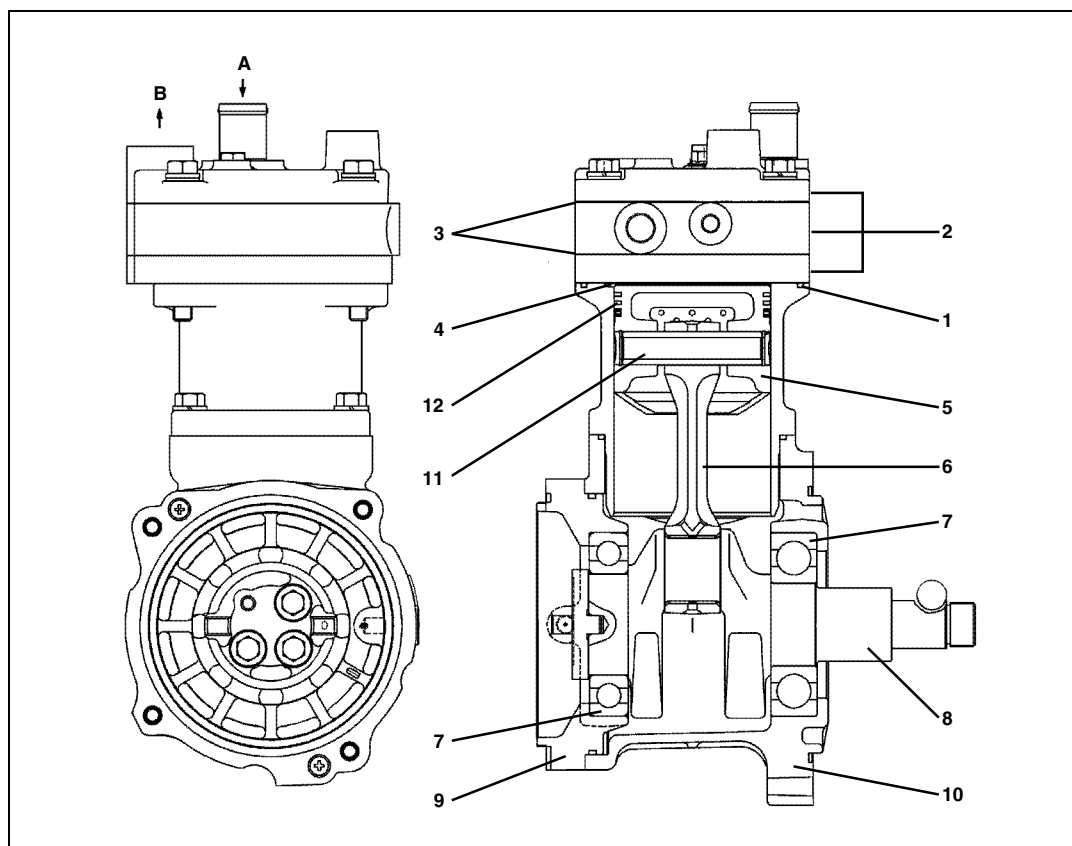
EN0110613I200001

Type	Reciprocating, single cylinder
Discharge amount	340 cm ³ {20.7 cu.in.}
Bore x stroke	85 mm x 60 mm {3.35 in. x 2.36 in.}
Lubrication system	Forced feed lubrication
Cooling system	Forced water-circulated



DESCRIPTION

EN0110613C100001



SAPH011061300001

1	O-ring *	8	Crankshaft
2	Cylinder head assembly	9	Bearing holder
3	Gasket *	10	Crankcase
4	Suction valve *	11	Piston pin
5	Piston	12	Piston ring
6	Connecting rod	A	Suction
7	Bearing	B	Delivery

* Nonreusable part

EN13-4

AIR COMPRESSOR (J08E: 340 cm³)

