Table of Contents

Tools and Accessories

EZ-Tech® Electronic Service Tool (EST)

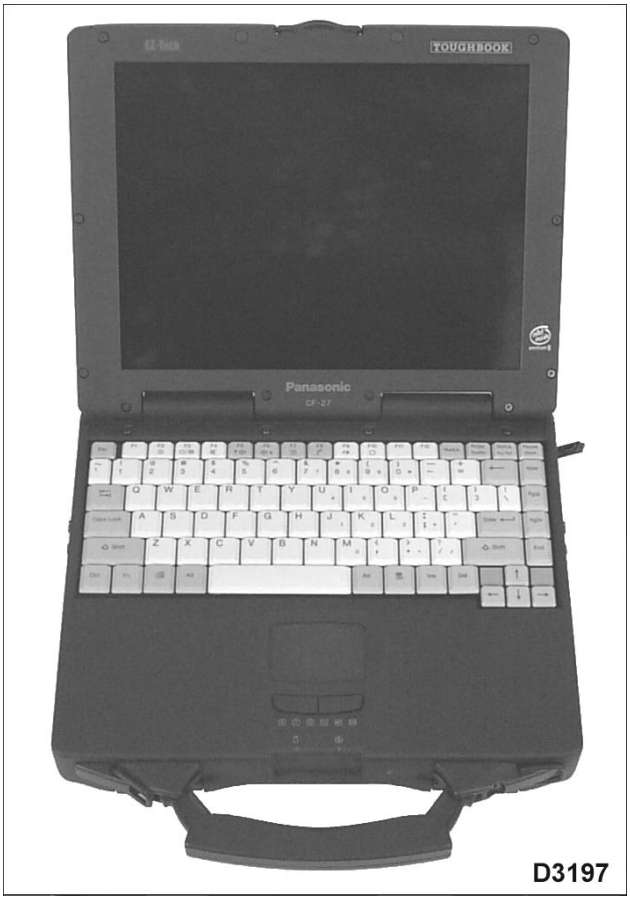

Figure 514 J-45067

The EST is used to run MasterDiagnostics® software for diagnosing and troubleshooting engine and vehicle problems.

EZ-Tech® Interface Kit

Figure 515 ZTSE4444B

These interface cables, included with the EZ-Tech®, connect the EST to Electronic Control Module (ECM).

MasterDiagnostics® Software

MasterDiagnostics® software, loaded to an EST or laptop computer, is used to check performance of engine systems, diagnose engine problems, and store troubleshooting history for an engine.

Digital Multimeter (Fluke 88)

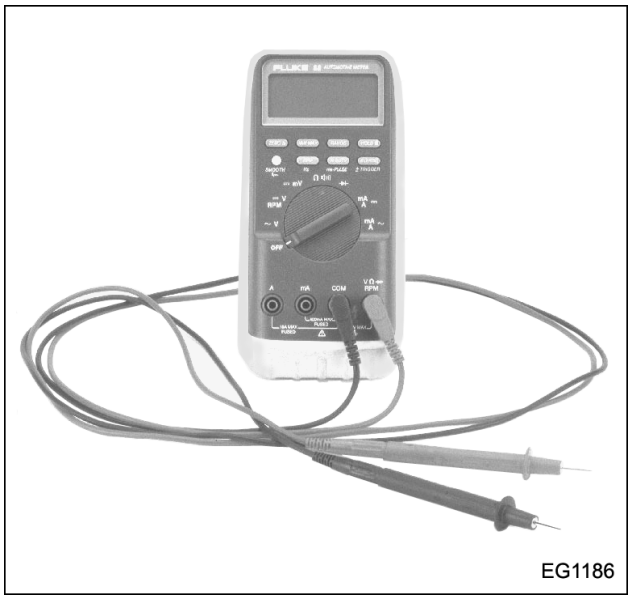

Figure 516 ZTSE4357

The Fluke 88 Digital Multimeter (DMM) is used to troubleshoot electrical components, sensors, injector solenoids, relays, and wiring harnesses. The DMM has a high input impedance that allows testing of sensors while the engine is running, without loading the circuit being tested. This ensures that the signal voltage measurement will not be affected by the voltmeter.

Amp Clamp

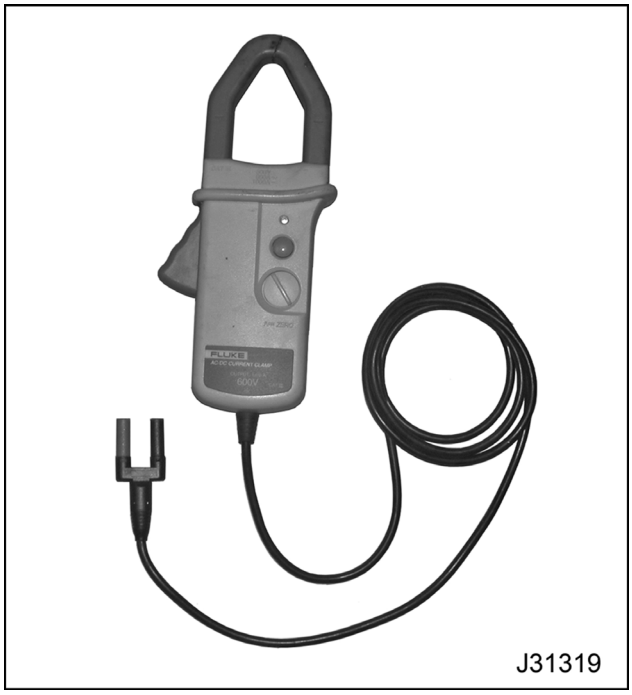

Figure 517 ZTSE4575

The Amp Clamp is to measure amperage draw for the glow plug and inlet air heater systems.

96-Pin Breakout Box – DLC II

Figure 518 ZTSE4582

The Breakout Box allows testing of the electronic control system components without disturbing connections or piercing wire insulation to access various signal voltages in the electronic control system.

CAUTION: The Breakout Box is used for measurement only, not to activate or control circuits. High current levels passing through the breakout box will burn out the internal circuitry.

Breakout Harness Kit

Figure 519 ZTSE4505A

The Breakout Harness Kit contains the following breakout harnesses and test leads:

- 3-Banana Plug Harness (ZTSE4498)
- VC Gasket Breakout Harness (ZTSE4658A)
- UVC Sensor Breakout Harness (ZTSE4686)
- 4-Pin Injector Harness (ZTSE4662)
- 12-Pin Breakout Harness (ZTSE4665)
- 500 Ohm Resistor Harness (ZTSE4497)
- Actuator Breakout Harness (ZTSE4484)
- APS/IVS Breakout Harness (ZTSE4485)
- Pressure Sensor Breakout Harness (ZTSE4347)
- Relay Breakout Harness (ZTSE4596)
- Relay Breakout Harness (ZTSE4674)
- Temperature Sensor Breakout Harness (ZTSE4483)
- Temperature Sensor Breakout Harness (ZTSE4602)
- Turbo Breakout Harness (ZTSE4659)

3-Banana Plug Harness

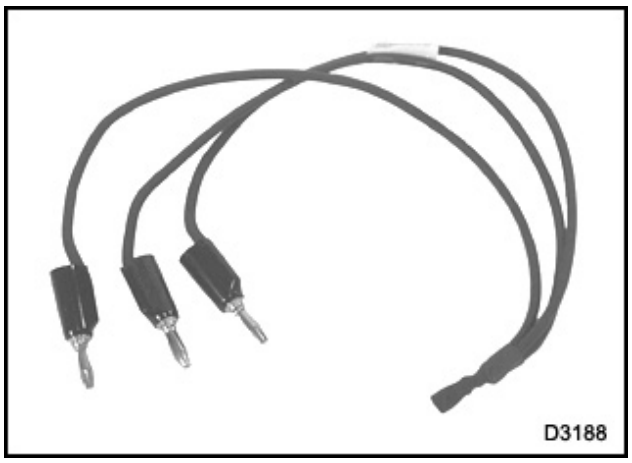

Figure 520 ZTSE4498

The 3-Banana Plug Harness is used for operational diagnostics of sensor circuits.

VC Gasket Breakout Harness

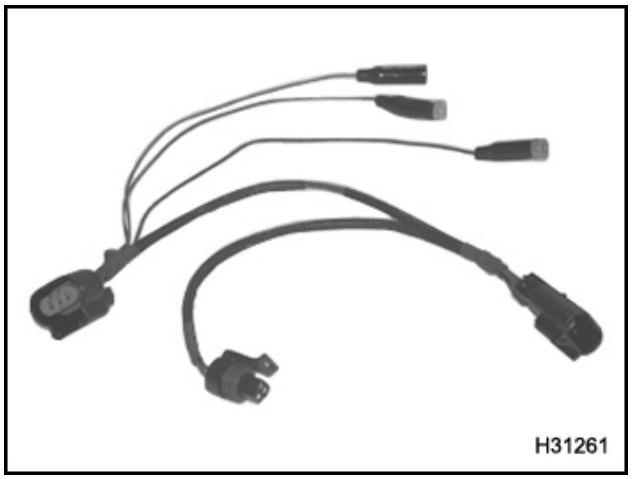

Figure 521 ZTSE4658A

The VC Gasket Breakout Harness is used to access V_{REF}, signal ground, and signal voltage circuits, before removing valve cover, for the following sensors:

- Injection Control Pressure (ICP)
- Brake Control Pressure (BCP)

The VC Gasket Breakout Harness is also used to check actuator ground and control for the brake shutoff valve circuit and ICP system diagnostics.

UVC Sensor Breakout Harness

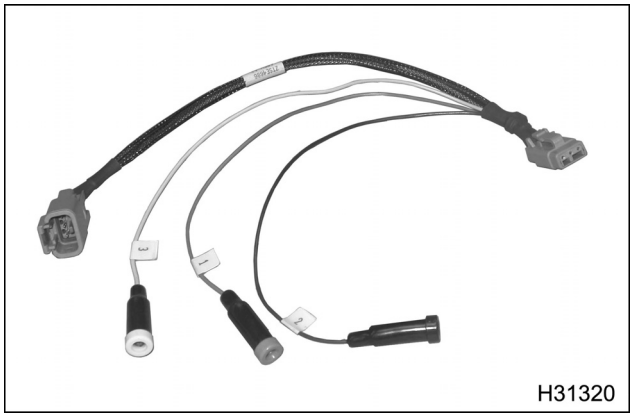

Figure 522 ZTSE4686

The UVC Sensor Breakout Harness is used to access V_{REF}, signal ground, and signal voltage circuits, after removing valve cover, for the following sensors:

- Injection Control Pressure (ICP)
- Brake Control Pressure (BCP)

4-Pin Injector Harness

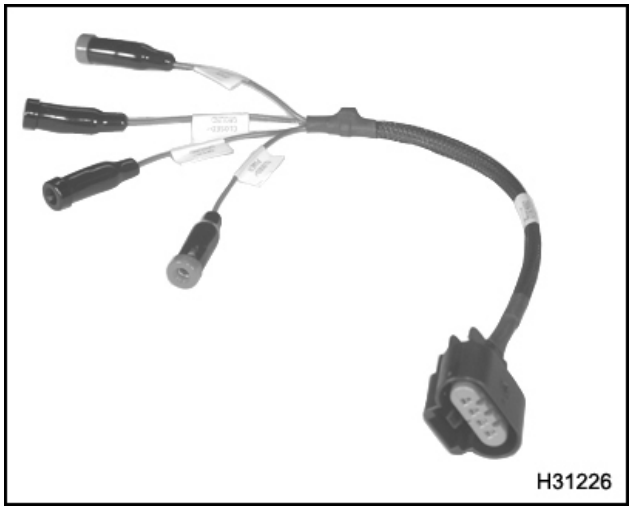

Figure 523 ZTSE4662

The 4-Pin Injector Harness is used to measure continuity of the UVC wiring and injector solenoids.

12-Pin Breakout Harness

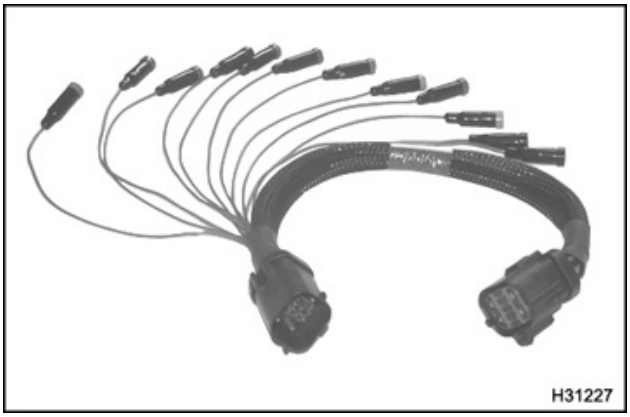

Figure 524 ZTSE4665

The 12-Pin Breakout Harness is used for circuit diagnostics for the Injector Drive Module (IDM) powers and ground, actuator power and ground (EGR and VGT), in addition to some applications (IAT, service brake switch signals to the ECM, and ATA data link to and from the IDM).

500 Ohm Resistor Harness

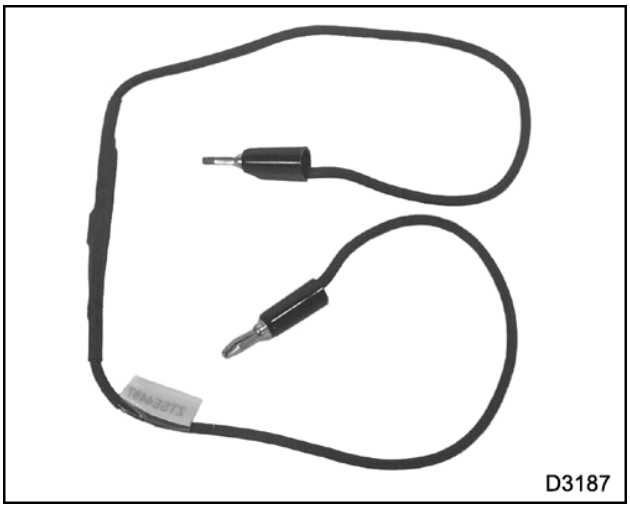

Figure 525 ZTSE4497

The 500 Ohm Resistor Harness is used for operational diagnostics of sensor circuits and Output State Tests for actuator control circuits.

Actuator Breakout Harness

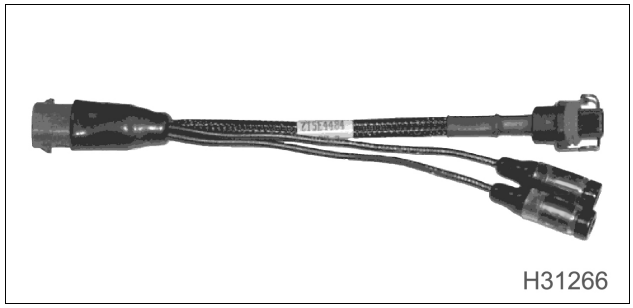

Figure 526 ZTSE4484

The Actuator Breakout Harness is used to measure the voltage supplied to the Injection Pressure Regulator (IPR).

For electrical circuit diagnostics, install the breakout harness between the electrical harness and the valve. For Injection Control Pressure (ICP) system diagnostics, plug the Actuator Breakout Harness into the IPR valve only.

APS/IVS Sensor Breakout Harness

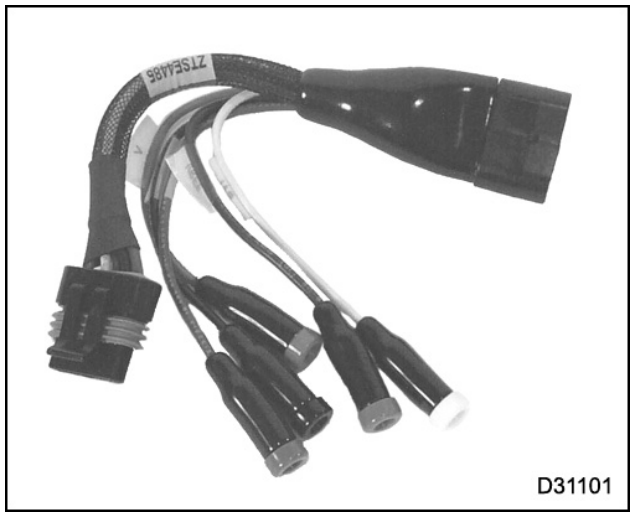

Figure 527 ZTSE4485

The Accelerator Position Sensor (APS) / Idle Validation Switch (IVS) harness is used to measure V_{REF}, APS signal, signal ground, IVS signal, and IVS power at the APS/IVS sensor.

Pressure Sensor Breakout Harness

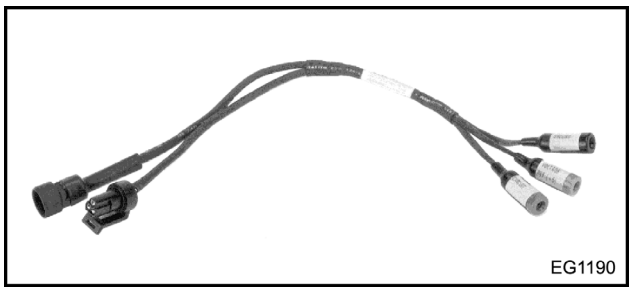

Figure 528 ZTSE4347

The Pressure Sensor Breakout Harness is used to access V_{REF}, signal ground, and signal voltage circuits for the following sensors:

- Manifold Absolute Pressure (MAP)
- Exhaust Back Pressure (EBP)
- Engine Oil Pressure (EOP)

Relay Breakout Harness

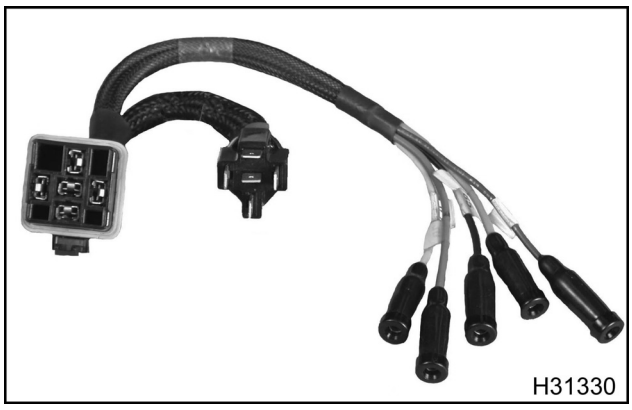

Figure 529 ZTSE4596

The Relay Breakout Harness is used to measure power from the IDM main power relay or ECM main power relay to check the operation of the relay in the circuit.

