

Troubleshooting Guide

Detroit Diesel® Series 60® DDEC® V

DETROIT DIESEL
CORPORATION



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NOTE:

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CALIFORNIA
Proposition 65 Warning

**Diesel engine exhaust and some of its
constituents are known to the State of
California to cause cancer, birth
defects, and other reproductive harm.**

ENGINE EXHAUST

Consider the following before servicing engines:

 WARNING:
PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. ❑ Always start and operate an engine in a well ventilated area. ❑ If operating an engine in an enclosed area, vent the exhaust to the outside. ❑ Do not modify or tamper with the exhaust system or emission control system.

TRADEMARK INFORMATION

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ECM/ECU WARNING

 WARNING
Unintended engine startup, acceleration, or shutdown could cause personal injury or death. This ECU is programmed for specific options. Replacing this ECU with one that has not been programmed with these exact options could have unintended results. Only replace with an ECU that has the identical inputs and outputs programmed.

43970

Figure 1 ECM/ECU Replacement Warning

SOFTWARE UPGRADES

NOTE:

These engines are equipped with DDEC software. This software generally assures optimal engine performance. The installation of software upgrades may cause minor changes in features and engine performance.

ABSTRACT

This manual provides instruction for troubleshooting the Series 60 on-highway engine with Detroit Diesel Electronic Controlled (DDEC®) engines.

Specifically covered in this manual are troubleshooting and repair steps that apply to the Series 60 on-highway engine with DDEC V.

SAFETY INSTRUCTIONS

To reduce the chance of personal injury and/or property damage, the instructions contained in this troubleshooting manual must be carefully observed. Proper service and repair are important to the safety of the service technician and the safe, reliable operation of the engine.

If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part number. Do not use a replacement part of lesser quality. The service procedures recommended and described in this manual are effective methods of performing repair. Some of these procedures require the use of specially designed tools. Accordingly, anyone who intends to use a replacement part, procedure or tool which is not recommended, must first determine that neither personal safety nor the safe operation of the engine will be jeopardized by the replacement part, procedure or tool selected.

It is important to note that this manual contains various hazard notices (Danger, Warning, Caution and Notice) that must be carefully observed in order to reduce the risk of personal injury during repair, or the possibility that improper repair may damage the engine or render it unsafe. It is also important to understand that these hazard notices are not exhaustive, because it is impossible to warn personnel of the possible hazardous consequences that might result from failure to follow these instructions.

A LETTER TO THE TECHNICIANS

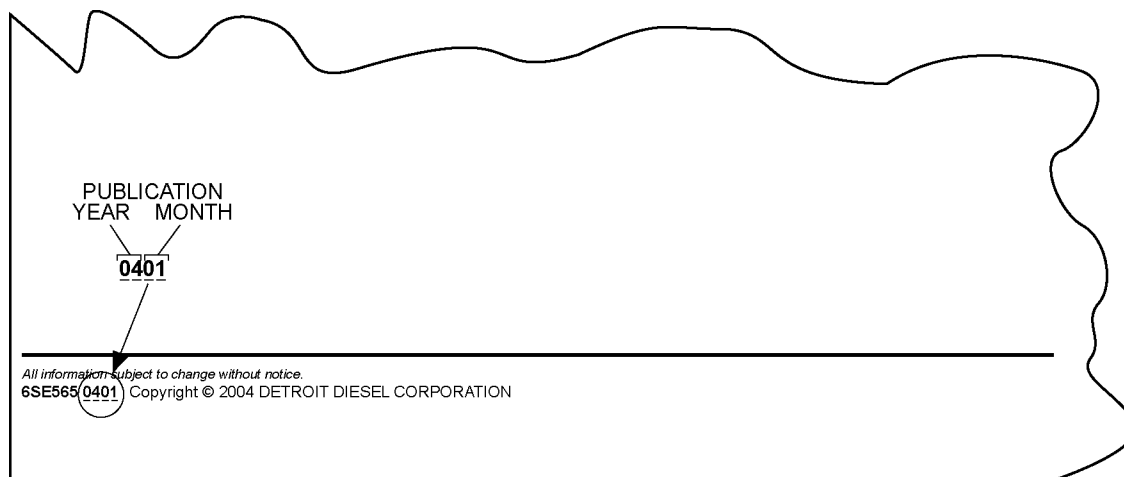
The Series 60 engine has been introduced in 1987. The technological changes that have occurred during those years have resulted in a different type of engine, requiring a different class of technicians. Technicians today are required to have computer skills, excellent comprehension of the written word and possess an extensive diagnostic understanding of the various technological systems and components. Technicians today must perform at a higher level of efficiency and competency than their predecessors and at the same time furnish professional quality support.

As the leader in engine computer systems and technology, Detroit Diesel Corporation remains focused on providing excellence in products, service support and training. As products become more and more advanced, technicians must become specialized in multiple areas. This manual is designed with that thought in mind. The Detroit Diesel Series 60 DDEC V Troubleshooting Guide will provide you with concentrated information that will allow you to excel in Series 60 and DDEC V technology.

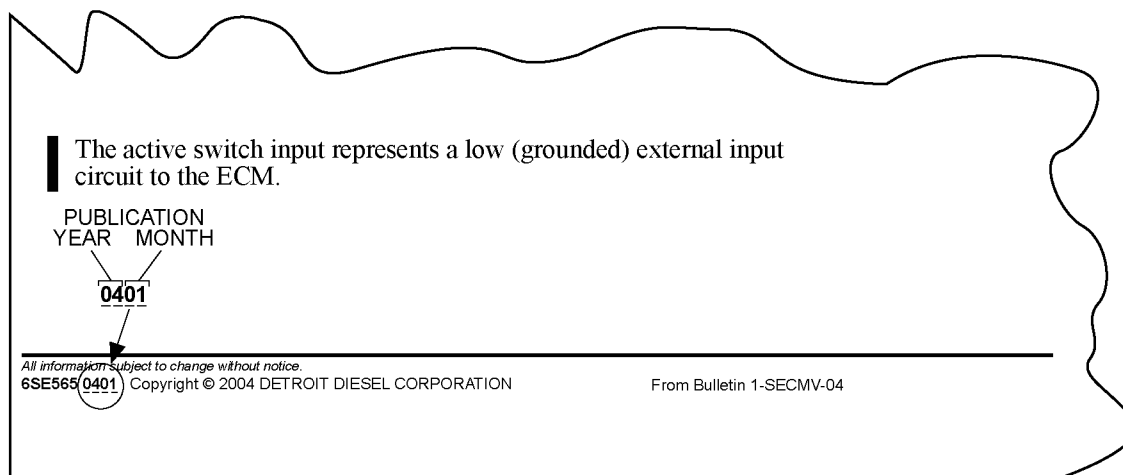
REVISION NOTIFICATION

Modifications to this manual are announced in the form of Service Information Bulletins. The bulletins include attachment pages and are posted on the DDC extranet.

Revisions to this manual will be sent marked with a revision bar (see Example 2). Sections containing revisions will have added information in the page footer (compare Examples 1 and 2).



Example 1 - Unchanged Pages



Example 2 - Changed Pages

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1 INTRODUCTION

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1.1 INTRODUCTION

Detroit Diesel Corporation is the world leader in diesel engines and diesel engine electronics. DDC has made technological leaps in engine performance and fuel economy. Today, we build the most dependable electronically controlled diesel engine in the industry.

DDEC V provides two industry standard serial data links: SAE Standards J1587 and J1939. SAE Standard J1587 provides two-way communications for the diagnostic equipment and vehicle displays. SAE Standard J1939 provides control data to other vehicle systems such as transmissions and traction control devices.

As the leader in engine computer systems and technology, Detroit Diesel Corporation remains focused on providing excellence in products, service support and training. As products become more and more advanced, today's technicians must become specialized in multiple areas. This manual is designed with that thought in mind.

Our goal at Detroit Diesel is to be the most customer focused and most responsive engine manufacturer in the world.

1.2 SCOPE AND USE OF THIS GUIDE

The first half of the manual contain mechanical troubleshooting procedures. The second half contains instructions for troubleshooting the electronic controls.

This manual is divided into numbered chapters. Each chapter begins with a table of contents. Pages and illustrations are numbered consecutively within each chapter.

Information can be located by using the table of contents at the front of the manual or the table of contents at the beginning of each chapter.

Instructions to "Contact Detroit Diesel Customer Service Center" indicate that at the time of this publication, all known troubleshooting checks have been included. Review any recent Service Information Bulletins (SIB) or Service Information letters before calling.

It is also suggested that other DDC outlets be contacted. e.g. if you are a dealer or user, contact your closest DDC Distributor.

Ensure you have the engine serial number when you call. The phone number for Detroit Diesel Customer Service Center is 313-592-5800.

Instructions in this manual may suggest replacing a non DDC component. It may be required to contact the supplier of the component, e.g. truck manufacturer for a TPS concern, to obtain approval to replace the component.

Important: To ensure you receive updates to this manual should the need arise, you must fill out the Information Card in the front of this manual. Service Information Bulletins are issued via the DDC extranet. Visit DDCDIRECT at www.accessfreightliner.com.

1.2.1 Mechanical Troubleshooting

Each chapter has a fault as the title (i.e. Excessive White Smoke). The next level within the chapter is the probable cause/symptom of the fault. Following this are the resolution and verification of the resolution. The mechanical troubleshooting should be used before the electronic troubleshooting.

1.2.2 Electronic Troubleshooting

The DDEC V system allows for an increased processor speed and increased memory. DDEC III ECMs and DDEC IV ECMs are not interchangeable with DDEC V.

Instructions for repair in this manual are generic. For example, "Repair Open" is used to advise the technician that a particular wire has been determined to be broken. In some cases it may not be best to try and locate the open. It may be that the best repair technique is to replace a complete harness. The technician should make the determination of the proper repair, with the best interest of the customer in mind.

Instructions to check terminals and connectors should include checking for proper contact tension. Using a mating terminal, a modest force should be required to remove a terminal from its mate. Replace terminals with poor tension.

After completing any repair, always clear fault codes that may have been generated during the troubleshooting process.

1.3 SAFETY PRECAUTIONS

The following safety precautions must be observed when working on a Detroit Diesel engine:

 WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. ☐ Always start and operate an engine in a well ventilated area. ☐ If operating an engine in an enclosed area, vent the exhaust to the outside. ☐ Do not modify or tamper with the exhaust system or emission control system.

 WARNING: PERSONAL INJURY
To avoid injury from accidental engine startup while servicing the engine, disconnect/disable the starting system.

All engine installations, especially those within enclosed spaces, should be equipped with an exhaust discharge pipe so that exhaust gases are delivered into the outside air.

 WARNING: PERSONAL INJURY
To avoid injury from the sudden release of a high-pressure hose connection, wear a face shield or goggles. Bleed the air from the air starter system before disconnecting the air supply hose.

1.3.1 Glasses

Select appropriate safety glasses for the job. It is especially important to wear safety glasses when using tools such as hammers, chisels, pullers or punches.

 WARNING: EYE INJURY
To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

1.3.2 Ether Start

The DDEC Ether Start System is a fully-automatic engine starting fluid system used to assist a DDEC equipped diesel engine in cold starting conditions. The amount of ether is properly controlled to optimize the starting process and prevent engine damage. DDEC will control ether injection using standard sensors to control the ether injection hardware.



WARNING:

FIRE AND TOXICITY

Some pressurized fluid may be trapped in the system. To avoid personal injury, loosen all connections slowly to avoid contact with fluid. When required, spray fluid into a proper container. The engine starting fluid used in DDEC Ether Start Systems contains extremely flammable and toxic substances.



WARNING:

FIRE AND TOXICITY

To avoid personal injury, spray the fluid from the bottom of the valve into an appropriate container. The engine starting fluid used in DDEC Ether Start Systems contains extremely flammable and toxic substances.

1.3.3 Fire

Keep a charged fire extinguisher within reach. Ensure you have the proper type of extinguisher on hand.



WARNING:

FIRE

To avoid injury from fire, keep a fire extinguisher near the grinding machine in case excessive heat should ignite the oil.

1.3.4 Exhaust (Start/Run Engine)

Before starting and running an engine, adhere to the following safety precautions:

 WARNING: PERSONAL INJURY
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

 WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. □ Always start and operate an engine in a well ventilated area. □ If operating an engine in an enclosed area, vent the exhaust to the outside. □ Do not modify or tamper with the exhaust system or emission control system.

1.3.5 Cleaning Agent

Avoid the use of carbon tetrachloride as a cleaning agent because of the harmful vapors that it releases. Ensure the work area is adequately ventilated. Use protective gloves, goggles or face shield, and apron.

 WARNING: PERSONAL INJURY
To avoid injury from harmful vapors or skin contact, do not use carbon tetrachloride as a cleaning agent.

1.3.6 Welding

Wear welding goggles and gloves when welding or using an acetylene torch. Ensure that a metal shield separates the acetylene and oxygen tanks. These must be securely chained to a cart.



WARNING:

PERSONAL INJURY

To avoid injury from arc welding, gas welding, or cutting, wear required safety equipment such as an arc welder's face plate or gas welder's goggles, welding gloves, protective apron, long sleeve shirt, head protection, and safety shoes. Always perform welding or cutting operations in a well ventilated area. The gas in oxygen/acetylene cylinders used in gas welding and cutting is under high pressure. If a cylinder should fall due to careless handling, the gage end could strike an obstruction and fracture, resulting in a gas leak leading to fire or an explosion. If a cylinder should fall resulting in the gage end breaking off, the sudden release of cylinder pressure will turn the cylinder into a dangerous projectile. Observe the following precautions when using oxygen/acetylene gas cylinders:

- ☐ Always wear required safety shoes.
- ☐ Do not handle tanks in a careless manner or with greasy gloves or slippery hands.
- ☐ Use a chain, bracket, or other restraining device at all times to prevent gas cylinders from falling.
- ☐ Do not place gas cylinders on their sides, but stand them upright when in use.
- ☐ Do not drop, drag, roll, or strike a cylinder forcefully.
- ☐ Always close valves completely when finished welding or cutting.



WARNING:

FIRE

To avoid injury from fire, check for fuel or oil leaks before welding or carrying an open flame near the engine.

1.3.7 Pressurized Fluids

Be extremely careful when dealing with fluids under pressure. Fluids under pressure can have enough force to penetrate the skin. These fluids can infect a minor cut or opening in the skin. If injured by escaping fluid, see a doctor at once. Serious infection or reaction can result without immediate medical treatment.



WARNING:

PERSONAL INJURY

To avoid injury from the sudden release of a high-pressure hose connection, wear a face shield or goggles.



WARNING:

PERSONAL INJURY

To avoid injury from penetrating fluids, do not put your hands in front of fluid under pressure. Fluids under pressure can penetrate skin and clothing.

1.3.8 Fuel

Keep the hose and nozzle or the funnel and container in contact with the metal of the fuel tank when refueling.

 WARNING: FIRE
To avoid injury from fire, keep all potential ignition sources away from diesel fuel, including open flames, sparks, and electrical resistance heating elements. Do not smoke when refueling.

The following cautions should be followed when filling a fuel tank:

 WARNING: FIRE
To avoid injury from fire caused by heated diesel-fuel vapors: ☐ Keep those people who are not directly involved in servicing away from the engine. ☐ Stop the engine immediately if a fuel leak is detected. ☐ Do not smoke or allow open flames when working on an operating engine. ☐ Wear adequate protective clothing (face shield, insulated gloves and apron, etc.). ☐ To prevent a buildup of potentially volatile vapors, keep the engine area well ventilated during operation.

 WARNING:

FIRE

To avoid injury from fire, contain and eliminate leaks of flammable fluids as they occur. Failure to eliminate leaks could result in fire.

1.3.9 Batteries

Electrical storage batteries emit highly flammable hydrogen gas when charging and continue to do so for some time after receiving a steady charge.

 WARNING:

Battery Explosion and Acid Burn

To avoid injury from battery explosion or contact with battery acid, work in a well ventilated area, wear protective clothing, and avoid sparks or flames near the battery. If you come in contact with battery acid:

- ☐ **Flush your skin with water.**
- ☐ **Apply baking soda or lime to help neutralize the acid.**
- ☐ **Flush your eyes with water.**
- ☐ **Get medical attention immediately.**

Always disconnect the battery cable before working on the electrical system.

 WARNING:

PERSONAL INJURY

To avoid injury from accidental engine startup while servicing the engine, disconnect/disable the starting system.

1.3.10 Diagnostic Equipment

For mobile applications, Detroit Diesel Diagnostic Link (DDDL) must be used by personnel other than the vehicle operator. The vehicle operator must maintain control of the vehicle while an assistant performs the diagnostic evaluations.

 WARNING: PERSONAL INJURY
To avoid injury from loss of vehicle/vessel control, the operator of a DDEC equipped engine must not use or read any diagnostic tool while the vehicle/vessel is moving.

1.3.11 Working on a Running Engine

When working on an engine that is running, accidental contact with the hot exhaust manifold can cause severe burns. Remain alert to the location of the rotating fan, pulleys and belts. Avoid making contact across the two terminals of a battery which can result in severe arcing, or battery explosion.

 WARNING: PERSONAL INJURY
To avoid injury from rotating belts and fans, do not remove and discard safety guards.

 WARNING: PERSONAL INJURY
To avoid injury when working near or on an operating engine, remove loose items of clothing and jewelry. Tie back or contain long hair that could be caught in any moving part causing injury.

1.3.12 Optimized Idle

Optimized Idle must be turned on by the factory via order entry or mainframe setup.

 CAUTION:
UNEXPECTED ENGINE START
To avoid injury from an unexpected startup of an engine equipped with the Optimized Idle system, remove the starter relay from the relay holder.

 WARNING:
PERSONAL INJURY
To avoid injury from accidental engine startup, replace a defective ECM with an ECM programmed with identical inputs and outputs.

1.3.13 Fluoroelastomer

Fluoroelastomer (Viton®) parts such as O-rings and seals are perfectly safe to handle under normal design conditions.

 WARNING:
CHEMICAL BURNS
To avoid injury from chemical burns, wear a face shield and neoprene or PVC gloves when handling fluoroelastomer O-rings or seals that have been degraded by excessive heat. Discard gloves after handling degraded fluoroelastomer parts.

A potential hazard may occur if these components are raised to a temperature above 600°F (316°C) (in a fire for example). Fluoroelastomer will decompose (indicated by charring or the appearance of a black, sticky mass) and produce hydrofluoric acid. This acid is extremely corrosive and, if touched by bare skin, may cause severe burns (the symptoms could be delayed for several hours).

2 MISFIRING CYLINDER

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2.1 POOR VEHICLE GROUND

To determine if poor vehicle ground is causing the cylinder to misfire, perform the following steps:

1. Remove alternator belt.
2. Start the engine.
3. Run the engine through operating range.
4. Listen for engine misfiring.
 - [a] If the engine is not misfiring, refer to section 2.1.1. Shut down the engine.
 - [b] If the engine is still misfiring, check for aerated fuel; refer to section 2.2.

2.1.1 Negative Lead Repair

Perform the following steps for negative lead repair:

1. Shut down the engine.
2. Remove negative lead(s) at frame ground stud near battery box.
3. Clean ground stud; refer to OEM guidelines.
4. Clean negative lead(s) terminal lugs with low grit sandpaper.
5. Repair any loose or damaged lead(s), using the splice method or rosin core solder.
6. Install negative lead(s) to frame ground stud; refer to OEM guidelines.
7. Install alternator belt. Tighten belt to:
 - [a] If installing a new belt, tighten to 170 N·m (125 lb).
 - [b] If installing a used belt, tighten to 135 N·m (100 lb).
 - [c] If a belt tension gage is not available, adjust the belt tension so that a firm push with the thumb, at a point midway between the two pulleys, will depress the belt 12.70 - 19.05 mm (0.500 - 0.750 in.).

NOTE:

When installing or adjusting an accessory drive belt, be sure the bolt at the accessory adjusting pivot point is properly tightened, as well as the bolt in the adjusting slot.

NOTE:

Drive belts (Vee and poly-vee) should be replaced every 2,000 hours or 160,000 km (100,000 miles).

8. Verify negative lead repair; refer to section 2.1.1.1.

2.1.1.1 Verification of Repair for Negative Lead

Perform the following steps to determine if negative lead repair resolved the misfiring cylinder condition:

1. Refer to section 2.1 for exhaust caution before proceeding. Start engine.
2. Run engine speed up to the occurrence of the misfiring.
3. Listen for misfiring cylinder.
 - [a] If the engine is not misfiring, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine is misfiring, check for aerated fuel. Shut down the engine; refer to section 2.2.

2.2 AERATED FUEL

To determine if aerated fuel is causing the cylinder to misfire, perform the following steps:

1. Disconnect the fuel line return hose from the fitting located at the fuel tank.
2. Place the opened end of fuel line into a suitable container.
3. Start the engine.
4. Run the engine at 1000 rpm.
5. Visually check to see if air bubbles are rising to the surface of the fuel within the container.
 - [a] If air bubbles are present, refer to section 2.2.1.
 - [b] If air bubbles are not present, check for improper calibration setting. Shut down the engine.

2.2.1 Aerated Fuel Repair

Perform the following steps for air in fuel repair:

1. Shut down engine.
2. Tighten all fuel line connections between fuel tank and fuel pump; refer to OEM guidelines.
3. Visually inspect all fuel lines between fuel tank and fuel pump for leaks.
4. Replace any damaged components; refer to appropriate service manual, fuel system chapter.
5. Verify repair of fuel lines:
 - [a] If no air in the fuel return, refer to section 2.2.1.1.
 - [b] If air in the fuel return, locate and repair. Then refer to section 2.2.1.1.

2.2.1.1 Test the Engine with Repair for Aerated Fuel

Perform the following steps to determine if the aerated fuel repair resolved the misfiring cylinder condition:

1. Refer to section 2.2 for exhaust caution before proceeding. Start engine.
2. Run engine at 1000 rpm.
3. Listen for misfiring cylinder.
 - [a] If the engine is not misfiring, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine is misfiring, shut down the engine and check for improper injector setting.

2.3 FAULTY FUEL INJECTOR

To determine if a faulty fuel injector is causing the cylinder to misfire, perform the following steps:

1. Install DDL adaptor to the data cable and plug the adaptor into the DDL connector in the vehicle; refer to OEM guidelines.
2. Start the engine.
3. From the DDEC III/IV Select Menu, scroll to select ENGINE and press the ENTER key.
4. Scroll to FUEL INJECTOR INFO (CUTOUT) and press the ENTER key.
5. Scroll to select NEW TEST and press the ENTER key.
6. Scroll to select RPM SETTING FOR CCO TEST NORMAL and scroll to select 1000 and press the ENTER key.
7. Scroll to select AUTO and press the ENTER key. Wait for END OF TEST.

NOTE:

If an injector cannot be cutout, you will see an ERROR message. Press FUNC to exit the cylinder cutout function, press the FUNC key.

8. Scroll the list to review the results of the cylinder cutout test. To find suspect injectors, look for a cylinder with a value that is within 0.2 degrees of the NO CUTOUT PULSE WIDTH, by comparing the CUTOUT PULSE WIDTH values to the NO CUTOUT PULSE WIDTH values.
 - [a] If any CUTOUT PULSE WIDTH values are within 0.2 degrees of the NO CUTOUT PULSE WIDTH, shut down the engine and refer to section 2.3.1.
 - [b] If any CUTOUT PULSE WIDTH values are not within 0.2 degrees of the NO CUTOUT PULSE WIDTH, shut down the engine and refer to section 2.4.

2.3.1 Faulty Fuel Injector Repair

Perform the following steps for faulty fuel injector assembly(s):

1. Remove and replace injector assembly(s) whose values are within 0.2 degrees of the NO CUTOUT PULSE WIDTH; refer to the appropriate service manual, fuel system chapter.
2. Verify replaced injector assembly(s), refer to section 2.3.1.1.

2.3.1.1 Verification of Repair for Faulty Fuel Injector

Perform the following steps to determine if the replaced fuel injector(s) resolved the misfiring cylinder condition:

1. Refer to section 2.3 for the exhaust caution before proceeding. Start the engine.
2. Run the engine speed up to the occurrence of the misfiring.
3. Listen for misfiring cylinder.

- [a] If the engine is not misfiring, shut down the engine. No further troubleshooting is required.
- [b] If the engine is misfiring, shut down the engine and check for a faulty Electronic Control Unit (ECU); refer to section 2.4.