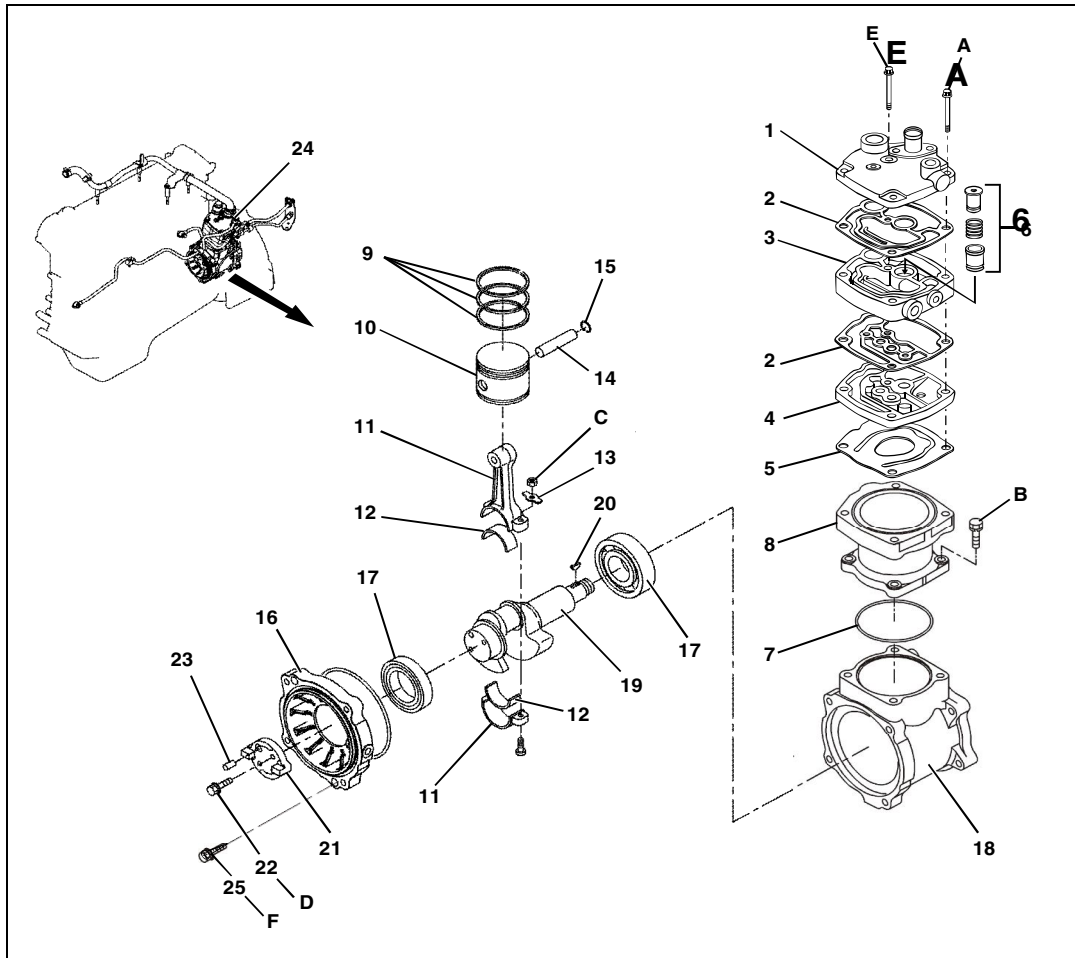
TROUBLESHOOTING

EN0110613F300001

Symptom	Possible cause	Remedy/Prevention
Charging efficiency dropped (Valve)	Abnormal wear, damage, or poor contact	Replace.
Charging efficiency dropped (Piston, cylinder liner and piston rings)	Worn piston and cylinder liner	Replace.
	Seized piston	Replace (piston, piston rings and cylinder liner).
	Worn or broken piston ring	Replace.
Charging efficiency dropped (Air pipe and joints)	Leakage of high-pressure air	Replace or tighten pipe joint.
	Clogged air pipe	Replace.
Charging efficiency dropped (Air cleaner)	Clogged element	Clean or replace element.
Noisy operation (Piston)	Wear of piston pin boss or piston pin	Replace.
	Seized, damaged or worn connecting rod small end	Replace.
	Worn piston or cylinder liner	Replace.
	Damaged or seized piston	Replace.
	Foreign particles on the top surface of piston	Clean or replace.
Noisy operation (Bearing)	Damaged, or worn ball bearing and/or connecting rod bearing	Replace.
Excessive carbon or oil in the compressor cylinder head or discharge line (Piston ring)	Worn, sticking or broken piston rings	Replace piston rings and/or cylinder liner.
	Insufficient piston ring tension	Replace piston rings and/or cylinder liner.
	Malfunction of piston rings	Replace piston rings and/or cylinder liner.
Excessive carbon or oil in the compressor cylinder head or discharge line (Cylinder liner and piston rings)	Worn cylinder liner and piston rings	Replace.

COMPONENT LOCATOR

EN0110613D100001



SAPH011061300002

EN13-6

AIR COMPRESSOR (J08E: 340 cm³)

1 Head cover	14 Piston pin
2 Gasket *	15 Retainer ring *
3 Cylinder head	16 Bearing holder
4 Valve seat	17 Ball bearing
5 Suction valve	18 Crankcase
6 Unloader valve	19 Crankshaft
7 O-ring *	20 Woodruff key
8 Cylinder liner	21 Coupling
9 Piston ring	22 Coupling bolt
10 Piston	23 Pin
11 Connecting rod	24 Air compressor assembly
12 Connecting rod bearing	25 Screw
13 Lock washer *	

* Nonreusable part

Tightening torque

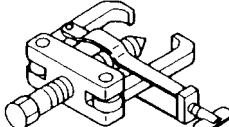
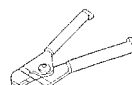
Unit: N·m {kgf·cm, lbf·ft}

A 29-34 {296-347, 22-25}	D 30-36 {305-367, 22-27}
B 25-29 {255-295, 19-21}	E 23-26 {235-265, 17-19}
C 23-26 {235-265, 17-19}	F 2.5-3.9 {26-39, 1.9-2.8}

SPECIAL TOOL

EN0110613K100001

Prior to starting an air compressor overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0965-01101	BEARING PULLER	
	S0944-01060	PISTON RING EXPANDER	

OVERHAUL

EN0110613H200001

IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE SUPPLY PUMP

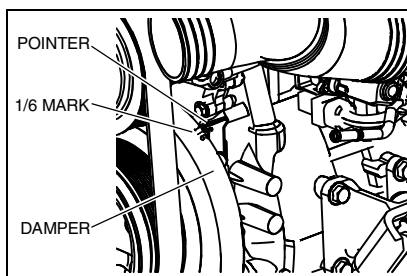
(1) Refer to the chapter "FUEL SYSTEM".

2. REMOVE THE AIR COMPRESSOR.

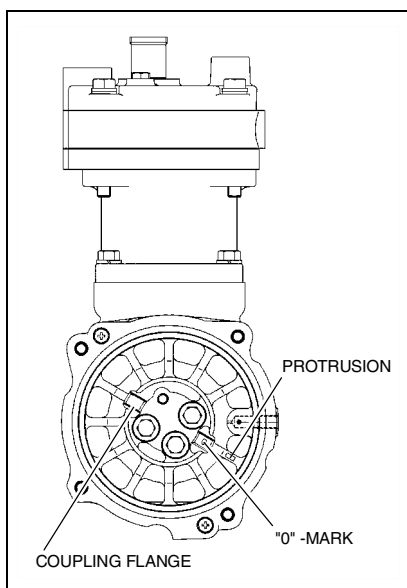
(1) Remove the six air compressor mounting bolts and remove the air compressor without applying excessive force.

NOTICE

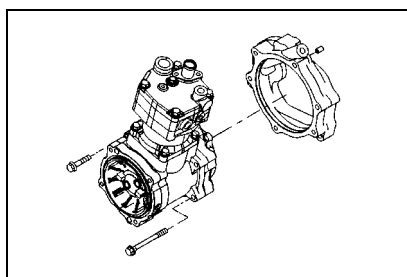
Excessive force to the air compressor may damage the mounting spigot or may cause oil leakage due to flaking of liquid gasket between the flywheel housing and plate.



SAPH011061300005



SAPH011061300006



SAPH011061300007

IMPORTANT POINTS - MOUNTING

1. INSTALLATION PROCEDURES

- (1) Fit the No.1 cylinder to the Top Dead Center.

NOTICE

Refer to the section "ENGINE TUNEUP" in the chapter "ENGINE INTRODUCTION".

- (2) Align the aligning mark "0" on the top of coupling flange with protrusion on the compressor housing.
- (3) Insert the O-ring in to the O-ring groove of the air compressor of bearing holder side.

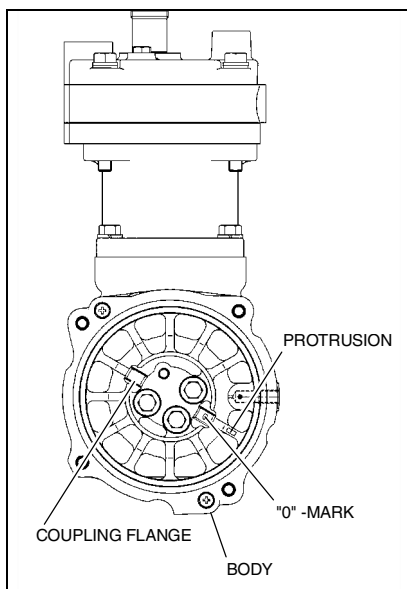
- (4) Place a guide stud bolt (M8 x 1.25, length: 50 mm {1.968 in.} or more) in the flywheel housing as shown in the figure and insert the compressor onto the stud bolt.
- (5) Tighten the mounting bolts (other than the stud bolt) then remove the stud bolt. Insert a bolt in the place of the stud bolt.