Relay Breakout Harness

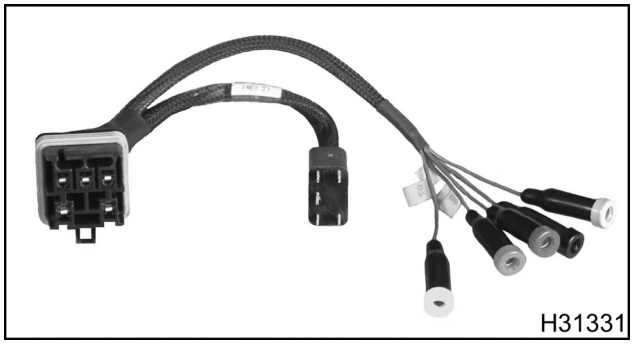

Figure 530 ZTSE4674

The Relay Breakout Harness is used to measure power from the IDM main power relay or ECM main power relay to check the operation of the relay in the circuit.

Temperature Sensor Breakout Harness

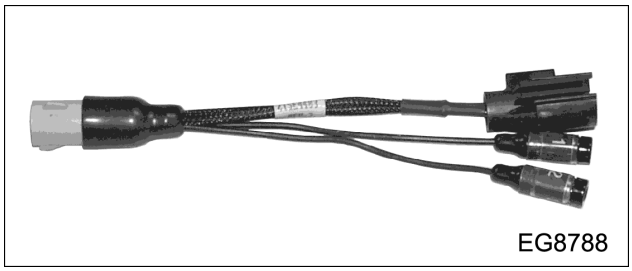

Figure 531 ZTSE4483

The Temperature Sensor Breakout Harness enables the technician to quickly connect a voltmeter and read voltage signals for the Intake Air Temperature (IAT) sensor.

Temperature Sensor Breakout Harness

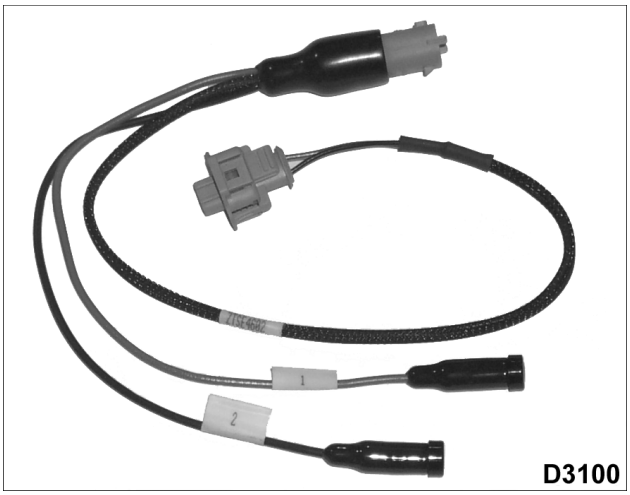

Figure 532 ZTSE4602

The Temperature Sensor Breakout Harness enables the technician to quickly connect a voltmeter and read voltage signals for the following sensors:

- Engine Coolant Temperature (ECT)
- Engine Oil Temperature (EOT)
- Manifold Absolute Temperature (MAT)

Turbo Breakout Harness

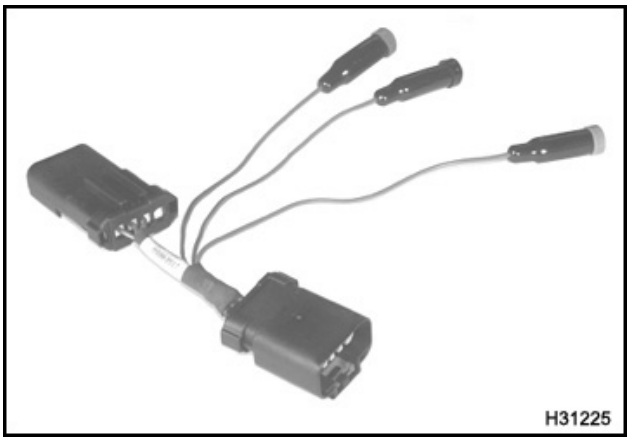

Figure 533 ZTSE4659

Turbo Breakout Harness is used to measure VGT actuator power, ground, and control.

EGR Valve Breakout Harness

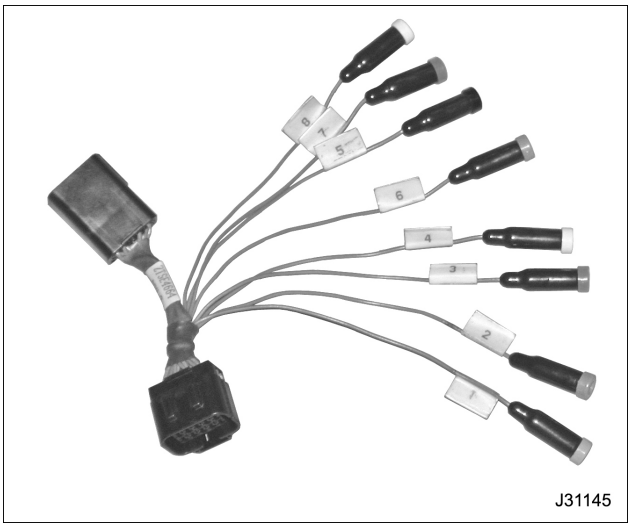

Figure 534 ZTSE4664

The EGR Breakout Harness is primarily used to pin out the harness to look for opens and shorts. The EGR Breakout Harness is also used to access supply voltage and ground to the EGR valve, as well as to monitor drive signals and position sensor signals.

Terminal Test Adapter Kit

Figure 535 ZTSE4435A

The Terminal Test Adapter Kit is used to access circuits in the connector harness and allows for the use of a DMM without damaging the harness connectors. The probes may also be used as a guide to determine whether the harness connector is retaining correct tension on the mating terminal.

Gauge Bar Tool

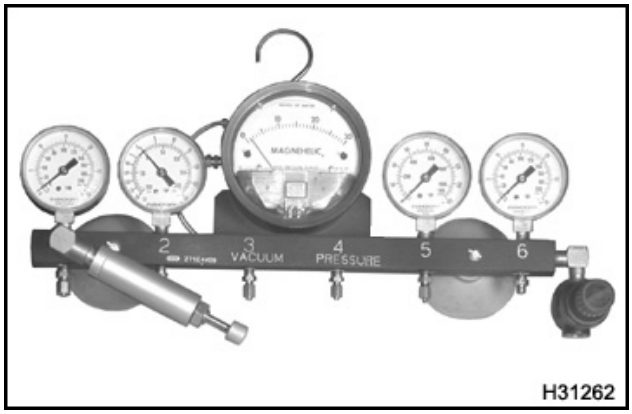

Figure 536 ZTSE4409

The Gauge Bar Tool is used to measure intake manifold (boost) pressure, fuel system inlet restriction, fuel pressure, oil pressure, air cleaner intake restriction, and crankcase pressure.

- 0 kPa to 200 kPa (0 psi to 30 psi) measures intake manifold pressure.
- 0-30 in Hg vacuum /0 kPa to 200 kPa (0 psi to 30 psi) compound gauge measures fuel system inlet restriction and intake manifold pressure.

  0-30 in H_2O 0 kPa to 7.5 kPa (0 psi to 1 psi) maximum pressure magnehelic gauge measures crankcase pressure and air inlet restriction.
- 60 kPa to 1100 kPa (0 psi to 160 psi) gauge may be used to check the fuel pressure and oil pressure.

Fuel Pressure Gauge

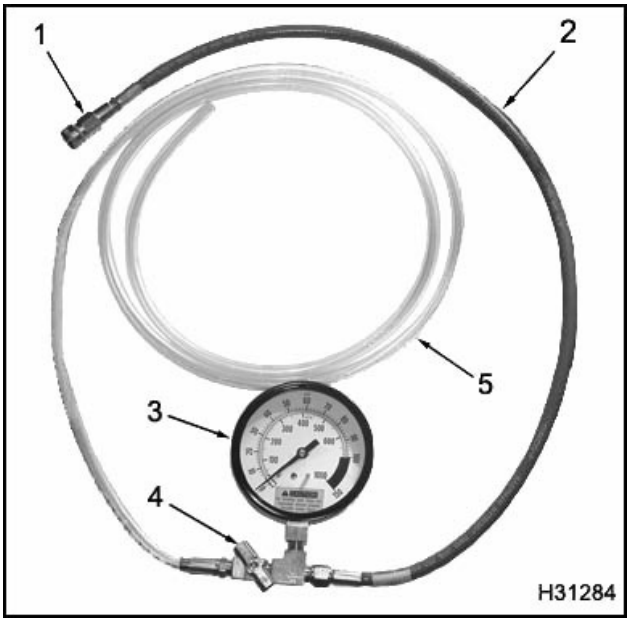

Figure 537 ZTSE4681

1. Quick disconnect check valve
2. Fuel test line
3. Fuel Pressure Gauge
4. Inline shut-off valve
5. Clear test line

The Fuel Pressure Gauge is used to check for aerated fuel at the fuel rail.

Slack Tube Manometer

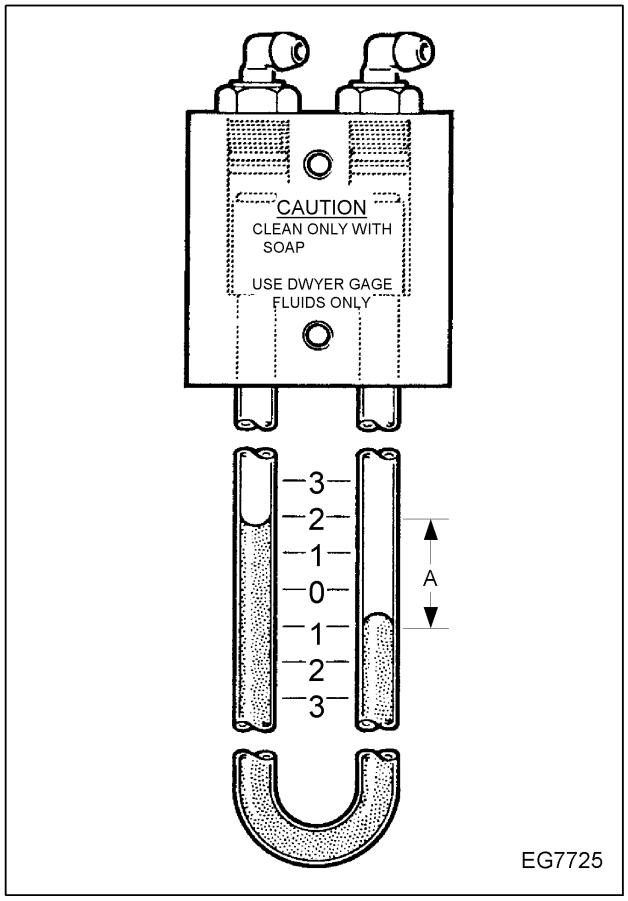

Figure 538 ZTSE2217A

The Slack Tube Manometer is a U-shaped tube with a scale mounted between the legs of the tube. When the portability of the gauge bar tool is not required, this manometer is used to measure low vacuum for intake restriction or low pressure for crankcase.

Filling

Fill the manometer with water before checking pressure. Use only distilled water. Add some colored water vegetable dye so the scale can be read more easily. With both legs of the manometer open to the atmosphere, fill the tube until the top of the fluid column is near the zero mark on the scale. Shake the tube to eliminate any air bubbles.

Installing, Reading, and Cleaning

1. Support the manometer vertically. Make sure the fluid level is in line with the zero indicator on the graduated scale.
2. Connect one leg of the manometer to the source of the pressure or vacuum. Leave the other leg open to atmospheric pressure.
3. Start the engine and allow it to reach normal operating temperature. Then run the engine to high idle. The manometer can be read after 10 seconds.
4. Record the average position of the fluid level when it is above and below the zero indicator. Add the two figures together. The sum of the two is the total column of fluid (distance A). This represents the crankcase pressure in inches of water (in H_2O).

   At times, both columns of the manometer will not travel the same distance. This is no concern if the leg not connected to the pressure or vacuum source is open to the atmosphere.
5. Compare the manometer reading with engine specifications.
6. When the test is done, clean the tube thoroughly using soap and water. Avoid liquid soaps and solvents.

Fuel Pressure Test Kit

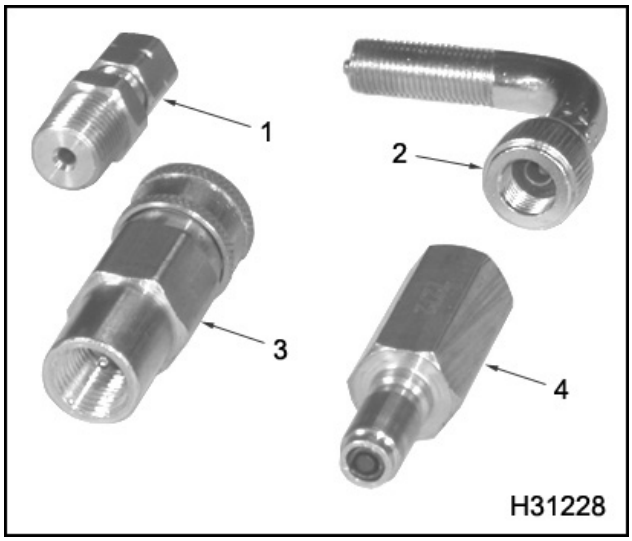

Figure 539 ZTSE4657

1. Compression fitting 1/8 NPT
2. 90° elbow
3. Quick disconnect check valve
4. Fuel pressure test adapter

The Fuel Pressure Test Kit includes a quick disconnect check valve and fittings that can be used to make a test line to check fuel pressure at the high-pressure fuel rail.

Fuel/Oil Pressure Test Coupler

Figure 540 ZTSE4526

The Fuel/Oil Pressure Test Coupler is used with the fuel pressure test fitting for an easy connection to measure fuel pressure.

Fuel Test Fitting

Figure 541 ZTSE4692

The fuel test fitting is used to measure fuel inlet restriction or fuel pressure.

When measuring fuel inlet restriction, the fitting is installed at the diagnostic port (inlet-side) of the fuel filter housing.

When measuring fuel pressure, the fitting can be installed on the fuel rail instead of the Shrader valve.

The Fuel/Oil Pressure Test Coupler can then be connected to the fuel test fitting to measure fuel pressure or fuel inlet restriction.

ICP System Test Adapter

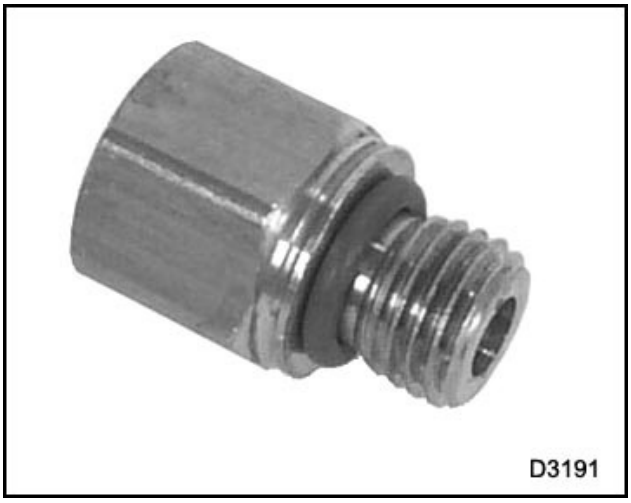

Figure 542 ZTSE4594

The Injection Control Pressure (ICP) System Test Adapter was first used to pressurize the ICP system for the International® VT 365 diesel engine to test ICP system integrity with the influence of the Injection Pressure Regulator (IPR) valve. This adapter is used to take an oil sample or measure oil pressure at the Engine Oil Temperature (EOT) sensor port for the International® DT 466, DT 570, and HT 570 diesel engine.

ICP Test Kit

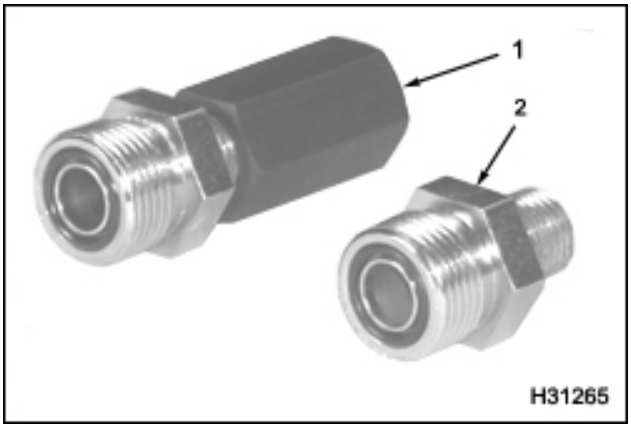

Figure 543 ZTSE4655

1. Fitting 13/16 - 16 NPT
2. ICP sensor adapter

The ICP Test Kit is used to check ICP system diagnostics. The ICP adapter is used with an ICP sensor and the VC Gasket Breakout Harness to check the integrity of the high-pressure pump and IPR. The fitting is adapted to an air line to pressurize the UVC components and check for leaks.