2.4 FAULTY ELECTRONIC CONTROL UNIT

To determine if a faulty electronic control module (ECU) is causing the cylinder to misfire, perform the following:

NOTE:

Carefully disengage the lock tab on the power harness and injector harness connector when removing.

1. Remove the thru-bolts holding the ECU to the engine; refer to the appropriate service manual, fuel system chapter.
2. Remove the ECU from the engine and tag the ECU for core return.
3. Obtain a new reprogrammed ECU for the engine you are troubleshooting.
4. Inspect the ECU isolators for any damage. Replace if necessary, refer to the appropriate service manual, fuel system chapter.
5. Install the ECU to the engine using thru-bolts; refer to the appropriate service manual, fuel system chapter.
6. Torque the ECU thru-bolts to 23 - 27 N·m (17 - 20 lb·ft).
7. Install the Engine Harness connector and shroud to the ECU. Torque the center screw and two nuts to 5.6 N·m (50 lb·in.).

2.4.1 Faulty ECU Repair

No repair authorized for ECU.

2.4.1.1 Verification of Repair for Faulty ECU

Perform the following steps to determine if the new ECU resolved the misfiring cylinder condition:

1. Start the engine.
2. Run the engine speed up to the occurrence of the misfiring.
3. Listen for misfiring cylinder.
 - [a] If the engine is not misfiring, shut down the engine. No further troubleshooting is required.
 - [b] If the engine is misfiring, shut down the engine and check for worn or damaged valves and cylinder kits; refer to section 2.5.

2.5 WORN OR DAMAGED VALVE OR CYLINDER KIT

Loss of compression in Series 60 engines may result from a variety of sources, including worn or broken fire or compression rings, holes in pistons, leaky valves, scored or worn cylinder walls, leaky or broken gaskets and cracked cylinder heads or cylinder liners. The detection and elimination of the cause or causes of cylinder pressure losses is vital to engine life and efficient operation. To assist the mechanic in effectively measuring the loss of cylinder pressure, and locating the source of abnormal leaks in individual cylinders, the following test procedure has been developed.

1. Move the vehicle requiring test to the chassis dynamometer; refer to OEM guidelines.
2. Disconnect air compressor; refer to the appropriate service manual, special equipment chapter.
3. Start the engine.
4. Run the engine and bring the engine coolant temperature to normal operating range.
5. Run vehicle to full load and rated speed.
6. Attach a manometer calibrated to read in kPa (in. H₂O), to the oil dipstick opening.
7. Measure and record crankcase pressure. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
8. Shut down engine.
9. Remove the vehicle from the chassis dynamometer.
10. Review the crankcase pressure test results.
 - [a] If the crankcase pressure was greater than 1.25 kPa (5 in. H₂O); refer to section 2.5.1.
 - [b] If the crankcase pressure was less than 1.25 kPa (5 in. H₂O); perform a cylinder compression test. Refer to section 2.5.1.2.
11. Compare the cylinder compression test results to specifications.
 - [a] If cylinder pressure is below specifications, refer to section 2.5.1.
 - [b] If cylinder pressure is within specification, call Detroit Diesel Customer Support Center (313-592-5800).

2.5.1 Worn or Damaged Valve or Cylinder Kit Repair

Perform the following steps for worn or damaged valve or cylinder kit:

1. Remove cylinder head; refer to the appropriate service manual, engine chapter.
2. Inspect the cylinder head for worn or damaged valves; refer to the appropriate service manual, engine chapter. For repair and replacement procedures, refer to the appropriate service manual, engine chapter.
3. Inspect the cylinder kit components for worn or damaged liners, pistons or piston rings; refer to the appropriate service manual, engine chapter.

4. Verification of repairs made to cylinder valve(s) or cylinder kit components is required; refer to section 2.5.1.1.

2.5.1.1 Verification of Repair for Worn or Damaged Valve or Cylinder Kit

Perform the following steps to determine if the repaired valve or cylinder kit resolved the misfiring cylinder condition:

1. Refer to section 2.5 for the exhaust caution before proceeding. Start the engine.
2. Run the engine speed up to the occurrence of the misfiring.
3. Listen for misfiring cylinder.
 - [a] If the engine is not misfiring, no further troubleshooting is required.
 - [b] If the engine is misfiring, call the Detroit Diesel Customer Support Center 313-592-5800.

2.5.1.2 Cylinder Compression Test

Perform the following steps for a compression test on a Series 60 Engine:

 WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. ☐ Always start and operate an engine in a well ventilated area. ☐ If operating an engine in an enclosed area, vent the exhaust to the outside. ☐ Do not modify or tamper with the exhaust system or emission control system.

1. Start and run the engine until normal operating temperature is reached. Stop the engine.
2. Clean and remove the rocker cover. If cover is a two-piece design, it is not necessary to remove the bottom.
3. Disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

⚠ WARNING:**EYE INJURY**

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing injectors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

4. Blow low pressure regulated air no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
5. Remove the three rocker shaft mounting bolts and nut from the front rocker shaft assembly. Using removal tool (J-35996-A), see Figure 2-1, lift the assembly straight up and off of the head and place in a clean area on the bench.

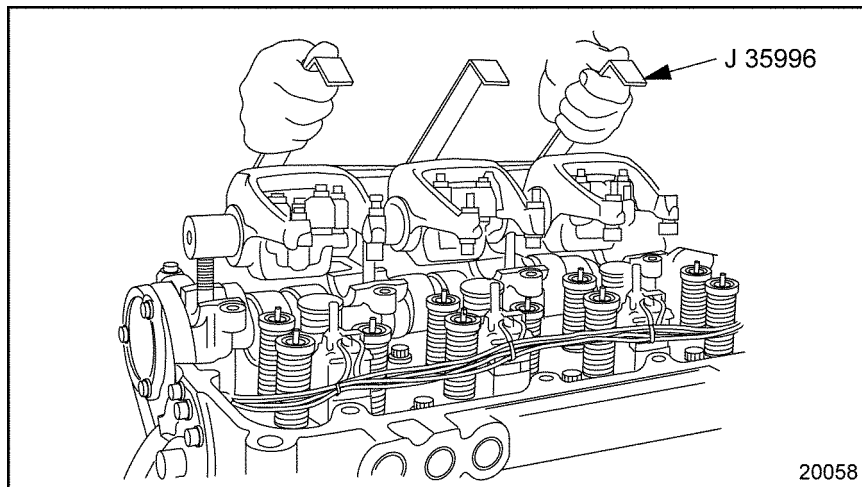


Figure 2-1 Rocker Arm/Shaft Assembly Removal/Installation

6. Disengage the locking tang on the harness plug connection, grasp the connector and gently pull it from the socket.
7. Remove the injector hold down clamps.

NOTICE:

Use extreme care when handling injectors to avoid costly damage by dropping or mishandling. Always install new O-rings when replacing injectors.

8. Remove the front three injectors from the cylinder head.
9. Place three compression test adaptors (J-38768-A) into the injector holes.
10. Install the injector hold down clamps and torque hold down bolts to 58-66 N·m (43-49 lb·ft).
11. Carefully remove the shaft from the rocker arm assembly by slowly pulling it out of the assembly. Place the shaft on the bench. Do not disturb the stack-up of the rocker arm sets.
12. Remove the three injector rocker arms and replace with spacers (J-38768-5) .
13. Lubricate the shaft with clean engine oil. With spacers in place, carefully reinstall the shaft through each rocker arm shaft. Make sure cup plug end faces inboard.
14. Install the modified rocker arm shaft assembly on the head. If the engine is equipped with a Jake Brake®, use non-Jake Brake rocker arm shaft bolts 8929129. Torque the three bolts and the nut to 102-108 N·m (75-80 lb·ft).
15. Reconnect and prime the fuel system.
16. Disconnect the gray connector (injector drive) from the Electronic Control Unit (ECU) for the “A” bank injectors.

NOTE:

To avoid excessive oil splash during the test, place the bottom half of a two piece design rocker cover (with head to cover gasket installed) on the cylinder head. Install bolts and tighten.

 WARNING:**PERSONAL INJURY**

To avoid injury when working on or near an operating engine, wear protective clothing, eye protection, and hearing protection.

 WARNING:**PERSONAL INJURY**

To avoid injury from hot surfaces, wear protective gloves, or allow engine to cool before removing any component.

 WARNING:**PERSONAL INJURY**

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- ☐ Always start and operate an engine in a well ventilated area.
- ☐ If operating an engine in an enclosed area, vent the exhaust to the outside.
- ☐ Do not modify or tamper with the exhaust system or emission control system.

17. Start and run the engine until the coolant out temperature reaches 40.5 C (105 F).

18. Attach cylinder compression gauge (J-6692-B) to the first adaptor. See Figure 2-2.

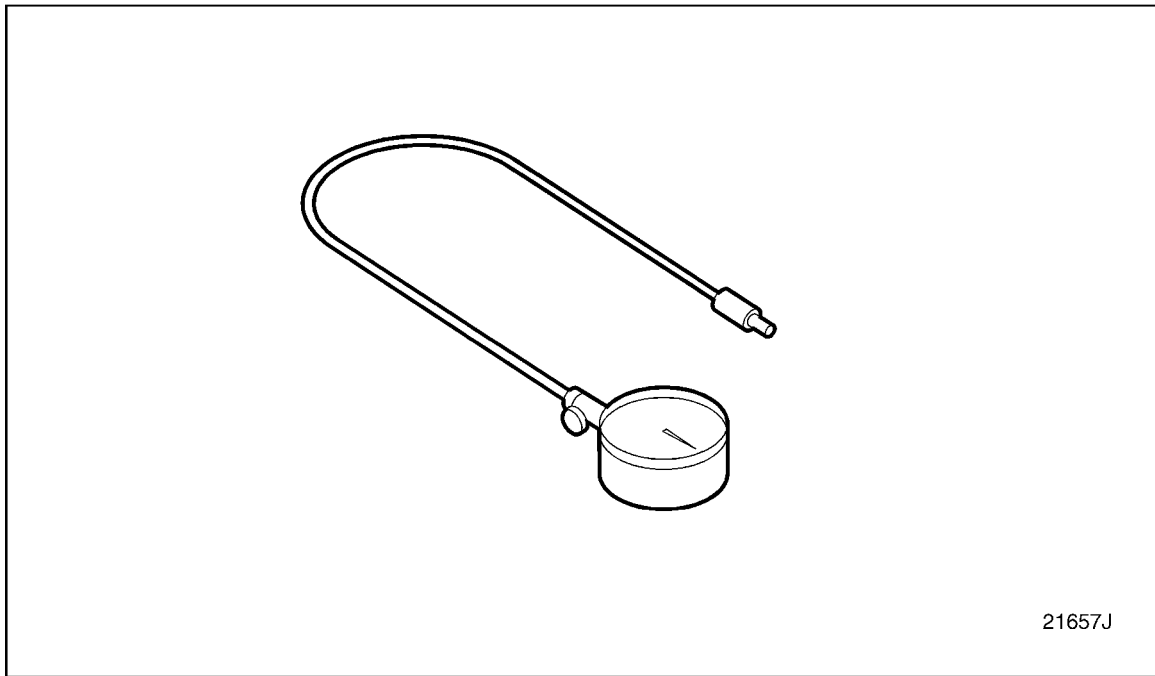


Figure 2-2 Attach Cylinder Compression Gauge J 6692-B

19. Push the pressure relief valve on the gauge several times until the highest compression reading is reached. This should be 3102-3793 kPa (450-550 psi) with no two cylinders differing by more than 276 kPa (40 psi). If compression readings are below specifications, repeat step 19 several times to be certain of the reading.
20. After testing the three cylinders, disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

 WARNING:**EYE INJURY**

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing the compression test adaptors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

21. Blow low pressure regulated air (no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
22. Remove bolts from the modified rocker arm shaft assembly and, using removal tool (J-35996), lift the assembly straight up and off the cylinder head. Place in a clean area on the bench.
23. Carefully remove the shaft from the rocker arm assembly, remove the three oil control sleeves, and replace the three injector rocker arms. Lubricate the shaft with clean engine oil and carefully reinstall through each rocker arm.
24. Remove the injector hold down clamps and remove the three compression test adaptors from the cylinder head. Using new seal rings, reinstall the injectors and clamps and torque bolts to specifications. For injector torque specifications, refer to the appropriate service manual, fuel system chapter.
25. Install harness plug into injector connector making sure the locking tang clicks into place.
26. Replace the completed rocker arm shaft assembly on the engine and torque nut and bolts to specifications
27. Perform steps 2 through 26 for the three rear cylinders.

3 STARTING DIFFICULTY (ENGINE ROTATES)

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3.1 ELECTRONIC CONTROL UNIT WIRING HARNESS

To determine if the Electronic Control Unit (ECU) Vehicle Interface Harness (VIH) is causing starting difficulty, perform the following steps:

1. Turn the ignition switch to the on position.
2. Install the Diagnostic Data Link (DDL) adaptor to the data cable and plug the adaptor into the DDL connector in the vehicle; refer to OEM guidelines.
3. Determine if ECU data is being received by the DDR; refer to OEM guidelines.
 - [a] If no data is being received by the DDR, check for intermittent code or a fault and no codes, refer to section 19.1.
 - [b] If data is being received by the DDR, check vehicle circuit breakers or fuses; refer to section 3.1.1.

3.1.1 Vehicle Circuit Breakers or Fuses Check

To determine if the vehicle circuit breakers are causing starting difficulty, perform the following steps:

1. Visually check ECU circuit breakers or fuses.
2. Determine if circuit breaker(s) or fuse(s) are tripped or blown; refer to OEM guidelines.
 - [a] If circuit breakers tripped, determine cause and repair or replace as necessary; refer to OEM guidelines. Perform validation; refer to section 3.1.3.1.
 - [b] If circuit breakers are not tripped, measure the voltage at the ECU power harness; refer to section 3.1.2.

3.1.2 VIH Troubleshooting

To determine if the VIH is causing circuit breakers to be tripped or blown, refer to section 77 and troubleshoot the VIH.

3.1.3 Vehicle Interface Harness Repair

Perform the following steps to repair the VIH:

1. Repair damage to the VIH.
2. Verify repair of the VIH; refer to section 3.1.3.1.

3.1.3.1 Test Engine with Repaired Harness

Perform the following steps to determine if the repair resolved starter difficulty:

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, check for empty fuel tank; refer to section 3.2.

3.2 EMPTY FUEL TANK

To determine if an empty fuel tank is causing starting difficulty, determine the amount of fuel in fuel tank; refer to OEM guidelines.

1. If fuel is at recommended level, check for a weak battery; refer to section 3.3.
2. If fuel is below recommended level, refer to section 3.2.1.

3.2.1 Low Fuel Level Resolution

Perform the following steps to resolve low fuel level:

1. Fill fuel tank to full; refer to OEM guidelines.
2. Verify fuel tank refill; refer to section 3.2.1.1.

3.2.1.1 Test Engine with Filled Tank

To determine if a filled fuel tank resolved starting difficulty, attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, check the battery; refer to section 3.3.

3.3 LOW BATTERY VOLTAGE

To determine if a weak battery is causing starting difficulty, perform the following steps:

1. Measure the battery voltage; refer to OEM guidelines.
2. Analyze your findings.
 - [a] If voltage is between 10.5 - 14 volts (21 - 26 volts for a 24 volt system), check the terminals; refer to section 3.4.
 - [b] If voltage is less than 10.5 volts (21 volts for a 24 volt system), replacement is necessary; refer to section 3.3.1.

3.3.1 Battery Replacement

Perform the following steps for battery repair:

1. Remove and replace the battery; refer to OEM guidelines.
2. Verify battery replacement; refer to section 3.3.1.1.

3.3.1.1 Test Engine with Replaced Battery

Perform the following steps to determine if the battery replacement resolved starting difficulty:

1. Attempt to start and run the engine.
 - [a] If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine fails to start and run, check the terminals; refer to section 3.4.

3.4 CORRODED OR DAMAGED BATTERY TERMINALS

Corroded or damaged terminals may cause starting difficulties.

3.4.1 Corroded or Damaged Battery Terminal Repair

To determine if corroded or damaged terminals is causing starting difficulty:

1. Visually inspect terminals for corrosion or damage.
 - [a] If corrosion or damage is not found, check the magnetic switch; refer to section 3.5.
 - [b] If corrosion or damage is found, repair is necessary; go to step 2.
2. Repair or replace any corroded or damaged terminals; refer to OEM guidelines.
3. Verify repair of corroded or damaged terminals; refer to section 3.4.1.1.

3.4.1.1 Test with Repaired Battery Terminals

Perform the following steps to determine if the repair resolved starting difficulty:

1. Attempt to start and run the engine.
 - [a] If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine fails to start and run, check the magnetic switch; refer to section 3.5.

3.5 DEFECTIVE MAGNETIC SWITCH

To determine if a defective magnetic switch is causing starting difficulty:

1. Start engine.
2. Clamp a heavy gauge battery jumper cable between the two large studs of the magnetic switch. See Figure 3-1.

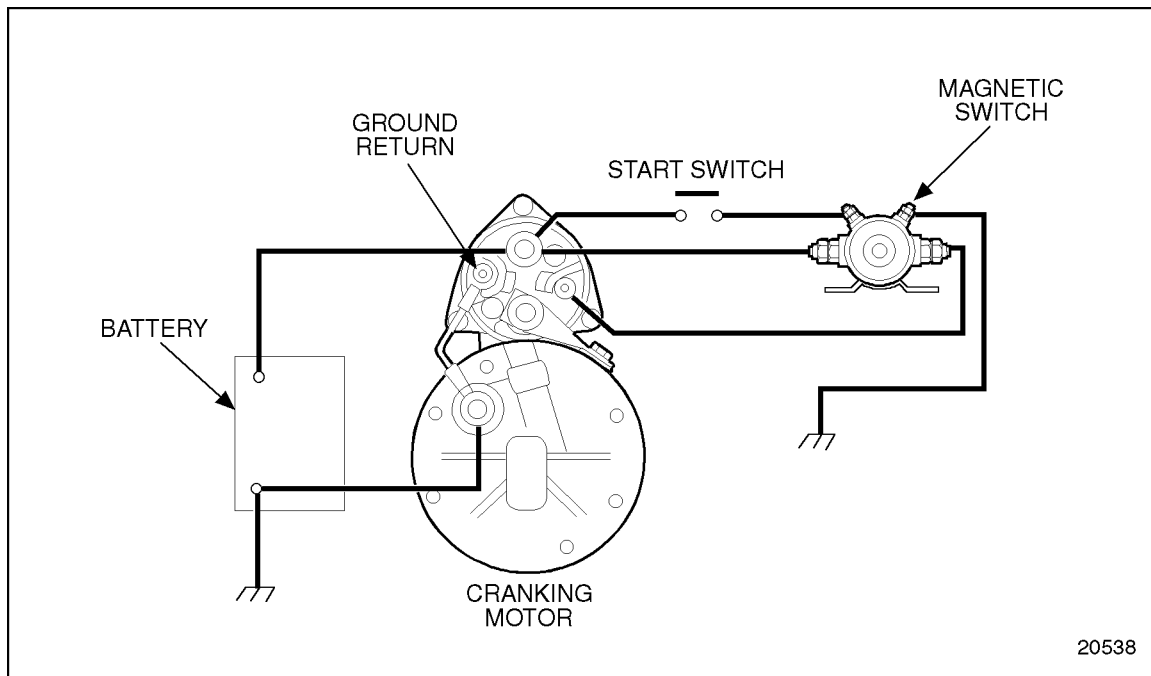


Figure 3-1 Basic Cranking Circuit

- [a] If the engine cranked with the jumper cable in place, the magnetic switch must be replaced; refer to section 3.5.1.
- [b] If the engine did not crank with the jumper cable in place, check the starter; refer to section 3.6.

3.5.1 Magnetic Switch Replacement

Perform the following steps for magnetic switch replacement:

1. Replace the magnetic switch; refer to OEM guidelines.
2. Verify magnetic switch replacement; refer to section 3.5.1.1.

3.5.1.1 Test Engine with Replaced Magnetic Switch

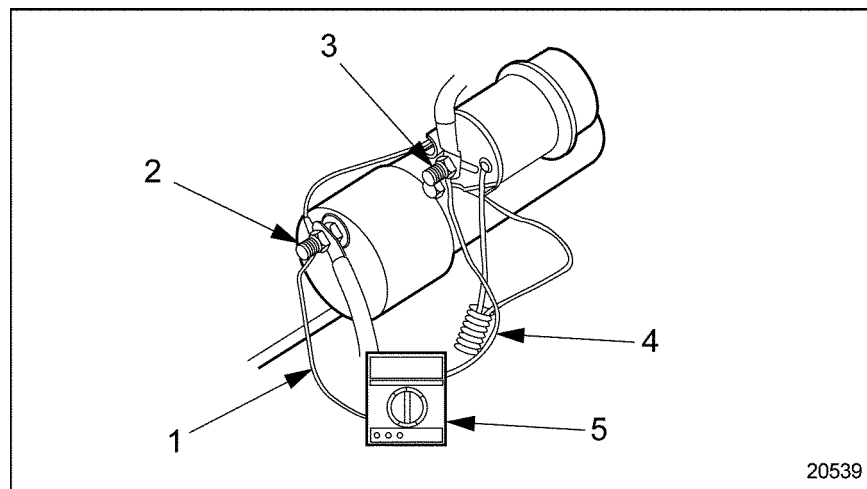
Refer to section 3.5 for the exhaust caution before proceeding. To determine if the magnetic switch replacement resolved starting difficulty, attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, check the starter; refer to section 3.6.

3.6 DEFECTIVE STARTER

To determine if a defective starter is causing starting difficulty, perform the following steps:

1. Place the red lead of a voltmeter to the solenoid "BAT" terminal, see Figure 3-2.



1. Black Voltmeter Lead	4. Harness Tube
2. Starter Ground Terminal Lug	5. Volt Ohm Meter
3. Red Voltmeter Lead	

Figure 3-2 Cranking Motor Available Voltage Test

2. Place the black voltmeter lead to the starter ground terminal, see Figure 3-1.
3. Engage the starter switch.
4. View the voltage reading on the meter.

- [a] If the voltage is less than specification while cranking the engine, replacement is necessary; refer to section 3.6.1.
- [b] If the voltage is to specification while cranking the engine, check the cranking speed; refer to section 3.7.

3.6.1 Starter Replacement

Perform the following steps for starter replacement:

1. Replace the starter; refer to the appropriate service manual, electrical equipment chapter.
2. Verify replacement of starter; refer to section 3.6.1.1.

3.6.1.1 Test Engine with Replaced Starter

Perform the following steps to determine if the replaced starter resolved starting difficulty:

1. Attempt to start and run the engine. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, check the cranking speed; refer to section 3.7.

3.7 LOW CRANKING SPEED

To determine if low cranking speed is causing starting difficulty, perform the following steps:

1. Install a tachometer to the engine.
2. Record engine revolution while cranking the engine; refer to OEM for guidelines.
 - [a] If the cranking speed is greater than 100 rpm, check the fuel supply valve; refer to section 3.8.
 - [b] If the cranking speed is less than 100 rpm; refer to section 3.7.1.

3.7.1 Low Cranking Speed Repair

Perform the following steps for low cranking speed repair:

1. Drain the engine oil; refer to the appropriate service manual, preventive maintenance engine chapter.
2. Remove oil filter(s); refer to the appropriate service manual, preventive maintenance chapter.
3. Install new oil filter(s); refer to the appropriate service manual, preventive maintenance chapter.
4. Refill the lubrication system with new oil; refer to the appropriate service manual, preventive maintenance chapter.
5. Verify low cranking speed repair; refer to section 3.7.1.1.

3.7.1.1 Test Engine with Replaced Oil

To determine if the replaced oil resolved starting difficulty, attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, check the fuel supply valve; refer to section 3.8.

3.8 FUEL SUPPLY VALVE

To determine if the fuel supply valve is causing starting difficulty, check that fuel supply valve is open; refer to OEM guidelines.

1. Check that fuel supply valve.
2. Is the valve open?
 - [a] If the fuel supply valve is open, check the fuel filters; refer to section 3.9.
 - [b] If the fuel supply valve is closed, repair is necessary; refer to section 3.8.1.

3.8.1 Fuel Supply Valve Repair

Perform the following steps for fuel supply valve repair:

1. Open the closed valve; refer to the appropriate service manual, fuel system chapter.
2. Prime the fuel system; refer to the appropriate service manual, operation and verification chapter.
3. Verify fuel supply valve repair; refer to section 3.8.1.1.