Tightening Torque:

28.5 N·m {290 kgf·cm, 20 lbf·ft}

EN13-8

AIR COMPRESSOR (J08E: 340 cm³)

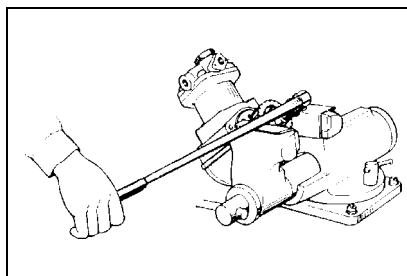


SAPH011061300008

- (6) Make sure that the aligning mark "0" on the top of coupling flange is aligned with protrusion on the compressor housing.

2. INSTALL THE SUPPLY PUMP AND AIR COMPRESSOR.

- (1) Refer to the chapter "FUEL SYSTEM".



SAPH011061300009

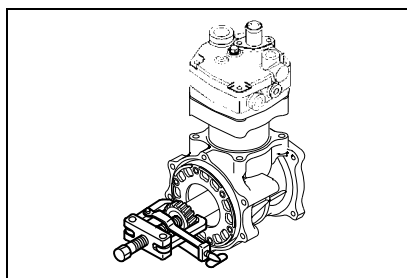
IMPORTANT POINTS - DISASSEMBLY

1. REMOVE THE DRIVE GEAR.

- (1) Remove the lock nut from the compressor drive gear.

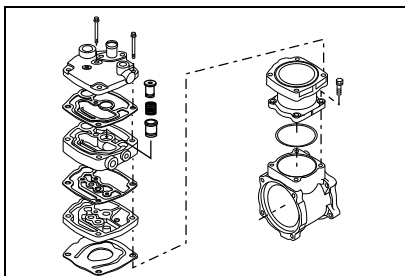
NOTICE

If the spread is insufficient, the drive gear will be damaged when loosening the nut.



SAPH011061300010

- (2) Pull the drive gear from the crankshaft, then remove the woodruff key.
SST: Bearing puller (S0965-01101)



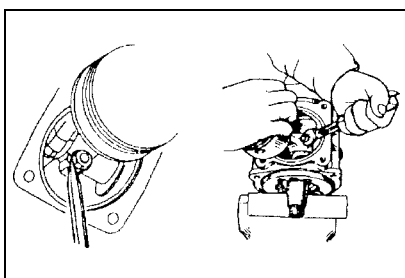
SAPH011061300011

2. REMOVE THE CYLINDER HEAD, ASSEMBLY AND O-RING.

- (1) Remove the cylinder head, assembly and O-ring.

NOTICE

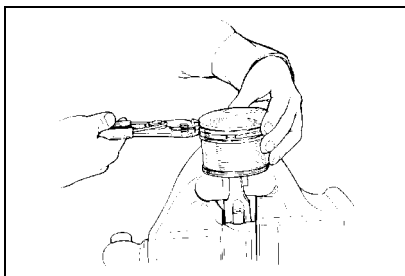
- Put the marking through the head cover to the cylinder liner.
- Do not decompose the cylinder head.



SAPH011061300012

3. REMOVE THE CONNECTING ROD WITH THE PISTON.

- (1) Rotate the crankshaft to the top dead center position.
- (2) Spread the staking of the nut completely with a chisel, then loosen the nut.
- (3) Remove the connecting rod with piston.



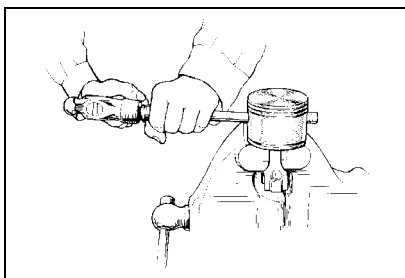
SAPH011061300013

4. REMOVE THE PISTON RINGS.

- (1) Remove the piston rings.
SST: Piston ring expander (S0944-01060)

NOTICE

- Handle the piston rings carefully because they are made of a special casting which is easily broken.
- When reusing the piston rings, first arrange them face up and in the correct installation sequence in order to prevent installing them incorrectly.



SAPH011061300014

5. REMOVE THE PISTON.

- (1) Remove the retainer rings installed on both ends of the piston, using retainer ring pliers.

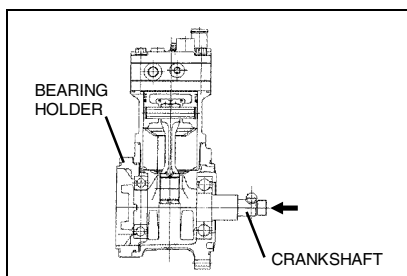
⚠ WARNING

Wear a pair of safety goggles, because the retainer rings may spring out the groove at the time of removal.

- (2) Strike out the piston pin.

NOTICE

Warm up the piston first in hot water, 80-90°C {176-194°F}, for approximately 5 minutes before removing the piston pin.



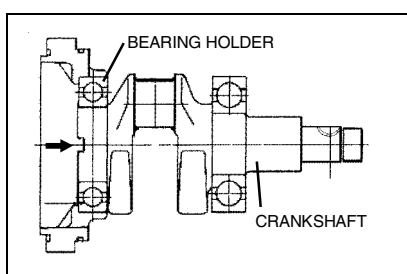
SAPH011061300015

6. REMOVE THE CRANKSHAFT.

- (1) Remove the bearing holder fitting screw.
- (2) Use the press to remove the crankshaft together with the bearing holder.

NOTICE

Be careful not to damage the bearing holder.



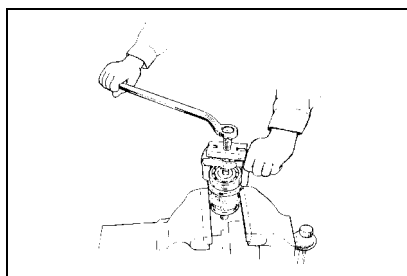
SAPH011061300016

7. REMOVE THE BEARING HOLDER.

- (1) Use the press to remove the bearing holder.

NOTICE

Be careful not to damage the bearing holder.



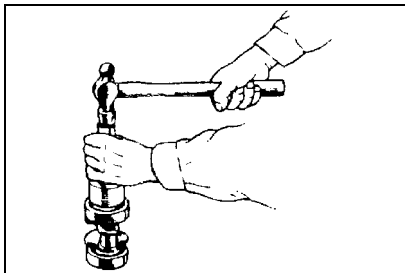
SAPH011061300017

8. REMOVE THE BALL BEARING.

- (1) Using the special tool, remove the ball bearing from the end of the crankshaft.