Inline Shut-off Valve

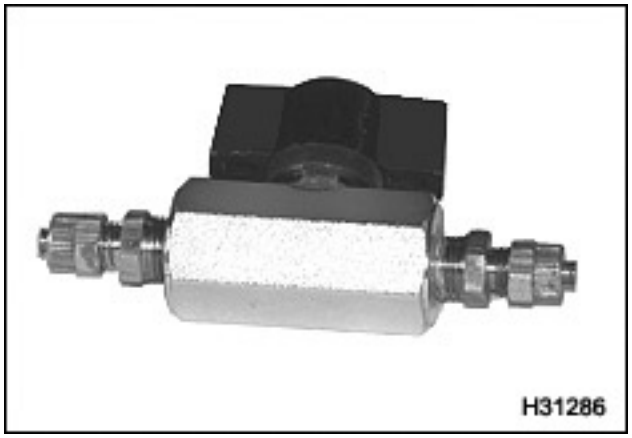

Figure 544 Part No. 221406

The Inline Shut-off Valve is used to make a test line assembly that connects to the ICP system test adapter to check for aerated oil specifically at the EOT sensor port. The shut-off valve can also be used to make a test line assembly to check for aerated fuel.

Vacuum Pump and Gauge

Figure 545 ZTSE2499

The Vacuum Pump and Gauge is used to test the operation of the fuel pump.

Charge Air Cooler Test Kit

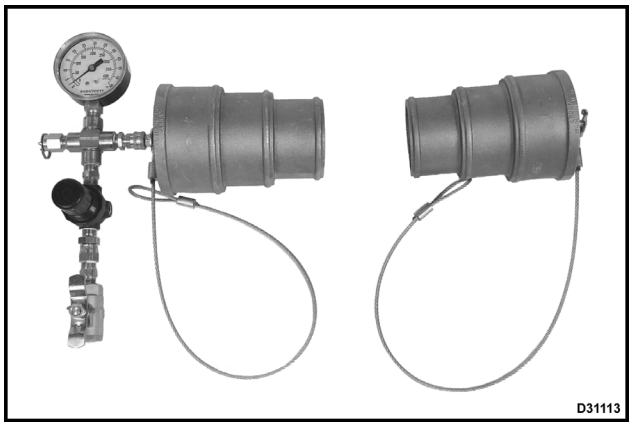

Figure 546 ZTSE4341

The Charge Air Cooler (CAC) Test Kit is used to pressurize the charge air cooler and piping to check for leaks.

Crankcase Pressure Test Adapter

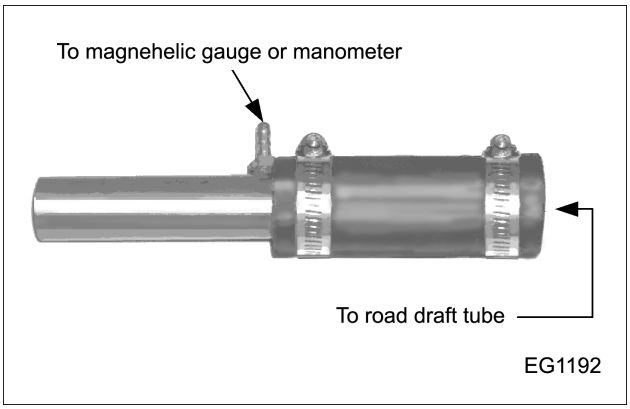

Figure 547 ZTSE4039

The Crankcase Pressure Test Adapter is used to measure combustion gas flow from the engine breather and may be used with the magnehelic gauge or slack tube manometer.

Pressure readings obtained with this adapter must be used as the main source of engine condition. Oil consumption trend data must also be used if the pressure readings are over the specified limits. Neither changes in oil consumption trends nor crankcase diagnostic pressure trends can establish a specific problem. These changes only indicate that a problem exists.

UV Leak Detection Kit

Figure 548 ZTSE4618

The UV leak detection kit is used with fuel dye to quickly identify leaks. The fuel dye combines with fuel and migrates out at the leak. The ultraviolet lamp illuminates the leaking fuel dye, which appears fluorescent yellow-green in color.

Electronic Circuit Testing

Electrical Theory

Voltage

Voltage is electrical pressure or force that pushes current through a circuit. The pressure is measured in volts. The symbol V (for example, 12 V) is used in circuit diagrams to denote voltage. The letter E (Electromotive force) is also used for voltage. Voltage can be compared to the pressure necessary to push water through a metering valve.

Low voltage to a lamp will cause the lamp to glow dimly. This can be caused by low source voltage (discharged battery or low alternator output) or by high circuit resistance resulting from a poor connection. Resistance from a poor connection or poor ground is an additional load in the circuit. The additional load reduces voltage available to push current through the load device. Before making any meter measurements, review Ohm's Law.

Ohm's Law

Ohm's Law describes the relationship between current, voltage, and resistance in an electrical circuit. Ohm's Law also provides the basic formula for calculations.

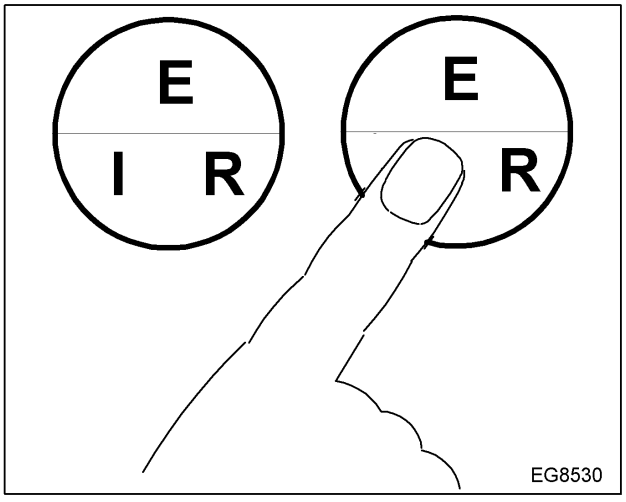

Figure 549 Ohm's Law

Memorize the formula in the circle. Cover the letter with a finger for the desired formula. For example, I is covered, the formula is I = E ÷ R.

If two values are known for a given circuit, the missing one can be found by substituting the values in amperes, volts, or ohms.

The three basic formulas for Ohm's Law are as follows:
I = Current (amperes)
E = Voltage (volts)
R = Resistance (ohms)

- I = E ÷ R

  This formula states that the current flow (I) in the circuit equals the voltage (E) applied to the circuit divided by the total resistance (R) in the circuit. This shows that an increase in voltage or a decrease in resistance increases the current flow.

- E = I × R

  This formula states that the voltage (E) applied to the circuit equals the current flow (I) in the circuit multiplied by the total resistance (R) in the circuit. The voltage drop is caused by resistance across a particular load device in a series of load devices.

- R = E ÷ I

  This formula states that the total resistance (R) in the circuit equals the voltage (E) applied to the circuit divided by the current flow (I) in the circuit. Resistance can be calculated for a specific current flow when a specific voltage is applied.

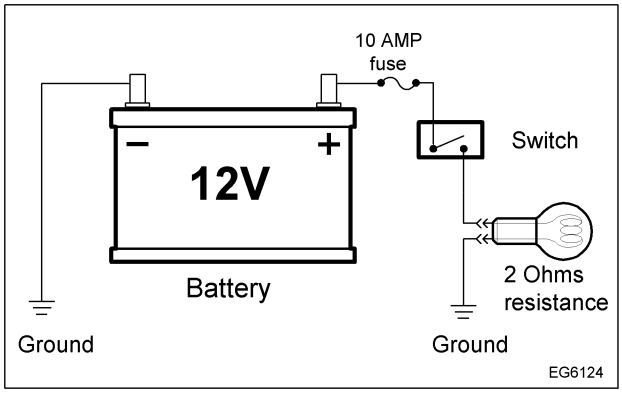

Figure 550 Simple electrical circuit

In a typical circuit, battery voltage is applied to a bulb through a 10 amp fuse and a switch. Closing the switch turns on the bulb.

To find the current flow, use the formula I = E ÷ R:

Fill in the numbers for the formula:

I = 12 V ÷ 2 ohms

I = 6 amps

The bulb in this circuit operates at 6 amps and is rated at 6 amps. With 12 volts applied, the bulb will glow at the rated output level (candlepower rating). However,

- If the voltage applied is low (low battery), the value of E is lower, current flow will be less, and the bulb will glow less brightly.
- If connections are loose or the switch is corroded, the circuit resistance will be greater (value of R will be larger), the current flow will be reduced, and the bulb will glow less brightly.

Voltage drops are important for the following reasons:

- High voltage drops indicate excessive resistance. For example, if a blower motor runs too slowly or a light glows too dimly, the circuit may have excessive resistance. Voltage drop readings can isolate problems in parts of a circuit (corroded or loose terminals, for example).
- Too low of a voltage drop indicates low resistance. For example, if a blower motor runs too fast, the problem could be low resistance in a resistor pack.
- Maximum allowable voltage drop under load is critical, especially for more than one high resistance problem. All voltage drops in a circuit are cumulative. Corroded terminals, loose connections, damaged wires or other similar conditions create undesirable voltage drops that decrease the voltage available across the key components in the circuit. Increased resistance will decrease current flow in the circuit, preventing other components from operating at peak efficiency. A small drop across wires (conductors), connectors, switches, etc., is normal because all conductors have some resistance, but the total should be less than 10% of the total voltage drop in the circuit.

Using the Digital Multimeter

The following electrical test equipment should be available for testing electronic circuits:

- Voltmeter
- Ohmmeter
- Ammeter
- Jumper wires
- Test lights

Test Meters

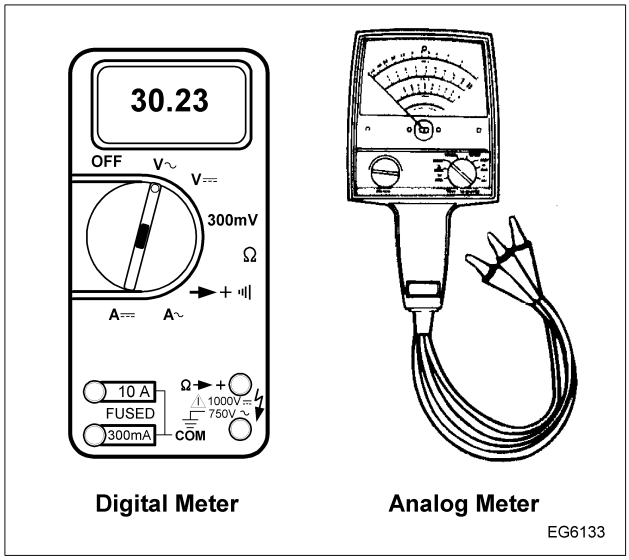

Figure 551 Typical Test Meters

Test meters come in a variety of models. Any working model will be adequate for simple tests. However, accurate readings are important. Make sure the test meter is of high quality. The Fluke 88 Digital Multimeter (DMM) is recommended because it has very little current and a high impedance (resistance) of 10 megaohms (10 MΩ).

CAUTION: Only use a high impedance digital multimeter when troubleshooting an electronic circuit. Do not use any kind of battery powered test light. Battery test lights can damage an electronic control circuit.

NOTE: Some devices in an electronic control system are not capable of carrying an appreciable amount of current. Therefore, test equipment must be designed to not damage any part the electronic control system. Do not use analog meters unless specified. Analog meters use too much current to test an electronic control system.

Jumper Wires

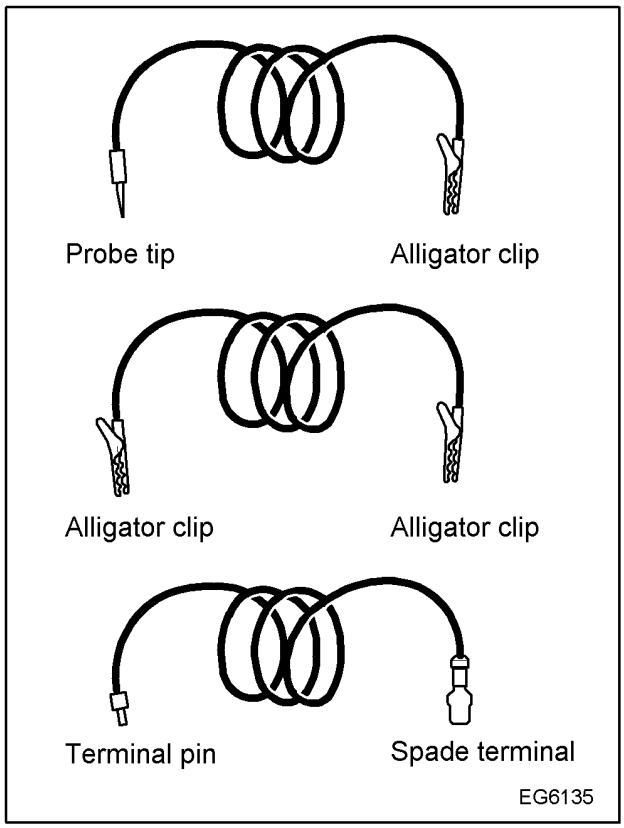

Figure 552 Jumper wires

Jumper wires allow a circuit to by-pass a suspected opening or break in a circuit. Use a jumper wire to check for open relay contacts, wire breaks and poor ground connections. Several jumper wires with different tips should be available.

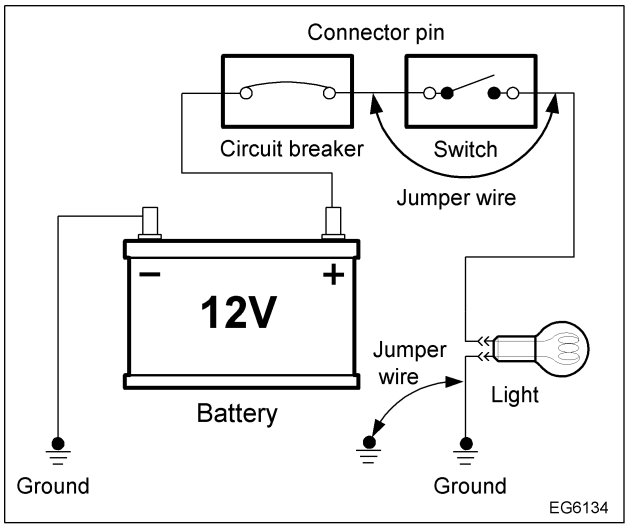

Figure 553 Troubleshooting with jumper wires

If the circuit works correctly with the jumper wire in place, but does not work when the jumper wire is removed, the circuit is open.

A circuit with no openings or breaks has continuity (uninterrupted current flow) and needs no further testing.

An opening in the ground circuit exists for the following:

- A switch is closed but the light does not illuminate.
- Jumping the switch does not illuminate the light.
- Jumping the light to the ground causes the light to illuminate.

Voltmeter

Use a voltmeter to answer the following questions:

- Does the circuit have voltage?
- What is the voltage reading?
- What is the voltage drop across a load device?

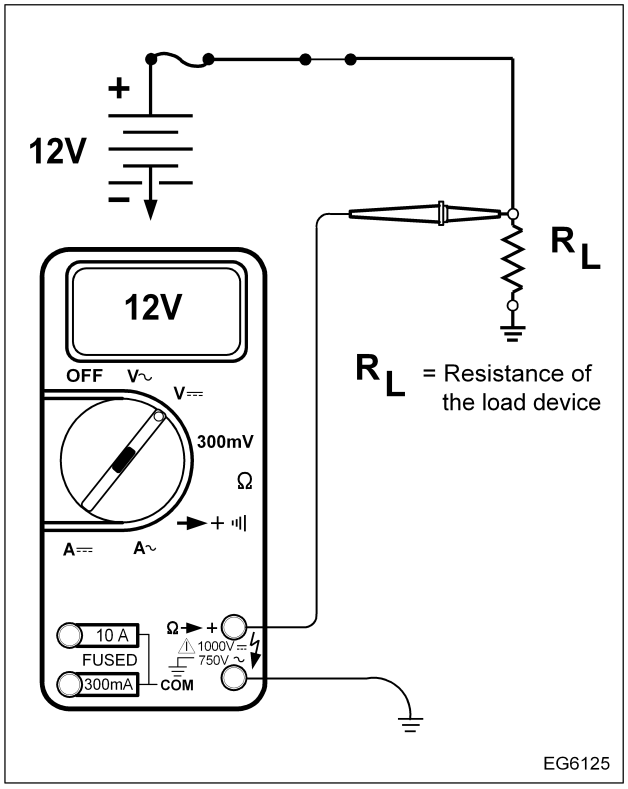

Figure 554 Checking power to a load device

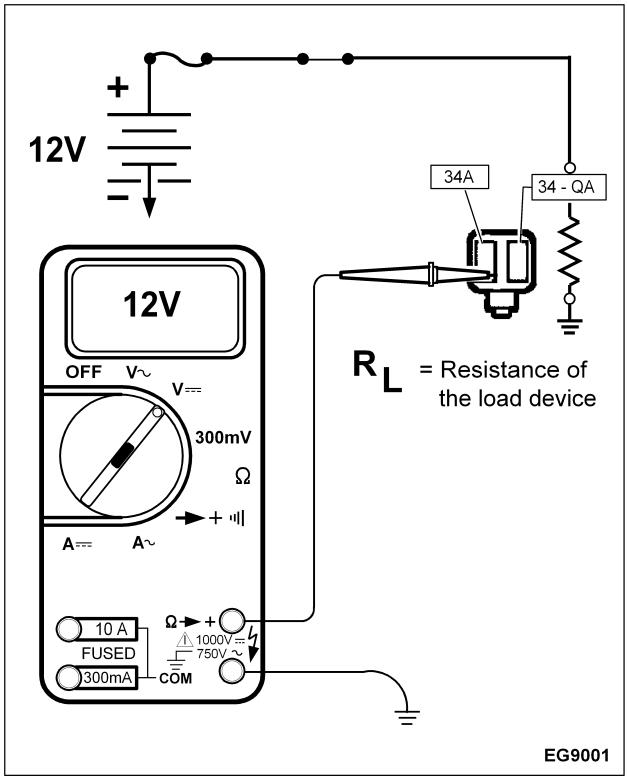

Figure 555 Checking power to a connector

To check for voltage to a load device, connect the positive meter lead to the input connection of the device (positive side) and connect the negative meter lead to a good vehicle ground.

Voltage to a device can also be measured by disconnecting the harness connector and using the correct tool in the Terminal Test Adapter Kit.