3.8.1.1 Test Engine with Fuel Supply Valve Open

To determine if opening the fuel supply valve resolved starting difficulty, attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, check the fuel filters; refer to section 3.9.

3.9 PLUGGED FUEL FILTER(S)

To determine if a plugged fuel filters is causing starting difficulty, perform the following steps:

1. Disconnect the fuel line return hose from the fitting located at the fuel tank.
2. Place the opened end of fuel line into a five gallon container.
3. Start the engine.
4. Run the engine at 1000 rpm.
5. Clock fuel rate for one minute.
6. Measure the amount of fuel flowed into the container.
 - [a] If the fuel flow is greater than 3.8 L/min (1 gal/min), check for air in fuel; refer to section 3.11.
 - [b] If the fuel flow is less than 3.8 L/min (1 gal/min), replace the fuel filters; refer to section 3.9.1.

3.9.1 Plugged Fuel Filter(s) Replacement

Perform the following steps to replace fuel filter(s):

1. Replace the fuel filter; refer to the appropriate service manual, preventive maintenance chapter.
2. Test the engine to determine if starting has been improved; refer to section 3.9.1.1.

3.9.1.1 Test Engine with Replaced Fuel Filters

To determine if the replaced fuel filters resolved the starting difficulty, refer to section 3.9 for the exhaust caution before proceeding. Attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, check the fuel pump; refer to section 3.10.

3.10 FUEL PUMP

To determine if the fuel pump is causing starting difficulty, perform the following steps:

1. Insert a piece of wire through the pump flange drain hole, see Figure 3-3.

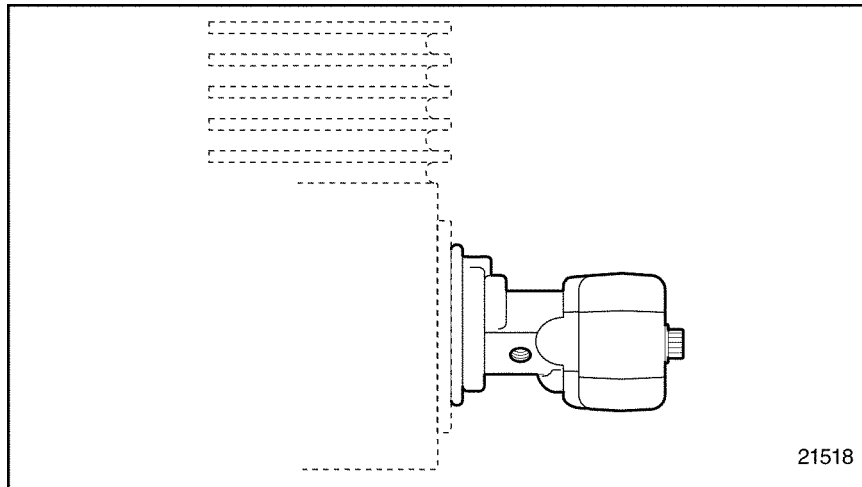


Figure 3-3 Fuel Pump Flange Drain Hole Location

2. Crank the engine momentarily and feel for wire vibration.
 - [a] If the wire did not vibrate, determine if the drive hub or coupling should be replaced; refer to section 3.10.1.
 - [b] If the wire did vibrate, check for aerated fuel. Refer to section 3.11.

3.10.1 Drive Hubs and Coupling Replacement

Perform the following steps for drive hub or coupling replacement:

1. Replace the drive hub or coupling; refer to the appropriate service manual, fuel system chapter.
2. Test the engine to determine if starting has been improved; refer to section 3.10.1.1.

3.10.1.1 Engine Test with Replaced Drive Hubs or Replaced Coupling

To determine if replaced drive hubs or coupling resolved starting difficulty, attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, check for aerated fuel; refer to section 3.11.

3.11 AERATED FUEL

To determine if aerated fuel is causing starting difficulty, perform the following steps:

1. Disconnect the fuel line return hose from the fitting located at the fuel tank; refer to OEM guidelines.
2. Place the opened end of the fuel line into a suitable container.
3. Start the engine.
4. Run the engine at 1000 rpm.
5. Visually check to see if air bubbles are rising to the surface of the fuel within the container.
 - [a] If air bubbles are present, repair is necessary; refer to section 3.11.1.
 - [b] If air bubbles are not present, check for a restrictive air filter. Shut down the engine; refer to section 3.12.

3.11.1 Aerated Fuel Resolution

Perform the following steps for aerated fuel resolution:

1. Shut down engine.
2. Tighten all fuel line connections between fuel tank and fuel pump; refer to OEM guidelines.
3. Visually inspect all fuel lines between fuel tank and fuel pump for leaks.
4. Replace damaged components as required; refer to OEM guidelines.
5. Verify aerated fuel resolution; refer to section 3.11.1.1.

3.11.1.1 Test Engine with Aerated Fuel Resolution

Refer to section 3.11 for exhaust caution before proceeding. Perform the following steps to determine if aerated fuel resolution resolved starting difficulty:

1. Attempt to start and run the engine. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, check for a restrictive air filter; refer to section 3.12.

3.12 RESTRICTIVE AIR FILTER

To determine if a restrictive air filter is causing starting difficulty, perform the following steps:

1. Remove the air filter element; refer to OEM guidelines.
2. Attempt to start and run the engine.
 - [a] If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine fails to start and run, refer to section 3.12.1.

3.12.1 Air Filter Replacement

Perform the following steps for air filter replacement:

1. Visually inspect the air filter for clogging and replace as necessary; refer to OEM guidelines.
2. Visually inspect gaskets for deterioration and replace as necessary; refer to OEM guidelines.
3. Visually inspect air inlets for restrictions and clean as necessary; refer to OEM guidelines.
4. Verify air filter replacement; refer to section 3.12.1.1.

3.12.1.1 Test Engine with Replaced Air Filter

Refer to section 3.12 for the exhaust before proceeding. Perform the following steps to determine if the replaced air filter resolved starting difficulty:

1. Attempt to start and run the engine. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, check compression; refer to section 3.13.

3.13 LOW COMPRESSION

To determine if low compression is causing starting difficulty, perform the following steps:

1. Perform a cylinder compression test. Refer to section 3.13.1.2.
2. Compare cylinder compression test results to specifications.
 - [a] If cylinder pressure is below specifications; refer to section 3.13.1.
 - [b] If cylinder pressure is within specifications, call Detroit Diesel Customer Support Center (313-592-5800).

3.13.1 Low Compression Repair

Perform the following steps for low compression repair:

1. Remove cylinder head; refer to the appropriate service manual, engine chapter.
2. Inspect the cylinder head for worn or damaged valves; refer to the appropriate service manual, engine chapter.
3. Replace damaged valves; refer to the appropriate service manual, engine chapter.
4. Inspect the cylinder kit components for worn or damaged liners, pistons or piston rings; refer to the appropriate service manual, engine chapter.
5. Verify repairs made to cylinder head valve(s) or cylinder kit components; refer to section 3.13.1.1.

3.13.1.1 Test Engine with Repaired Cylinder Head Valve(s), and Cylinder Kit

Perform the following steps to determine if the cylinder head valve and cylinder kit repair resolved starting difficulty:

1. Attempt to start and run the engine. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start and run, call the Detroit Diesel Customer Support Center at 313-592-5800.

3.13.1.2 Cylinder Compression Test

Perform the following steps for a compression test on a Series 60 Engine:

 WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. ☐ Always start and operate an engine in a well ventilated area. ☐ If operating an engine in an enclosed area, vent the exhaust to the outside. ☐ Do not modify or tamper with the exhaust system or emission control system.

1. Start and run the engine until normal operating temperature is reached. Stop the engine.
2. Clean and remove the rocker cover. If cover is a two-piece design, it is not necessary to remove the bottom.
3. Disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

! WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing injectors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

4. Blow low pressure regulated air no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
5. Remove the three rocker shaft mounting bolts and nut from the front rocker shaft assembly. Using removal tool (J-35996-A), see Figure 3-4, lift the assembly straight up and off of the head and place in a clean area on the bench.

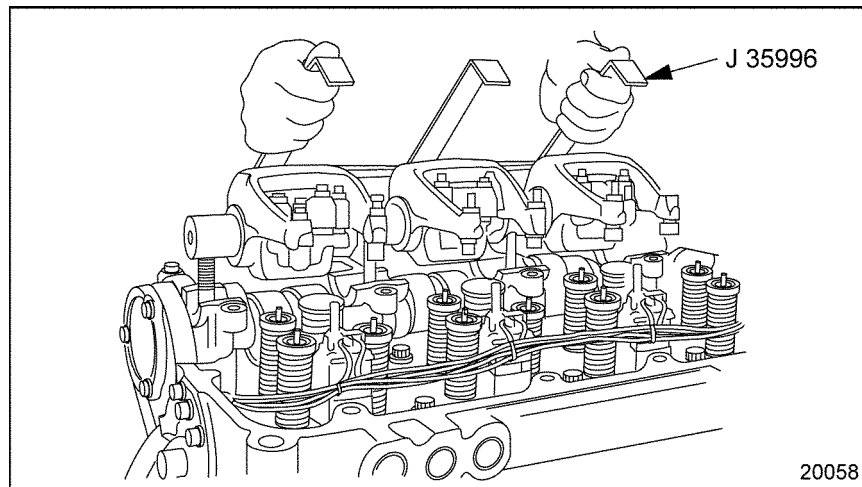


Figure 3-4 Rocker Arm/Shaft Assembly Removal/Installation

6. Disengage the locking tang on the harness plug connection, grasp the connector and gently pull it from the socket.
7. Remove the injector hold down clamps.

NOTICE:

Use extreme care when handling injectors to avoid costly damage by dropping or mishandling. Always install new O-rings when replacing injectors.

8. Remove the front three injectors from the cylinder head.
9. Place three compression test adaptors (J-38768-A) into the injector holes.
10. Install the injector hold down clamps and torque hold down bolts to 58-66 N·m (43-49 lb·ft).
11. Carefully remove the shaft from the rocker arm assembly by slowly pulling it out of the assembly. Place the shaft on the bench. Do not disturb the stack-up of the rocker arm sets.
12. Remove the three injector rocker arms and replace with spacers (J-38768-5) .
13. Lubricate the shaft with clean engine oil. With spacers in place, carefully reinstall the shaft through each rocker arm shaft. Make sure cup plug end faces inboard.
14. Install the modified rocker arm shaft assembly on the head. If the engine is equipped with a Jake Brake®, use non-Jake Brake rocker arm shaft bolts 8929129. Torque the three bolts and the nut to 102-108 N·m (75-80 lb·ft).
15. Reconnect and prime the fuel system.
16. Disconnect the gray connector (injector drive) from the Electronic Control Unit (ECU) for the “A” bank injectors.

NOTE:

To avoid excessive oil splash during the test, place the bottom half of a two piece design rocker cover (with head to cover gasket installed) on the cylinder head. Install bolts and tighten.



WARNING:

PERSONAL INJURY

To avoid injury when working on or near an operating engine, wear protective clothing, eye protection, and hearing protection.



WARNING:

PERSONAL INJURY

To avoid injury from hot surfaces, wear protective gloves, or allow engine to cool before removing any component.



WARNING:

PERSONAL INJURY

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- ☐ Always start and operate an engine in a well ventilated area.
- ☐ If operating an engine in an enclosed area, vent the exhaust to the outside.
- ☐ Do not modify or tamper with the exhaust system or emission control system.

17. Start and run the engine until the coolant out temperature reaches 40.5 C (105 F).

18. Attach cylinder compression gauge (J-6692-B) to the first adaptor. See Figure 3-5.

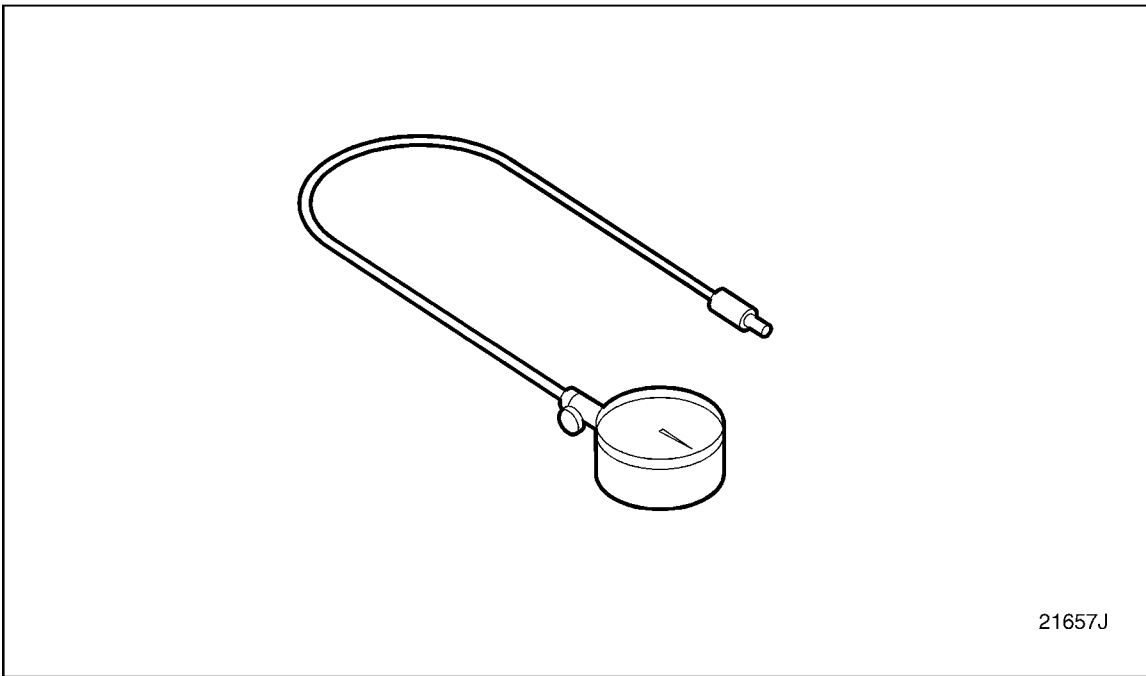


Figure 3-5 Attach Cylinder Compression Gauge J 6692-B

19. Push the pressure relief valve on the gauge several times until the highest compression reading is reached. This should be 3102-3793 kPa (450-550 psi) with no two cylinders differing by more than 276 kPa (40 psi). If compression readings are below specifications, repeat step 19 several times to be certain of the reading.
20. After testing the three cylinders, disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.



WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing the compression test adaptors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

21. Blow low pressure regulated air (no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
22. Remove bolts from the modified rocker arm shaft assembly and, using removal tool (J-35996), lift the assembly straight up and off the cylinder head. Place in a clean area on the bench.
23. Carefully remove the shaft from the rocker arm assembly, remove the three oil control sleeves, and replace the three injector rocker arms. Lubricate the shaft with clean engine oil and carefully reinstall through each rocker arm.
24. Remove the injector hold down clamps and remove the three compression test adaptors from the cylinder head. Using new seal rings, reinstall the injectors and clamps and torque bolts to specifications. For injector torque specifications, refer to appropriate service manual, fuel system chapter.
25. Install harness plug into injector connector making sure the locking tang clicks into place.
26. Replace the completed rocker arm shaft assembly on the engine and torque nut and bolts to specifications
27. Perform steps 2 through 26 for the three rear cylinders.

4 NO START (ENGINE WILL NOT ROTATE)

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4.1 DISCHARGED BATTERY	4-3
4.2 DEFECTIVE MAGNETIC SWITCH	4-4
4.3 DEFECTIVE STARTER	4-5
4.4 INTERNAL ENGINE DAMAGE	4-7

4.1 DISCHARGED BATTERY

To determine if a discharged battery is causing the engine not to start, measure and record the voltage at the battery terminals; refer to OEM guidelines.

1. If the voltage recorded is below OEM specifications and the engine failed to start, replacement is necessary; refer to section 4.1.1.
2. If the voltage recorded is at recommended OEM specifications and the engine failed to start, check the magnetic switch; refer to section 4.2.

4.1.1 Discharged Battery Resolution

Perform the following steps for battery replacement:

1. Replace the battery; refer to OEM guidelines.
2. Verify replacement of the battery; refer to section 4.1.1.1.

4.1.1.1 Test Engine with New Battery

To determine if the new battery resolved the no start condition, attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start or run, check the magnetic switch; refer to section 4.2.

4.2 DEFECTIVE MAGNETIC SWITCH

To determine if a defective magnetic switch is causing no start:

1. Start engine.
2. Clamp a heavy gage battery jumper cable between the two large studs of the magnetic switch; see Figure 4-1.

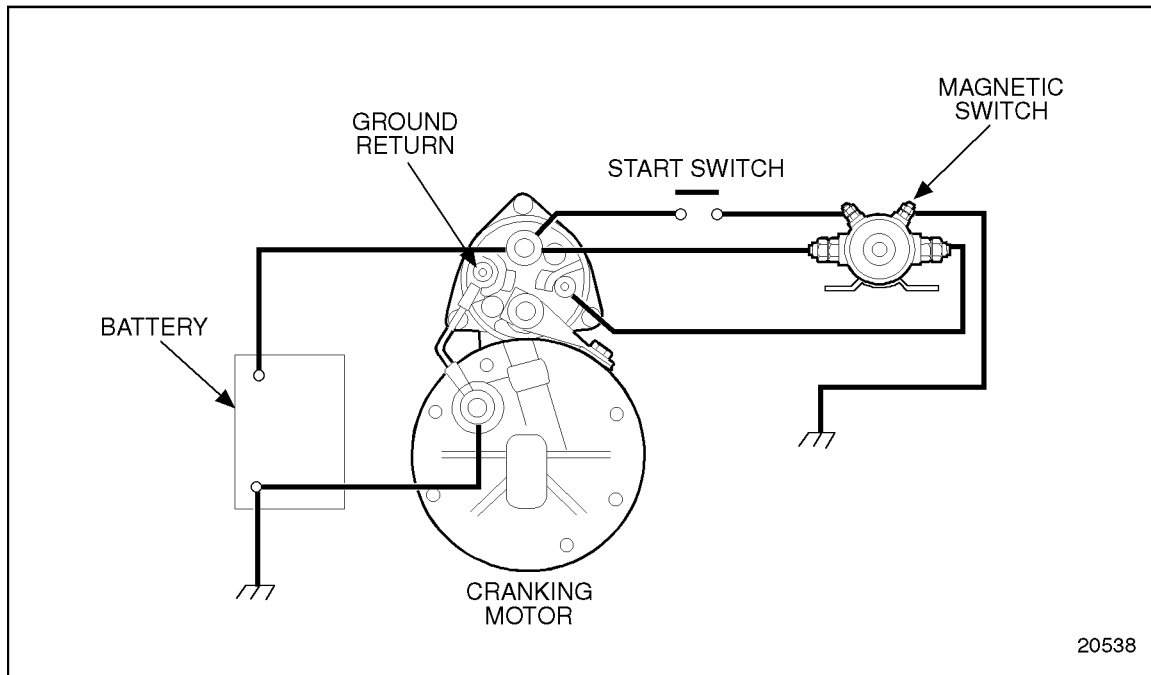


Figure 4-1 Basic Cranking Circuit

- [a] If the engine cranked with the jumper cable in place, the magnetic switch must be replaced; refer to section 4.2.1.
- [b] If the engine did not crank with the jumper cable in place, check the starter; refer to section 4.3.

4.2.1 Magnetic Switch Replacement

Perform the following steps for magnetic switch replacement:

1. Replace the magnetic switch. Refer to OEM guidelines.
2. Perform verification of magnetic switch replacement; refer to section 4.2.1.1.

4.2.1.1 Test Engine with New Magnetic Switch

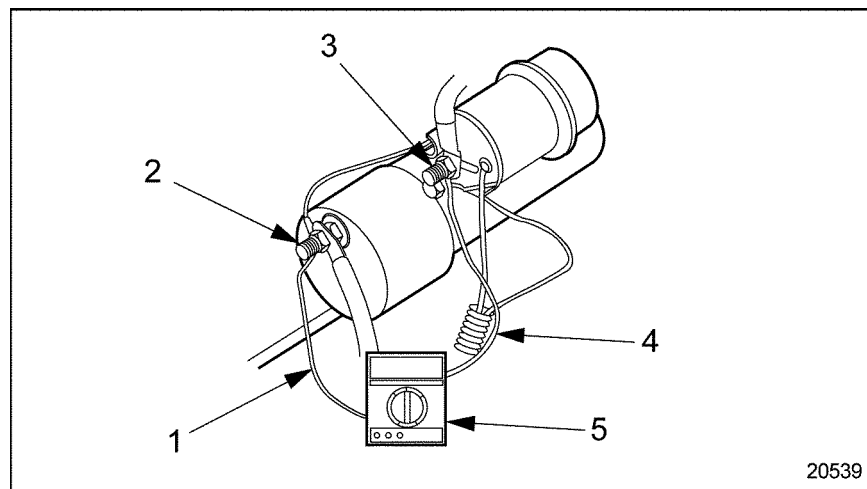
Refer to section 4.2 for exhaust caution before proceeding. To determine if the magnetic switch replacement resolved the no start condition, attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start or run, check the starter; refer to section

4.3 DEFECTIVE STARTER

To determine if a defective starter is causing no start, perform the following steps:

1. Place the red lead of a voltmeter to the solenoid "BAT" or terminal; see Figure 4-2.



1. Red Lead	4. Black Lead
2. Starter Ground	5. Voltmeter
3. Solenoid Terminal	

Figure 4-2 Cranking Motor Available Voltage Test

2. Place the black voltmeter lead to the starter ground terminal; see Figure 4-2.
3. Engage the starter switch.
4. View the voltage reading on the meter.

- [a] If the voltage is less than specification (refer to OEM guidelines) while cranking the engine, starter replacement is necessary; refer to section 4.3.1.
- [b] If the voltage is to specification (refer to OEM guidelines) while attempting to crank the engine, check for internal damage; refer to section 4.4.

4.3.1 Starter Replacement

Perform the following steps for starter replacement:

1. Replace the starter; refer to appropriate service manual, electrical equipment chapter.
2. Verify replacement of starter; refer to section 4.3.1.1.

4.3.1.1 Test Engine with New Starter

To determine if the new starter resolved no start condition, attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start or run, check for internal engine damage. Refer to section 4.4.

4.4 INTERNAL ENGINE DAMAGE

To determine if internal engine damage is causing no start condition, perform the following steps:

1. Install a 3/4 in. breaker bar or ratchet and attempt to bar the engine over by hand.
2. Determine severity of internal engine damage.
 - [a] If the engine rotates freely, check the Electronic Control Unit wiring harness; refer to section 3.1.
 - [b] If the engine binds and will not rotate freely, replace crankshaft bearings and cylinder liners; refer to appropriate service manual, engine chapter.

4.4.1 Internal Engine Damage Replacement

Perform the following steps for crankshaft bearings, and cylinder liners replacement:

1. Replace the crankshaft bearings; refer to appropriate service manual, engine chapter.
2. Replace the cylinder liners; refer to appropriate service manual, engine chapter.
3. Verify replacement of components; refer to section 4.4.1.1.

4.4.1.1 Test Engine with Replaced Components

To determine if the new components resolved no start condition, attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required. Shut down the engine.
2. If the engine fails to start or run, call Detroit Diesel Customer Support Center at 313-592-5800.

5 EXCESSIVE OIL CONSUMPTION

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5.2 EXTERNAL OIL LEAKS	5-3
5.3 LEAKING OIL COOLER CORE	5-4
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5.1 MISCALIBRATED DIPSTICK

To determine if an overfilled crankcase is causing excessive oil consumption, perform the following:

1. Ensure vehicle is parked on level ground.
2. Perform a universal dipstick calibration check; refer to SIB 12-60-94R (May 1995).
 - [a] If the calibration check indicates that the oil level is off by more than 2 mm (0.078 in.), contact your Detroit Diesel regional support office.
 - [b] Check for oil leaks; refer to section 5.2.

5.2 EXTERNAL OIL LEAKS

To determine if oil leaks are causing excessive oil consumption, perform the following:

1. Start and run the engine to operating temperature 88°C (190°F).
2. Check for leaks at oil lines, connections, mating joints, seals, and gaskets.
 - [a] If no oil leaks are found, shut down the engine and check for a leaking oil cooler core; refer to section 5.3.
 - [b] If oil leaks are found, shut down the engine; refer to section 5.2.1.

5.2.1 Engine Oil Leak Repair

Perform the following steps, as necessary, to resolve engine oil leaks:

1. Repair or replace components leaking oil; refer to appropriate service manual, lubrication system chapter.
2. Verify repairs made to correct oil leaks; refer to section 5.2.1.1.