SST: Bearing puller (S0965-01101)

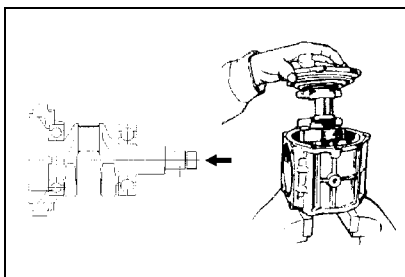
IMPORTANT POINTS - ASSEMBLY



SAPH011061300018

1. INSTALL THE BALL BEARING.

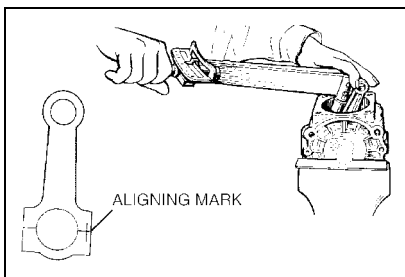
- (1) Install the ball bearing onto the both ends of the crankshaft.



SAPH011061300019

2. INSTALL THE CRANKSHAFT.

- (1) Using the press, install the crankshaft to the bearing holder.
- (2) Install the crankshaft and bearing holder into the crankcase.
- (3) Tighten the bearing holder fitting screw.

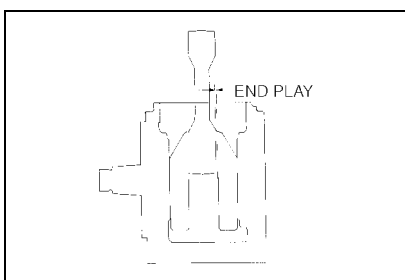


SAPH011061300020

3. INSTALL THE CONNECTING ROD AND MEASURE THE END PLAY.

NOTICE

- Be sure to align the aligning mark.
 - Apply engine oil to the connecting rod and cap.
- (1) Apply engine oil to the thread before installing the connecting rod bolt.

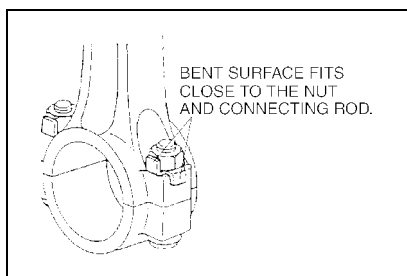


SAPH011061300021

- (2) Measure the connecting rod end play.
Assembly standard: 0.2-0.4 mm {0.008-0.015 in.}
Limit: 0.5 mm {0.02 in.}

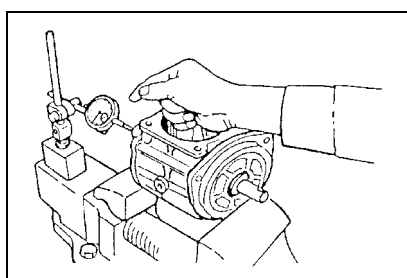
EN13-12

AIR COMPRESSOR (J08E: 340 cm³)



SAPH011061300022

- (3) Lock the nut with a lock washer.

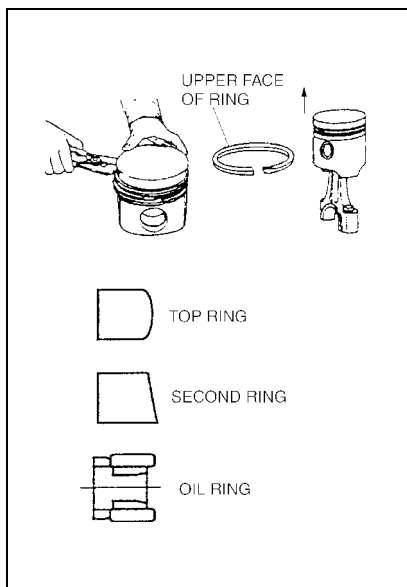


SAPH011061300023

4. MEASURE THE END PLAY OF THE CRANKSHAFT.

Assembly standard: 0-0.6 mm {0-0.0236 in.}

Limit: 1.0 mm {0.0394 in.}



SAPH011061300024

5. ASSEMBLE THE PISTON.

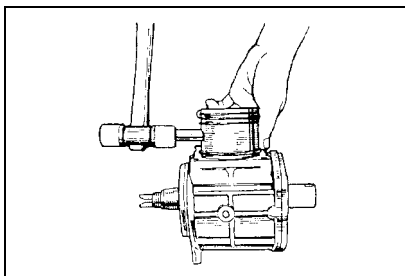
NOTICE

Assemble the various parts after applying engine oil to the sliding parts.

- (1) When installing the piston rings on the piston, ensure that the piston skirt is at the bottom, and use the special tool.
SST: Piston ring expander (S0944-01060)

NOTICE

Install the piston rings in order shown in the figure.



SAPH011061300025

6. ASSEMBLE THE PISTON AND CONNECTING ROD.

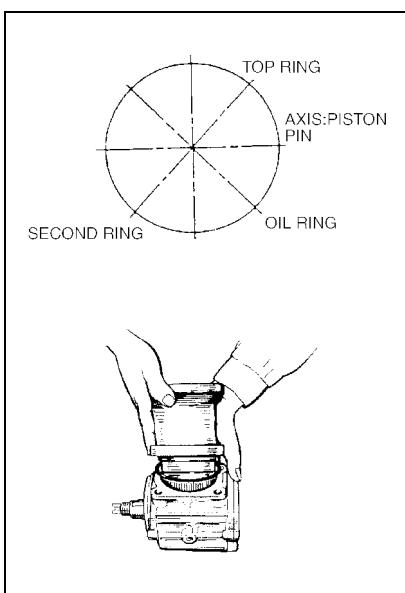
NOTICE

Warm up the piston first in hot water, to 80-90°C {176-194°F}, for approximately 5 minutes.

- (1) Install the retainer ring at one end of the piston pin holes.
- (2) Apply engine oil to the piston pin.
- (3) Fix the piston and connecting rod by inserting the pin.
- (4) Fit the new retainer ring at the other end.

CAUTION

The retainer ring may spring out of the groove during assembly. Wear a pair of safety goggles during assembly.



SAPH011061300026

7. INSTALL THE CYLINDER LINER AND CYLINDER HEAD.

NOTICE

Do not twist the O-ring when installing it on the cylinder liner and cylinder head.

- (1) Rotate the crankshaft to the top dead center position.
- (2) Arrange the piston rings so that their gaps are equally spaced.
- (3) Install the cylinder liner and cylinder head.

8. INSTALL THE DRIVE GEAR.

- (1) Install the woodruff key to the crankshaft.
- (2) Insert the drive gear.
- (3) Insert the collar and lock nut.