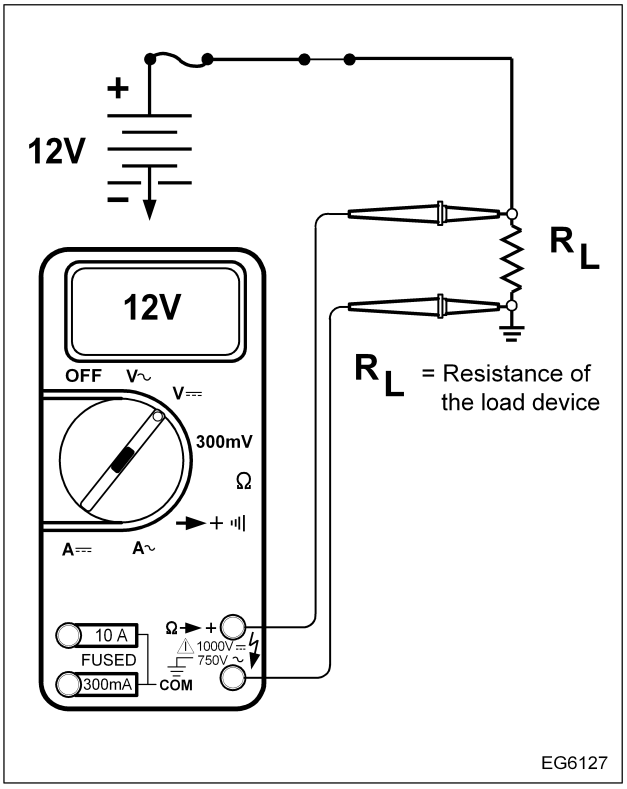

Figure 556 Checking voltage drop

To check the voltage drop across a load device, connect the positive lead of the voltmeter to the positive side of the device and the negative meter lead to the negative side of the device.

With the device operating, this will measure the voltage drop across the device. With only one device, all of the voltage should be dropped at the device. In any circuit, the voltage applied will equal the voltage dropped in the circuit. If this circuit only dropped 9 V across the load, it indicates the wires and connections dropped 3 V, indicating excessive circuit resistance.

Ammeter

An ammeter measures current flow (amperage) in a circuit. Amperes (or amps) are units of electron flow that indicate how many electrons are passing through the circuit. An amp is the unit of measurement for the current flow in the circuit.

Ohm's Law states that the current flow is equal to the circuit voltage divided by the total circuit resistance (I = E ÷ R). Therefore, increasing the voltage also increases the current flow. Any decrease in resistance will also increase the current flow.

At normal operating voltage, most circuits have a characteristic amount of current flow (current draw). Current draw can be measured with an ammeter. Valuable diagnostic information can be provided by referring to a specified current draw rating for a component (electrical device), measuring the current flow in the circuit, and then comparing the two measurements (the specified current draw versus the actual measurement).

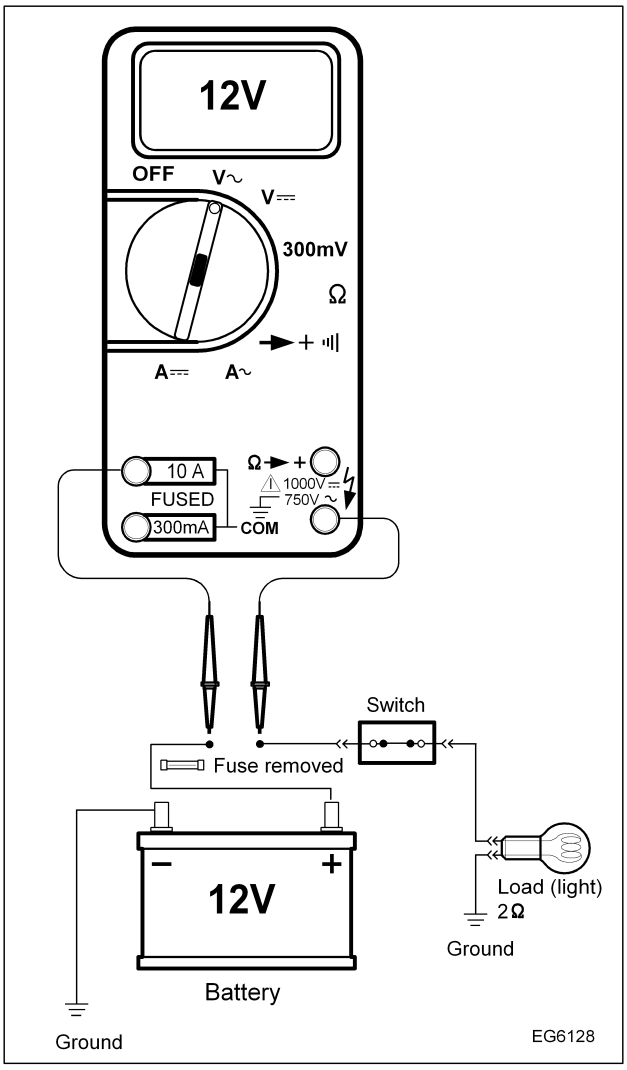

Figure 557 Installing the ammeter

An ammeter is connected in series with the load, switches, resistors, etc., so that all of the current

flows through the meter. The ammeter measures current flow only when the circuit is powered up and operating. The DMM is fused to measure up to 10 amps using the 10 A connection point.

Before measuring current flow, determine approximately how many amps are in the circuit to correctly connect the ammeter. The estimate of current flow can easily be calculated. The resistance of the light bulb is 2 ohms. Applying Ohm's law, current flow will be 6 amps (6 amps = 12 V ÷ 2 ohms). If the fuse is removed and an ammeter is installed with the switch closed, 6 amps of current will be measured flowing in the circuit. Notice that the ammeter is installed in series so that all the current in the circuit flows through it.

WARNING: To avoid serious personal injury or possible death, always make sure the power is off before cutting, soldering, removing circuit components, or before inserting the digital multimeter for current measurements. Even small amounts of current can be dangerous.

Excessive current draw means that more current is flowing in a circuit than the fuse and circuit were designed to handle. Excessive current draw will open fuses and circuit breakers, and will also quickly discharge batteries. An ammeter can diagnose these conditions.

Reduced current draw will cause a device (an electric window motor, for example) to operate poorly. Increased circuit resistance will cause lower current flow (often due to loose or corroded connections).

Ohmmeter

CAUTION: To prevent damage to the test meter, only use the ohmmeter on circuits when the power is OFF. Power from 12 V systems may damage the meter.

The ohmmeter measures resistance (ohms) in a circuit. Ohmmeters use a small battery to supply voltage and current flow through the circuit being tested. Based on Ohm's Law, the ohmmeter calculates resistance in the circuit by measuring the voltage of the meter battery and the amount of current flow in the circuit. Range selection and meter adjustment are not necessary with the DMM.

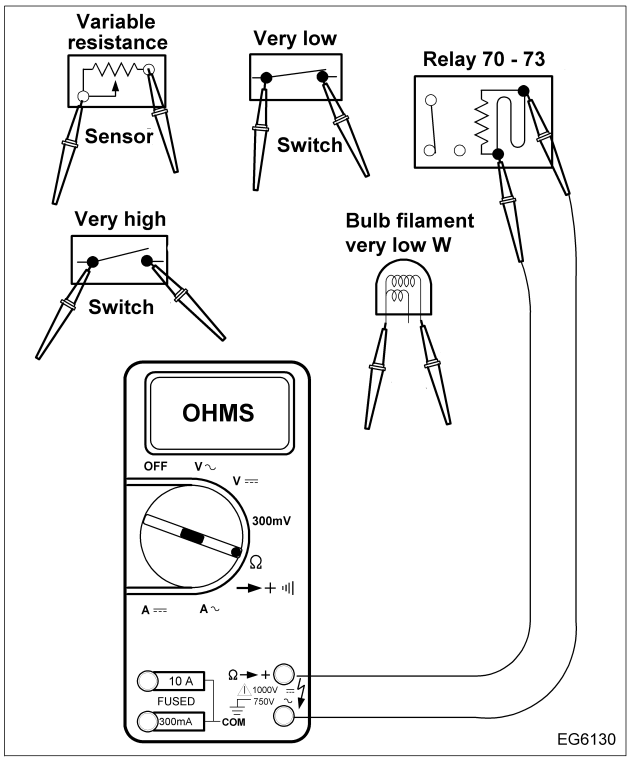

Figure 558 Measuring resistance

Resistance measurements are used to determine the resistance of a load or conductors, the value of resistors and the operation of variable resistors.

To measure the resistance of a component or a circuit, remove power from the circuit. Isolate the component or circuit from other components and circuits so that the meter current (from probe to probe) only flows through the selected component or circuit. When measuring the resistance of the load, most of the current flow from the meter will go through the indicator lamp because it has less resistance.

Remove one connector to the load. It is not always apparent when a component must be isolated, so it is a good practice to isolate a component or circuit by disconnecting one circuit. Place the ohmmeter leads across the component or circuit to display the resistance in ohms. When checking a sensor or variable resistor such as the fuel level gauge, heating the element or moving the arm should move the meter through a range of resistance that can be compared to a specification.

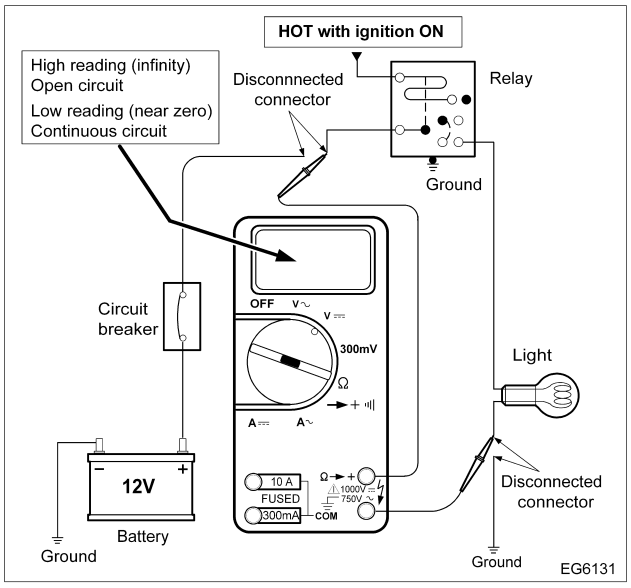

Figure 559 Checking for open circuits

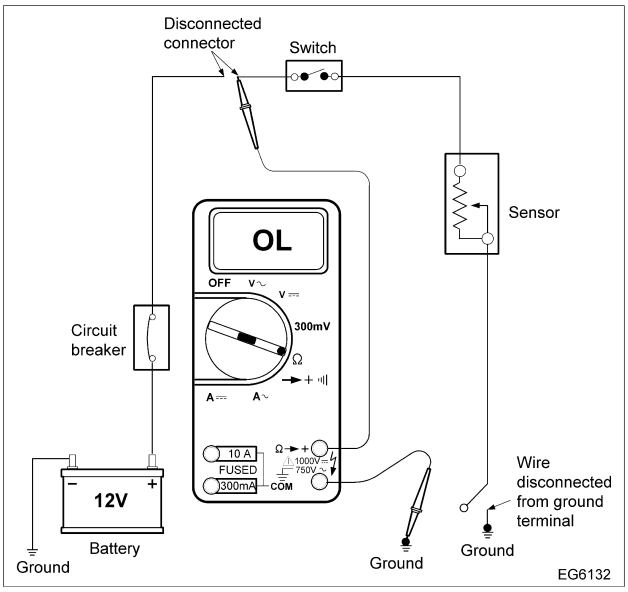

Figure 560 Checking for short circuits

Open electrical circuits can be diagnosed using an ohmmeter. Disconnect the power supply to the circuit and isolate the circuit from all other circuits. The circuit between the light and the ground is disconnected to prevent reading a circuit that may be shorted to ground ahead of the load device as a continuous circuit. Connect the ohmmeter to the open ends of the circuit. A high reading (infinity) indicates an open circuit. A reading near zero indicates a continuous circuit. With the Fluke 88 Digital Multimeter (DMM), an open circuit will read OL (over limit).

Checks for short circuits are similar to checks for open circuits. Isolate the circuit from the power source and the ground point. Connect the ohmmeter between an isolated circuit and a good ground point to check the circuit for a short to ground. A short to ground will be indicated by a reading near zero. A circuit that is not shorted to ground will cause a high meter reading.

Measuring Duty Cycle with FLUKE 88

When measuring duty cycle, ensure that the large dial on the meter is pointing to volts DC, the DUTY button is set to the Duty Cycle function, and the trigger has a positive slope.

Use the following procedure to check duty cycle:

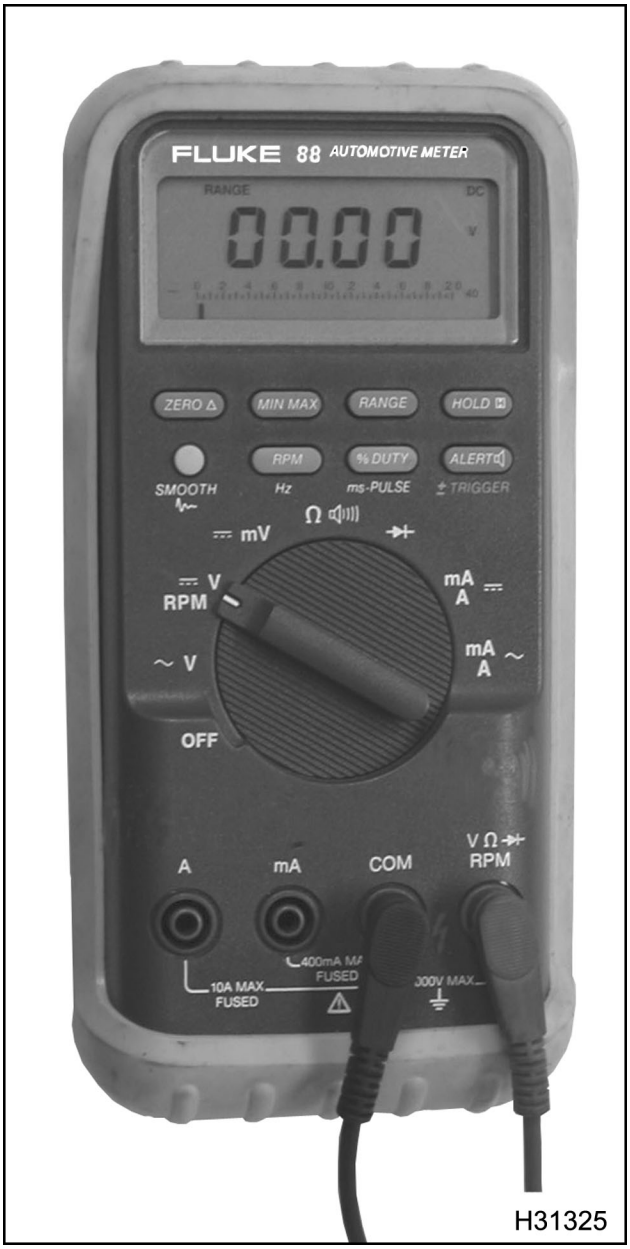

Figure 561 FLUKE 88 in volts dc mode

1. Turn the large dial on the meter to volts DC, indicated by **V RPM**.

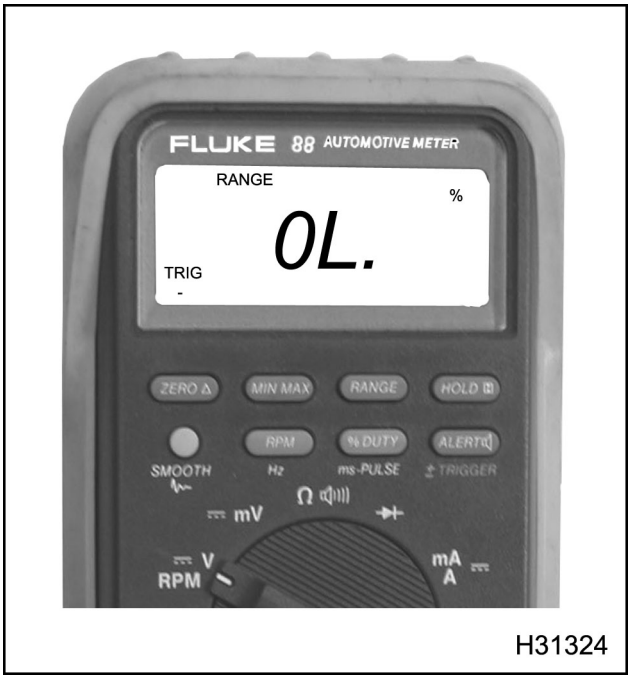

Figure 562 FLUKE 88 with negative trigger slope in duty cycle mode

2. Press the **% DUTY** button to select duty cycle mode. The screen on the meter will show TRIG (with a _ under the TRIG) in the lower left hand corner of the screen. A percent sign will appear on the upper right hand corner of the screen.

Figure 563 FLUKE 88 in duty cycle mode with positive trigger slope

3. In duty cycle mode, press the **ALERT** button to change from negative to positive trigger slope. The slope is indicated by a plus or minus sign below TRIG in the lower left hand corner of the screen. A percent sign will appear on the upper right hand corner of the screen.
4. After the meter has been set to the correct settings, connect meter as indicated in Pin-Point Diagnostics.

Troubleshooting

1. Verify the problem.

   Operate the complete system and list all symptoms as follows:

   - Check the accuracy and completeness of the complaint.
   - Learn more that might give a clue to the nature and location of the problem.
   - Analyze what parts of the system are working.

2. See Section 7 in this manual or the correct chassis manual.

   Read the electrical operation for the problem circuit and review the circuit diagram. Understanding electrical operation and the circuit diagram can narrow the cause of the problem to one component or certain parts of the circuit.

3. Check the circuit diagram.

   Check the circuit diagram for possible clues to the problem. Location of specific components in the circuit will help identify the source of the problem.

   Circuit diagrams are designed to make it easy to identify common points in circuits. This helps to narrow the problem to a specific area. For example, if several circuits fail at the same time, check for a common power source or common ground connection (i.e., V_{REF}, signal ground, actuator power, actuator ground).