5.2.1.1 Test Engine with Repairs Made to Correct Oil Leaks

Perform the following steps to determine if the repairs resolved the oil leaks:

1. Refer to section 5.2 for exhaust caution before proceeding. Start and run the engine to operating temperature 88°C (190°F).
2. Shut down the engine.
3. Check the engine for oil leaks.
 - [a] If no oil leaks are observed, check for a leaking oil cooler core; refer to section 5.3.
 - [b] If external oil leaks are still present, repeat section 5.2.1.

5.3 LEAKING OIL COOLER CORE

To determine if a leaking oil cooler core is causing excessive oil consumption, perform the following:

1. Check for oil in the engine coolant or radiator.
 - [a] If oil is present in either the engine coolant or radiator; perform step 2
 - [b] If no oil is present in either the engine coolant or radiator, check for a defective air compressor; refer to section 5.4.
2. Remove the oil cooler core and housing; refer to appropriate service manual, lubrication system chapter.
3. Clean both the oil side and water side of oil cooler core; refer to appropriate service manual, lubrication system chapter.
4. Perform an oil cooler core pressure test; refer to appropriate service manual, lubrication system chapter.
5. Visually check to see if air bubbles are rising to the surface of the water within the container.
 - [a] If air bubbles are present, refer to section 5.3.1.
 - [b] If no air bubbles are present, complete a lube oil consumption report, call the Detroit Diesel Customer Support Center (313-592-5800) for a form.

5.3.1 Oil Cooler Core Replacement

Perform the following for oil cooler core replacement:

1. Remove and install a new oil cooler core; refer to appropriate service manual, lubrication system chapter.
2. Verify replacement of oil cooler core; refer to section 5.3.1.1.

5.3.1.1 Test Engine with New Oil Cooler Core

Perform the following steps to determine if the replaced oil cooler core reduced oil consumption:

1. Start and run the engine to operating temperature 88°C (190°F).
2. Shut down the engine.
3. Check the engine coolant for the presence of oil.
 - [a] If no oil is present in the coolant, perform an lube oil consumption test report; refer to section 5.3.1.2.
 - [b] If oil is present in the coolant, repeat section 5.3.1.

5.3.1.2 Test Engine for Reduced Oil Consumption

Perform a lube oil consumption report as follows:

1. Call the Detroit Diesel Customer Support Center (313-592-5800) for a form.
2. Review the oil consumption report.
 - [a] If the oil consumption report data is within specifications, check for defective air compressor. Refer to section 5.4.
 - [b] If the oil consumption report data is not within specifications, call Detroit Diesel Customer Support Center (313-592-5800).

5.4 DEFECTIVE AIR COMPRESSOR

To determine if a defective air compressor is causing excessive oil consumption, perform the following:

1. Perform a crankcase pressure test and record the test results. refer to appropriate service manual, preventive maintenance chapter. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
2. Disconnect the air outlet line from the air compressor; see Figure 5-1; refer to appropriate service manual, special equipment chapter.

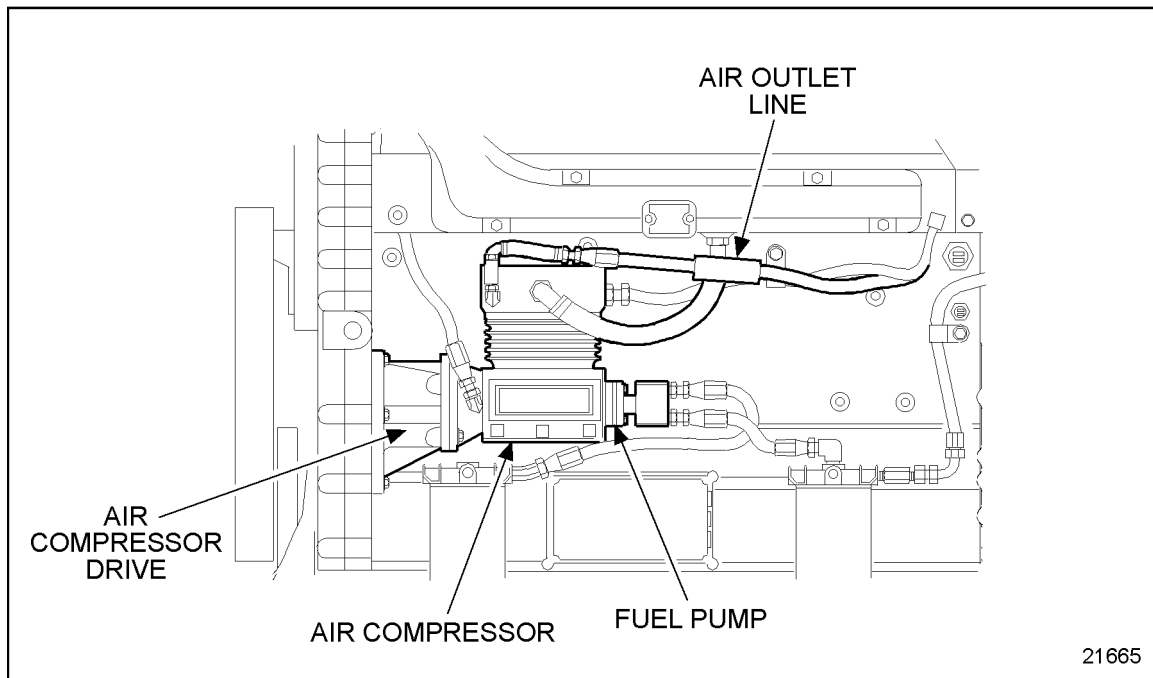


Figure 5-1 Air Compressor Air Outlet Line

3. Repeat step 1 and record the test results.
4. Compare the results of test one with test two.
 - [a] If the engine crankcase pressure remained the same, check the turbocharger; refer to section 5.5.
 - [b] If the engine crankcase pressure decreased, replace the air compressor; refer to section 5.4.1.

5.4.1 Air Compressor Removal

Perform the following steps to remove the defective air compressor:

1. Remove the air compressor from the engine; refer to appropriate service manual, special equipment chapter.
2. Disassemble and repair the air compressor; refer to OEM guidelines.
3. Install the repaired air compressor to the engine; refer to appropriate service manual, special equipment chapter.
4. Verify repair of the air compressor; refer to section 5.4.1.1.

5.4.1.1 Test Engine with Repaired Air Compressor

Perform the following steps to determine if the repaired air compressor resolved the excessive crankcase pressure:

1. Start and run the engine.
2. Perform a crankcase pressure test. Refer to appropriate service manual, preventive maintenance chapter. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
 - [a] If the engine crankcase pressure exceeds 1.25 kPa (5 in. H₂O), refer to section 5.5. Shut down the engine.
 - [b] If the engine crankcase pressure is within 1.25 kPa (5 in. H₂O), shut down the engine; no further troubleshooting is required.

5.5 DEFECTIVE TURBOCHARGER

To determine if a defective turbocharger is causing excessive oil consumption, perform the following:

1. Remove the turbocharger drain line connected to the crankcase and place the drain line into a suitable container.
2. Perform a crankcase pressure test. Refer to appropriate service manual, preventive maintenance chapter. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
 - [a] If the engine crankcase pressure is less than 1.25 kPa (5 in. H₂O), replace the turbocharger; refer to appropriate service manual, air intake system chapter.
 - [b] If the engine crankcase pressure is 1.25 kPa (5 in. H₂O) or more, check for worn or damaged valve and cylinder kit; refer to section 5.6.

5.5.1 Turbocharger Replacement

Perform the following steps to replace a defective turbocharger:

1. Remove the defective turbocharger from the engine; refer to appropriate service manual, air intake system chapter.
2. Tag removed turbocharger for remanufacture.
3. Install a new turbocharger to the engine; refer to appropriate service manual, air intake system chapter.
4. Verify replacement of new turbocharger; refer to section 5.5.1.1.

5.5.1.1 Test Engine with New Turbocharger

Perform the following steps to determine if a new turbocharger resolved the excessive crankcase pressure:

1. Remove the turbocharger drain line connected to the crankcase and place the drain line into a suitable container.
2. Perform a crankcase pressure test. Refer to appropriate service manual, preventive maintenance chapter. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
 - [a] If the engine crankcase pressure is greater than 1.25 kPa (5 in. H₂O), check for worn or damaged valve or cylinder kit; refer to section 5.6.
 - [b] If the engine crankcase pressure is 1.25 kPa (5 in. H₂O) or less, no further troubleshooting is required.

5.6 WORN OR DAMAGED VALVE OR CYLINDER KIT

A loss of cylinder pressure can cause increased oil consumption. The detection and elimination of cylinder pressure losses is vital to engine life and efficient operation. To assist the mechanic in effectively measuring the loss of cylinder pressure, and locating the source of abnormal leaks in individual cylinders, the following test procedure has been developed.

1. Move the vehicle requiring test to the chassis dynamometer; refer to OEM guidelines.
2. Disconnect air compressor, refer to appropriate service manual, special equipment chapter.
3. Start the engine.
4. Run the engine and bring the engine coolant temperature to normal operating range.
5. Run vehicle to full load and rated speed.
6. Attach a manometer calibrated to read in inches of water, to the oil dipstick opening. Measure and record the crankcase pressure.
7. Shut down engine.
8. Remove the vehicle from the chassis dynamometer.
9. Review the crankcase pressure test results.
 - [a] If the crankcase pressure exceeds 1.25 kPa (5 in. H₂O), repair worn or damaged valve(s) or cylinder kit; refer to section 5.6.1.
 - [b] If the crankcase pressure was less than or equal to 1.25 kPa (5 in. H₂O), perform cylinder compression test. Refer to section 5.6.1.2.
10. Compare the cylinder compression test results to specifications.
 - [a] If the cylinder compression is below specifications, repair worn or damaged valve(s) or cylinder kit; refer to section 5.6.1.
 - [b] If the cylinder compression is within specification, call Detroit Diesel Customer Support Center (313-592-5800).

5.6.1 Worn or Damaged Valve(s) or Cylinder Kit(s) Repair

Perform the following steps to repair worn or damaged valve(s) and cylinder kit(s):

1. Remove cylinder head; refer to appropriate service manual, engine chapter.
2. Inspect the cylinder head for worn or damaged valves; refer to appropriate service manual, engine chapter.
3. Inspect the cylinder kit components for worn or damaged liners, pistons or piston rings; refer to appropriate service manual, engine chapter.
4. Replace damaged cylinder kit components; refer to appropriate service manual, engine chapter.
5. Verify repairs made to cylinder head valve(s) or cylinder kit components; refer to section 5.6.1.1.

5.6.1.1 Test Engine with Repaired Cylinder Head Valve(s), and Cylinder Kit

Refer to section 5.6 for exhaust caution before proceeding. To determine if the cylinder head valve and cylinder kit repair resolved starting difficulty, attempt to start and run the engine.

1. If the engine starts and runs, no further troubleshooting is required.
2. If the engine fails to start and run, call the Detroit Diesel Customer Support Center at 313-592-5800.

5.6.1.2 Cylinder Compression Test

Perform the following steps for a compression test on a Series 60 Engine:

 WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. ☐ Always start and operate an engine in a well ventilated area. ☐ If operating an engine in an enclosed area, vent the exhaust to the outside. ☐ Do not modify or tamper with the exhaust system or emission control system.

1. Start and run the engine until normal operating temperature is reached. Stop the engine.
2. Clean and remove the rocker cover. If cover is a two-piece design, it is not necessary to remove the bottom.
3. Disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

! WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing injectors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

4. Blow low pressure regulated air no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
5. Remove the three rocker shaft mounting bolts and nut from the front rocker shaft assembly. Using removal tool J-35996-A, see Figure 5-2, lift the assembly straight up and off of the head and place in a clean area on the bench.

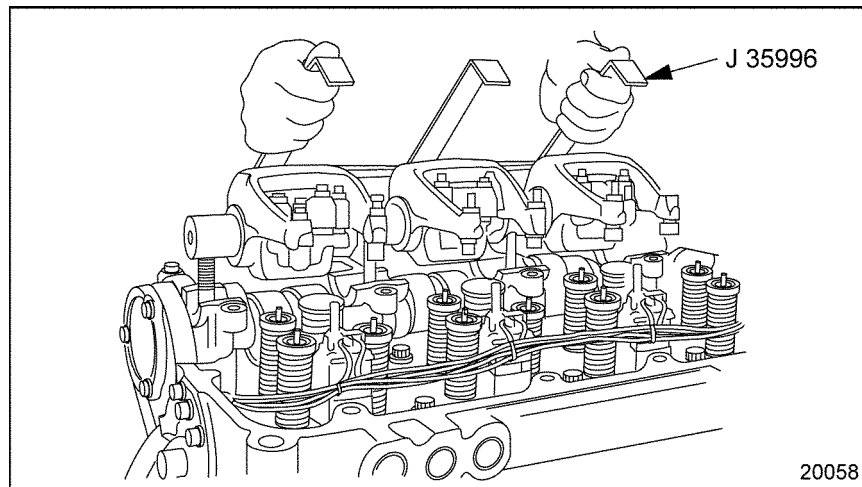


Figure 5-2 Rocker Arm/Shaft Assembly Removal/Installation

6. Disengage the locking tang on the harness plug connection, grasp the connector and gently pull it from the socket.
7. Remove the injector hold down clamps.

NOTICE:

Use extreme care when handling injectors to avoid costly damage by dropping or mishandling. Always install new O-rings when replacing injectors.

8. Remove the front three injectors from the cylinder head.
9. Place three compression test adaptors (J-38768-A) into the injector holes.
10. Install the injector hold down clamps and torque hold down bolts to 58-66 N·m (43-49 lb·ft).
11. Carefully remove the shaft from the rocker arm assembly by slowly pulling it out of the assembly. Place the shaft on the bench. Do not disturb the stack-up of the rocker arm sets.
12. Remove the three injector rocker arms and replace with spacers (J-38768-5).
13. Lubricate the shaft with clean engine oil. With sleeves in place, carefully reinstall the shaft through each rocker arm shaft. Make sure cup plug end faces inboard.
14. Install the modified rocker arm shaft assembly on the head. If the engine is equipped with a Jake Brake®, use non-Jake Brake rocker arm shaft bolts 8929129. Torque the three bolts and the nut to 102-108 N·m (75-80 lb·ft).
15. Reconnect and prime the fuel system.
16. Disconnect the gray connector (injector drive) from the Electronic Control Unit (ECU) for the “A” bank injectors.

NOTE:

To avoid excessive oil splash during the test, place the bottom half of a two piece design rocker cover (with head to cover gasket installed) on the cylinder head. Install bolts and tighten.



WARNING:

PERSONAL INJURY

To avoid injury when working on or near an operating engine, wear protective clothing, eye protection, and hearing protection.



WARNING:

PERSONAL INJURY

To avoid injury from hot surfaces, wear protective gloves, or allow engine to cool before removing any component.



WARNING:

PERSONAL INJURY

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- ☐ Always start and operate an engine in a well ventilated area.
- ☐ If operating an engine in an enclosed area, vent the exhaust to the outside.
- ☐ Do not modify or tamper with the exhaust system or emission control system.

17. Start and run the engine until the coolant out temperature reaches 40.5 C (105 F).

18. Attach cylinder compression gauge (J-6692-B) to the first adaptor. See Figure 5-3.

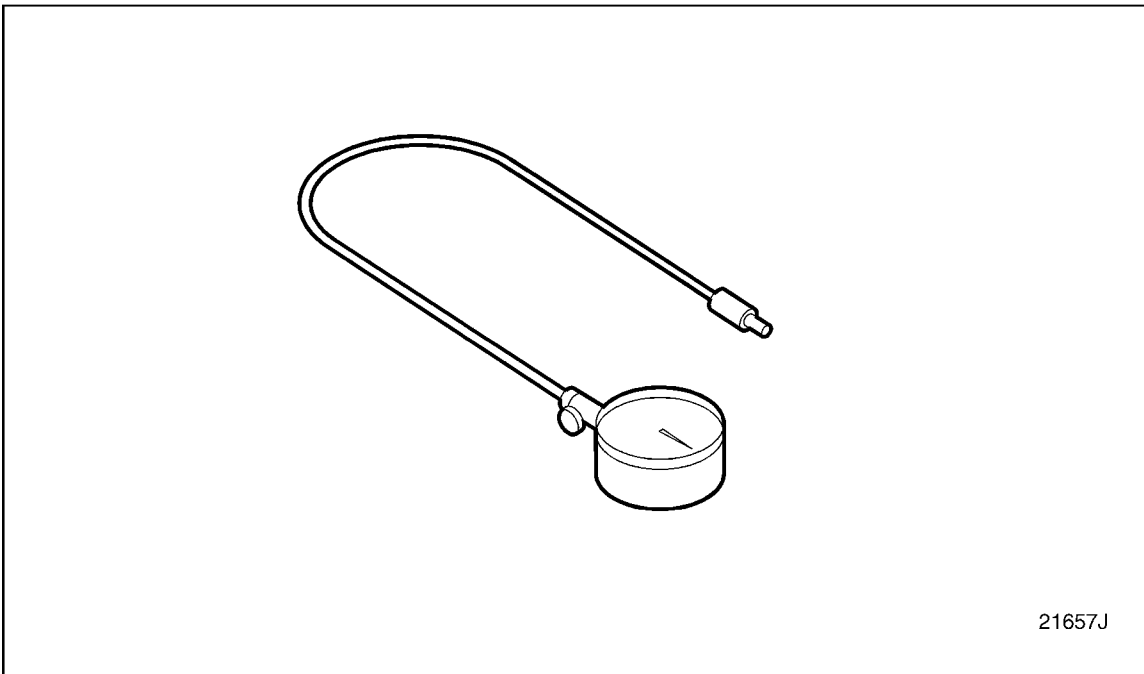


Figure 5-3 Attach Cylinder Compression Gauge J 6692-B

19. Push the pressure relief valve on the gauge several times until the highest compression reading is reached. This should be 3102-3793 kPa (450-550 psi) with no two cylinders differing by more than 276 kPa (40 psi). If compression readings are below specifications, repeat step 19 several times to be certain of the reading.
20. After testing the three cylinders, disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.



WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing the compression test adaptors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

21. Blow low pressure regulated air (no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
22. Remove bolts from the modified rocker arm shaft assembly and, using removal tool (J-35996), lift the assembly straight up and off the cylinder head. Place in a clean area on the bench.
23. Carefully remove the shaft from the rocker arm assembly, remove the three oil control sleeves, and replace the three injector rocker arms. Lubricate the shaft with clean engine oil and carefully reinstall through each rocker arm.
24. Remove the injector hold down clamps and remove the three compression test adaptors from the cylinder head. Using new seal rings, reinstall the injectors and clamps and torque bolts to specifications. For injector torque specifications, refer to appropriate service manual, fuel system chapter.
25. Install harness plug into injector connector making sure the locking tang clicks into place.
26. Replace the completed rocker arm shaft assembly on the engine and torque nut and bolts to specifications
27. Perform steps 2 through 26 for the three rear cylinders.

6 EXCESSIVE CRANKCASE PRESSURE

Section	Page
6.1 OBSTRUCTION OR DAMAGE TO ROCKER COVER BREATHER	6-3
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6.3 DEFECTIVE TURBOCHARGER	6-6
6.4 WORN OR DAMAGED VALVE OR CYLINDER KIT	6-7

6.1 OBSTRUCTION OR DAMAGE TO ROCKER COVER BREATHER

To determine if an obstructed or damaged breather is causing excessive crankcase pressure, perform the following:

1. Perform a crankcase pressure test. Refer to appropriate service manual, preventive maintenance chapter. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
2. Check the results, if the engine crankcase pressure is greater than 1.25 kPa (5 in. H₂O), replace wire mesh element. Refer to section 6.1.1.

6.1.1 Rocker Cover Breather Resolution

Perform the following steps to replace wire mesh element replacement:

1. Remove the valve rocker cover(s) (one-piece, two piece, three piece); refer to appropriate service manual, engine chapter.
2. Remove the wire mesh form the rocker cover; refer to appropriate service manual, engine chapter.
3. Install a new wire mesh element to the rocker cover; refer to appropriate service manual, engine chapter.
4. Install the rocker cover to the engine; (one-piece, two piece, three piece) refer to appropriate service manual, engine chapter.
5. Verify replacement of wire mesh element; refer to section 6.1.1.1.

6.1.1.1 Test Engine with New Wire Mesh Element

Perform the following steps to determine if the new wire mesh element resolved the excessive crankcase pressure:

1. Start and run the engine.
2. Perform a crankcase pressure test. Refer to appropriate service manual, preventive maintenance chapter. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
 - [a] If the engine crankcase pressure is less than 1.25 kPa (5 in. H₂O), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine crankcase pressure is greater than 1.25 kPa (5 in. H₂O), check the air compressor; refer to section 6.2. Shut down the engine.

6.2 DEFECTIVE AIR COMPRESSOR

To determine if a defective air compressor is causing excessive crankcase pressure, perform the following:

1. Perform a crankcase pressure test, refer to appropriate service manual, preventive maintenance chapter and record the test results. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
2. Disconnect the air outlet line from the air compressor; see Figure 6-1; refer to appropriate service manual, special equipment chapter.

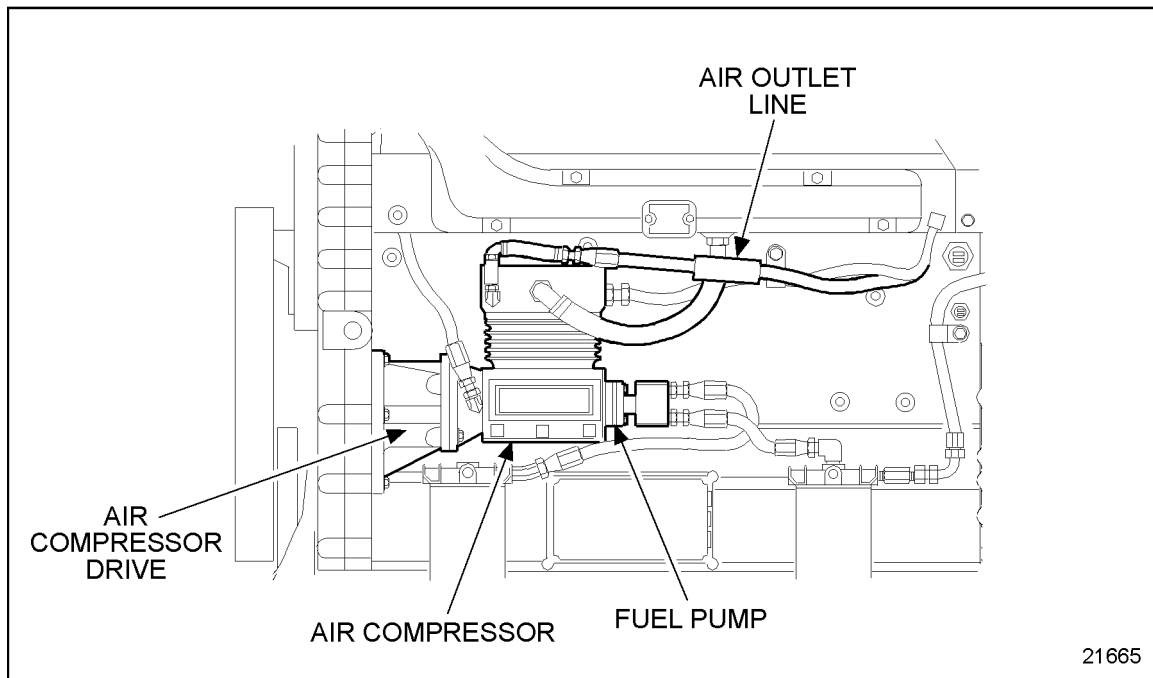


Figure 6-1 Air Compressor Air Outlet Line

3. Repeat step 1 and record the test results.
4. Compare the results of test one with test two.
 - [a] If the engine crankcase pressure remained the same, check the turbocharger; refer to section 6.3.
 - [b] If the engine crankcase pressure decreased, repair the air compressor; refer to section 6.2.1.

6.2.1 Air Compressor Repair

Perform the following steps to repair the defective air compressor:

1. Remove the air compressor from the engine; refer to appropriate service manual, special equipment chapter.

2. Install the repaired air compressor to the engine; refer to appropriate service manual, special equipment chapter.
3. Verify repair of the air compressor; refer to section 6.2.1.1.