Tightening Torque:

142 N·m {1,450 kgf·cm, 105 lbf·ft}

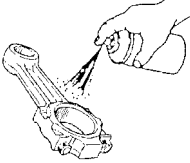

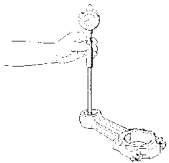
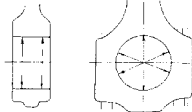



NOTICE

Apply oil to the threads and seat surface before tightening.

INSPECTION AND REPAIR

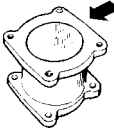

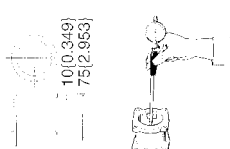

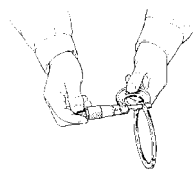
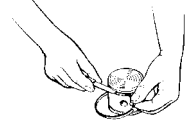
EN0110613H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cracks or defects of the connecting rod	—	—	Replace.	Visual check 
Outside diameter of piston pin	18 {0.709}	—	Replace.	Measure 
Clearance between the piston pin and connecting rod	0.016-0.044 {0.0007-0.0017}	0.07 {0.0028}		
Inside diameter of the connecting rod (Tighten the bearing cap to the specified torque.)	34 {1.339}	—	Replace.	Measure 
Outside diameter of the crank pin	34 {1.339}	—		
Oil clearance between the connecting rod and the crank pin	0.025-0.075 {0.0010-0.0029}	0.1 {0.0039}		
Connecting rod end play	0.2-0.4 {0.0079-0.0157}	0.5 {0.0197}	Replace connecting rod or crankshaft.	Measure 

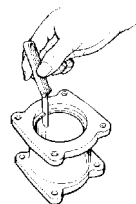
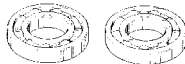
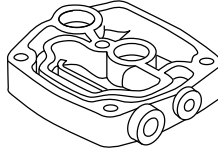
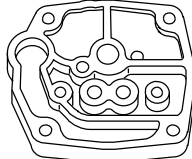
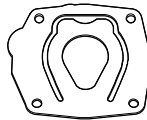

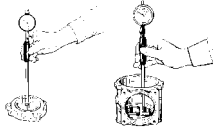
AIR COMPRESSOR (J08E: 340 cm³)

EN13-15

Inspection item		Standard	Limit	Remedy	Inspection procedure
Damage and scratches of the cylinder liner		—	—	Replace.	Visual check 
Outside diameter of the piston		85 {3.346}	—	Replace.	Measure 
Inside diameter of the cylinder liner		85 {3.346}	—		
Clearance between the piston and the cylinder liner		A: 0.23-0.295 {0.0091-0.0116}	0.335 {0.0132}		
		B: 0.09-0.155 {0.0036-0.0061}	0.195 {0.0077}		
Clearance between the piston pin hole and the piston pin		0-0.028 {0-0.0011}	0.08 {0.0031}	Replace.	Measure 
Outer diameter of the piston pin		18 {0.709}	—		
Piston ring thickness	Compression ring	2.0 {0.0787}	—	Replace.	Measure 
	Oil ring	4.0 {0.1575}	—		
Piston ring groove	Compression ring	2.0 {0.0787}	—		
	Oil ring	4.0 {0.1575}	—		
Clearance between the ring groove and the compression ring		0.01-0.045 {0.0004-0.0017}	0.08 {0.0031}		

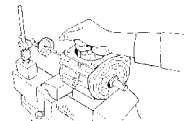

EN13-16

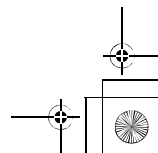
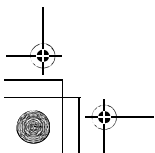
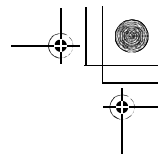
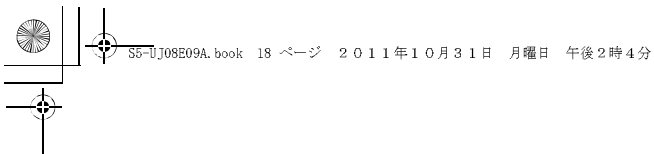
AIR COMPRESSOR (J08E: 340 cm³)

Inspection item		Standard	Limit	Remedy	Inspection procedure
Gap between ends of piston ring	Top	0.1-0.3 {0.0040-0.0118}	1.0 {0.0394}	Replace.	Measure 
	2nd	0.1-0.3 {0.0040-0.0118}	1.0 {0.0394}		
Worn or damaged bearing		—	—	Replace.	Visual check 
Worn or damaged cylinder head and delivery valve		—	—	Replace.	Visual check 
Worn or damaged valve seat		—	—	Replace valve seat.	Visual check 
Worn or damaged suction valve		—	—	Replace valve seat.	Visual check 
Outside diameter of the crankshaft journal	Drive gear side	45 {1.7716}	44.995 {1.7714}	Replace.	Measure 
	Opposite drive gear side	55 {2.1654}	54.995 {2.1651}		
Inside diameter of the bearing holder	Cylinder block	100 {3.9370}	100.04 {3.9385}	Replace.	Measure 
	Bearing holder	100 {3.9370}	100.04 {3.9385}		

AIR COMPRESSOR (J08E: 340 cm³)

EN13-17

Inspection item	Standard	Limit	Remedy	Inspection procedure
Crankshaft end play	0-0.6 {0-0.0236}	1.0 {0.0394}	Replace crankshaft and/or ball bearing.	Measure 
Worn or damaged unloader valve piston	—	—	Replace.	Visual check 





ENGINE CONTROL (J08E)