   If part of a circuit fails, check the connections between the part that works and the part that does not work. For example, if the low-beam headlights work, but both high-beam headlights and the high-beam indicator do not work, the power and ground paths must be good. Since the dimmer switch is the component that switches the power to the high-beam headlights, it is probably the cause of failure.

4. Determine the cause of the problem and follow diagnostic procedures in Section 7.
5. Make the repair.

   Repair the problem circuit as directed in the diagnostic tables

6. Verify that the repair is complete.

   Operate the system. Check that the repair has removed all symptoms and that the repair has not caused new symptoms.

Table of Contents

Abbreviations and Acronyms

ABS – Antilock Brake System
AC – Alternating Current
ACCEL – Accelerate
amp – Ampere
AMS – Air Management System
API – American Petroleum Institute
APS – Accelerator Position Sensor
ATA – American Trucking Association
AWA – Acoustic Wave Attenuator

BAP – Barometric Absolute Pressure
BCP – Brake Control Pressure
BDC – Bottom Dead Center
bhp – Brake horsepower

C – Celsius
CAC – Charge Air Cooler
CAN – Controller Area Network
CAN 1 – Controller Area Network (public)
CAN 2 – Controller Area Network (private)
CAP – Cold Ambient Protection
cc – Cubic centimeter
CDPF – Catalyzed Diesel Particulate Filter
cfs – Cubic feet per second
CKP – Crankshaft Position
CKPO – Crankshaft Position Output
cm – Centimeter
CMP – Camshaft Position
CMPO – Camshaft Position Output
CPU – Central Processing Unit
CTC – Coolant Temperature Compensation

DC – Direct Current
DDS – Driveline Disengagement Switch
DLC – Data Link Control
DMM – Digital Multimeter
DT – Diesel Turbocharged
DTC – Diagnostic Trouble Code

ECL – Engine Coolant Level
EBP – Exhaust Back Pressure
ECI – Engine Crank Inhibit
ECM – Electronic Control Module
ECT – Engine Coolant Temperature
EFAN – Engine Fan
EFRC – Engine Family Rating Code
EGR – Exhaust Gas Recirculating
EGRP – Exhaust Gas Recirculating Position
EOP – Engine Oil Pressure
EOT – Engine Oil Temperature
EPA – Environmental Protection Agency
EPR – Engine Pressure Regulator
ESC – Electronic System Controller
ESN – Engine Serial Number
EST – Electronic Service Tool
EURO – Eurpoean
EVRT™ – Electronic Variable Response Turbocharger
EWPS – Engine Warning Protection System

F – Fahrenheit
ft – Feet
FMI – Failure Mode Indicator

gal – Gallon
gph – Gallons Per Hour
GVW – Gross Vehicle Weight

H_2O – Water
Hg – Mercury
hp – Horsepower
HT – High Torque

IAT – Intake Air Temperature
ICP – Injector Control Pressure
IDM – Injector Drive Module
IGN – Ignition
in – Inch
in Hg – Inches of mercury
in H_2O – Inches of water
INJ – Injector drive
IPR – Injection Pressure Regulator
ISIS® – International® Service Information Solutions
IST – Idle Shutdown Timer
IVS – Idle Validation Switch

kg – Kilogram
km – Kilometer
KOEO – Key-On Engine-Off
KOER – Key-On Engine-Running
kPa – Kilopascal

L – Liter
lb – Pound
lbf – Pounds of force
lbf•ft – Pounds of force per foot
lbf•in – Pounds of force per inch

m – Meter
m/s – Meters per second
MAP – Manifold Absolute Pressure
MAT – Manifold Air Temperature
mm – Millimeter
mph – Miles per hour
MY – Model Year

N – Newton

NEG – Negative
NETS – Navistar Electronics Technical Support
N•m – Newton meter
NO – Nitrogen Oxide
NO_x – Nitrogen Oxides
NSBU – Neutral Start Backup Switch

OCC – Output Circuit Check
OL – Over Limit

PID – Parameter Identifier
P/N – Part Number
POS – Positive
POSE – Positive On Shaft Excluder
PROM – Programmable Read Only Memory
psi – Pounds per square inch
pt – Pint
PTO – Power Take Off

RAM – Random Access Memory
rev – Revolution
rpm – Revolutions per minute
ROM – Read Only Memory
RSE – Radiator Shutter Enable

SAE – Society of Automotive Engineers
SCCS – Speed Control Command Switches
SID – Subsystem Identifier
SO_2 – Sulfur Dioxide
SYNC – Synchronization

TACH – Tachometer output signal
TCAPE – Truck Computer Analysis of Performance and Economy
TDC – Top Dead Center

UVC – Under Valve Cover

V – Volt
V_{BAT} – Battery Voltage
V_{IGN} – Ignition Voltage
V_{REF} – Reference Voltage
V_{REF} A – Reference Voltage (engine)
V_{REF} B – Reference Voltage (chassis)
VGT – Variable Geometry Turbocharger
VIN – Vehicle Identification Number
VOP – Valve Opening Pressure
VSS – Vehicle Speed Sensor

WIF – Water In Fuel
WTEC – World Transmission Electronically Controlled automatic transmissions (Allison)

Table of Contents

Terminology

Accelerator Position Sensor (APS) – A potentiometer sensor that indicates the position of the accelerator pedal.

Accessory work – The work per cycle required to drive engine accessories (normally, only those essential to engine operation).

Actuator – A device that performs work in response to an input signal.

Aeration – The entrainment of gas (air or combustion gas) in the coolant, lubricant, or fuel.

After cooler (Charge Air Cooler) – A heat exchanger mounted in the charge air path between the turbocharger and engine intake manifold. The after cooler reduces the charge air temperature by transferring heat from the charge air to a cooling medium (usually air).

Air Management System (AMS) – The AMS controls and directs air through the intake and exhaust which affects engine performance and controls emissions.

Alternating Current (AC) – An electric current that reverses its direction at regularly recurring intervals.

Ambient temperature – The environmental air temperature in which a unit is operating. In general, the temperature is measured in the shade (no solar radiation) and represents the air temperature for other engine cooling performance measurement purposes. Air entering the radiator may or may not be the same ambient due to possible heating from other sources or recirculation. (SAE J1004 SEP81)

Ampere (amp) – The standard unit for measuring the strength of an electrical current. The flow rate of a charge in a conductor or conducting medium of one coulomb per second. (SAE J1213 NOV82)

Analog – A continuously variable voltage.

Analog to digital converter (A/D) – A circuit in the ECM processing section that converts an analog signal (DC or AC) to a usable digital signal for the microprocessor.

American Trucking Association (ATA) Data link – A serial data link specified by the American Trucking Association and the SAE.

Acoustic Wave Attenuator – A component of the high-pressure oil rail designed to reduce hydraulic fluctuations resulting in a decrease of acoustic energy.

Barometric Absolute Pressure (BAP) sensor – A variable capacitance sensor which, when supplied with a 5 volt reference signal from the ECM, produces a linear analog voltage signal indicating atmospheric pressure.

Boost pressure – 1. The pressure of the charge air leaving the turbocharger.

2. Inlet manifold pressure that is greater than atmospheric pressure. Obtained by turbocharging.

Bottom Dead Center (BDC) – The lowest position of the piston during the stroke.

Brake Control Pressure (BCP) sensor – The BCP sensor is a variable capacitance sensor that senses the oil pressure in the brake gallery of the high-pressure oil rail.

Brake Horsepower (bhp) – The power output from an engine, not the indicated horsepower. The power output of an engine, sometimes called flywheel horsepower is less than the indicated horsepower by the amount of friction horsepower consumed in the engine.

Brake Horsepower (bhp) net – Net brake horsepower is measured with all engine components. The power of an engine when configured as a fully equipped engine. (SAE J1349 JUN90)

Calibration – The data values used by the strategy to solve equations and make decisions. Calibration values are stored in ROM and put into the processor during programming to allow the engine to operate within certain parameters.

Camshaft Position (CMP) sensor – The CMP sensor is a magnetic pickup sensor which indicates engine position. Speed is indicated by the number of vanes counted per revolution of the camshaft. Camshaft position is indicated by a single position peg that indicates Cylinder Number 1.

Catalyst – A substance that produces a chemical reaction without undergoing a chemical change itself.

Catalytic converter – An antipollution device in the exhaust system that contains a catalyst for chemically converting some pollutants in the exhaust gases (carbon monoxide, unburned hydrocarbons, and oxides of nitrogen) into harmless compounds.

Cavitation – A dynamic condition in a fluid system that forms gas-filled bubbles (cavities) in the fluid.

Cetane number – 1. The auto ignition quality of diesel fuel.

2. A rating applied to diesel fuel similar to octane rating for gasoline.

3. A measure of how readily diesel fuel starts to burn (autoignites) at high compression temperature.

Diesel fuel with a high cetane number autoignites shortly after injection into the combustion chamber. Therefore, it has a short ignition delay time. Diesel fuel with a low cetane number resists autoignition. Therefore, it has a longer ignition delay time.

Charge air – Dense, pressurized, heated air discharged from the turbocharger.

Charge Air Cooler (CAC) – See **After cooler**.

Closed crankcase – Crankcase ventilation system that recycles crankcase gases through a breather, then back to the clean air intake.

Closed loop operation – A system that uses a sensor to provide feedback to the ECM. The ECM uses the sensor to continuously monitor variables and it make adjustments to match engine requirements.

Cloud point – The point when wax crystals occur in fuel, making fuel cloudy or hazy. Usually below –12°C (10°F).

Cold cranking ampere rating (battery rating) – The sustained constant current (in amperes) needed to produce a minimum terminal voltage under a load of 7.2 volts per battery after 30 seconds.

Continuous Monitor Test – An ECM function that continuously monitors the inputs and outputs to ensure that readings are within set limits.

Controller Area Network (CAN) – This is a J1939 high speed communication link. **CAN 1** is a public drive train data link between the vehicle modules and ECM. **CAN 2** is a private link between the ECM and IDM.

Coolant – A fluid used to transport heat from one point to another.

Coolant level switch – A switch used to indicate coolant level.

Cooling system capacity (volume) – The amount of coolant that completely fills a cooling system to its designated cold level mark. (SAE J1004 SEP81)

Crankcase – The housing that encloses the crankshaft, connecting rods, and allied parts.

Crankcase breather – A vent for the crankcase to release excess interior air pressure.

Crankcase pressure – The force of air inside the crankcase against the crankcase housing.

Crankshaft (CKP) sensor – The CKP sensor is a magnetic pickup sensor that indicates crankshaft speed and position.

Current – The flow of electrons passing through a conductor. Measured in amperes.

Damper – A device that reduces the amplitude of torsional vibration. (SAE J1479 JAN85)

Deaeration – The removal or purging of gases (air or combustion gas) entrapped in coolant or lubricating oil.

Deaeration tank – A separate tank in the cooling system used for one or more of the following functions:

- Deaeration
- Coolant reservoir (fluid expansion and after boil)
- Coolant retention
- Filling
- Fluid level indication (visible)

Diagnostic Trouble Code (DTC) – Formerly called a Fault Code or Flash Code. A DTC is a three digit numeric code used for troubleshooting.

Diamond Logic® Engine Brake – The Diamond Logic® Engine Brake is a compression release braking system that uses a high-pressure oil rail components together with the VGT for additional braking. The operator controls the engine brake for different operating conditions.

Diamond Logic® Exhaust Brake – The Diamond Logic® Exhaust Brake is an exhaust brake system that uses only the VGT to restrict exhaust flow for additional braking. The operator controls the exhaust brake for different operating conditions.

Digital Multimeter (DMM) – An electronic meter that uses a digital display to indicate a measured value. Preferred for use on microprocessor systems because it has a very high internal impedance and will not load down the circuit being measured.

Direct Current (DC) – An electric current flowing in one direction only and substantially constant in value.

Disable – A computer decision that deactivates a system and prevents operation of the system.

Displacement – The stroke of the piston multiplied by the area of the cylinder bore multiplied by the number of cylinders in the engine.

Driveline Disengagement Switch (DDS) – A switch that indicates when the driveline is disengaged from the engine.

Driver (high side) – A transistor in an electronic module that controls the power to an actuator circuit.

Driver (low side) – A transistor in an electronic module that controls the ground to an actuator circuit.

Drivetrain data link (CAN 1) J1939 – The primary communication link for the ECM, ESC, and instrument cluster.

Duty cycle – A control signal that has a controlled on/off time measurement from 0 to 100%. Normally used to control solenoids.

Elastomer – An elastic, rubber like substance such as natural or synthetic rubber material. (SAE J111 MAR85)

Electronic Control Module (ECM) – The Electronic Control Module is an electronic microprocessor that monitors and controls engine performance, exhaust emissions, and vehicle system performance (cruise control, transmission control, starter engagement, etc.). The ECM provides diagnostic information for engine and vehicle systems and can be programmed at different levels for engine protection, warning, and shutdown.

Electronic Service Tool (EST) – A computer diagnostic and programming tool for the ECM and ESC. The hardware is typically a laptop computer or notebook computer. The diagnostic and programming software includes International Master Diagnostics, ISIS on-line documentation, and NETS for factory programming.

Electronic System Controller (ESC) – An electronic module that provides multiple analog and switched input interfaces to monitor vehicle functions through solid state switches, relay driver outputs, and serial data communication.

Engine Control Module (ECM) power relay – An ECM controlled relay that supplies power to the ECM.

Engine Coolant Temperature (ECT) sensor – A thermistor sensor that senses engine coolant temperature.

Engine Fuel Pressure (EFP) sensor – A variable capacitance sensor that senses fuel pressure.

Engine Family Rating Code (EFRC) – A readable code in the calibration list of the EST that identifies engine horsepower and emission calibrations.

Engine lamp – An instrument panel lamp that comes on when DTCs are set. DTCs can be read as flash codes (red and amber instrument panel lamps).

Engine OFF tests – Tests that are done with the ignition key ON and the engine OFF.

Engine RUNNING tests – Tests done with the engine running.

Engine Oil Pressure (EOP) sensor – A variable capacitance sensor that senses engine oil pressure.

Engine Oil Temperature (EOT) sensor – A thermistor sensor that senses engine oil temperature.

Exhaust brake – A brake device using engine exhaust back pressure as a retarding medium.

Exhaust Gas Recirculation (EGR) – The Exhaust Gas Recirculation is a system that recycles a controlled portion of exhaust gas back into the combustion chamber to reduce Nitrogen Oxide exhaust emissions.

Exhaust Gas Recirculation (EGR) drive module – The EGR drive module controls the position of the EGR valve.

Exhaust Gas Recirculation (EGR) cooler – The exhaust gas is cooled in the EGR cooler and flows through the EGR control valve to the EGR mixer duct.

Exhaust Gas Recirculation (EGR) valve – The EGR valve, when open, will mix exhaust gas with filtered intake air which flows into the intake manifold. The EGR valve, when closed, only allows filtered air to flow into the intake manifold.

Exhaust manifold – Exhaust gases flow through the exhaust manifold to the turbocharger exhaust inlet and are directed to the EGR cooler or out the exhaust system.

EVRT® electronic controlled turbocharger – International's version of a Variable Geometry Turbocharger (VGT).

EZ-Tech® inerface cable – The EZ-Tech® inerface cable connects to the EST to communicate with the Electronic Controlled Module (ECM).

Fault detection and management – An alternate control strategy that reduces adverse effects that can be caused by a system failure. If a sensor fails, the ECM substitutes a good sensor signal or assumed sensor value in its place. A lit amber or red instrument panel lamp signals that the vehicle needs service.

Filter restriction – A blockage, usually from contaminants, that prevents the flow of fluid through a filter.

Flash code – See **Diagnostic Trouble Code (DTC)**.

Fuel inlet restriction – A blockage, usually from contaminants, that prevents the flow of fluid through the fuel inlet line.

Fuel pressure – The force that the fuel exerts on the fuel system as it is pumped through the fuel system.

Fuel strainer – A pre filter in the fuel system that keeps larger contaminants from entering the fuel system.

Fully equipped engine – A fully equipped engine is an engine equipped with only those accessories necessary to perform its intended service. A fully equipped engine does not include components that are used to power auxiliary systems. If these components are integral with the engine or for any reason are included on the test engine, the power absorbed may be determined and add to the net brake power. (SAE J1995 JUN90)

Fusible link (fuse link) – A fusible link is a special section of low tension cable designed to open the circuit when subjected to an extreme current overload. (SAE J1156 APR86)

Gradeability – The maximum percent grade which the vehicle can transverse for a specified time at a specified speed. The gradeability limit is the grade upon which the vehicle can just move forward. (SAE J227a)

Gross brake horsepower – The power of a complete basic engine, with air cleaner, without fan, and alternator and air compressor not charging.

Hall effect – The development of a transverse electric potential gradient in a current-carrying conductor or semiconductor when a magnetic field is applied.

Hall effect sensor – Generates a digital on or off signal that indicates speed or position.

High speed digital inputs – Inputs to the ECM from a sensor that generates varying frequencies (engine speed and vehicle speed sensors).

Horsepower (hp) – Horsepower is the unit of work done in a given period of time, equal to 33,000 pounds multiplied by one foot per minute. **1 hp = 33,000 lb x 1 ft /1 min**.

Hydrocarbons – Unburned or partially burned fuel molecules.

Idle speed – Low idle is the minimum engine speed. High idle is the maximum governed engine speed with no load.

Idle Validation Switch (IVS) – An On/Off switch that senses when the accelerator pedal is in the idle position. There is also a cold idle advance that increases low idle speed for a short period to aid in engine warm-up in cold temperatures.

Injector Drive Module (IDM) power relay – An IDM controlled relay that supplies power to the IDM.

Indicated horsepower – The theoretical power transmitted to the pistons by gas in the cylinders.

Injection Control Pressure (ICP) – High lube oil pressure generated by a high-pressure pump/pressure regulator used to hydraulically actuate the fuel injectors and the optional Diamond Logic® engine brake.

Injection Pressure Regulator (IPR) – A Pulse Width Modulated (PWM) regulator valve, controlled by the ECM, that regulates injection control pressure.