6.2.1.1 Test Engine with Repaired Air Compressor

Perform the following steps to determine if a repaired air compressor resolved the excessive crankcase pressure:

1. Start and run the engine.
2. Perform a crankcase pressure test. Refer to appropriate service manual, preventive maintenance chapter. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
 - [a] If the engine crankcase pressure is within 1.25 kPa (5 in. H₂O), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine crankcase pressure is not within 1.25 kPa (5 in. H₂O), check the turbocharger, refer to section 6.3. Shut down the engine.

6.3 DEFECTIVE TURBOCHARGER

To determine if a defective turbocharger is causing excessive crankcase pressure, perform the following:

NOTICE:
Ensure that the engine is not allowed to operate longer than necessary to perform the crankcase pressure test. A complete loss of crankcase oil will severely damage the engine.

1. Remove the turbocharger drain line connected to the crankcase and place the drain line into a suitable container; refer to appropriate service manual, air intake system chapter.
2. Perform a crankcase pressure test. Refer to appropriate service manual, preventive maintenance chapter. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
 - [a] If the engine crankcase pressure is less than 1.25 kPa (5 in. H₂ O), replace the turbocharger; refer to section 6.3.1. Shut down the engine.
 - [b] If the engine crankcase pressure indicates no change, check for a worn or damaged valve or cylinder kit; refer to section 6.4. Shut down the engine.

6.3.1 Turbocharger Replacement

Perform the following steps to replace a defective turbocharger:

1. Remove defective turbocharger from the engine; refer to appropriate service manual, air intake system chapter.
2. Tag removed turbocharger for remanufacture.
3. Install a replacement turbocharger to the engine; refer to appropriate service manual, air intake system chapter.
4. Verify replacement of new turbocharger; refer to section 6.3.1.1.

6.3.1.1 Test Engine with New Turbocharger

To determine if a new turbocharger resolved the excessive crankcase pressure, perform a crankcase pressure test. Refer to appropriate service manual, preventive maintenance chapter. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.

1. If the engine crankcase pressure is 1.25 kPa (5 in. H₂O) or less, no further troubleshooting is required.
2. If the engine crankcase pressure is greater than 1.25 kPa (5 in. H₂O), check for a worn or damaged valve or cylinder kit; refer to section 6.4.

6.4 WORN OR DAMAGED VALVE OR CYLINDER KIT

To determine if a worn or damaged cylinder kit is causing excessive crankcase pressure, perform the following:

1. Move the vehicle requiring test to the chassis dynamometer; refer to OEM guidelines.
2. Disconnect air compressor; refer to appropriate service manual, special equipment chapter.
3. Start the engine.
4. Run the engine and bring the engine coolant temperature to normal operating range.
5. Run the vehicle to full load and rated speed.
6. Attach a manometer calibrated to read in inches of water, to the oil dipstick opening.
7. Measure and record crankcase pressure. .
8. Shut down the engine.
9. Remove the vehicle from the chassis dynamometer.
10. Review the crankcase pressure test. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
 - [a] If the crankcase pressure is greater than 1.25 kPa (5 in. H₂O), refer to step 11.
 - [b] If the crankcase pressure is less than 1.25 kPa (5 in. H₂O); no further troubleshooting required.
11. Perform the cylinder compression test. Refer to section 6.4.1.

6.4.1 Cylinder Compression Test

Perform the following steps for a compression test on a Series 60 Engine:

 WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. ☐ Always start and operate an engine in a well ventilated area. ☐ If operating an engine in an enclosed area, vent the exhaust to the outside. ☐ Do not modify or tamper with the exhaust system or emission control system.

1. Start and run the engine until normal operating temperature is reached. Stop the engine.

2. Clean and remove the rocker cover. If cover is a two-piece design, it is not necessary to remove the bottom.
3. Disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

! WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing injectors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

4. Blow low pressure regulated air no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
5. Remove the three rocker shaft mounting bolts and nut from the front rocker shaft assembly. Using removal tool (J-35996-A), see Figure 6-2, lift the assembly straight up and off of the head and place in a clean area on the bench.

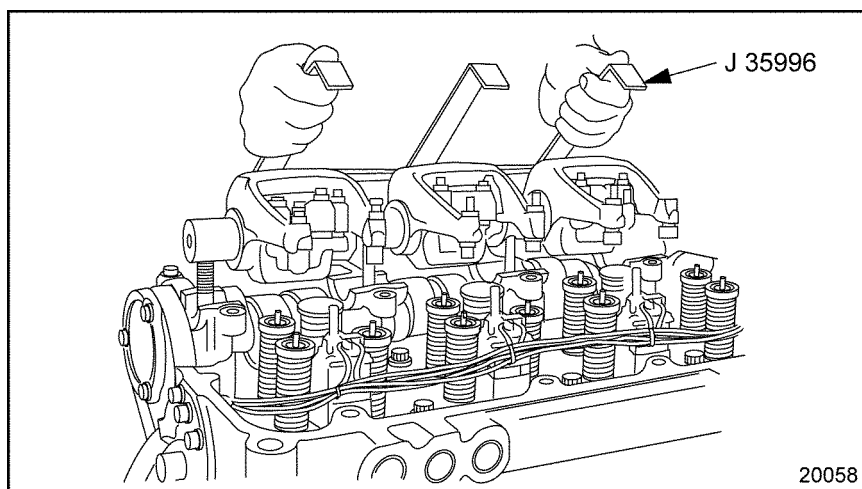


Figure 6-2 Rocker Arm/Shaft Assembly Removal/Installation

6. Disengage the locking tang on the harness plug connection, grasp the connector and gently pull it from the socket.
7. Remove the injector hold down clamps.

NOTICE:

Use extreme care when handling injectors to avoid costly damage by dropping or mishandling. Always install new O-rings when replacing injectors.

8. Remove the front three injectors from the cylinder head.
9. Place three compression test adaptors (J-38768-A) into the injector holes.
10. Install the injector hold down clamps and torque hold down bolts to 58-66 N·m (43-49 lb·ft).
11. Carefully remove the shaft from the rocker arm assembly by slowly pulling it out of the assembly. Place the shaft on the bench. Do not disturb the stack-up of the rocker arm sets.
12. Remove the three injector rocker arms and replace with spacers (J-38768-5).
13. Lubricate the shaft with clean engine oil. With sleeves in place, carefully reinstall the shaft through each rocker arm shaft. Make sure cup plug end faces inboard.
14. Install the modified rocker arm shaft assembly on the head. If the engine is equipped with a Jake Brake®, use non-Jake Brake rocker arm shaft bolts 8929129. Torque the three bolts and the nut to 102-108 N·m (75-80 lb·ft).
15. Reconnect and prime the fuel system.
16. Disconnect the gray connector (injector drive) from the Electronic Control Unit (ECU) for the “A” bank injectors.

NOTE:

To avoid excessive oil splash during the test, place the bottom half of a two piece design rocker cover (with head to cover gasket installed) on the cylinder head. Install bolts and tighten.

 WARNING:**PERSONAL INJURY**

To avoid injury when working on or near an operating engine, wear protective clothing, eye protection, and hearing protection.

 WARNING:**PERSONAL INJURY**

To avoid injury from hot surfaces, wear protective gloves, or allow engine to cool before removing any component.

 WARNING:**PERSONAL INJURY**

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- ☐ Always start and operate an engine in a well ventilated area.
- ☐ If operating an engine in an enclosed area, vent the exhaust to the outside.
- ☐ Do not modify or tamper with the exhaust system or emission control system.

17. Start and run the engine until the coolant out temperature reaches 40.5 C (105 F).

18. Attach cylinder compression gauge (J-6692-B) to the first adaptor. See Figure 6-3.

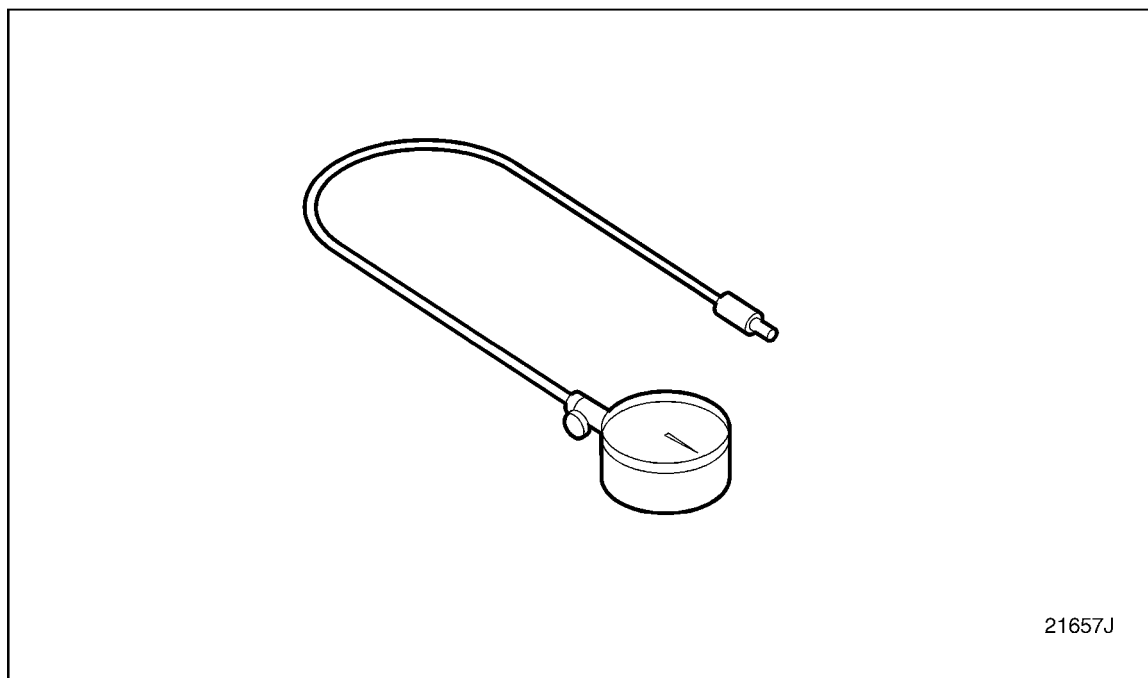


Figure 6-3 Attach Cylinder Compression Gauge J 6692-B

19. Push the pressure relief valve on the gauge several times until the highest compression reading is reached. This should be 3102-3793 kPa (450-550 psi) with no two cylinders differing by more than 276 kPa (40 psi). If compression readings are below specifications, repeat 19 several times to be certain of the reading.
20. After testing the three cylinders, disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

! WARNING:**EYE INJURY**

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing the compression test adaptors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

21. Blow low pressure regulated air (no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
22. Remove bolts from the modified rocker arm shaft assembly and, using removal tool (J-35996), lift the assembly straight up and off the cylinder head. Place in a clean area on the bench.
23. Carefully remove the shaft from the rocker arm assembly, remove the three oil control sleeves, and replace the three injector rocker arms. Lubricate the shaft with clean engine oil and carefully reinstall through each rocker arm.
24. Remove the injector hold down clamps and remove the three compression test adaptors from the cylinder head. Using new seal rings, reinstall the injectors and clamps and torque bolts to specifications. For injector torque specifications, refer to appropriate service manual, fuel system chapter.
25. Install harness plug into injector connector making sure the locking tang clicks into place.
26. Replace the completed rocker arm shaft assembly on the engine and torque nut and bolts to specifications
27. Perform steps 2 through 26 for the three rear cylinders.
 - [a] If cylinder pressure is below specifications, refer to section 6.4.2.
 - [b] If cylinder pressure is within specifications, call Detroit Diesel Customer Support Center (313-592-5800).

6.4.2 Worn or Damaged Valve or Cylinder Kit Repair

Perform the following steps for worn or damaged valve or cylinder kit:

1. Remove the cylinder head; refer to appropriate service manual, engine chapter.
2. Inspect the cylinder head for worn or damaged valves; refer to appropriate service manual, engine chapter.

3. Inspect the cylinder kit components for worn or damaged liners, piston, or piston rings; refer to appropriate service manual, engine chapter.
4. Verify repair to cylinder valve(s) or cylinder kit components; refer to section 6.4.2.1.

6.4.2.1 Test Engine with Repairs Made to Correct Worn or Damaged Valve or Cylinder Kit

Perform the following to determine if the repaired valve or cylinder kit resolved the excessive crankcase pressure:

1. Move the vehicle requiring test to the chassis dynamometer; refer to OEM guidelines.
2. Disconnect air compressor; refer to appropriate service manual, special equipment chapter.
3. Refer to section 6.4 for exhaust caution before proceeding. Start the engine.
4. Run the engine and bring the engine coolant temperature to normal operating range.
5. Run the vehicle to full load and rated speed.
6. Attach a manometer calibrated to read in inches of water, to the oil dipstick opening.
7. Measure and record crankcase pressure. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
8. Shut down the engine.
9. Remove the vehicle from the chassis dynamometer.
10. Compare the cylinder pressure test results to specifications.
 - [a] If cylinder pressure is within specifications, no further troubleshooting is required.
 - [b] If cylinder pressure is not within specifications, call Detroit Diesel Customer Support Center at 313-592-5800.

7 EXCESSIVE EXHAUST SMOKE (BLACK OR GRAY)

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7.6 DEFECTIVE TURBOCHARGER	7-9

7.1 IMPROPER GRADE OF FUEL OIL

To determine if an improper grade of fuel oil is causing excessive black or gray smoke, perform the following:

1. Acquire a fuel oil sample from the vehicle fuel tank(s).
2. Submit fuel oil sample for an ASTM test analysis.
 - [a] If the fuel oil meets specifications, check for a restrictive air cleaner; refer to section 7.2.
 - [b] If the fuel oil did not meet specifications, resolve improper grade of fuel; refer to section 7.1.1.

7.1.1 Improper Grade of Fuel Resolution

Perform the following steps to resolve the improper grade of fuel oil:

1. Drain the fuel oil tanks, refer to OEM guidelines, and dispose of properly.
2. Refill the fuel oil tanks with new fuel oil having a cetane number greater than 40.
3. Verify fuel oil resolution; refer to section 7.1.1.1.

7.1.1.1 Test the Engine with New Fuel Oil

Perform the following steps to determine if the fuel oil refill resolved the excessive exhaust smoke condition:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive smoke.
 - [a] If the engine exhaust smoke emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust smoke is excessively black or gray, shut down the engine. Check the air filter; refer to section 7.2.

7.2 RESTRICTED AIR CLEANER ELEMENT

To determine if a restrictive air cleaner is causing excessive black or gray smoke, perform the following:

1. Remove the air filter element from the air cleaner container; refer to OEM guidelines.
2. Visually inspect the air cleaner element for damage or clogging.
 - [a] If no damage or clogging is found, check the charge air cooler; refer to section 7.3.
 - [b] If damage or clogging is found, refer to section 7.2.1.

7.2.1 Air Filter Element Replacement

Perform the following to replace the air filter element:

1. Remove and replace the damaged or clogged air filter element; refer to OEM guidelines.
2. Verify air filter element replacement; refer to section 7.2.1.1.

7.2.1.1 Test the Engine with Replaced Air Filter Element

Perform the following to determine if the new filter element resolved excessive exhaust smoke:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive smoke.
 - [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust emission is excessively black or gray, shut down the engine. Check the charge air cooler; refer to section 7.3.

7.3 RESTRICTED OR CRACKED CHARGE AIR COOLER

To determine if a charge air cooler is causing excessive exhaust smoke, perform the following:

NOTICE:
To avoid engine damage, follow the installation instructions provided with the air-to-air charge air cooler test kit.

1. Attach a WK93 air-to-air charge air cooler test kit; refer to OEM guidelines.
2. Disconnect the air inlet hose from the outlet side of the turbocharger compressor housing; refer to appropriate service manual, air intake system chapter.
3. Attach the air-to-air cooler test kit adaptor plug to fit into the hose at the compressor connector; refer to OEM guidelines.
4. Attach an air pressure hose to the air chuck at the regulator and gradually pressurize the air inlet system to a pressure of 177 kPa (25 psi).
5. Apply a water and soap solution to each hose connection, across the face of the charge air cooler.
6. Apply a water and soap solution to the air intake manifold and cylinder head mating surface area.
7. Visually inspect all joints for air leaks and all charge air cooler welded surfaces for stress cracks.
 - [a] If air leaks are present around the joints, replace the charge air cooler; refer to section 7.3.1.
 - [b] If any leaks are present around the air intake manifold, repair the air intake manifold; refer to section 7.3.2.
 - [c] If no leaks are present, check for faulty exhaust system; refer to section 7.4.

7.3.1 Charge Air Cooler Replacement

Perform the following steps to replace the charge air cooler:

1. Replace the charge air cooler, refer to OEM guidelines.
2. Verify replacement of the charge air cooler; refer to section 7.3.2.1.

7.3.2 Air Intake Manifold Repair

Perform the following steps to repair the air intake manifold:

1. Remove the air intake manifold; refer to appropriate service manual, air intake system chapter.
2. Inspect the air intake manifold; refer to appropriate service manual, air intake system chapter.
3. Install the air intake manifold; refer to appropriate service manual, air intake system chapter.
4. Verify repair of the air intake manifold; refer to section 7.3.2.1.

7.3.2.1 Test the Engine with Replaced Charge Air Cooler and Air Intake Manifold

To determine if the replaced charge air cooler and air intake manifold resolved the excessive exhaust smoke condition, perform the following:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive smoke.
 - [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust emission is excessively black or gray, shut down the engine. Check the faulty exhaust system; refer to section 7.4.

7.4 FAULTY EXHAUST SYSTEM

To determine if a faulty exhaust system is causing excessive exhaust smoke, perform the following:

1. Drill an 11/32 in. hole in the exhaust pipe, 5 to 12 in. (127 - 305 mm) from the turbocharger exhaust outlet.

NOTE:

The tapped hole must be in a comparatively straight area of the turbocharger exhaust outlet.

2. Tap the hole to accommodate an 1/8 in. pipe plug. Connect a manometer to the tapped hole.
3. Start and run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
4. Run the engine speed to full load.
 - [a] If the exhaust back pressure at full load is less than 10.1 kPa (3.0 in. Hg), check the fuel injectors, refer to section 7.5. Shut down the engine.
 - [b] If the exhaust back pressure at full load is 10.1 kPa (3.0 in. Hg) or greater, refer to section 7.4.1. Shut down the engine.

7.4.1 Engine Exhaust System Resolution

Perform the following steps to resolve the engine exhaust system:

1. Visually inspect the engine exhaust system; refer to OEM guidelines.
2. Repair and replace defective exhaust system components; refer to OEM guidelines.
3. Verify exhaust system resolution; refer to section 7.4.1.1.

7.4.1.1 Test the Engine with Replaced Exhaust System

Perform the following steps to determine if replaced engine exhaust system components resolved excessive exhaust smoke condition:

1. Refer to section 7.4 for exhaust caution before proceeding. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive smoke.
 - [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust emission is excessively black or gray, shut down the engine. Check the fuel injectors; refer to section 7.5.

7.5 FAULTY FUEL INJECTOR

To determine if a faulty fuel injector is causing the cylinder to misfire, perform the following steps:

1. Install DDL adaptor to the data cable and plug the adaptor into the DDL connector in the vehicle; refer to OEM guidelines.
2. Start and run the engine at no-load.
3. From the DDEC III/IV Select Menu, scroll to select ENGINE and press the ENTER key.
4. Scroll to FUEL INJECTOR INFO (CUTOUT) and press the ENTER key.
5. Scroll to select NEW TEST and press the ENTER key.
6. Scroll to select RPM SETTING FOR CCO TEST NORMAL and scroll to select 1000 and press the ENTER key.
7. Scroll to select AUTO and press the ENTER key. Wait for END OF TEST.

NOTE:

If an injector cannot be cutout, an ERROR message will appear. Press FUNC to exit the cylinder cutout function, press the FUNC key.

8. Scroll the list to review the results of the cylinder cutout test. To find suspect injectors, look for a cylinder with a value that is within 0.2° of the NO CUTOUT PULSE WIDTH, by comparing the CUTOUT PULSE WIDTH values to the NO CUTOUT PULSE WIDTH values.
 - [a] If any CUTOUT PULSE WIDTH values are within 0.2° of the NO CUTOUT PULSE WIDTH, shut down the engine; refer to section 7.5.1.
 - [b] If any CUTOUT PULSE WIDTH values are not within 0.2° of the NO CUTOUT PULSE WIDTH, shut down the engine; refer to section 7.6.

7.5.1 Faulty Fuel Injector Repair

Perform the following steps for faulty fuel injector assembly(s):

1. Remove and replace injector assembly(s) whose values are within 0.2° of the NO CUTOUT PULSE WIDTH; refer to appropriate service manual, fuel system chapter.
2. Verify replaced injector assembly(s); refer to section 7.5.1.1.

7.5.1.1 Verification of Repair for Faulty Fuel Injector

Perform the following to determine if the replaced fuel injector(s) resolved the excessive exhaust smoke condition:

1. Refer to section 7.5 for exhaust caution before proceeding. Start the engine.
2. Run the engine speed to full load.
3. Visually inspect the exhaust for excessive smoke.

- [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
- [b] If the engine exhaust emission is excessive, check for defective turbocharger; refer to section 7.6. Shut down the engine.

7.6 DEFECTIVE TURBOCHARGER

To determine if a defective turbocharger is causing excessive exhaust smoke, perform the following:

1. Remove the exhaust pipe from the turbine outlet and remove the air intake pipe from the compressor inlet.
2. Visually inspect the turbine and compressor wheels for missing blades or blade damage.
3. Inspect the turbine and compressor wheels for heavy deposits of dirt, coke or carbon.
4. Using a flashlight, check the wheels and housings for signs of rubbing.
5. Rotate the turbine wheel to check for freedom of movement.
6. Replace the turbocharger if there is any visible damage. refer to appropriate service manual, air intake system chapter.

7.6.1 Turbocharger Replacement

Perform the following steps to replace a defective turbocharger:

1. Remove defective turbocharger from the engine; refer to appropriate service manual, air intake system chapter.
2. Tag removed turbocharger for remanufacture.
3. Install a new turbocharger to the engine; refer to appropriate service manual, air intake system chapter.
4. Verify replacement of new turbocharger; refer to section 7.6.1.1.

7.6.1.1 Test Engine with Replaced Turbocharger

Perform the following steps to determine if a replaced turbocharger resolved the excessive exhaust smoke condition:

1. Start the engine.
2. Run the engine speed to full load.
3. Visually inspect the exhaust for excessive smoke.
 - [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust emission is excessive, shut down the engine. Call Detroit Diesel Customer Support Center (313-592-5800).