EN16-001

ACCELERATOR PEDAL.....EN16-2

DESCRIPTION EN16-2

ENGINE ECUEN16-3

COMPONENT LOCATOR..... EN16-3

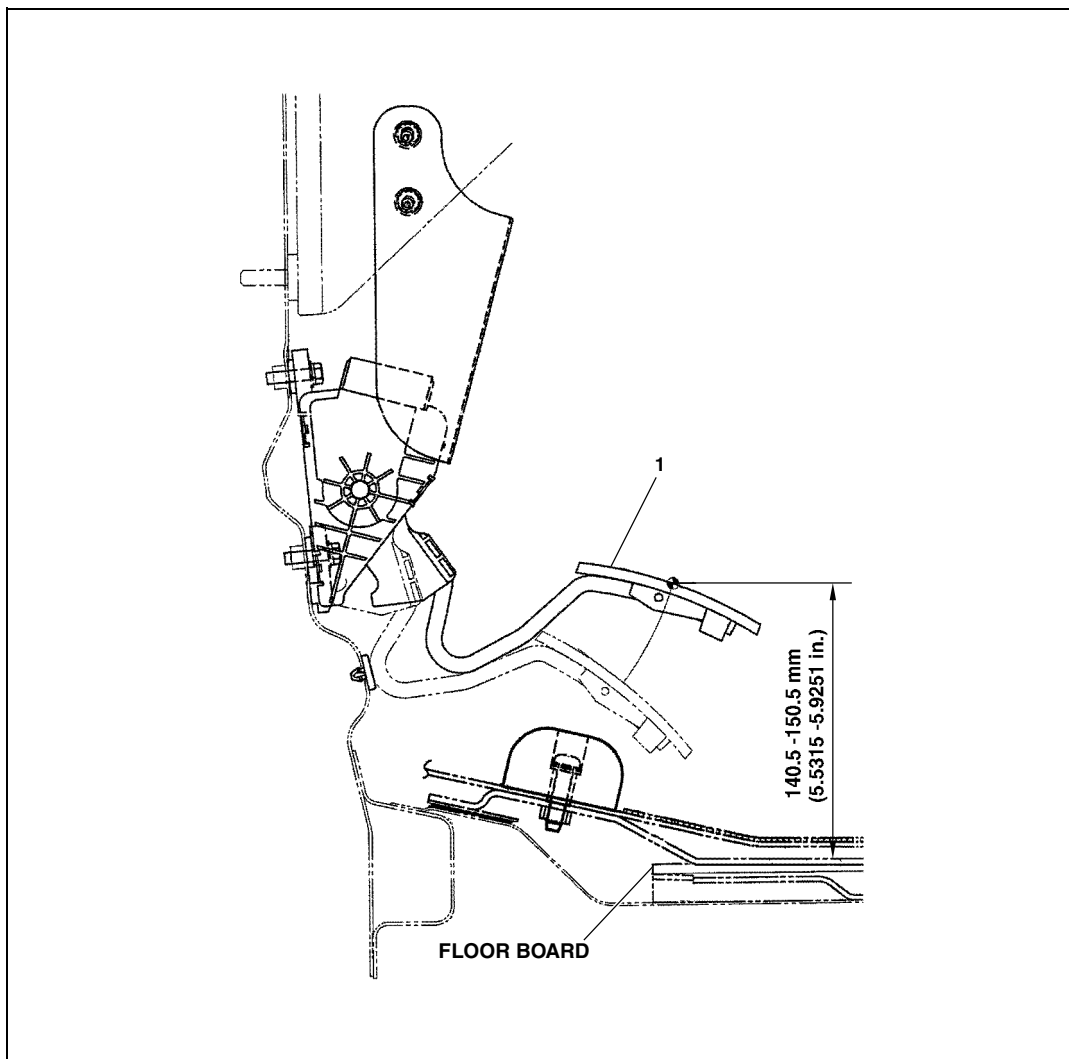
REPLACEMENT EN16-4



ACCELERATOR PEDAL

DESCRIPTION

EN0110616F200001



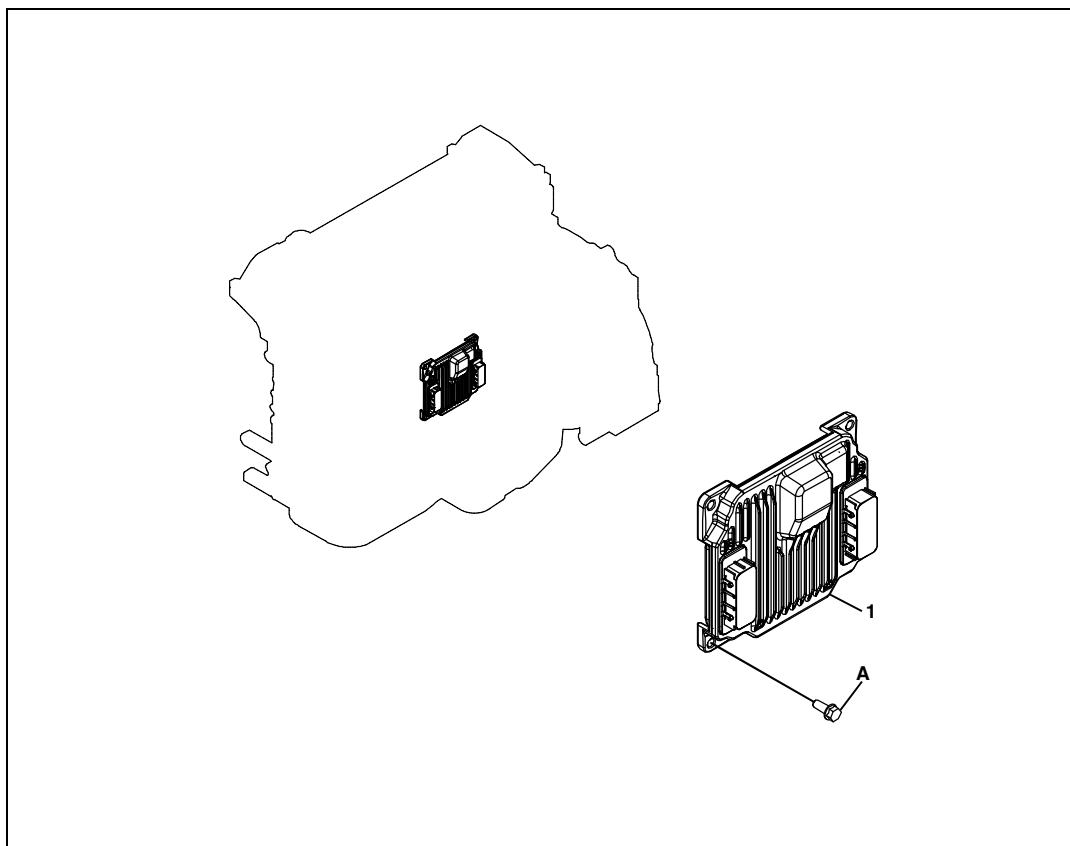
SAPH011061600001

1 Accelerator pedal assy

ENGINE ECU

COMPONENT LOCATOR

EN0110610J100004



SAPH011061600002

1	Engine ECU	
Tightening torque		Unit: N·m {kgf·cm, lbf·ft}
A	28.5 {291, 21}	

REPLACEMENT

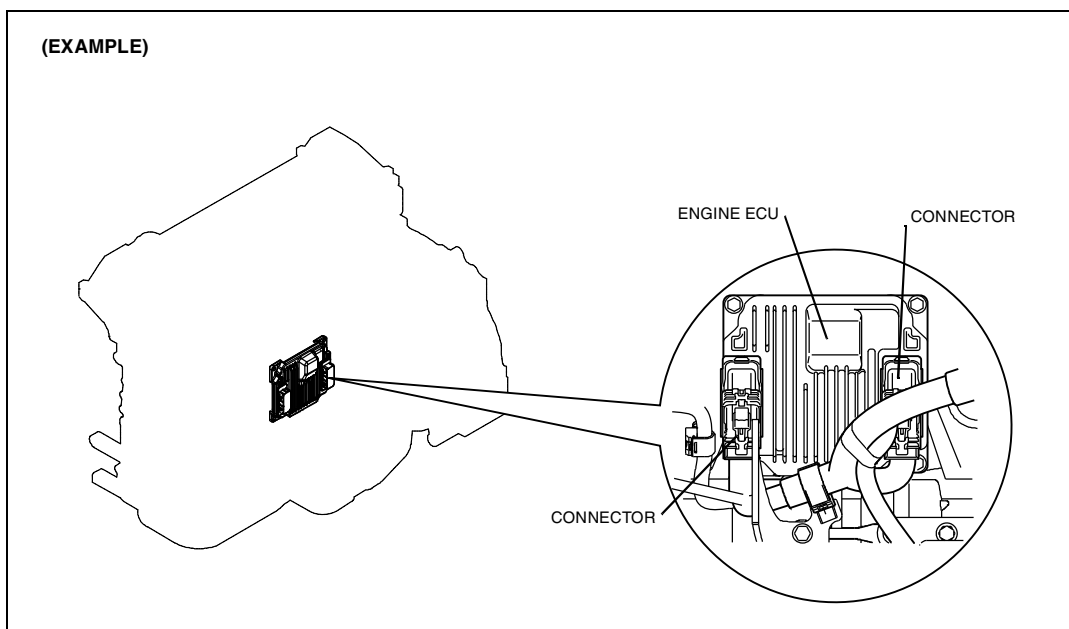
EN0110610H100002

DISCONNECTING THE ENGINE ECU CONNECTOR

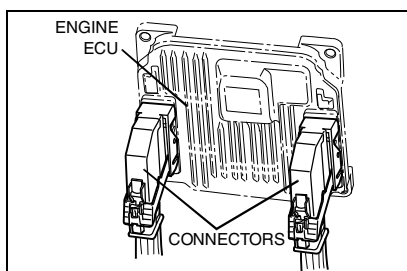
⚠ WARNING

Perform replacement after cooling to prevent burns. (Wait for at least 30 minutes after setting the starter key to the "LOCK" position.)

(EXAMPLE)



SAPH011061600003



SAPH011061600004

1. CLEANING AND DISCONNECTING THE ENGINE ECU CONNECTOR

- (1) Check that the engine ECU connector is completely connected to the engine ECU.
- (2) Directly spray water around the engine ECU connector by using a spray bottle.

NOTICE

While working, do not disconnect the connectors.

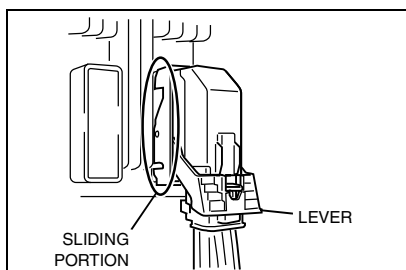
HINT

If it is much dirty, squirt water at the connector sliding portion and connector surface.

- (3) Blow air around the engine ECU connector and engine ECU surface to remove dirt and foreign matter.

NOTICE

- While working, do not disconnect the connectors.
- Blow off water with air as much as possible for drying.



- (4) Using a small brush, carefully remove dirt and foreign matter remaining at the sliding portion.

NOTICE

While working, do not disconnect the connectors.

- (5) Using a waste cloth, wipe off around the engine ECU connector and engine ECU surface.

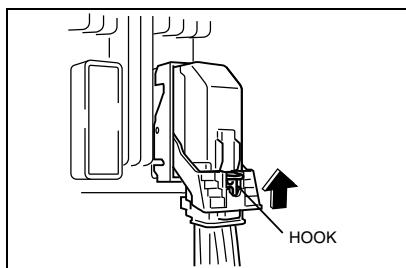