Injection Control Pressure (ICP) sensor – A variable capacitance sensor that senses injection control pressure.

Intake Air Temperature (IAT) sensor – A thermistor sensor that senses intake air temperature.

Intake manifold – A plenum through which the air mixture flows from the charged air cooler piping to the intake passages of the cylinder head.

International NGV Tool Utilized for Next Generation Electronics (INTUNE) – The

diagnostics software for chassis related components and systems.

Low speed digital inputs – Switched sensor inputs that generate an on/off (high/low) signal to the ECM. The input to the ECM from the sensor could be from a high input source switch (usually 5 or 12 volts) or from a grounding switch that grounds the signal from a current limiting resistor in the ECM that creates a low signal (0 volts).

Lubricity – Lubricity is the ability of a substance to reduce friction between solid surfaces in relative motion under loaded conditions.

Lug (engine) – A condition when the engine is operating at or below maximum torque speed.

Manifold Absolute Pressure (MAP) – Intake manifold pressure (boost pressure).

Manifold Absolute Pressure (MAP) sensor – A variable capacitance sensor that senses intake manifold pressure.

Manometer – A double-leg liquid-column gauge, or a single inclined gauge, used to measure the difference between two fluid pressures. Typically, a manometer records in inches of water.

Master Diagnostics (MD) – The diagnostics software for engine related components and systems to use on the electronic service tool or personal computer.

Manifold Air Temperature (MAT) – Intake manifold air temperature

Manifold Air Temperature (MAT) sensor – A thermistor style sensor housed in the intake manifold used to indicate air temperature after passing through the charge air cooler.

Microprocessor – An integrated circuit in a microcomputer that controls information flow.

Nitrogen Oxides (NO_x) – Nitrogen oxides form by a reaction between nitrogen and oxygen at high temperatures and pressures in the combustion chamber.

Normally closed – Refers to a switch that remains closed when no control force is acting on it.

Normally open – Refers to a switch that remains open when no control force is acting on it.

Ohm (Ω) – The unit of resistance. One ohm is the value of resistance through which a potential of one volt will maintain a current of one ampere. (SAE J1213 NOV82)

On demand test – A self test that the technician initiates using the EST. It is run from a program in the processor.

Output Circuit Check (OCC) – An On demand test done during an Engine OFF self test to check the continuity of selected actuators.

Output State Check (OSC) – An On demand test that forces the processor to activate actuators (High or Low) for additional diagnostics.

pH – A measure of the acidity or alkalinity of a solution.

Particulate matter – Particulate matter includes mostly burned particles of fuel and engine oil.

Piezometer – An instrument for measuring fluid pressure.

Positive On Shaft Excluder (POSE) – It is a separate piece from the rest of the front or rear seal used to keep out dust / debris.

Potentiometer – A potentiometer is a variable voltage divider that senses the position of a mechanical component. A reference voltage is applied to one end of the potentiometer. Mechanical rotary or linear motion moves the wiper along the resistance material, changing voltage at each point along the resistive material. Voltage is proportional to the amount of mechanical movement.

Power – Power is a measure of the rate at which work is done. Compare with **Torque**.

Power Take Off (PTO) – Accessory output, usually from the transmission, used to power a hydraulic pump for a special auxiliary feature (garbage packing, lift equipment, etc.).

Pulse Width Modulation (PWM) – The time that an actuator, such as an injector, remains energized.

Random Access Memory (RAM) – Computer memory that stores information. Information can be written to and read from RAM. Input information (current engine speed or temperature) can be stored in RAM to be compared to values stored in Read Only Memory (ROM). All memory in RAM is lost when the ignition switch is turned off.

Rated gross horsepower – Engine gross horsepower at rated speed as declared by the manufacturer. (SAE J1995 JUN90)

Rated horsepower – Maximum brake horsepower output of an engine as certified by the engine manufacturer. The power of an engine when configured as a basic engine. (SAE J1995 JUN90)

Rated net horsepower – Engine net horsepower at rated speed as declared by the manufacturer. (SAE J1349 JUN90)

Rated speed – The speed, as determined by the manufacturer, at which the engine is rated. (SAE J1995 JUN90)

Rated torque – Maximum torque produced by an engine as certified by the manufacturer.

Read Only Memory (ROM) – Computer memory that stores permanent information for calibration tables and operating strategies. Permanently stored information in ROM cannot be changed or lost by turning the engine off or when ECM power is interrupted.

Reference voltage (V_{REF}) – A 5 volt reference supplied by the ECM to operate the engine and chassis sensors.

Reserve capacity – Time in minutes that a fully charged battery can be discharged to 10.5 volts at 25 amperes.

Signal ground – The common ground wire from the ECM for the sensors.

Speed Control Command Switches (SCCS) – A set of switches used for cruise control, Power Take Off (PTO), and remote hand throttle system.

Steady state condition – An engine operating at a constant speed and load and at stabilized temperatures and pressures. (SAE J215 JAN80)

Strategy – A plan or set of operating instructions that the microprocessor follows for a desired goal. Strategy is the computer program itself, including all equations and decision making logic. Strategy is always stored in ROM and cannot be changed during calibration.

Stroke – Stroke is the movement of the piston from Top Dead Center (TDC) to Bottom Dead Center (BDC).

Substrate – Material that supports the wash coating or catalytic materials.

Sulfur dioxide (SO_2) – Sulfur dioxide is caused by oxidation of sulfur contained in fuel.

Switch sensors – Switch sensors indicate position. They operate open or closed, allowing or preventing the flow of current. A switch sensor can be a voltage input switch or a grounding switch. A voltage input switch supplies the ECM with a voltage when it is closed. A grounding switch grounds the circuit closed, causing a zero voltage signal. Grounding switches are usually installed in series with a current limiting resistor.

System restriction (air) – The static pressure differential that occurs at a given air flow from air entrance through air exit in a system. Usually measured in inches (millimeters) of water. (SAE J1004 SEP81)

Tachometer output signal – Engine speed signal for remote tachometers.

Thermistor – A thermistor sensor changes its electrical resistance to temperature. Resistance in the thermistor decreases as temperature increases, and increases as temperature decreases. Thermistors works with a resistor that limits current in the ECM to form a voltage signal matched with a temperature value.

Thrust load – A thrust load pushes or reacts through a bearing in a direction parallel to the shaft.

Top Dead Center (TDC) – The highest position of the piston during the stroke.

Top Dead Center (compression) – Top Dead Center (compression) is when the piston is at the highest position and both intake and exhaust valves are closed.

Torque – Torque is a measure of force producing torsion and rotation around an axis. Torque is the product of the force, usually measured in pounds, and radius perpendicular to the axis of the force extending to the point where the force is applied or where it originates, usually measured in feet.

Truck Computer Analysis of Performance and Economy (TCAPE) – Truck Computer Analysis of Performance and Economy is a computer program that simulates the performance and fuel economy of trucks.

Turbocharger – A turbine driven compressor mounted to the exhaust manifold. The turbocharger increases the pressure, temperature and density of intake air to charge air.

Valve cover gasket – A valve cover gasket that contains the pass through electronic wiring harness connectors for the ICP and BCP sensors, the brake shutoff valve, and six fuel injectors.

Variable capacitance sensor – A variable capacitance sensor is a sensor that measures pressure. The pressure measured is applied to a ceramic material. The pressure forces the ceramic material closer to a thin metal disk. This action changes the capacitance of the sensor.

Variable Geometry Turbocharger (VGT) – The VGT is a turbocharger with actuated vanes inside the turbine housing. The vanes modify flow characteristics of exhaust gases through the turbine housing for boast pressure control at various engine speeds and load conditions.

(VGT) control module – The VGT control module is an electronic microprocessor that converts a pulse width modulated signal from the ECM to control a DC motor that controls the VGT vane position.

Vehicle Electronic System Programming System – The computer system used to program electronically controlled vehicles.

Vehicle Retarder Enable/Engage – Output from the ECM to a vehicle retarder.

Vehicle Speed Sensor (VSS) – A magnetic pickup sensor mounted in the tail shaft housing of the transmission, used to calculate ground speed.

Viscosity – The internal resistance to the flow of any fluid.

Viscous fan – A fan drive that is activated when a thermostat, sensing high air temperature, forces fluid through a special coupling. The fluid activates the fan.

Volt (v) – A unit of electromotive force that will move a current of one ampere through a resistance of one Ohm.

Voltage – Electrical potential expressed in volts.

Voltage drop – Reduction in applied voltage from the current flowing through a circuit or portion of the circuit current multiplied by resistance.

Voltage ignition – Voltage supplied by the ignition switch when the key is ON.

Water In Fuel (WIF) switch – The WIF switch detects water in the fuel.

Water supply housing (Freon bracket) – The water supply housing (Freon Bracket) is a coolant supply housing with a deaeration port and a connection for cab heat.

Table of Contents

11 APPENDIX A: DT 466 PERFORMANCE SPECIFICATIONS 2004 MODEL YEAR

DT 466 (Standard and High Torque - all ratings)

Temperature, Fuel, and Lubrication

International® DT 466 diesel engine specifications	
Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 26.7 °C (80 °F) or above.	
Water temperature differential across radiator	3 to 7 °C (6 to 12 °F)
Thermostat	
Type	Balanced pressure, wax pellet
Minimum recommended coolant operating temperature	60 °C (140 °F)
Nominal opening temperature, 0.38 mm (0.015 in)	86 °C (187 °F) Minimum
	88 °C (192 °F) Maximum
Full open temperature, 8 mm (0.315 in) stroke	96 °C (205 °F)
Diesel fuel (maximum sulfur content of 0.05%)	
Minimum fuel requirements	42 cetane
Expected temperature	**Preferred fuel grade**
Above -1 °C (30 °F)	Grade 2-D
Below -17 °C (0 °F)	Grade 1-D
NOTE: If Grade 1-D is not available, use a winterized or climatized Grade 2-D fuel. This is made by blending Grade 1-D with 2-D fuel to match the temperature conditions in your area.	
Between -1 and -17 °C (30 and 0 °F)	1-D / 2-D Blended
Lubrication	
Oil quality	API category CI-4, CI-4 PLUS
Oil viscosity recommendations	15W-40 preferred above -6 °C (20 °F)
	10W-30 preferred between -6 and -17 °C (20 and 0 °F)
	5W-40 synthetic or 0W-30 synthetic below -17 °C (0 °F)

Cold Start Component Guidelines	
Battery Requirements	1300 CCA minimum above -12 °C (10 °F)
	1950 CCA minimum below -12 °C (10 °F)
Starting Aid Recommendations	Below -12 °C (10 °F) use block heater
	Below -17 °C (0 °F) use fuel heater
	Below -17 °C (0 °F) use oil pan heater

DT 466 (Standard Torque)

210 hp @ 2300 rpm (12NPL)

DT 466/210 hp @ 2300 rpm / 520 ft•lb @ 1400 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPL	
International® DT 466 diesel engine specifications	
Engine model	International® DT 466/210
Engine rating	210 bhp @ 2300 rpm
Engine Family Rating Code (EFRC)	1121
Injector part number, original equipment	1842576C91
Turbocharger part number	1842216C92, 1842218C92, 1842219C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2770 rpm
High idle speed - automatic transmission	2770 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	65 %
Engine cranking	
Minimum recommended battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	5 MPa (725 psi) / 1.0 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	4.5 ± 0.5 MPa (650 ± 70 psi) / 0.925 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	15 ± 2 MPa (2175 ± 300 psi) / 2.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	23 ± 1 MPa (3335 ± 145 psi) / 3.7 V @ 2300 rpm
Injection Control Pressure/voltage (full load, peak torque)	17 ± 1 MPa (2466 ± 145 psi) / 2.8 V @ 1400 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.95 V
Intake manifold pressure/voltage (full load, rated speed)	152 ± 14 kPa (22 ± 2 psi) / 3.27 ± 0.2 V @ 2300 rpm
Intake manifold pressure/voltage (full load, peak torque)	90 ± 14 kPa (13 ± 2 psi) / 2.2 ± 0.2 V @ 1400 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	170 kPa (25 psi) / 2.4 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	95 kPa (14 psi) / 1.6 V
Exhaust restriction (after turbocharger), maximum	16.1 kPa (4.75 in Hg) @ 2300 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	2200 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

220 hp @ 2300 rpm (12NPM)

DT 466/220 hp @ 2300 rpm / 540 ft•lb @ 1400 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPM	
International® DT 466 diesel engine specifications	
Engine model	International® DT 466/220
Engine rating	220 bhp @ 2300 rpm
Engine Family Rating Code (EFRC)	1131
Injector part number, original equipment	1842576C91
Turbocharger part number	1842216C92, 1842218C92, 1842219C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2770 rpm
High idle speed - automatic transmission	2770 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	65 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	5 MPa (725 psi) / 1.0 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	4.5 ± 0.5 MPa (650 ± 70 psi) / 0.93 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	15 ± 2 MPa (2175 ± 300 psi) / 2.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	23 ± 1 MPa (3335 ± 145 psi) / 3.7 V @ 2300 rpm
Injection Control Pressure/voltage (full load, peak torque)	17 ± 1 MPa (2466 ± 145 psi) / 2.8 V @ 1400 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.9 V
Intake manifold pressure/voltage (full load, rated speed)	152 ± 14 kPa (22 ± 2 psi) / 3.2 ± 0.2 V @ 2300 rpm
Intake manifold pressure/voltage (full load, peak torque)	88 ± 14 kPa (13 ± 2 psi) / 2.2 ± 0.2 V @ 1400 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	172 kPa (25 psi) / 2.4 V @ 2300 rpm
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	105 kPa (15 psi) / 1.75 V @ 1400 rpm
Exhaust restriction (after turbocharger), maximum	16.1 kPa (4.75 in Hg) @ 2300 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	2300 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

225 hp @ 2300 rpm (12NPN)

DT 466/225 hp @ 2300 rpm / 560 ft•lb @ 1400 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPN	
International® DT 466 diesel engine specifications	
Engine model	International® DT 466/225
Engine rating	225 bhp @ 2300 rpm
Engine Family Rating Code (EFRC)	1141
Injector part number, original equipment	1842576C91
Turbocharger part number	1842216C92, 1842218C92, 1842219C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2770 rpm
High idle speed - automatic transmission	2770 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	65 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	5 MPa (725 psi) / 1.0 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	4.5 ± 0.5 MPa (650 ± 70 psi) / 0.925 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	15 ± 2 MPa (2175 ± 300 psi) / 2.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	23 ± 1 MPa (3335 ± 145 psi) / 3.7 V @ 2300 rpm
Injection Control Pressure/voltage (full load, peak torque)	17 ± 1 MPa (2466 ± 145 psi) / 2.8 V @ 1400 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.95 V
Intake manifold pressure/voltage (full load, rated speed)	144 ± 14 kPa (21 ± 2 psi) / 3.7 ± 0.2 V @ 2300 rpm
Intake manifold pressure/voltage (full load, peak torque)	98 ± 14 kPa (14 ± 2 psi) / 2.3 ± 0.2 V @ 1400 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	159 kPa (23 psi) / 2.3 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	103 kPa (15 psi) / 1.7 V
Exhaust restriction (after turbocharger), maximum	16.1 kPa (4.75 in Hg) @ 2300 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	2300 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

245 hp @ 2300 rpm (12NPP)

DT 466/245 hp @ 2300 rpm / 620 ft•lb @1400 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPP	
International® DT 466 diesel engine specifications	
Engine model	International® DT 466/245
Engine rating	245 bhp @ 2300 rpm
Engine Family Rating Code (EFRC)	2131
Injector part number, original equipment	1842577C91
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2770 rpm
High idle speed - automatic transmission	2770 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	65 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	5 MPa (725 psi) / 1.0 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	4.5 ± 0.5 MPa (650 ± 70 psi) / 0.925 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	15 ± 2 MPa (2175 ± 300 psi) / 2.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	25 ± 1 MPa (3625 ± 145 psi) / 4.0 V @ 2300 rpm
Injection Control Pressure/voltage (full load, peak torque)	16 ± 1 MPa (2320 ± 145 psi) / 2.7 V @ 1400 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.9 V
Intake manifold pressure (full load, rated speed)	171 ± 14 kPa (25.3 ± 2 psi) / 3.5 ± 0.2 V @ 2300 rpm
Intake manifold pressure (full load, peak torque)	128 ± 14 kPa (18.5 ± 2 psi) / 2.8 ± 0.2 V @ 1400 rpm
Exhaust Back Pressure/voltage (sensor), maximum (full load, rated speed)	200 kPa (29 psi) / 2.7 V
Exhaust Back Pressure/voltage (sensor), maximum (full load, peak torque)	145 kPa (21 psi) / 2.2 V
Exhaust restriction (after turbocharger), maximum	16.1 kPa (65 in H_2O) @ 2300 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	2300 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

DT 466 (High Torque)

225 hp @ 2300 rpm (12NPR)

DT 466/225 hp @ 2300 rpm / 620 ft•lb @ 1400 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPR	
International® DT 466 diesel engine specifications	
Engine model	International® DT 466/225
Engine rating	225 bhp @ 2300 rpm
Engine Family Rating Code (EFRC)	1122
Injector part number, original equipment	1842576C91
Turbocharger part number	1842216C92, 1842218C92, 1842219C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2600 rpm
High idle speed - automatic transmission	2600 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	65 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	5 MPa (725 psi) / 1.0 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	4.5 ± 0.5 MPa (650 ± 70 psi) / 0.925 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	15 ± 2 MPa (2175 ± 300 psi) / 2.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	23 ± 1 MPa (3335 ± 145 psi) / 3.7 V @ 2300 rpm
Injection Control Pressure/voltage (full load, peak torque)	17 ± 1 MPa (1466 ± 145 psi) / 2.8 V @ 1400 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.9 V
Intake manifold pressure/voltage (full load, rated speed)	145 ± 14 kPa (21 ± 2 psi) / 3.0 ± 0.2 V @ 2300 rpm
Intake manifold pressure/voltage (full load, peak torque)	110 ± 14 kPa (16 ± 2 psi) / 2.5 ± 0.2 V @ 1400 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	165 kPa (24 psi) / 2.4 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	110 kPa (16 psi) / 1.8 V
Exhaust restriction (after turbocharger), maximum	16.1 kPa (65 in H_2O) @ 2300 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	2300 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	1187 °C (245 °F)