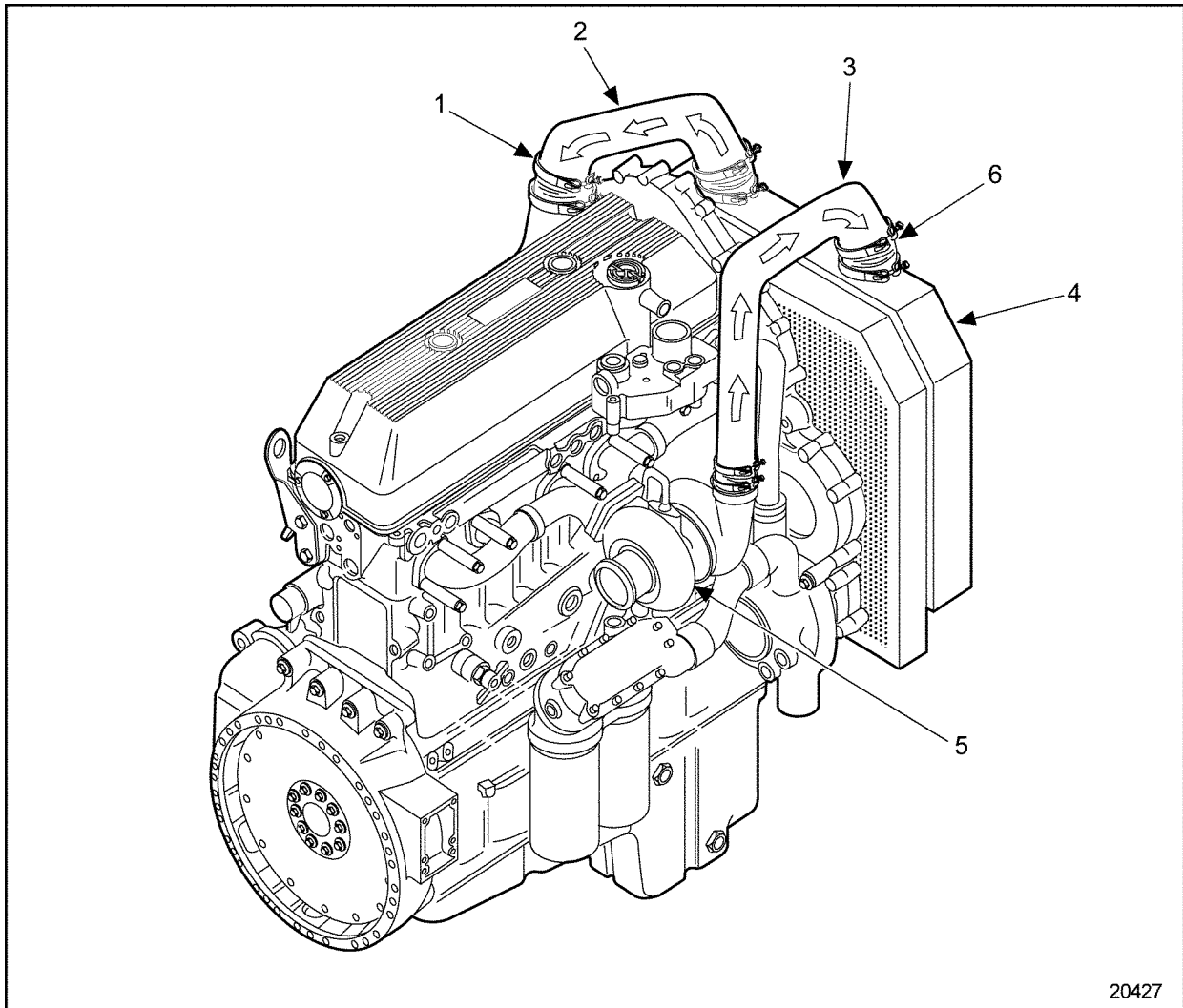
8 EXCESSIVE BLUE SMOKE

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8.2 WORN OR DAMAGED VALVE OR CYLINDER KIT	8-5

8.1 DEFECTIVE TURBOCHARGER

To determine if a defective turbocharger is causing excessive exhaust smoke, perform the following:

1. Remove the charge air cooler inlet duct connected between the turbocharger and charge air cooler; see Figure 8-1.



1. Flexible Coupling	4. Charge Air Cooler
2. Charge Air Cooler Outlet Duct	5. Turbocharger
3. Charge Air Cooler Inlet Duct	6. Coupling Hose Clamp

Figure 8-1 Charge Air Cooler and Related Parts

2. Visually inspect the charge air cooler outlet duct.
 - [a] If excessive engine lube oil is present, refer to section 8.1.1.
 - [b] If no engine lube oil is present, check for worn or damaged valve or cylinder kit, refer to section 8.2.

8.1.1 Turbocharger Replacement

Perform the following steps to replace a defective turbocharger:

1. Remove defective turbocharger from the engine; refer to appropriate service manual, air intake system chapter.
2. Tag removed turbocharger for remanufacture.
3. Install a replacement turbocharger to the engine; refer to appropriate service manual, air intake system chapter.
4. Verify replacement of new turbocharger; refer to section 8.1.1.1.

8.1.1.1 Test Engine with Replaced Turbocharger

Perform the following steps to determine if a replaced turbocharger resolved the excessive exhaust smoke condition:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range, 88-96°C (190-210°F).
3. Visually inspect exhaust for excessive smoke.
 - [a] If the engine exhaust smoke emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust smoke is excessively black or gray, shut down the engine. Check for worn or damaged valve or cylinder kit; refer to section 8.2.

8.2 WORN OR DAMAGED VALVE OR CYLINDER KIT

To determine if a worn or damaged cylinder kit is causing excessive crankcase pressure, perform the following:

1. Move the vehicle requiring testing to the chassis dynamometer; refer to OEM guidelines.
2. Disconnect air compressor; refer to appropriate service manual, special equipment chapter.
3. Start the engine.
4. Run the engine and bring the engine coolant temperature to normal operating range.
5. Run the vehicle to full load and rated speed.
6. Attach a manometer calibrated to read in inches of water, to the oil dipstick opening.
7. Measure and record crankcase pressure. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
8. Shut down the engine.
9. Remove the vehicle from the chassis dynamometer.
10. Review the crankcase pressure test. For crankcase pressure guidelines refer to Service Information Letter 02 TS-20 found on the DDC extranet.
 - [a] If the crankcase pressure was greater than 1.25 kPa (5 in. H₂O), refer to section 8.2.1.
 - [b] If the crankcase pressure was less than 1.25 kPa (5 in. H₂O), perform a cylinder compression test. Refer to section 8.2.1.2.
11. Compare the cylinder compression test results to specifications.
 - [a] If cylinder pressure is below specifications, refer to section 8.2.1.
 - [b] If cylinder pressure is within specifications, call Detroit Diesel Customer Support Center (313-592-5800).

8.2.1 Worn or Damaged Valve or Cylinder Kit Repair

Perform the following steps for worn or damaged valve or cylinder kit:

1. Remove the cylinder head; refer to appropriate service manual, engine chapter.
2. Inspect the cylinder head for worn or damaged valves; refer to appropriate service manual, engine chapter.
3. Inspect the cylinder kit components for worn or damaged liners, pistons, or piston rings; refer to appropriate service manual, engine chapter.
4. Verify repair to cylinder valve(s) or cylinder kit components; refer to section 8.2.1.1.

8.2.1.1 Test Engine with Repairs Made to Correct Worn or Damaged Valve or Cylinder Kit

Perform the following to determine if the repaired valve or cylinder kit resolved the excessive crankcase pressure:

1. Refer to section 8.2 for exhaust caution before proceeding. Start the engine.
2. Run the engine and bring the engine coolant temperature to normal operating range, 88-96°C (190-210°F).
3. Run the vehicle to full load and rated speed.
4. Visually inspect exhaust for excessive smoke.
 - [a] If the engine exhaust smoke emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust smoke is excessively black or gray, call the Detroit Diesel Customer Support Center (313-592-5800). Shut down the engine.

8.2.1.2 Cylinder Compression Test

Perform the following steps for a compression test on a Series 60 Engine:

 WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. ☐ Always start and operate an engine in a well ventilated area. ☐ If operating an engine in an enclosed area, vent the exhaust to the outside. ☐ Do not modify or tamper with the exhaust system or emission control system.

1. Start and run the engine until normal operating temperature is reached. Stop the engine.
2. Clean and remove the rocker cover. If cover is a two-piece design, it is not necessary to remove the bottom.
3. Disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

! WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing injectors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

4. Blow low pressure regulated air no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
5. Remove the three rocker shaft mounting bolts and nut from the front rocker shaft assembly. Using removal tool (J-35996-A), see Figure 8-2, lift the assembly straight up and off of the head and place in a clean area on the bench.

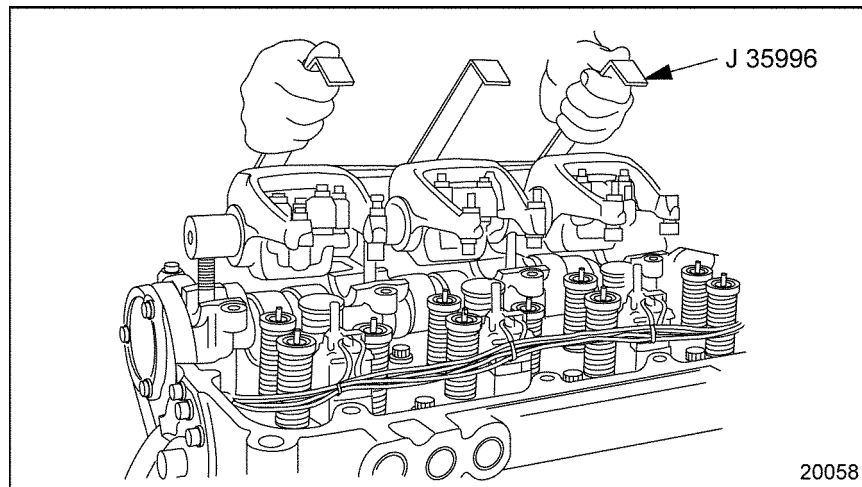


Figure 8-2 Rocker Arm/Shaft Assembly Removal/Installation

6. Disengage the locking tang on the harness plug connection, grasp the connector and gently pull it from the socket.
7. Remove the injector hold down clamps.

NOTICE:

Use extreme care when handling injectors to avoid costly damage by dropping or mishandling. Always install new O-rings when replacing injectors.

8. Remove the front three injectors from the cylinder head.
9. Place three compression test adaptors (J-38768-A) into the injector holes.
10. Install the injector hold down clamps and torque hold down bolts to 58-66 N·m (43-49 lb·ft).
11. Carefully remove the shaft from the rocker arm assembly by slowly pulling it out of the assembly. Place the shaft on the bench. Do not disturb the stack-up of the rocker arm sets.
12. Remove the three injector rocker arms and replace with spacers (J-38768-5).
13. Lubricate the shaft with clean engine oil. With sleeves in place, carefully reinstall the shaft through each rocker arm shaft. Make sure cup plug end faces inboard.
14. Install the modified rocker arm shaft assembly on the head. If the engine is equipped with a Jake Brake®, use non-Jake Brake rocker arm shaft bolts 8929129. Torque the three bolts and the nut to 102-108 N·m (75-80 lb·ft).
15. Reconnect and prime the fuel system.
16. Disconnect the gray connector (injector drive) from the Electronic Control Unit (ECU) for the “A” bank injectors.

NOTE:

To avoid excessive oil splash during the test, place the bottom half of a two piece design rocker cover (with head to cover gasket installed) on the cylinder head. Install bolts and tighten.



WARNING:

PERSONAL INJURY

To avoid injury when working on or near an operating engine, wear protective clothing, eye protection, and hearing protection.



WARNING:

PERSONAL INJURY

To avoid injury from hot surfaces, wear protective gloves, or allow engine to cool before removing any component.



WARNING:

PERSONAL INJURY

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- ☐ Always start and operate an engine in a well ventilated area.
- ☐ If operating an engine in an enclosed area, vent the exhaust to the outside.
- ☐ Do not modify or tamper with the exhaust system or emission control system.

17. Start and run the engine until the coolant out temperature reaches 40.5 C (105 F).

18. Attach cylinder compression gauge (J-6692-B) to the first adaptor. See Figure 8-3.

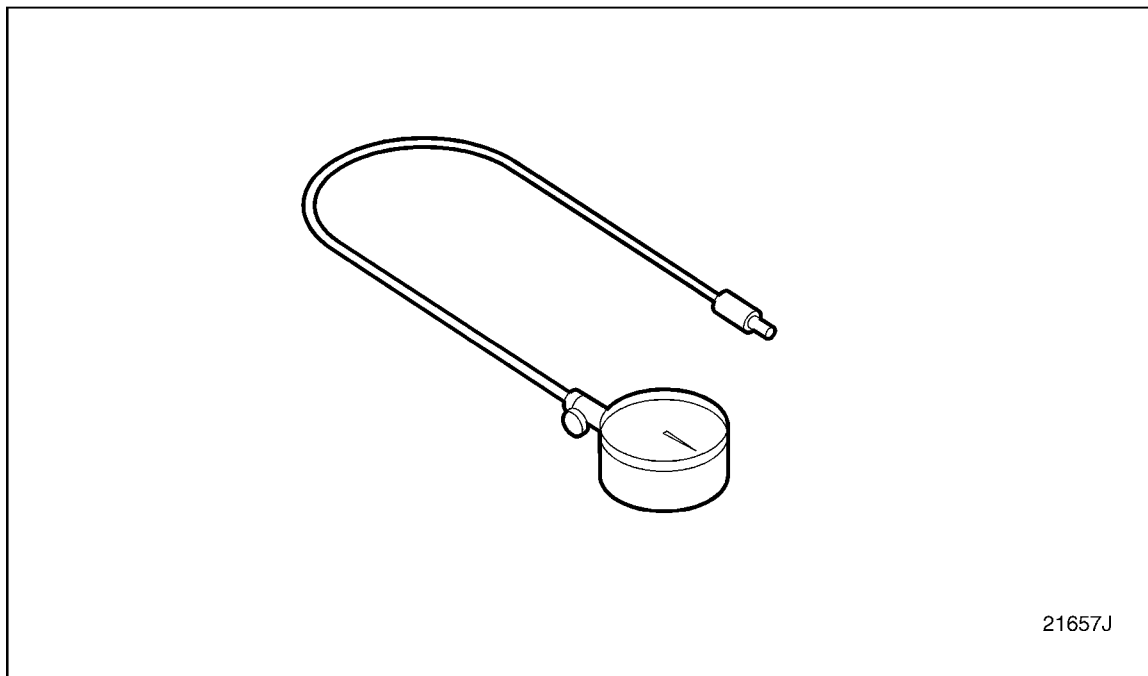


Figure 8-3 Attach Cylinder Compression Gauge J 6692-B

19. Push the pressure relief valve on the gauge several times until the highest compression reading is reached. This should be 3102-3793 kPa (450-550 psi) with no two cylinders differing by more than 276 kPa (40 psi). If compression readings are below specifications, repeat 19 several times to be certain of the reading.
20. After testing the three cylinders, disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.



WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing the compression test adaptors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

21. Blow low pressure regulated air (no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
22. Remove bolts from the modified rocker arm shaft assembly and, using removal tool (J-35996), lift the assembly straight up and off the cylinder head. Place in a clean area on the bench.
23. Carefully remove the shaft from the rocker arm assembly, remove the three oil control sleeves, and replace the three injector rocker arms. Lubricate the shaft with clean engine oil and carefully reinstall through each rocker arm.
24. Remove the injector hold down clamps and remove the three compression test adaptors from the cylinder head. Using new seal rings, reinstall the injectors and clamps and torque bolts to specifications. For injector torque specifications, refer to appropriate service manual, fuel system chapter.
25. Install harness plug into injector connector making sure the locking tang clicks into place.
26. Replace the completed rocker arm shaft assembly on the engine and torque nut and bolts to specifications
27. Perform steps 2 through 26 for the three rear cylinders.

9 EXCESSIVE WHITE SMOKE

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9.1 IMPROPER GRADE OF FUEL

To determine if an improper grade of fuel oil is causing excessive white smoke, perform the following:

1. Acquire a fuel oil sample from the vehicle fuel tank(s).
2. Submit fuel oil sample for an ASTM test analysis.
 - [a] If the fuel oil meets specifications, check the fuel pump; refer to section 9.2.
 - [b] If the fuel oil did not meet specifications, resolve improper grade of fuel; refer to section 9.1.1.

9.1.1 Improper Grade of Fuel Resolution

Perform the following steps to resolve the improper grade of fuel oil:

1. Drain the fuel oil tank(s), refer to OEM guidelines, and dispose of properly.
2. Refill the fuel oil tanks with new fuel oil having a cetane number greater than 40.
3. Verify fuel oil resolution; refer to section 9.1.1.1.

9.1.1.1 Test the Engine with New Fuel Oil

Perform the following steps to determine if the new fuel oil refill resolved the excessive white smoke condition:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive smoke.
 - [a] If the engine exhaust smoke emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust smoke is excessively white, shut down the engine. Check the fuel pump; refer to section 9.2.

9.2 DEFECTIVE FUEL PUMP

To determine if the fuel pump is causing excessive white smoke, perform the following steps:

1. Insert a piece of wire through the fuel pump flange drain hole; see Figure 9-1.

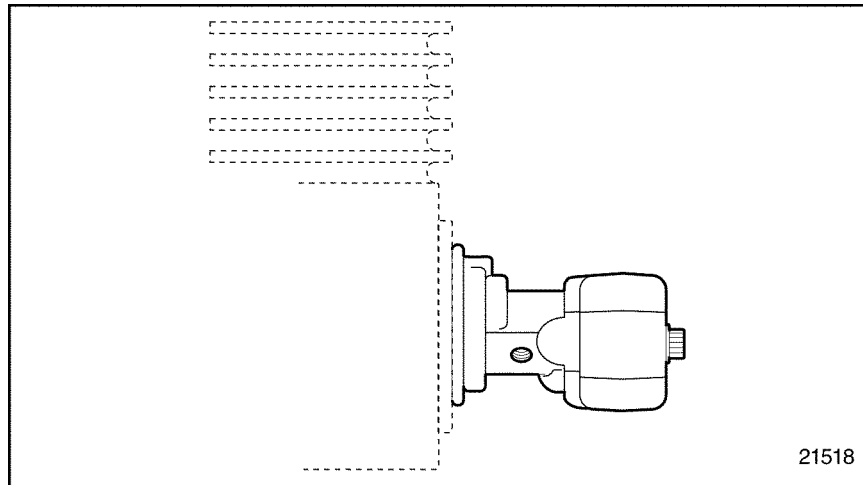


Figure 9-1 Fuel Pump Flange Drain Hole Location

2. Crank the engine momentarily and feel for wire vibration.
 - [a] If the wire did not vibrate; refer to section 9.2.1.
 - [b] If the wire did vibrate, check for aerated fuel; refer to section 9.3.

9.2.1 Drive Hubs and Coupling Replacement

Perform the following for drive hubs or coupling replacement:

1. Replace the drive hubs or coupling; refer to appropriate service manual, fuel system chapter.
2. Verify the drive hubs and coupling replacement; refer to section 9.2.1.1.

9.2.1.1 Engine Test with Replaced Drive Hubs or Replaced Coupling

Perform the following to determine if replaced drive hubs and coupling resolved excessive white smoke:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive white smoke.
 - [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust emission is excessively white, shut down the engine. Check for aerated fuel; refer to section 9.3.

9.3 AERATED FUEL

To determine if aerated fuel is causing excessive white smoke, perform the following steps:

1. Disconnect the fuel line return hose from the fitting located at the fuel tank; refer to OEM guidelines.
2. Place the open end of the fuel line into a suitable container.
3. Start and run the engine.
4. Operate the engine at 1000 rpm.
5. Visually check to see if air bubbles are rising to the surface of the fuel within the container.
 - [a] If air bubbles are present, shut down engine; refer to section 9.3.1.
 - [b] If air bubbles are not present, shut down engine, check for improper injector calibration setting; refer to section 9.4.

9.3.1 Aerated Fuel Resolution

Perform the following to resolve aerated fuel:

1. Tighten all fuel line connections between fuel tank and fuel pump; refer to OEM guidelines.
2. Visually inspect all fuel lines between fuel tank and fuel pump for leaks.
3. Repair damaged components as required; refer to OEM guidelines.
4. Verify aerated fuel resolution; refer to section 9.3.1.1.

9.3.1.1 Test the Engine with Aerated Fuel Resolution

Perform the following to determine if aerated fuel resolution resolved excessive white smoke condition:

1. Refer to section 9.3 for the exhaust caution before proceeding. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive white smoke.
 - [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust emission is excessively white, shut down the engine. Check for improper injector calibration setting; refer to section 9.4.

9.4 IMPROPER INJECTOR CALIBRATION SETTING (DDEC V ENGINES ONLY)

To determine if an improper injector calibration setting is causing excessive white smoke, perform the following:

1. Check for improper injector setting repair.
2. Verify injector setting repair; refer to section 9.4.1.

9.4.1 Test Engine with Corrected Injector Setting

Perform the following to determine if injector setting repair resolved excessive white smoke:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive white smoke.
 - [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust emission is excessively white, shut down the engine. Check for improper valve clearance or injector height, worn or damaged camshaft lobes and rollers; refer to section 9.5.

9.5 IMPROPER VALVE CLEARANCE OR INJECTOR HEIGHT, WORN OR DAMAGED CAMSHAFT LOBES AND ROLLERS

To determine if an improper valve clearance or injector height, worn or damaged camshaft lobes and rollers is causing excessive white smoke, perform the following:

1. Check for improper valve clearance or injector height, worn or damaged camshaft lobes and rollers.
2. Check for improper valve clearance or injector height repair.
3. Verify valve clearance or injector height, worn or damaged camshaft lobes and rollers repair; refer to section 9.5.1.

9.5.1 Test Engine with Corrected Valve Clearance or Injector Height, Worn or Damaged Camshaft Lobes and Rollers

Perform the following to determine if the valve clearance or injector height, worn or damaged camshaft lobes and rollers repair resolved excessive white smoke:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive white smoke.
 - [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust emission is excessively white, shut down the engine. Check for faulty fuel injector; refer to section 9.6.

9.6 FAULTY FUEL INJECTOR

To determine if a faulty fuel injector is causing excessive white smoke, perform the following:

1. Check for faulty fuel injector.
2. Check for faulty fuel injector repair.
3. Verify fuel injector repair; refer to section 9.6.1.

9.6.1 Test the Engine with Repaired Fuel Injector

Perform the following to determine if the fuel injector repair resolved excessive white smoke:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive white smoke.
 - [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust emission is excessively white, shut down the engine. Check for faulty Electronic Control Unit; refer to section 9.7.

9.7 FAULTY ELECTRONIC CONTROL UNIT

To determine if a faulty Electronic Control Unit is causing excessive white smoke, perform the following:

1. Check for faulty ECU.
2. Check for faulty ECU repair.
3. Verify ECU repair; refer to section 9.7.1.

9.7.1 Test Engine with Repair to the Electronic Control Unit

Perform the following to determine if the ECU repair resolved excessive white smoke:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Visually inspect exhaust for excessive white smoke.
 - [a] If the engine exhaust emission appears normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine exhaust emission is excessively white, shut down the engine. Call Detroit Diesel Customer Support Center (313-592-5800).

10 ROUGH RUNNING OR STALLING

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10.1 LOW BATTERY VOLTAGE

To determine if a weak battery is causing rough running or stalling, perform the following steps:

1. Start and run the engine.
2. Measure the battery voltage; refer to OEM guidelines.
 - [a] If the battery voltage is greater than or equal to 10.5 volts, check for aerated fuel oil; refer to section 10.2.
 - [b] If the battery voltage is less than 10.5 volts, replace the battery; refer to section 10.1.1.

10.1.1 Battery Replacement

Perform the following steps for battery replacement:

1. Remove and replace the battery; refer to OEM guidelines.
2. Verify battery replacement; refer to section 10.1.1.1.

10.1.1.1 Test Engine with Replaced Battery

Perform the following steps to determine if the battery replacement resolved difficulty:

1. Refer to section 10 for exhaust caution before proceeding. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range, 88-96°C (190-210°F).
 - [a] If the engine is not running rough or stalling, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine is running rough or stalling shut down the engine. Check for aerated fuel oil; refer to section 10.2.

10.2 AERATED FUEL OIL

To determine if aerated fuel is causing rough running or stalling, perform the following steps:

1. Test for aerated fuel; refer to section 9.3.
2. Aerated fuel resolution, refer to section 9.3.1.
3. Verify aerated fuel resolution; refer to section 10.2.1.

10.2.1 Test Engine with Aerated Fuel Resolution

Perform the following steps to determine if the aerated fuel resolution resolved rough running or stalling condition:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range, 88-96°C (190-210°F).
 - [a] If the engine is not running rough or stalling, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine is running rough or stalling, shut down the engine. Check for insufficient fuel oil flow; refer to section 10.3.

10.3 INSUFFICIENT FUEL OIL FLOW

To determine if insufficient fuel oil flow is causing rough running or stalling, do the following steps:

1. Perform a fuel oil flow test.
2. Analyze the fuel oil flow test results.
 - [a] If the fuel oil rate is 246 L/hr (65 gal/hr) or more, no further troubleshooting is required; refer to section 10.4.
 - [b] If the fuel oil rate is less than 246 L/hr (65 gal/hr), resolve the insufficient fuel oil flow; refer to section 10.3.1.

10.3.1 Insufficient Fuel Oil Flow Resolution

Perform the following steps to resolve the insufficient fuel oil flow:

1. Replace the fuel filter(s); refer to appropriate service manual, fuel system chapter.

NOTE:

Always fill the filter(s) with clean fuel oil before installing. Turn the filter(s) until they contact the gasket fully. Then, turn them an additional two-thirds by hand.

2. Inspect the fuel lines for restrictions due to pinching, kinking or other damage. If damage is found, repair as necessary; refer to OEM guidelines.

3. Inspect the cylinder head for a correct restricted fitting. If an incorrect fitting is found, replace with a new fitting; refer to appropriate service manual, engine chapter.
4. Inspect the fuel return check valve for restrictive movement; refer to appropriate service manual, fuel system chapter.
5. Inspect the fuel pump drive assembly. If damage is found, repair as necessary; refer to appropriate service manual, fuel system chapter.
6. Verify repairs done to correct insufficient fuel oil flow; refer to section 10.3.1.1.