NOTICE

- **While working, do not disconnect the connectors.**
- **Wipe up water thoroughly.**

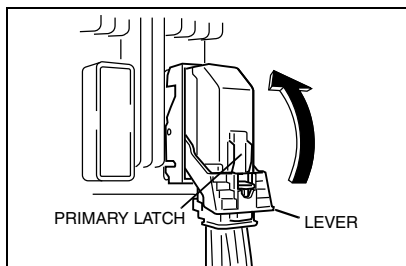
- (6) If you feel the movement of the lever unsmooth, repeat steps (1) through (5).

- (7) Disconnect the engine ECU connector and check it for deposition of dirt and foreign matter.

- a. Set the hook of the connector in the direction of the arrow to release the lock.



- b. While pushing the primary latch of the connector, move the lever in the direction of the arrow as shown in the figure until a "click" is heard and then disconnect the connector.



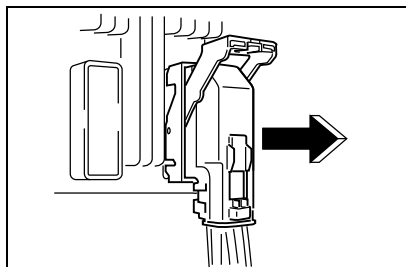
- c. Pull out the connector straight.

NOTICE

- **Do not insert and remove the connector more than necessary.**
- **Do not give shocks to the engine ECU.**
- **Never disconnect the harness by holding and pulling or prying as it may result in wire or terminal deformation.**
- **Never insert a test lead from the rear of the connector.**
- **Do not paint or apply grease or oil to the ECU surface and connector to maintain their functions and durability.**

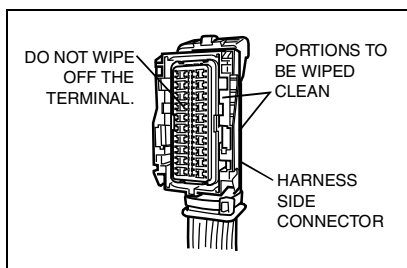
HINT

If it cannot be pulled out with a light force, check if the lever is fully open.



EN16-6

ENGINE CONTROL (J08E)

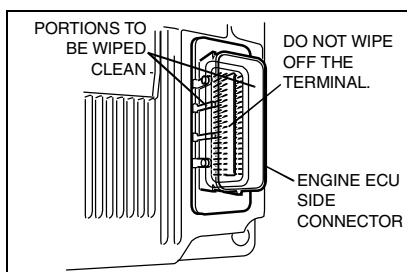


SAPH011061600009

- (8) If the side of the harness side connector is found dirty, wipe it off with a moistened waste cloth while being careful not allowing dirt and foreign matter to drop.

NOTICE

- Use a thoroughly wrung waste cloth.
- Do not wipe off the terminal opening.
- Do not directly spray water.



SAPH011061600010

- (9) If the engine ECU side connector is found dirty, wipe off its side with a moistened waste cloth.