245 hp @ 2300 rpm (12NPS)

DT 466/245 hp @ 2300 rpm / 660 ft•lb @ 1400 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPS	
International® DT 466 diesel engine specifications	
Engine model	International® DT 466/245
Engine rating	245 bhp @ 2300 rpm
Engine Family Rating Code (EFRC)	2132
Injector part number, original equipment	1842577C91
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2600 rpm
High idle speed - automatic transmission	2600 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	65 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	5 MPa (725 psi) / 1.0 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	4.5 ± 0.5 MPa (650 ± 70 psi) / 0.925 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	15 ± 2 MPa (2175 ± 300 psi) / 2.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	25 ± 1 MPa (3625 ± 145 psi) / 4.0 V @ 2300 rpm
Injection Control Pressure/voltage (full load, peak torque)	16 ± 1 MPa (2320 ± 145 psi) / 2.7 V @ 1400 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.9 V
Intake manifold pressure/voltage (full load, rated speed)	173 ± 14 kPa (25 ± 2 psi) 3.4 ± 0.2 V @ 2300 rpm
Intake manifold pressure/voltage (full load, peak torque)	142 ± 14 kPa (20.6 ± 2 psi) 3.0 ± 0.2 V @ 1400 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	200 kPa (29 psi) / 2.7 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	165 kPa (24 psi) / 2.4 V
Exhaust restriction (after turbocharger), maximum	16.1 kPa (65 in H_2O) @ 2300 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1900 rpm or greater @ / 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

255 hp @ 2300 rpm (12NPT)

DT 466/255 hp @ 2300 rpm / 660 ft•lbs @ 1400 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPT	
International® DT 466 diesel engine specifications	
Engine model	International® DT 466/255
Engine rating	255 bhp @ 2300 rpm
Engine Family Rating Code (EFRC)	2141
Injector part number, original equipment	1842577C91
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2775 rpm
High idle speed - automatic transmission	2775 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	65 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	5 MPa (725 psi) / 1.0 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	4.5 ± 0.5 MPa (650 ± 70 psi) / 0.925 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	15 ± 2 MPa (2175 ± 300 psi) / 2.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	25 ± 1 MPa (3625 ± 145 psi) / 4.0 V @ 2300 rpm
Injection Control Pressure/voltage (full load, peak torque)	16 ± 1 MPa (2320 ± 145 psi) / 2.65 V @ 2300 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.9 V
Intake manifold pressure/voltage (full load, rated speed)	173 ± 14 kPa (25 ± 2 psi) / 3.4 ± 0.2 V @ 2300 rpm
Intake manifold pressure/voltage (full load, peak torque)	139 ± 14 kPa (20.1 ± 2 psi) 2.9 ± 0.2 V @ 1400 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	205 kPa (30 psi) / 2.8 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	165 kPa (24 psi) / 2.4 V
Exhaust restriction (after turbocharger), maximum	16.1 kPa (65 in H_2O) @ 2300 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1900 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

260 hp @ 2300 rpm (12NPU)

DT 466/260 hp @ 2300 rpm / 800 ft•lbs @ 1400 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPU	
International® DT 466 diesel engine specifications	
Engine model	International® DT 466/260
Engine rating	260 bhp @ 2300 rpm
Engine Family Rating Code (EFRC)	2152
Injector part number, original equipment	1842577C91
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2600 rpm
High idle speed - automatic transmission	2600 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	65 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	5 MPa (725 psi) / 1.0 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	4.5 ± 0.5 MPa (650 ± 70 psi) / 0.925 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	15 ± 2 MPa (2175 ± 300 psi) / 2.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	25 ± 1 MPa (3625 ± 145 psi) / 4.0 V @ 2300 rpm
Injection Control Pressure/voltage (full load, peak torque)	16 ± 1 MPa (2320 ± 145 psi) / 2.65 V @ 1400 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.9 V
Intake manifold pressure/voltage (full load, rated speed)	189 ± 14 kPa (27.5 ± 2 psi) 3.5 ± 0.2 V @ 2300 rpm
Intake manifold pressure/voltage (full load, peak torque)	179 ± 14 kPa (26 ± 2 psi) 3.5 ± 0.2 V @ 1400 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	215 kPa (31 psi) / 2.9 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	193 kPa (28 psi) / 2.7 V
Exhaust restriction (after turbocharger), maximum	16.1 kPa (65 in H_2O) @ 2300 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

285 hp @ 2300 rpm (12NPV)

DT 466/285 hp @ 2300 rpm / 800 ft•lbs @ 1400 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPV	
International® DT 466 diesel engine specifications	
Engine model	International® DT 466/285
Engine rating	285 bhp @ 2300 rpm
Engine Family Rating Code (EFRC)	2162
Injector part number, original equipment	1842577C91
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2600 rpm
High idle speed - automatic transmission	2600 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	65 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	5 MPa (725 psi) / 1.0 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	4.5 ± 0.5 MPa (650 ± 70 psi) / 0.925 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	15 ± 2 MPa (2175 ± 300 psi) / 2.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	25 ± 1 MPa (3625 ± 145 psi) / 4.0 V @ 2300 rpm
Injection Control Pressure/voltage (full load, peak torque)	15.6 ± 1 MPa (2260 ± 145 psi) / 2.6 V @ 1400 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.9 V
Intake manifold pressure/voltage (full load, rated speed)	191 ± 14 kPa (27.7 ± 2 psi) / 3.79 ± 0.2 V @ 2300 rpm
Intake manifold pressure/voltage (full load, peak torque)	174 ± 14 kPa (25.2 ± 2 psi) / 3.4 ± 0.2 V @ 1400 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	225 kPa (32.5 psi) / 3.0 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	193 kPa (28 psi) / 2.7 V
Exhaust restriction (after turbocharger), maximum	16.1 kPa (65 in H_2O) @ 2300 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

300 hp @ 2300 rpm (12NPX)

DT 466/300 hp @ 2300 rpm / 860 ft•lbs @ 1400 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPX	
International® DT 466 diesel engine specifications	
Engine model	International® DT 466/300
Engine rating	300 bhp @ 2300 rpm
Engine Family Rating Code (EFRC)	2172
Injector part number, original equipment	1842577C91
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2600 rpm
High idle speed - automatic transmission	2600 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	65 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	5 MPa (725 psi) / 1.0 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	4.5 ± 0.5 MPa (650 ± 70 psi) / 0.925 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	15 ± 2 MPa (2175 ± 300 psi) / 2.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	25 ± 1 MPa (3625 ± 145 psi) / 4.0 V @ 2300 rpm
Injection Control Pressure/voltage (full load, peak torque)	17.2 ± 1 MPa (2495 ± 145 psi) / 2.8 V @ 1400 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.95 V
Intake manifold pressure/voltage (full load, rated speed)	202 ± 14 kPa (29.2 ± 2 psi) / 3.8 ± 0.2 V @ 2300 rpm
Intake manifold pressure/voltage (full load, peak torque)	187 ± 14 kPa (27.2 ± 2 psi) / 3.6 ± 0.2 V @ 1400 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	230 kPa (33.5 psi) / 3.0 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	213 kPa (31 psi) / 2.9 V
Exhaust restriction (after turbocharger), maximum	16.1 kPa (65 in H_2O) @ 2300 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

Table of Contents

12 APPENDIX B: DT 570 AND HT 570 PERFORMANCE SPECIFICATIONS 2004 MODEL YEAR

DT 570 and HT 570 (all ratings)

Temperature, Fuel, and Lubrication

International® DT 570 and HT 570 diesel engine specifications	
Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 26.7 °C (80 °F) or above.	
Water temperature differential across radiator	3 to 7 °C (6 to 12 °F)
Thermostat	
Type	Balanced pressure, wax pellet
Minimum recommended coolant operating temperature	60 °C (140 °F)
Nominal opening temperature, 0.38 mm (0.015 in)	86 °C (187 °F) Minimum
	88 °C (192 °F) Maximum
Full open temperature, 8 mm (0.315 in) stroke	96 °C (205 °F)
Diesel fuel (maximum sulfur content of 0.05%)	
Minimum fuel requirements	42 cetane
Expected temperature	**Preferred fuel grade**
Above -1 °C (30 °F)	Grade 2-D
Below -17 °C (0 °F)	Grade 1-D
NOTE: If Grade 1-D is not available, use a winterized or climatized Grade 2-D fuel. This is made by blending Grade 1-D with 2-D fuel to match the temperature conditions in your area.	
Between -1 and -17 °C (30 and 0 °F)	1-D / 2-D Blended
Lubrication	
Oil quality	API category CI-4, CI-4 PLUS
Oil viscosity recommendations	15W-40 preferred above -6 °C (20 °F)
	10W-30 preferred between -6 and -17 °C (20 and 0 °F)
	5W-40 synthetic or 0W-30 synthetic below -17 °C (0 °F)

Cold Start Component Guidelines	
Battery Requirements	1300 CCA minimum above -12 °C (10 °F)
	1950 CCA minimum below -12 °C (10 °F)
Starting Aid Recommendations	Below -12 °C (10 °F) use block heater
	Below -17 °C (0 °F) use fuel heater
	Below -17 °C (0 °F) use oil pan heater

DT 570 (Standard Torque)

12NPW (285 hp @ 2000 rpm)

DT 570/285 hp @ 2000 rpm / 800 ft•lbs @ 1200 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPW	
International® DT 570 diesel engine specifications	
Engine model	International® DT 570/285
Engine rating	285 bhp @ 2000 rpm
Engine Family Rating Code (EFRC)	5121
Injector part number, original equipment	1842578C94
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2425 rpm
High idle speed - automatic transmission	2425 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	73 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	6 MPa (670 psi) / 1.2 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	6 ± 0.5 MPa (670 ± 73 psi) / 1.2 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	7.0 ± 2 MPa (1015 ± 290 psi) / 1.3 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	24 ± 1 MPa (3481 ± 145 psi) / 3.85 V @ 2000 rpm
Injection Control Pressure/voltage (full load, peak torque)	12 ± 1 MPa (1740 ± 145 psi) / 2.0 V @1200 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	420 kPa (61 psi) / 2.95 V
Intake manifold pressure/voltage (full load, rated speed)	193 ± 14 kPa (28 ± 2 psi) / 3.7 ± 0.2 V @ 2000 rpm
Intake manifold pressure/voltage (full load, peak torque)	193 ± 14 kPa (28 ± 2 psi) / 3.7 ± 0.2 V @ 1200 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	230 kPa (33 psi) / 3.0 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	170 kPa (25 psi) / 2.4 V
Exhaust restriction (after turbocharger), maximum	20 kPa (82 in H_2O) @ 2000 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), max.	118 °C (245 °F)

12NPZ (310 hp @ 2000 rpm)

DT 570/310 hp @ 2000 rpm / 950 ft•lbs @ 1200 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NPZ	
International® DT 570 diesel engine specifications	
Engine model	International® DT 570/310
Engine rating	310 bhp @ 2000 rpm
Engine Family Rating Code (EFRC)	5151
Injector part number, original equipment	1842578C94
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2425 rpm
High idle speed - automatic transmission	2425 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	73 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	6 MPa (870 psi) / 1.2 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	6 ± 0.5 MPa (870 ± 73 psi) / 1.2 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	7.0 ± 2 MPa (1015 ± 290 psi) / 1.3 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	24 ± 1 MPa (3481 ± 145 psi) / 3.85 V @ 2000 rpm
Injection Control Pressure/voltage (full load, peak torque)	13.9 ± 1 MPa (2016 ± 145 psi) / 2.4 V @ 1200 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Intake manifold pressure/voltage (full load, rated speed)	206 ± 14 kPa (30 ± 2 psi) / 3.9 ± 0.2 V @ 2000 rpm
Intake manifold pressure/voltage (full load, peak torque)	163 ± 14 kPa (23 ± 2 psi) / 1.8 ± 0.2 V @ 1200 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	240 kPa (35 psi) / 3.1 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	190 kPa (28 psi) / 2.6 V
Exhaust restriction (after turbocharger), maximum	20 kPa (82 in H_2O) @ 2000 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

12NRB (330 hp @ 2000 rpm)

DT 570/330 hp @ 2000 rpm / 950 ft•lbs @ 1200 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NRB	
International® DT 570 diesel engine specifications	
Engine model	International® DT 570/330
Engine rating	330 bhp @ 2000 rpm
Engine Family Rating Code (EFRC)	6161
Injector part number, original equipment	1842579C94
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2425 rpm
High idle speed - automatic transmission	2425 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	75 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	6 MPa (870 psi) / 1.2 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	6 ± 0.5 MPa (870 ± 73 psi) / 1.2 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	8.5 ± 2 MPa (1230 ± 290 psi) / 1.53 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	26 ± 1 MPa (3770 ± 145 psi) / 4.15 V @ 2000 rpm
Injection Control Pressure/voltage (full load, peak torque)	13.8 ± 1 MPa (2000 ± 145 psi) / 2.3 V @ 1200 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Intake manifold pressure/voltage (full load, rated speed)	193 ± 14 kPa (28 ± 2 psi) / 2.3 ± 0.2 V @ 2000 rpm
Intake manifold pressure/voltage (full load, peak torque)	165 ± 14 kPa (24 ± 2 psi) 1.8 ± 0.2 V @ 1200 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	214 kPa (31 psi) / 2.9 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	207 kPa (30 psi) / 2.8 V
Exhaust restriction (after turbocharger), maximum	20 kPa (82 in H_2O) @ 2000 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

HT 570 (High Torque)

12NRC (295 hp @ 2000 rpm)

HT 570/295 hp @ 2000 rpm / 950 ft•lbs @ 1200 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NRC	
International® HT 570 diesel engine specifications	
Engine model	International® HT 570/295
Engine rating	295 bhp @ 2000 rpm
Engine Family Rating Code (EFRC)	5122
Injector part number, original equipment	1842578C94
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2325 rpm
High idle speed - automatic transmission	2425 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	73 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	6 MPa (870 psi) / 1.2 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	6 ± 0.5 MPa (870 ± 73 psi) / 1.2 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	8.5 ± 2 MPa (1231 ± 290 psi) / 1.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	24 ± 1 MPa (3480 ± 145 psi) / 3.9 V @ 2000 rpm
Injection Control Pressure/voltage (full load, peak torque)	13 ± 1 MPa (1885 ± 145 psi) / 2.2 V @ 1200 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Intake manifold pressure/voltage (full load, rated speed)	200 ± 14 kPa (29 ± 2 psi) / 2.4 ± 0.2 V @ 2000 rpm
Intake manifold pressure/voltage (full load, peak torque)	169 ± 14 kPa (24.5 ± 2 psi) / 1.9 ± 0.2 V @ 1200 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	230 kPa (33 psi) / 3.0 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	207 kPa (30 psi) / 2.8 V
Exhaust back pressure/voltage (after turbocharger), maximum	20 kPa (82 in H_2O) @ 2000 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

12NRD (295 hp @ 2000 rpm)

HT 570/295 hp @ 2000 rpm / 950 ft•lbs @ 1200 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NRD	
International® HT 570 diesel engine specifications	
Engine model	International® HT 570/295
Engine rating	295 bhp @ 2000 rpm
Engine Family Rating Code (EFRC)	5122
Injector part number, original equipment	1842578C94
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2325 rpm
High idle speed - automatic transmission	2425 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	73 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	6 MPa (870 psi) / 1.2 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	6 ± 0.5 MPa (870 psi ± 73 psi) / 1.2 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	8.5 ± 2 MPa (1231 ± 290 psi) / 1.5 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	24 ± 1 MPa (3480 ± 145 psi) / 3.9 V @ 2000 rpm
Injection Control Pressure/voltage (full load, peak torque)	13 ± 1 MPa (1885 ± 145 psi) / 2.2 V @ 1200 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Intake manifold pressure/voltage (full load, rated speed)	200 ± 14 kPa (29 ± 2 psi) 2.4 ± 0.2 V @ 2000 rpm
Intake manifold pressure/voltage (full load, peak torque)	169 ± 14 kPa (24.5 psi ± 2 psi) 1.9 ± 0.2 V @ 1200 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	207 kPa (30 psi) / 2.8 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	207 kPa (30 psi) / 2.8 V
Exhaust restriction (after turbocharger), maximum	20 kPa (82 in H_2O) @ 2000 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

12NRE (310 hp @ 2000 rpm)

HT 570/310 hp @ 2200 rpm / 1050 ft•lbs @ 1200 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NRE	
International® HT 570 diesel engine specifications	
Engine model	International® HT 570/310
Engine rating	310 bhp @ 2000 rpm
Engine Family Rating Code (EFRC)	5151
Injector part number, original equipment	1842578C94
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2325 rpm
High idle speed - automatic transmission	2425 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	73 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	6 MPa (870 psi) / 1.2 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	6 ± 0.5 MPa (870 ± 73 psi) / 1.2 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	7 ± 2 MPa (1015 ± 290 psi) / 1.3 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	24 ± 1 MPa (3481 ± 145 psi) / 3.85 V @ 2000 rpm
Injection Control Pressure/voltage (full load, peak torque)	13.9 ± 1 MPa (2016 ± 145 psi) / 2.3 V @ 1200 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Intake manifold pressure/voltage (full load, rated speed)	206 ± 14 kPa (30 ± 2 psi) / 2.44 ± 0.2 V @ 2000 rpm
Intake manifold pressure/voltage (full load, peak torque)	163 ± 14 kPa (23 ± 2 psi) / 1.81 ± 0.2 V @ 1200 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	240 kPa (35 psi) / 3.1 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	193 kPa (28 psi) / 2.7 V
Exhaust restriction (after turbocharger), maximum	20 kPa (82 in H_2O) @ 2000 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