10.3.1.1 Test the Engine with Resolved Fuel Oil Flow

Perform the following steps to determine if the fuel oil flow resolution resolved rough running or stalling:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range, 88-96°C (190-210°F).
 - [a] If the engine is not running rough or stalling, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine is running rough or stalling, shut down the engine. Check for high fuel oil temperature return; refer to section 10.4.

10.4 HIGH FUEL OIL TEMPERATURE RETURN

To determine if high fuel oil temperature return is causing rough running or stalling, perform the following steps:

1. Install the Diagnostic Data Reader to the vehicles Display Data Line Adaptor, see Figure 10-1; refer to OEM guidelines.

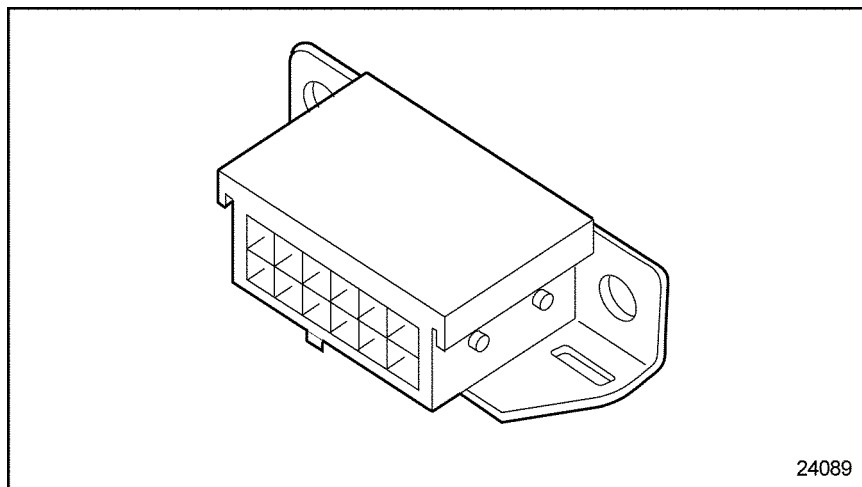


Figure 10-1 Typical Display Data Line Adaptor

2. Start and run the engine.
3. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range, 88-96°C (190-210°F).
 - [a] If the return fuel oil temperature is less than or equal to 60°C (140°F), check for improper injector calibration setting; refer to section 10.5.
 - [b] If the return fuel oil temperature is greater than 60°C (140°F), resolve the high fuel oil temperature; refer to section 10.4.1.

10.4.1 High Fuel Oil Temperature Resolution

Perform the following steps to resolve high fuel oil temperature:

1. Remove and replace fuel oil filter(s); refer to appropriate service manual, fuel system chapter.
2. Inspect check valve for any restricted fitting; refer to appropriate service manual, fuel system chapter.
3. Replace both the restrictive fitting or check valve; refer to appropriate service manual, fuel system chapter.
4. Verify fuel oil filter(s) replacement; refer to section 10.4.1.1.

10.4.1.1 Test the Engine with Replaced Oil Filters

Perform the following steps to determine if the replaced oil filter(s) resolved the rough running or stalling condition:

1. Refer to section 10.4 for exhaust caution before proceeding. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range, 88-96°C (190-210°F).
 - [a] If the engine is not running rough or stalling, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine is running rough or stalling, shut down the engine. Check for improper injector calibration setting; refer to section 10.5.

10.5 IMPROPER INJECTOR CALIBRATION SETTING (DDEC V ENGINES ONLY)

To determine if improper injector calibration setting (DDEC V engines only) is causing rough running or stalling, perform the following steps:

1. Test for improper injector setting.
2. Compare the calibration code(s) shown on the Detroit Diesel Diagnostic Link display with the two digit calibration code(s) on the injector(s). See Figure 10-2.

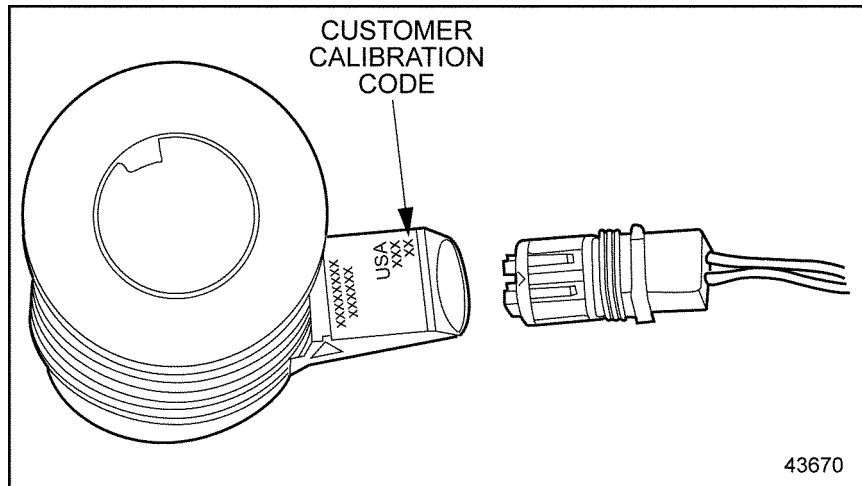


Figure 10-2 **Injector Calibration Code**

- [a] If the calibration codes match, check compression pressure; refer to section 10.6.
- [b] If the calibration code on the display is different then the calibration code on the suspect injector for that cylinder, the injector setting must be reset, see Figure 10-2; refer to section 10.5.1.

10.5.1 Improper Injector Setting Repair

Perform the following steps to recalibrate improper injector setting:

1. Reset incorrect injector setting.
2. Verify injector setting repair; refer to section 10.5.1.1.

10.5.1.1 Test the Engine with Corrected Injector Setting

Perform the following steps to determine if the corrected injector setting resolved rough running or stalling:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range, 88-96°C (190-210°F).

- [a] If the engine is not running rough or stalling, no further troubleshooting is required. Shut down the engine.
- [b] If the engine is running rough or stalling, shut down the engine. Check for low compression pressure; refer to section 10.6.

10.6 LOW COMPRESSION PRESSURE

To determine if low compression pressure is causing rough running or stalling, perform the cylinder compression test. Refer to section 10.6.1

10.6.1 Cylinder Compression Test

Perform the following steps for a compression test on a Series 60 Engine:

 WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. ☐ Always start and operate an engine in a well ventilated area. ☐ If operating an engine in an enclosed area, vent the exhaust to the outside. ☐ Do not modify or tamper with the exhaust system or emission control system.

1. Start and run the engine until normal operating temperature is reached. Stop the engine.
2. Clean and remove the rocker cover. If cover is a two-piece design, it is not necessary to remove the bottom.
3. Disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

⚠ WARNING:**EYE INJURY**

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing injectors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

4. Blow low pressure regulated air no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
5. Remove the three rocker shaft mounting bolts and nut from the front rocker shaft assembly. Using removal tool (J-35996-A), see Figure 10-3, lift the assembly straight up and off of the head and place in a clean area on the bench.

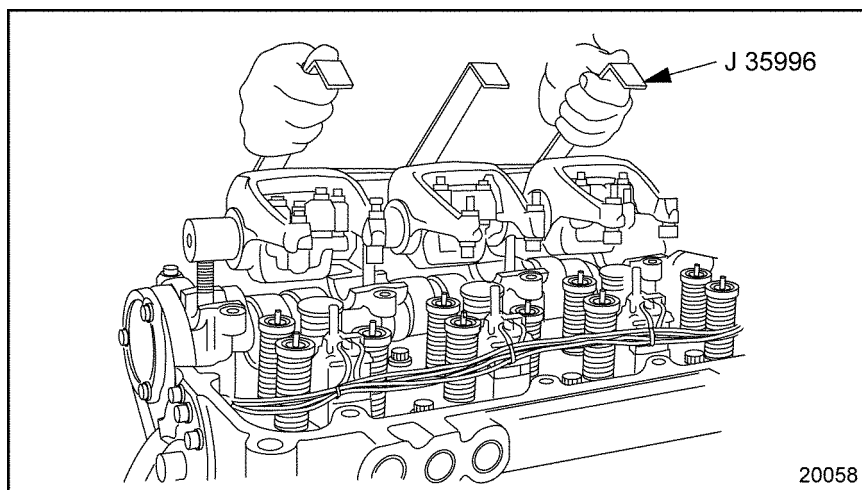


Figure 10-3 Rocker Arm/Shaft Assembly Removal/Installation

6. Disengage the locking tang on the harness plug connection, grasp the connector and gently pull it from the socket.
7. Remove the injector hold down clamps.

NOTICE:

Use extreme care when handling injectors to avoid costly damage by dropping or mishandling. Always install new O-rings when replacing injectors.

8. Remove the front three injectors from the cylinder head.
9. Place three compression test adaptors (J-38768-A) into the injector holes.
10. Install the injector hold down clamps and torque hold down bolts to 58-66 N·m (43-49 lb·ft).
11. Carefully remove the shaft from the rocker arm assembly by slowly pulling it out of the assembly. Place the shaft on the bench. Do not disturb the stack-up of the rocker arm sets.
12. Remove the three injector rocker arms and replace with spacers (J-38768-5).
13. Lubricate the shaft with clean engine oil. With sleeves in place, carefully reinstall the shaft through each rocker arm shaft. Make sure cup plug end faces inboard.
14. Install the modified rocker arm shaft assembly on the head. If the engine is equipped with a Jake Brake®, use non-Jake Brake rocker arm shaft bolts 8929129. Torque the three bolts and the nut to 102-108 N·m (75-80 lb·ft).
15. Reconnect and prime the fuel system.
16. Disconnect the gray connector (injector drive) from the Electronic Control Unit (ECU) for the “A” bank injectors.

NOTE:

To avoid excessive oil splash during the test, place the bottom half of a two piece design rocker cover (with head to cover gasket installed) on the cylinder head. Install bolts and tighten.

 WARNING:**PERSONAL INJURY**

To avoid injury when working on or near an operating engine, wear protective clothing, eye protection, and hearing protection.

 WARNING:**PERSONAL INJURY**

To avoid injury from hot surfaces, wear protective gloves, or allow engine to cool before removing any component.

 WARNING:**PERSONAL INJURY**

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- ☐ Always start and operate an engine in a well ventilated area.
- ☐ If operating an engine in an enclosed area, vent the exhaust to the outside.
- ☐ Do not modify or tamper with the exhaust system or emission control system.

17. Start and run the engine until the coolant out temperature reaches 40.5 C (105 F).

18. Attach cylinder compression gauge (J-6692-B) to the first adaptor. See Figure 10-4.

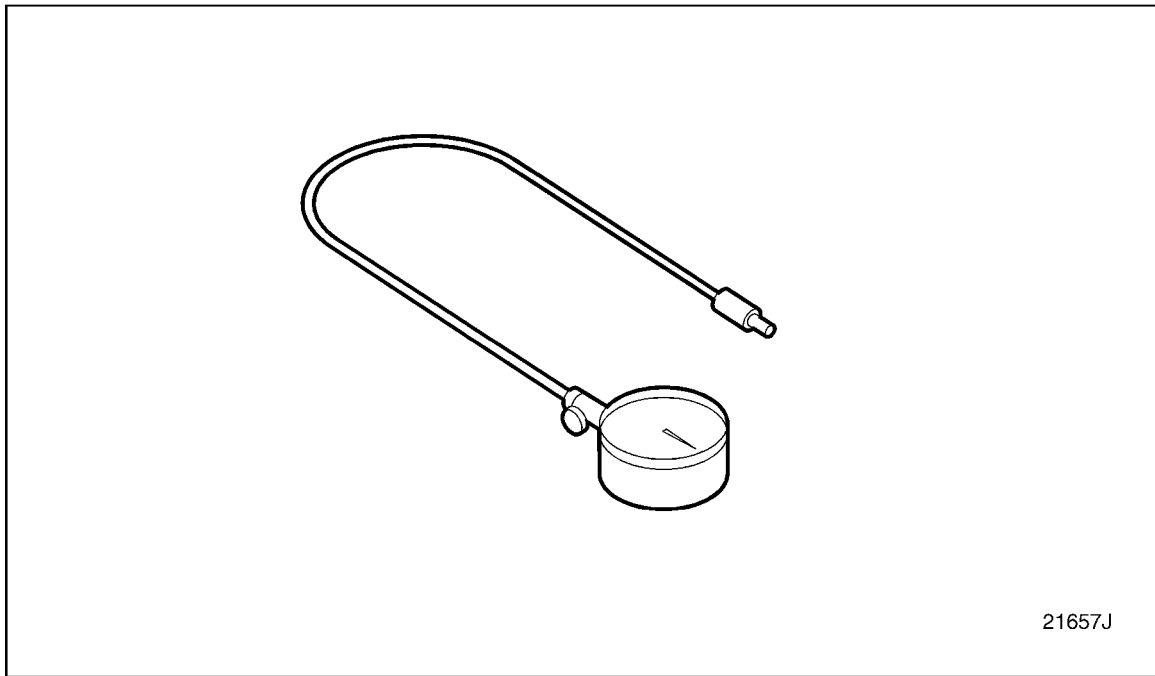


Figure 10-4 Attach Cylinder Compression Gauge J 6692-B

19. Push the pressure relief valve on the gauge several times until the highest compression reading is reached. This should be 3102-3793 kPa (450-550 psi) with no two cylinders differing by more than 276 kPa (40 psi). If compression readings are below specifications, repeat step 19 several times to be certain of the reading.
20. After testing the three cylinders, disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

! WARNING:**EYE INJURY**

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing the compression test adaptors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

21. Blow low pressure regulated air (no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
22. Remove bolts from the modified rocker arm shaft assembly and, using removal tool (J-35996), lift the assembly straight up and off the cylinder head. Place in a clean area on the bench.
23. Carefully remove the shaft from the rocker arm assembly, remove the three oil control sleeves, and replace the three injector rocker arms. Lubricate the shaft with clean engine oil and carefully reinstall through each rocker arm.
24. Remove the injector hold down clamps and remove the three compression test adaptors from the cylinder head. Using new seal rings, reinstall the injectors and clamps and torque bolts to specifications. For injector torque specifications, refer to appropriate service manual, fuel system chapter.
25. Install harness plug into injector connector making sure the locking tang clicks into place.
26. Replace the completed rocker arm shaft assembly on the engine and torque nut and bolts to specifications
27. Perform steps 2 through 26 for the three rear cylinders.
28. Compare cylinder compression test results to specifications.
 - [a] If cylinder pressure is within specifications, call Detroit Diesel Customer Support Center (313-592-5800).
 - [b] If cylinder pressure is below specifications, refer to section 10.6.2.

10.6.2 Low Compression Repair

Perform the following steps for low compression repair:

1. Perform low compression repair.
2. Verify repairs to cylinder head valve or cylinder kit components; refer to section 10.6.2.1.

10.6.2.1 Test Engine with Repaired Cylinder Head Valve(s) and Cylinder Kit

Perform the following steps to determine if the cylinder head valve and cylinder kit repair resolved starting difficulty:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range, 88-96°C (190-210°F).
 - [a] If the engine is not running rough or stalling, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine is running rough or stalling, shut down the engine. Call Detroit Diesel Customer Support Center (313-592-5800).

11 LACK OF POWER

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11.1 AERATED FUEL

To determine if aerated fuel is causing lack of power, perform the following steps:

1. Test for aerated fuel; refer to section 9.3.
2. Visually check to see if air bubbles are rising to the surface of the fuel within the container.
 - [a] If air bubbles are not present, shut down engine, check for high fuel pressure; refer to section 11.2.
 - [b] If air bubbles are present, shut down engine; refer to section 11.1.1.

11.1.1 Aerated Fuel Resolution

Perform the following steps to resolve aerated fuel:

1. Perform aerated fuel repair; refer to section 9.3.1.
2. Verify aerated fuel resolution; refer to section 11.1.1.1.

11.1.1.1 Test the Engine with Aerated Fuel Resolution

Perform the following steps to determine if aerated fuel resolution resolved lack of power condition:

1. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Test drive the vehicle to ensure lack of power has been resolved.
 - [a] If no lack of power occurred during the test drive, no further troubleshooting is required. Shut down the engine.
 - [b] If lack of power occurred during the test drive, shut down the engine. Check for high fuel pressure; refer to section 11.2.

11.2 HIGH FUEL PRESSURE

To determine if high fuel pressure is causing lack of power, perform the following steps:

1. Remove the supply fuel temperature sensor (SFT) fitting from the secondary filter, if equipped; see Figure 11-1 for SFT.

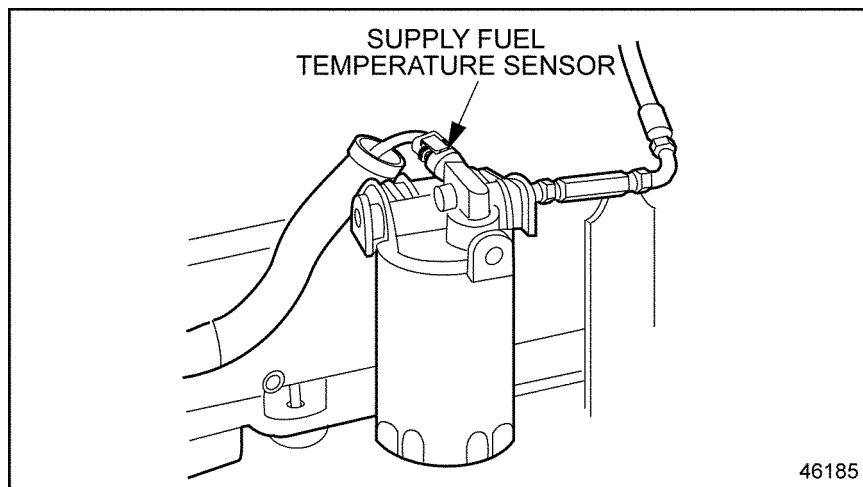


Figure 11-1 Supply Fuel Temperature Sensor

2. Install a tee fitting between the secondary filter and fuel outlet line.
3. Attach a calibrated gauge capable of reading 0 - 689 kPa (0 - 100 psi) to the tee fitting.
4. Start and run the engine to the speeds listed in Table 11-1 and record the fuel pressure:

NOTE:

When checking fuel pressure, start the engine, run at the speeds listed in Table 11-1, and record fuel pressure. Shut down the engine.

Engine Speed, rpm	Fuel Pressure, kPa (psi)
600	103-152 (15 - 22 psi)
1200 - 1300	207-310 (30 - 45 psi)
1800 - 2100	448 - 552 (65 - 80 psi)

Table 11-1 Fuel Pressure at Various Speeds

5. Shut down the engine.
6. Remove the tee fitting and calibrated gauge from the secondary filter.
7. Reinstall the SFT Sensor, refer to the appropriate service manual fuel system chapter.
8. Analyze the measured fuel pressure readings.
 - [a] If the fuel oil pressure is within specification listed in Table 11-1, check for high fuel oil temperature return; refer to section 11.3.

- [b] If the fuel oil pressure is greater than specifications listed in Table 11-1, refer to section 11.2.1.

11.2.1 Restricted Fitting and Check Valve Replacement

Perform the following steps to replace the restricted fitting and check valve.

1. Remove the restricted fitting; refer to appropriate service manual, fuel system chapter.
2. Install a new restricted fitting; refer to appropriate service manual, fuel system chapter.
3. Remove the check valve; refer to OEM guidelines.
4. Install a new check valve; refer to OEM guidelines.
5. Verify check valve and restricted fitting replacement; refer to section 11.2.1.1.

NOTICE:

Do not increase the size of the orifice in restricted fittings. Increasing restricted fitting hole size can cause injector cavitation, resulting in reduced durability of injectors and other engine components, and increased engine emissions.

11.2.1.1 Test the Engine with Replaced Check Valve and Restricted Fitting

Perform the following steps to determine if the replaced check valve and restricted fitting resolved lack of power condition:

1. Refer to section 11.2 for exhaust caution before proceeding. Start and run the engine.
2. Run the engine at idle with a no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
3. Test drive the vehicle to ensure lack of power has been resolved.
 - [a] If no lack of power occurred during the test drive, no further troubleshooting is required. Shut down the engine.
 - [b] If lack of power occurred during the test drive, shut down the engine. Check for high fuel oil temperature return; refer to section 11.3.

11.3 HIGH FUEL OIL TEMPERATURE RETURN

To determine if high fuel oil temperature return is causing lack of power, perform the following steps:

1. Test for high fuel oil temperature return.
2. Analyze the high fuel oil temperature test results.
 - [a] If the return fuel oil temperature is less than or equal to 60°C (140°F), check for air cleaner restriction; refer to section 11.4.
 - [b] If the return fuel oil temperature is greater than 60°C (140°F), resolve the high fuel oil temperature return condition; refer to section 11.3.1.

11.3.1 High Fuel Oil Temperature Resolution

Perform the following steps to resolve high fuel oil temperature return:

1. Remove and replace fuel oil filter(s); refer to appropriate service manual, fuel system chapter.
2. Inspect the check valve for a restricted fitting, replace if necessary; refer to appropriate service manual, fuel system chapter.
3. Verify high fuel oil temperature repair; refer to section 11.3.1.1.

11.3.1.1 Test the Engine with Resolved High Fuel Oil Temperature

Perform the following steps to determine if high fuel oil temperature repairs resolved lack of power condition:

1. Start and run the engine.
2. Test drive the vehicle to ensure lack of power has been resolved.
 - [a] If lack of power did not occur during the test drive, no further troubleshooting is required. Shut down the engine.
 - [b] If lack of power occurred during the test drive, shut down the engine. Check for a restricted air cleaner element; refer to section 11.4.

11.4 RESTRICTED AIR CLEANER ELEMENT

To determine if a restricted air cleaner element is causing lack of power, perform the following steps:

1. Remove the air filter element from the air cleaner container; refer to OEM guidelines.
2. Visually inspect the air cleaner element for damage or clogging.
 - [a] If no damage or clogging is found, check the charge air cooler; refer to section 11.5.
 - [b] If damage or clogging is found; refer to section 11.4.1.

11.4.1 Air Filter Element Replacement

Perform the following steps to replace the air filter element:

1. Remove and replace the damaged or clogged air filter element; refer to OEM guidelines.
2. Verify air filter element replacement; refer to section 11.4.1.1.

11.4.1.1 Test the Engine with Replaced Air Filter Element

Perform the following steps to determine if the new filter element resolved lack of power:

1. Start and run the engine.
2. Test drive the vehicle to ensure lack of power has been resolved.
 - [a] If lack of power did not occur during the test drive, no further troubleshooting is required. Shut down the engine.
 - [b] If lack of power occurred during the test drive, shut down the engine. Check the charge air cooler; refer to section 11.5.

11.5 RESTRICTED OR CRACKED CHARGE AIR COOLER OR LEAKING INTAKE MANIFOLD

To determine if a restricted or cracked charge air cooler or leaking manifold is causing lack of power, perform the following steps:

1. Test the charge air cooler; refer to section 7.3.
2. Visually inspect all joints for air leaks and all charge air cooler welded surfaces for stress cracks.
 - [a] If charge air cooler leaks are present around the joints, replace the charge air cooler; refer to section 11.5.1.
 - [b] If the intake manifold leaks, repair intake manifold; refer to section 11.5.2.
 - [c] If neither charge air cooler nor intake manifold leaked, check the exhaust system; refer to section 11.6.

11.5.1 Charge Air Cooler Replacement

Perform the following steps to replace the charge air cooler:

1. Remove and replace the charge air cooler; refer to OEM guidelines.
2. If the intake manifold doesn't leak, verify replacement of the charge air cooler; refer to section 11.5.2.1.
3. If the intake manifold leaks, repair intake manifold; refer to section 11.5.2.

11.5.2 Air Intake Manifold Repair

Perform the following steps to repair the air intake manifold:

1. Remove the air intake manifold; refer to appropriate service manual, fuel system chapter.
2. Inspect the air intake manifold; refer to appropriate service manual, fuel system chapter.
3. Install the air intake manifold; refer to appropriate service manual, fuel system chapter.
4. Verify repair of the intake manifold; refer to section 11.5.2.1.