NOTICE

- Use a thoroughly wrung waste cloth.
- Do not wipe off the terminal opening.
- Do not directly spray water.

- (10) Blow air on the terminal part inside the engine ECU side connector to remove dirt and foreign matter.

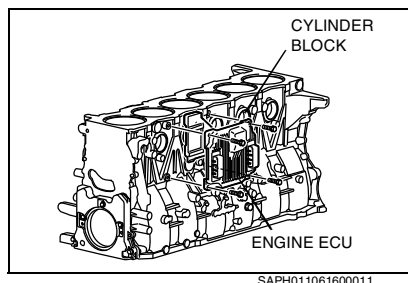
REMOVING THE ENGINE ECU

1. REMOVING THE ENGINE ECU

- (1) Unfasten the bolts (4 pcs.) and remove the engine ECU from the cylinder block.

NOTICE

- Protect with plastic covers to avoid entry of dirt and foreign matter into the connectors of the engine ECU.
- Do not give shocks to the ECU.
- Do not use the engine ECU if dropped.
- Do not directly touch the connector terminals by hand.
- The engine ECU is non-disassemblable.
- Do not paint or apply grease or oil to the ECU surface and connector to maintain their functions and durability.



MOUNTING THE ENGINE ECU

1. MOUNTING THE ENGINE ECU

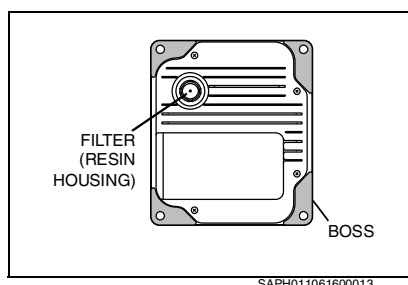
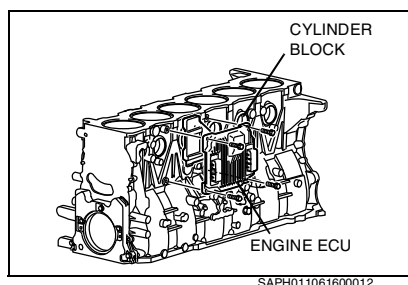
- (1) Mount the engine ECU the cylinder block with the bolts (4 pcs.). For the tightening order, tighten them diagonally.

Tightening Torque:

28.5 N·m {291 kgf-cm, 21 lbf-ft}

NOTICE

- Check that there are no dirt and foreign matter in the engine ECU connectors.
- Do not give shocks to the ECU.
- Do not use the engine ECU if dropped.
- Do not directly touch the connector terminals by hand.
- The engine ECU is non-disassemblable.
- Do not paint or apply grease or oil to the ECU surface and connector to maintain their functions and durability.
- Check that there is no dirt on the bosses (4 places) on the back of the engine ECU.
- Check that there are no grease and damage on the filter (resin housing) on the back of the engine ECU.



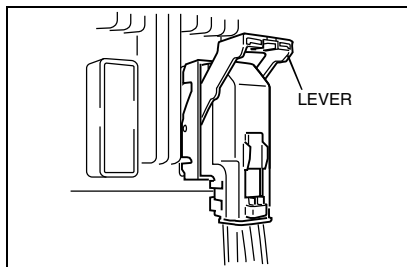
CONNECTING THE ENGINE ECU CONNECTOR

1. CONNECTING THE ENGINE ECU CONNECTOR

- (1) Check that the harness side connector lever is fully open and place it straight on the engine ECU side connector.

NOTICE

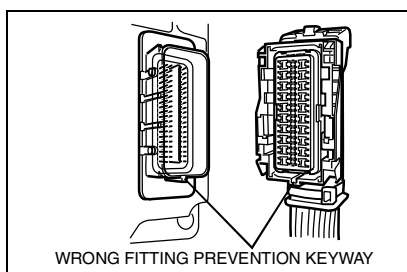
At this time, check that the lever is fully open.



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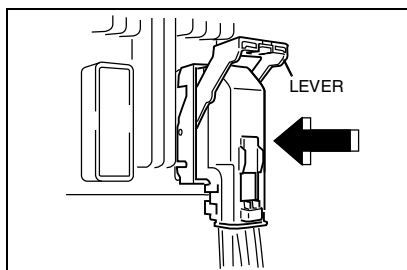
HINT

Check that it is inserted along the wrong fitting prevention keyway.



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- (2) Press the upper part of the harness side connector and insert the connector uniformly.

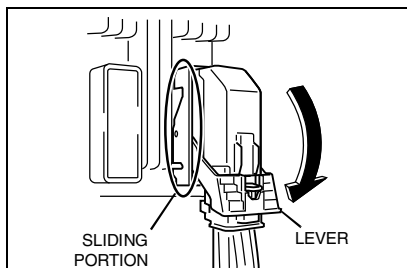


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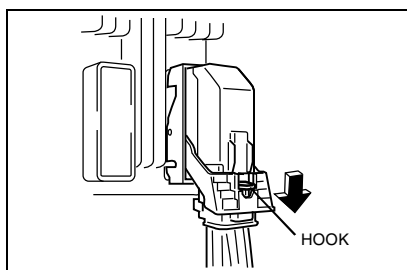
- (3) Move the lever in the direction of the arrow as shown in the figure until a "click" is heard and connect the connector.

NOTICE

If the lever cannot move smoothly, repeat steps (1) and (2). Also drop a few drops of water to the sliding portion to make it smooth.

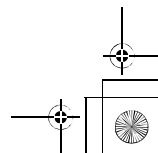
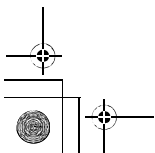
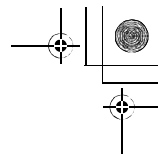
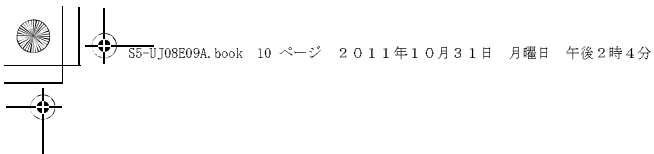


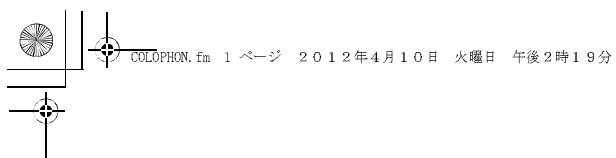
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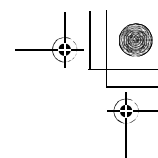
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- (4) Move the hook in the direction of the arrow as shown in the figure until a "click" is heard in order to lock the connector.





COLOPHON.fm 1 ページ 2012年4月10日 火曜日 午後2時19分



Hino Motors Sales U.S.A., Inc.

41180 Bridge Street, Novi, MI 48375

Telephone: (248) 699-9300

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