12NRA 300 hp @ 2000 rpm

HT 570/300 hp @ 2000 rpm / 950 ft•lbs @ 1000 rpm	
US Non-road 2004 Model Year (MY)	
Engine unit code 12NRA	
International® HT 570 diesel engine specifications	
Engine model	International® HT 570/310
Engine rating	310 bhp @ 2000 rpm
Engine Family Rating Code (EFRC)	5132
Injector part number, original equipment	1842578C94
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2425 rpm
High idle speed - automatic transmission	2425 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	73 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	6 MPa (870 psi) / 1.2 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	6 ± 0.5 MPa (870 ± 73 psi) / 1.2 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	24 ± 1 MPa (3481 ± 145 psi) / 3.85 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	25 ± 1 MPa (3625 ± 145 psi) / 4.0 V @ 2000 rpm
Injection Control Pressure/voltage (full load, peak torque)	15.7 ± 1 MPa (2275 ± 145 psi) / 2.6 V @ 2000 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Intake manifold pressure/voltage (full load, rated speed)	203 ± 14 kPa (29 ± 2 psi) / 2.39 ± 0.2 V @ 2000 rpm
Intake manifold pressure/voltage (full load, peak torque)	183 ± 14 kPa (27 ± 2psi) / 2.1 ± 0.2 V @ 1200 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	234 kPa (34 psi) / 3.1 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	220 kPa (32 psi) / 2.9 V
Exhaust restriction (after turbocharger), maximum	20 kPa (52 in H_2O) @ 2000 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

12NRG (310 hp @ 2000 rpm)

HT 570/310 hp @ 2000 rpm / 1050 ft•lbs @ 1200 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NRG	
International® HT 570 diesel engine specifications	
Engine model	International® HT 570/310
Engine rating	310 bhp @ 2000 rpm
Engine Family Rating Code (EFRC)	5132
Injector part number, original equipment	1842578C94
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2325 rpm
High idle speed - automatic transmission	2425 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	73 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	6 MPa (870 psi) / 1.2 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	6 ± 0.5 MPa (870 ± 73 psi) / 1.2 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	7 ± 2 MPa (1015 ± 290 psi) / 1.3 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	25 ± 1 MPa (3626 ± 145 psi) / 4.0 V @ 2000 rpm
Injection Control Pressure/voltage (full load, peak torque)	15.7 ± 1 MPa (2275 ± 145 psi) / 2.6 V @ 1200 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Intake manifold pressure/voltage (full load, rated speed)	203 ± 14 kPa (29 ± 2 psi) / 2.39 ± 0.2 V @ 2000 rpm
Intake manifold pressure/voltage (full load, peak torque)	183 ± 14 kPa (27 ± 2psi) / 2.1 ± 0.2 V @ 1200 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	234 kPa (34 psi) / 3.1 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	220 kPa (32 psi) / 2.9 V
Exhaust restriction (after turbocharger), maximum	20 kPa (82 in H_2O) @ 2000 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

12NRH (330 hp @ 2000 rpm)

HT 570/330 hp @ 2000 rpm / 1150 ft•lbs @ 1200 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NRH	
International® HT 570 diesel engine specifications	
Engine model	International® HT 570/330
Engine rating	330 bhp @ 2000 rpm
Engine Family Rating Code (EFRC)	6122
Injector part number, original equipment	1842579C94
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2325 rpm
High idle speed - automatic transmission	2325 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	75 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	6 MPa (870 psi) / 1.2 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	6 ± 0.5 MPa (870 ± 73 psi) / 1.2 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	8.5 ± 2 MPa (1233 ± 290 psi) / 1.53 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	26 ± 1 MPa (3771 ± 145 psi) / 4.15 V @ 2000 rpm
Injection Control Pressure/voltage (full load, peak torque)	15 ± 1 MPa (2175 ± 145 psi) / 2.5 V @ 1200 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Intake manifold pressure/voltage (full load, rated speed)	200 ± 14 kPa (29 ± 2 psi) / 2.4 ± 0.2 V @ 2000 rpm
Intake manifold pressure/voltage (full load, peak torque)	214 ± 14 kPa (31 ± 2psi) / 2.6 ± 0.2 V @ 1200 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	230 kPa (33 psi) / 3.0 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	248 kPa (36 psi) / 3.2 V
Exhaust restriction (after turbocharger), maximum	20 kPa (82 in H_2O) @ 2000 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

12NRZ (340 hp @ 2000 rpm)

HT 570/340 hp @ 2000 rpm / 1150 ft•lbs @ 1200 rpm	
50 state 2004 Model Year (MY)	
Engine unit code 12NRZ	
International® HT 570 diesel engine specifications	
Engine model	International® HT 570/340
Engine rating	340 bhp @ 2000 rpm
Engine Family Rating Code (EFRC)	6132
Injector part number, original equipment	1842579C94
Turbocharger part number	1842337C92, 1842338C92, 1842339C92
Injection timing	Nonadjustable
High idle speed - manual transmission	2325 rpm
High idle speed - automatic transmission	2325 rpm
Low idle speed	700 rpm
KOEO	
VGT Duty Cycle	75 %
Engine cranking	
Minimum battery voltage	10 V
Minimum cranking rpm	130 rpm
Minimum ICP pressure/voltage	6 MPa (870 psi) / 1.2 V
Minimum oil pressure/voltage	138 kPa (20 psi) / 0.9 V
EGRP starting	0%
Minimum fuel pressure/voltage	138 kPa (20 psi) / 0.9 V after 10 second crank

Data taken at low idle, no load, stabilized operating temperature	
Injection Control Pressure/voltage	6 ± 0.5 MPa (870 ± 73 psi) / 1.2 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	205 kPa (30 psi) / 1.4 V
Data taken at high idle, no load, stabilized operating temperature	
Air cleaner restriction, maximum	3.1 kPa (12.5 in H_2O)
Injection Control Pressure/voltage	8.5 ± 2 MPa (1231 ± 290 psi) / 1.53 V
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Data taken at full load, rated speed on chassis dynamometer or highway, stabilized operating temperature	
Air cleaner restriction, maximum	6.2 kPa (25 in H_2O)
Injection Control Pressure/voltage (full load, rated speed)	26 ± 1 MPa (3771 ± 145 psi) / 4.15 V @ 2000 rpm
Injection Control Pressure/voltage (full load, peak torque)	15 ± 1 MPa (2175 ± 145 psi) / 2.5 V @ 1200 rpm
Fuel pressure/voltage, minimum	345 kPa (50 psi) / 2.4 V
Fuel inlet restriction, maximum	152 mm Hg (6 in Hg)
Oil pressure/voltage, minimum	480 kPa (70 psi) / 4.1 V
Intake manifold pressure/voltage (full load, rated speed)	200 ± 14 kPa (29 ± 2 psi) 2.35 ± 0.2 V @ 2000 rpm
Intake manifold pressure/voltage (full load, peak torque)	207 ± 14 kPa (30 ± 2psi) 2.45 ± 0.2 V @ 1200 rpm
Exhaust Back Pressure/voltage (sensor), (full load, rated speed)	230 kPa (33 psi) / 3.0 V
Exhaust Back Pressure/voltage (sensor), (full load, peak torque)	241 kPa (35 psi) / 3.2 V
Exhaust restriction (after turbocharger), maximum	20 kPa (82 in H_2O) @ 2000 rpm
Data taken after engine reaches stabilized operating temperature	
Torque converter stall (rpm/time)	1700 rpm or greater @ 5 seconds or less
Lube oil temperature (oil gallery), maximum	118 °C (245 °F)

Table of Contents

Diagnostic Trouble Code Index

DTC	PID	SID	FMI	Circuit	Condition Description
111				ECM (page 388)	No errors detected - flash code only
112†	168	0	3	ECM PWR (page 381)	Electrical system voltage B+ out-of-range high
113†	168	0	4	ECM PWR (page 381)	Electrical system voltage B+ out-of-range low
114*	110	0	4	ECT (page 391)	Engine Coolant Temperature signal out-of-range low
115*	110	0	3	ECT (page 391)	Engine Coolant Temperature signal out-of-range high
121*	102	0	3	MAP (page 500)	Intake Manifold Absolute Pressure signal out-of-range high
122*	102	0	4	MAP (page 500)	Intake Manifold Absolute Pressure signal out-of-range low
123*	102	0	2	MAP (page 500)	Intake Manifold Absolute Pressure signal in-range fault
124*	164	0	4	ICP (page 457)	Injection Control Pressure signal out-of-range low
125*	164	0	3	ICP (page 457)	Injection Control Pressure signal out-of-range high
126*	118	4	N/A	BCP (page 318)	Engine Brake Control Pressure signal out-of-range low
127*	118	3	N/A	BCP (page 318)	Engine Brake Control Pressure signal out-of-range high
131*†	91	0	4	APS/IVS (page 300)	APS signal out-of-range low
132*†	91	0	3	APS/IVS (page 300)	APS signal out-of-range high
133*†	91	0	2	APS/IVS (page 300)	APS signal in-range DTC
134*†	91	0	7	APS/IVS (page 300)	APS signal and IVS disagree
135*†	0	230	11	APS/IVS (page 300)	Idle Validation Switch circuit fault
136	94	0	4	EFP (page 406)	Engine Fuel Pressure signal out-of-range low
137	94	0	3	EFP (page 406)	Engine Fuel Pressure signal out-of-range high
141†	84	0	4	VSS (page 544)	Vehicle Speed Sensor signal out-of-range low
142†	84	0	3	VSS (page 544)	Vehicle Speed Sensor signal out-of-range high
143	0	21	2	CMP (page 355)	Incorrect CMP signal signature
145	0	21	12	CMP (page 355)	CMP signal inactive
146	0	64	12	CKP (page 351)	CKP signal inactive

† See chassis circuit diagrams and *Engine Diagnostics Manual* for more information.

* Indicates amber ENGINE lamp on when a Diagnostic Trouble Code (DTC) is set.

** Indicates red ENGINE lamp on if the Engine Warning Protection System (EWPS) is enabled and a DTC is set.

DTC	PID	SID	FMI	Circuit	Condition Description
147	0	64	2	CKP (page 351)	Incorrect CKP signal signature
151*†	108	0	3	BAP (page 314)	Barometric Absolute Pressure signal out-of-range high
152*†	108	0	4	BAP (page 314)	Barometric Absolute Pressure signal out-of-range low
153†	97	0	4	WIF(page 550)	Water In Fuel signal out-of-range low
154	171	0	4	IAT (page 451)	Inlet Air temperature signal out-of-range low
155	171	0	3	IAT (page 451)	Inlet Air temperature signal out-of-range high
161*	105	0	4	MAT (page 508)	Manifold Air Temperature Signal out-of-range low
162*	105	0	3	MAT (page 508)	Manifold Air Temperature Signal out-of-range high
163*	27	0	4	EGR (page 413)	Exhaust Gas Recirculation Valve Position Signal out-of-range low
211*	100	0	4	EOP (page 426)	Engine Oil Pressure signal out-of-range low
212*	100	0	3	EOP (page 426)	Engine Oil Pressure signal out-of-range high
215†	84	0	8	VSS (page 544)	Vehicle Speed Sensor signal frequency out-of-range high
225	100	0	0	EOP (page 426)	EOP sensor signal in-range fault
231†	0	250	2	ATA (page 309)	ATA data communication link error
236†	111	0	2	ECL (page 370)	ECL switch circuit fault
241†	0	42	11	IPR (page 494)	Injection Control Pressure regulator OCC self test failed
246†	0	56	11	EFAN (page 398)	Engine Fan - OCC self test fault
247†	121	0	11	BSV (page 334)	Engine Brake enable OCC self test failed
251†	0	38	11	IAH (page 444)	Inlet Air Heater OCC self test failed
256†	0	55	11	RSE (page 514)	Radiator Shutter Enable OCC fault
261†	0	27	11	VGT (page 526)	Variable Geometry Turbo control OCC self test failed
267†	0	39	11	ECI (page 366)	Engine Crank Inhibit OCC self test failed
311*	175	0	4	EOT (page 433)	Engine Oil Temperature signal out-of-range low
312*	175	0	3	EOT (page 433)	Engine Oil Temperature signal out-of-range high
313**	100	0	1	EWPS (page 440)	Engine Oil Pressure below warning level

† See chassis circuit diagrams and *Engine Diagnostics Manual* for more information.

* Indicates amber ENGINE lamp on when a Diagnostic Trouble Code (DTC) is set.

** Indicates red ENGINE lamp on if the Engine Warning Protection System (EWPS) is enabled and a DTC is set.

DTC	PID	SID	FMI	Circuit	Condition Description
314**	100	0	7	EWPS (page 440)	Engine Oil Pressure below critical level
315*	190	0	0	EWPS (page 440)	Engine speed above warning level
316	110	0	1	EWPS (page 440)	Engine Coolant Temperature unable to reach commanded set point
321**	110	0	0	EWPS (page 440)	Engine Coolant Temperature above warning level
322**	110	0	7	EWPS (page 440)	Engine Coolant Temperature above critical level
323**	111	0	1	EWPS (page 440)	Engine Coolant Level below warning/critical level
324**	71	0	14	IST (page 497)	Idle Shutdown Timer enabled engine shutdown
325	110	0	14	EWPS (page 440)	Power reduced, matched to cooling system performance
331*	164	0	0	ICP SYS (page 472)	Injection Control Pressure above system working range
332*	164	0	13	ICP (page 457)	Injection Control Pressure above spec. with engine not running
333*	164	0	10	ICP SYS (page 472)	Injection Control Pressure above/below desired level
334	164	0	7	ICP SYS (page 472)	ICP unable to achieve setpoint in time (poor performance)
335	164	0	1	ICP SYS (page 472)	ICP unable to build pressure during cranking
341*	0	34	4	EBP (page 359)	Exhaust Back Pressure signal out-of-range low
342*	0	34	3	EBP (page 359)	Exhaust Back Pressure signal out-of-range high
343*	0	34	0	AMS (page 294)	Excessive exhaust back pressure (gauge)
344*	0	34	13	EBP (page 359)	Exhaust back pressure above spec. when engine off
345	0	27	2	AMS (page 294)	Faults detected during VGT portion of the AMS Test
346	27	0	2	AMS (page 294)	Faults detected during EGR portion of the AMS Test
351	0	34	7	AMS (page 294)	Change in exhaust back pressure did not occur when expected
353	0	27	5	AMS (page 294)	Variable Geometry Turbo control over duty cycle
354	0	27	6	AMS (page 294)	Variable Geometry Turbo control under duty cycle

† See chassis circuit diagrams and *Engine Diagnostics Manual* for more information.

* Indicates amber ENGINE lamp on when a Diagnostic Trouble Code (DTC) is set.

** Indicates red ENGINE lamp on if the Engine Warning Protection System (EWPS) is enabled and a DTC is set.

DTC	PID	SID	FMI	Circuit	Condition Description
355	103	0	0	AMS (page 294)	Variable Geometry Turbo overspeed
361	0	27	10	AMS (page 294)	VGT control input (MAP/EBP) above/below desired level
365*	27	0	10	AMS (page 294)	EGR Valve Position above/below desired level
368*	0	146	7	AMS (page 413)	EGR driver module/ECM2 communication fault
371	94	0	0	EFP (page 406)	Engine Fuel Pressure is above normal operating range
372	94	0	1	EFP (page 406)	Engine Fuel Pressure is below normal operating range
421-426	0	1-6	5	INJ (page 489)	High side to low side open (cylinder number indicated)
431-436	0	1-6	4	INJ (page 489)	High side shorted to low side (cylinder number indicated)
451-456	0	1-6	6	INJ (page 489)	High side short to ground or V_{BAT} (cylinder number indicated)
523†	0	233	4	IDM (page 479)	IDM V_{IGN} voltage low
525*	0	254	6	IDM (page 479)	IDM fault
533†	0	221	3	IDM (page 479)	IDM relay voltage high
534†	0	221	4	IDM (page 479)	IDM relay voltage low
546*	121	0	1	BCP (page 318)	Engine Brake Contol Pressure is below expected range
547*	121	0	0	BCP (page 318)	Engine Brake Contol Pressure is above expected range
543*	0	155	7	ECM/IDM (page 373)	ECM/IDM communications fault
551	0	22	12	ECM/IDM (page 373)	IDM/CMPO signal inactive
552	0	22	2	ECM/IDM (page 373)	IDM incorrect CMPO signal signature
553	0	22	11	ECM/IDM (page 373)	IDM CKPO signal inactive
554	0	22	8	ECM/IDM (page 373)	IDM incorrect CKPO signal signature
613*	0	252	1	ECM (page 388)	ECM/IDM software not compatible
614*	0	252	13	ECM (page 388)	EFRC/ECM configuration mismatch
621*	0	253	1	ECM (page 388)	Engine using mfg. default rating
622*	0	253	0	ECM (page 388)	Engine using field default rating
623*	0	253	13	ECM (page 388)	Invalid Engine Family Rating Code (EFRC)
624	0	240	14	ECM (page 388)	Field default active

† See chassis circuit diagrams and *Engine Diagnostics Manual* for more information.

* Indicates amber ENGINE lamp on when a Diagnostic Trouble Code (DTC) is set.

** Indicates red ENGINE lamp on if the Engine Warning Protection System (EWPS) is enabled and a DTC is set.

DTC	PID	SID	FMI	Circuit	Condition Description
626†	0	254	8	ECM PWR (page 381)	Unexpected reset fault
631	0	240	2	ECM (page 388)	Read Only Memory (ROM) self test fault
632	0	254	12	ECM (page 388)	Random Access Memory (RAM) - CPU self test fault
655	0	240	13	ECM (page 388)	Programmable parameter list level incompatible
661	0	240	11	ECM (page 388)	RAM programmable parameter list corrupt
664	0	253	14	ECM (page 388)	Calibration level incompatible
665	0	252	14	ECM (page 388)	Programmable parameter memory content corrupt

† See chassis circuit diagrams and *Engine Diagnostics Manual* for more information.

* Indicates amber ENGINE lamp on when a Diagnostic Trouble Code (DTC) is set.

** Indicates red ENGINE lamp on if the Engine Warning Protection System (EWPS) is enabled and a DTC is set.

Table of Contents

Description

Technical Service Information (TSI) letters are periodically published to inform service technicians of product enhancements and field service issues. File TSIs in this section for supplemental reference.

Printed in the United States of America