11.5.2.1 Test the Engine with Replaced Charge Air Cooler and Air Intake Manifold

To determine if the repairs resolved the lack of power condition, perform the following steps:

1. Start and run the engine.
2. Test drive the vehicle to ensure lack of power has been resolved.
 - [a] If no lack of power occurred during the test drive, no further troubleshooting is required. Shut down the engine.
 - [b] If lack of power occurred during the test drive, shut down the engine. Check the exhaust system; refer to section 11.6.

11.6 FAULTY EXHAUST SYSTEM

To determine if a faulty exhaust system is causing lack of power, perform the following steps:

1. Test the exhaust system; refer to section 7.4.
2. Run the engine speed to full load.
 - [a] If the exhaust back pressure at full load is less than 10.1 kPa (3.0 in.Hg), check for high inlet air temperature; refer to section 11.7.
 - [b] If the exhaust back pressure at full load is 10.1 kPa (3.0 in.Hg) or greater, refer to section 11.6.1.

11.6.1 Engine Exhaust System Resolution

Perform the following steps to resolve the engine exhaust system:

1. Visually inspect the engine exhaust system; refer to OEM guidelines.
2. Repair or replace defective exhaust system components; refer to OEM guidelines.
3. Verify exhaust system resolution; refer to section 11.6.1.1.

11.6.1.1 Test the Engine with Replaced Exhaust System

Perform the following steps to determine if replaced engine exhaust system components resolved lack of power condition:

1. Refer to section 11.6 for the exhaust caution before proceeding. Start and run the engine.
2. Test drive the vehicle to ensure lack of power has been resolved.
 - [a] If no lack of power occurred during the test drive, no further troubleshooting is required. Shut down the engine.
 - [b] If lack of power occurred during the test drive, shut down the engine. Check for high inlet air temperature; refer to section 11.7.

11.7 HIGH INLET AIR TEMPERATURE

To determine if high inlet air temperature is causing lack of power, perform the following:

1. Test the radiator fan, fan drive, or fan shroud for proper operation or configuration; refer to OEM guidelines.
2. Examine test results.
 - [a] If the radiator fan, fan drive, or fan shroud pass OEM test, check high altitude operation; refer to section 11.8.
 - [b] If the radiator fan, drive or shroud did not operate correctly; refer to section 11.7.1.

11.7.1 Radiator Fan, Drive and Shroud Replacement

Perform the following steps to replace the radiator fan, drive and or shroud:

1. Remove and replace the radiator fan, drive and/or shroud; refer to OEM guidelines.
2. Verify replacement; refer to section 11.7.1.1.

11.7.1.1 Test the Engine with Radiator Fan, Fan Drive, or Fan Shroud Replacement

Perform the following steps to determine if replaced radiator fan, fan drive, or fan shroud resolved lack of power condition:

1. Start and run the engine.
2. Test drive the vehicle to ensure lack of power has been resolved.
 - [a] If no lack of power occurred during the test drive, no further troubleshooting is required. Shut down the engine.
 - [b] If lack of power occurred during the test drive, shut down the engine. Check high altitude operation; refer to section 11.8.

11.8 HIGH ALTITUDE OPERATION

To determine if high altitude operation is causing lack of power:

1. Examine the altitude performance curve, see Figure 11-2.
2. Based on the altitude curve data, , decide if high altitude is causing the lack of power.
 - [a] If your vehicle is operating above sea level, a loss of power will be encountered, no further troubleshooting is required.
 - [b] If your vehicle is operating at or below sea level and there is a lack of power, refer to section 11.9.

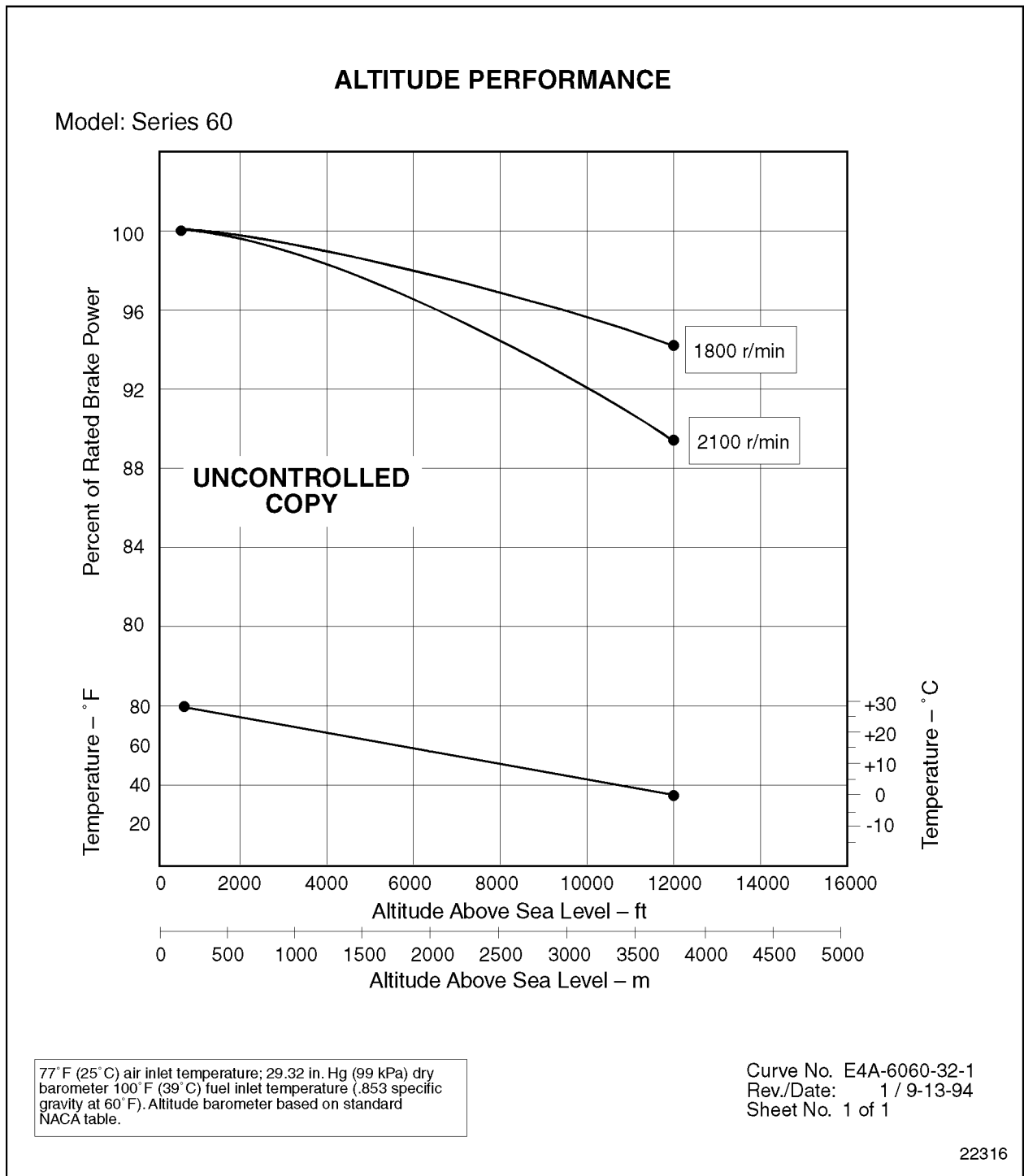


Figure 11-2 Altitude Performance Curve

11.9 INCORRECT CAMSHAFT TIMING

To determine if incorrect camshaft timing is causing lack of power, perform the following steps:

1. Check the camshaft timing; refer to appropriate service manual, engine chapter.
 - [a] If the dial indicator reading is within 0.173 -0.215 in. (4.39 - 5.46 mm), no further troubleshooting is required.
 - [b] If the dial indicator reading is not within 0.173 -0.215 in. (4.39 - 5.46 mm), check engine timing; refer to section 11.9.1.

11.9.1 Engine Timing Resolution

Perform the following steps to resolve incorrect engine timing:

1. Perform an engine gear train timing check; refer to appropriate service manual, engine chapter.
2. Verify engine timing resolution; refer to section 11.9.1.1.

11.9.1.1 Test Engine with Correct Timing

Perform the following steps to determine if corrected engine timing resolved lack of power condition:

1. Start and run the engine.
2. Test drive the vehicle to ensure lack of power has been resolved.
 - [a] If no lack of power occurred during the test drive, no further troubleshooting is required. Shut down the engine.
 - [b] If lack of power occurred during the test drive, shut down the engine. Call the Detroit Diesel Customer Support Center (313-592-5800).

12 HIGH ENGINE COOLANT TEMPERATURE

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12.1 IMPROPER ENGINE COOLANT LEVEL

To determine if improper engine coolant level is causing high engine coolant temperature, perform the following:

1. Visually inspect the radiator coolant level; refer to OEM guidelines.
2. Examine the results.
 - [a] If the radiator coolant level is within 2.0 in. (approximately 50 mm) of the radiator filler neck, check insufficient radiator air circulation; refer to section 12.2.
 - [b] If the radiator coolant level is not within 2 in. (approximately 50 mm) of the radiator filler neck, refer to section 12.1.1.

12.1.1 Improper Coolant Level Resolution

Perform the following steps to resolve improper coolant level:

1. Fill coolant system to correct level; refer to appropriate service manual, preventive maintenance chapter.
2. Verify coolant level resolution; refer to section 12.1.1.1.

12.1.1.1 Test Engine with Proper Coolant Level

Perform the following to determine if proper coolant level resolved high engine coolant temperature:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
 - [a] If the engine coolant temperature is 88-96°C (190-210°F), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine coolant temperature is not 88-96°C (190-210°F), shut down the engine. Check for insufficient radiator air circulation; refer to section 12.2.

12.2 INSUFFICIENT RADIATOR AIR CIRCULATION

To determine if insufficient radiator air circulation is causing high engine coolant temperature, perform the following:

1. Visually examine the radiator and radiator shrouding.
2. Check for excessive clogging, a damaged shrouding or a faulty pressure control cap.

12.2.1 Exterior Radiator Repair

Perform the following for exterior radiator repair:

1. Clean the exterior radiator of all clogging, debris, or excessive dirt; refer to OEM guidelines.
2. Verify exterior radiator repair; refer to section 12.2.2.1.
 - [a] If the radiator is absent of clogging, debris, and dirt, check the pressure control cap; refer to section 12.3.
 - [b] If the radiator has excessive clogging, debris, or dirt; refer to section 12.2.1.
 - [c] If the radiator shrouding is not damaged, incorrectly positioned, or inadequate, check the pressure control cap; refer to section 12.3.
 - [d] If the radiator shrouding is damaged, incorrectly positioned, or inadequate, refer to section 12.2.2.

12.2.2 Radiator Shroud Repair

Perform the following for radiator shroud repair:

1. Repair or replace damaged radiator shrouding; refer to OEM guidelines
2. Verify exterior radiator repair; refer to section 12.2.2.1.

12.2.2.1 Test Engine with Repaired Exterior Radiator and Shrouding

Perform the following to determine if exterior radiator and shrouding repair resolved high engine coolant temperature:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
 - [a] If the engine coolant temperature is 88-96°C (190-210°F), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine coolant temperature is not 88-96°C (190-210°F), shut down the engine. Check the pressure control cap; refer to section 12.3.

12.3 FAULTY PRESSURE CONTROL CAP

To determine if a faulty pressure control cap is causing high engine coolant temperature, perform the following:

1. Perform coolant pressure control cap tests; refer to appropriate service manual, cooling system chapter.
2. Check the test results.
 - [a] If the cooling system pressure is less than or equal to 48.3 kPa (7 psi), check the coolant hoses; refer to section 12.4.
 - [b] If the cooling system pressure is greater than 48.3 kPa (7 psi), refer to section 12.3.1.

12.3.1 Pressure Control Cap Resolution

Perform the following steps to resolve faulty pressure control cap:

1. Remove and replace pressure control cap; refer to OEM guidelines.
2. Install a new pressure control cap; refer to OEM guidelines.
3. Verify pressure control repair; refer to section 12.3.1.1.

12.3.1.1 Test Engine with Replaced Pressure Control Cap

Perform the following to determine if exterior radiator repair resolved high engine coolant temperature:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
 - [a] If the engine coolant temperature is normal, no further troubleshooting is required. Shut down the engine.
 - [b] If the engine coolant temperature is not normal, shut down the engine. Check coolant hoses; refer to section 12.4.

12.4 DEFECTIVE COOLANT HOSES

To determine if defective coolant hoses is causing high engine coolant temperature, perform the following:

1. Visually examine cooling system hoses; refer to OEM guidelines.
2. Check for soft, deteriorated, or collapsed hoses.
 - [a] If cooling system hoses are not soft, deteriorated, or collapsed, check the fan belts; refer to section 12.5.
 - [b] If cooling system hoses are soft, deteriorated, or collapsed, refer to section 12.4.1.

12.4.1 Coolant System Hoses Replacement

Perform the following steps to resolve worn or damaged coolant system hoses:

1. Remove and replace damaged or worn coolant hoses as necessary; refer to OEM guidelines.
2. Install new coolant hoses as necessary; refer to OEM guidelines.
3. Verify replaced coolant system hoses; refer to section 12.4.1.1.

12.4.1.1 Test Engine with Replaced Coolant Hoses

Perform the following to determine if the new coolant hoses resolved high engine coolant temperature:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range, and visually examine replaced hoses for any leaks.
 - [a] If the engine coolant temperature is 88-96°C (190-210°F) and no leaks are found, no further troubleshooting is required.
 - [b] If the engine coolant temperature is 88-96°C (190-210°F) and leaks are found, repair leaks; refer to section 12.4.1. Shut down the engine.
 - [c] If the engine coolant temperature is not 88-96°C (190-210°F) and no leaks are found, shut down the engine. Check fan belts; refer to section 12.5.

12.5 FAN BELTS ARE INCORRECTLY ADJUSTED

To determine if misadjusted fan belts are causing high engine coolant temperature, perform the following:

1. Test fan belt(s) tension; refer to appropriate service manual, preventive maintenance chapter.
2. Compare tension to belt specifications listed in Table 12-1.
 - [a] If the belt(s) tension is within specification, check the thermo-modulated fan; refer to section 12.6.
 - [b] If the belt(s) tension is not within specification, refer to section 12.5.1.

Single Belt, N (lb)	2 or 3 Belts, N (lb)
355 - 445 (80 - 100)	266 - 355 (60 - 80)

Table 12-1 Fan Belt Tension

12.5.1 Belt Tension Resolution

Perform the following steps to resolve incorrect belt tension:

1. Readjust belt(s) tension as necessary; refer to appropriate service manual, preventive maintenance chapter.
2. Verify belt tension resolution; refer to section 12.5.1.1.

12.5.1.1 Test Engine with Correct Belt Tension

Perform the following to determine if exterior radiator repair resolved high engine coolant temperature:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
 - [a] If the engine coolant temperature is 88-96°C (190-210°F), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine coolant temperature is not 88-96°C (190-210°F), shut down the engine. Check thermo-modulated fan; refer to section 12.6.

12.6 INOPERATIVE THERMO-MODULATED FAN

To determine if an inoperative thermo-modulated fan is causing high engine coolant temperature, test the thermo-modulated fan; refer to OEM guidelines.

1. If the thermo-modulated fan is functioning correctly, check thermostats; refer to section 12.7.
2. If the thermo-modulated fan is not functioning correctly, refer to section 12.6.1.

12.6.1 Thermo-modulated Fan Replacement

Perform the following steps to replace inoperative thermo-modulated fan:

1. Replace inoperative thermo-modulated fan; refer to OEM guidelines.
2. Verify thermo-modulated fan replacement; refer to section 12.6.1.1.

12.6.1.1 Test Engine with Replaced Thermo-modulated Fan

Perform the following to determine if thermo-modulated fan replacement resolved high engine coolant temperature:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
 - [a] If the engine coolant temperature is 88-96°C (190-210°F), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine coolant temperature is not 88-96°C (190-210°F), shut down the engine. Check thermostats; refer to section 12.7.

12.7 FAULTY THERMOSTATS

To determine if faulty thermostats are causing high engine coolant temperature, perform the following:

1. Remove thermostat from the thermostat housing; refer to appropriate service manual, cooling system chapter.
2. Inspect thermostat for correct operation; refer to appropriate service manual, cooling system chapter.
 - [a] If thermostat opened at 97°C (207°F), check water pump; refer to section 12.8.
 - [b] If thermostat did not open at 97°C (207°F), refer to section 12.7.1.

12.7.1 Thermostat Replacement

Perform the following steps to replace thermostats:

1. Install new thermostat; refer to appropriate service manual, cooling system chapter.
2. Verify replaced thermostat; refer to section 12.7.1.1.

12.7.1.1 Test Engine with New Thermostat

Perform the following to determine if thermostat replacement resolved high engine coolant temperature:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
 - [a] If the engine coolant temperature is 88-96°C (190-210°F), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine coolant temperature is not 88-96°C (190-210°F), shut down the engine. Check water pump; refer to section 12.8.

12.8 FAULTY WATER PUMP

To determine if a faulty water pump is causing high engine coolant temperature, perform the following:

1. Remove the water pump, (gear case mounted) or (gear case cover mounted); refer to appropriate service manual, cooling system chapter.
2. Turn the water pump over and install J-35687, water pump impeller slip and lash tester, into the tapped holes provided in the impeller; see Figure 12-1.

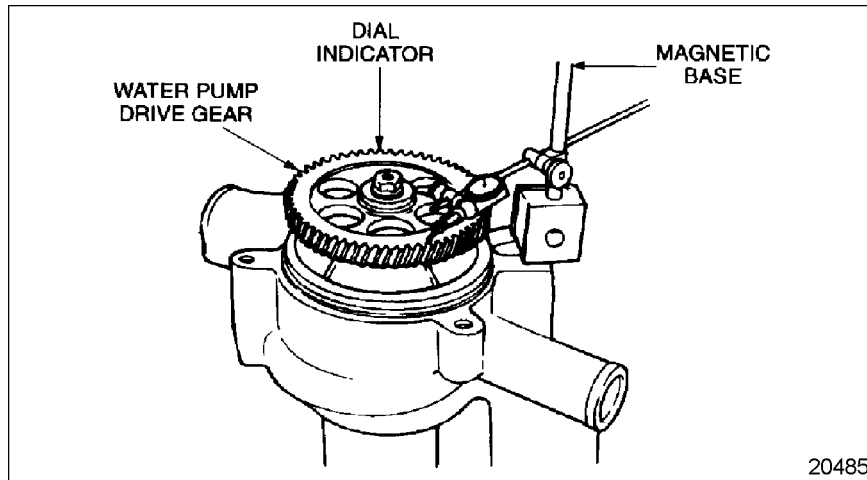


Figure 12-1 Measuring Water Pump Drive Gear Run-out

3. Clamp the water pump drive gear in a vise, with the impeller facing up. Use soft jaws to prevent damage to the gear teeth.
4. Using a 1/2 in. drive torque wrench in the hole provided in the center of the slip-lash tester, apply 68 N·m (50 lb·ft) torque in either direction. The impeller must withstand 68 N·m (50 lb·ft) torque without slipping.
 - [a] If the torque 68 N·m (50 lb·ft) is satisfied without the impeller slipping, check combustion gases in coolant; refer to section 12.9.
 - [b] If the torque 68 N·m (50 lb·ft) is not satisfied and the impeller is slipping, refer to section 12.8.1.

12.8.1 Water Pump Impeller Replacement

Perform the following steps to replace water pump impeller:

1. Disassemble the water pump and replace worn or damaged impeller for (gear case mounted) or (gear case cover mounted); refer to appropriate service manual, cooling system chapter..
2. Reassemble the water pump with new components as necessary for (gear case mounted) or (gear case cover mounted); refer to appropriate service manual, cooling system chapter..

12.8.1.1 Test Engine with Repaired Water Pump

Perform the following to determine if thermo-modulated fan replacement resolved high engine coolant temperature:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
 - [a] If the engine coolant temperature is 88-96°C (190-210°F), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine coolant temperature is not 88-96°C (190-210°F), shut down the engine. Check combustion gases in coolant; refer to section 12.9.

12.9 COMBUSTION GASES IN COOLANT

To determine if combustion gases in coolant is causing high engine coolant temperature, perform the cylinder compression test. Refer to section 12.9.1.

12.9.1 Cylinder Compression Test

Perform the following steps for a compression test on a Series 60 Engine:

 WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. ☐ Always start and operate an engine in a well ventilated area. ☐ If operating an engine in an enclosed area, vent the exhaust to the outside. ☐ Do not modify or tamper with the exhaust system or emission control system.

1. Start and run the engine until normal operating temperature is reached. Stop the engine.
2. Clean and remove the rocker cover. If cover is a two-piece design, it is not necessary to remove the bottom.
3. Disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

 WARNING: EYE INJURY
To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:
All the fuel must be removed from the cylinder head before removing injectors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

4. Blow low pressure regulated air no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.

5. Remove the three rocker shaft mounting bolts and nut from the front rocker shaft assembly. Using rocker arm lifter J-35996-A, see Figure 12-2, lift the assembly straight up and off of the head and place in a clean area on the bench.

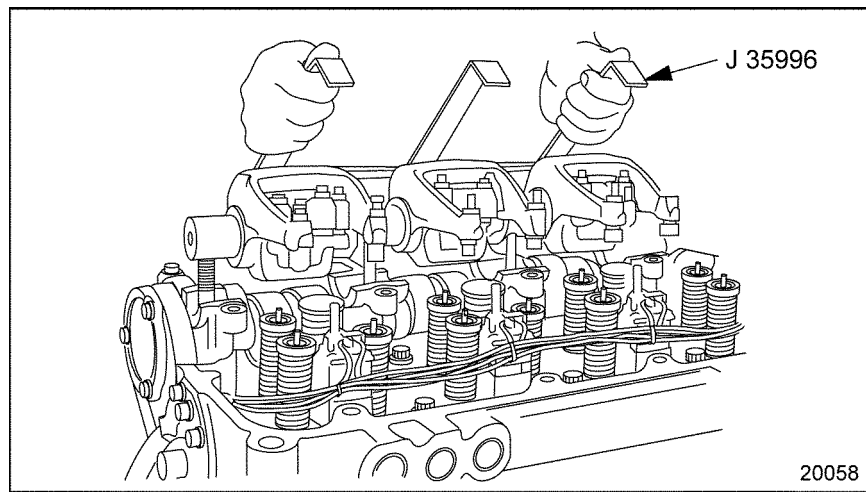


Figure 12-2 Rocker Arm/Shaft Assembly Removal/Installation

6. Disengage the locking tang on the harness plug connection, grasp the connector and gently pull it from the socket.
7. Remove the injector hold down clamps.

NOTICE:

Use extreme care when handling injectors to avoid costly damage by dropping or mishandling. Always install new O-rings when replacing injectors.

8. Remove the front three injectors from the cylinder head.
9. Place three compression test adaptors (J-38768-A) into the injector holes.
10. Install the injector hold down clamps and torque hold down bolts to 58-66 N·m (43-49 lb·ft).
11. Carefully remove the shaft from the rocker arm assembly by slowly pulling it out of the assembly. Place the shaft on the bench. Do not disturb the stack-up of the rocker arm sets.
12. Remove the three injector rocker arms and replace with spacers (J-38768-5) .
13. Lubricate the shaft with clean engine oil. With sleeves in place, carefully reinstall the shaft through each rocker arm shaft. Make sure cup plug end faces inboard.
14. Install the modified rocker arm shaft assembly on the head. If the engine is equipped with a Jake Brake®, use non-Jake Brake rocker arm shaft bolts 8929129. Torque the three bolts and the nut to 102-108 N·m (75-80 lb·ft).
15. Reconnect and prime the fuel system.

16. Disconnect the gray connector (injector drive) from the Electronic Control Unit (ECU) for the “A” bank injectors.

NOTE:

To avoid excessive oil splash during the test, place the bottom half of a two piece design rocker cover (with head to cover gasket installed) on the cylinder head. Install bolts and tighten.

 WARNING:**PERSONAL INJURY**

To avoid injury when working on or near an operating engine, wear protective clothing, eye protection, and hearing protection.

 WARNING:**PERSONAL INJURY**

To avoid injury from hot surfaces, wear protective gloves, or allow engine to cool before removing any component.

 WARNING:**PERSONAL INJURY**

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- ☐ Always start and operate an engine in a well ventilated area.
- ☐ If operating an engine in an enclosed area, vent the exhaust to the outside.
- ☐ Do not modify or tamper with the exhaust system or emission control system.

17. Start and run the engine until the coolant out temperature reaches 40.5 C (105 F).

18. Attach cylinder compression gauge (J-6692-B) to the first adaptor. See Figure 12-3.

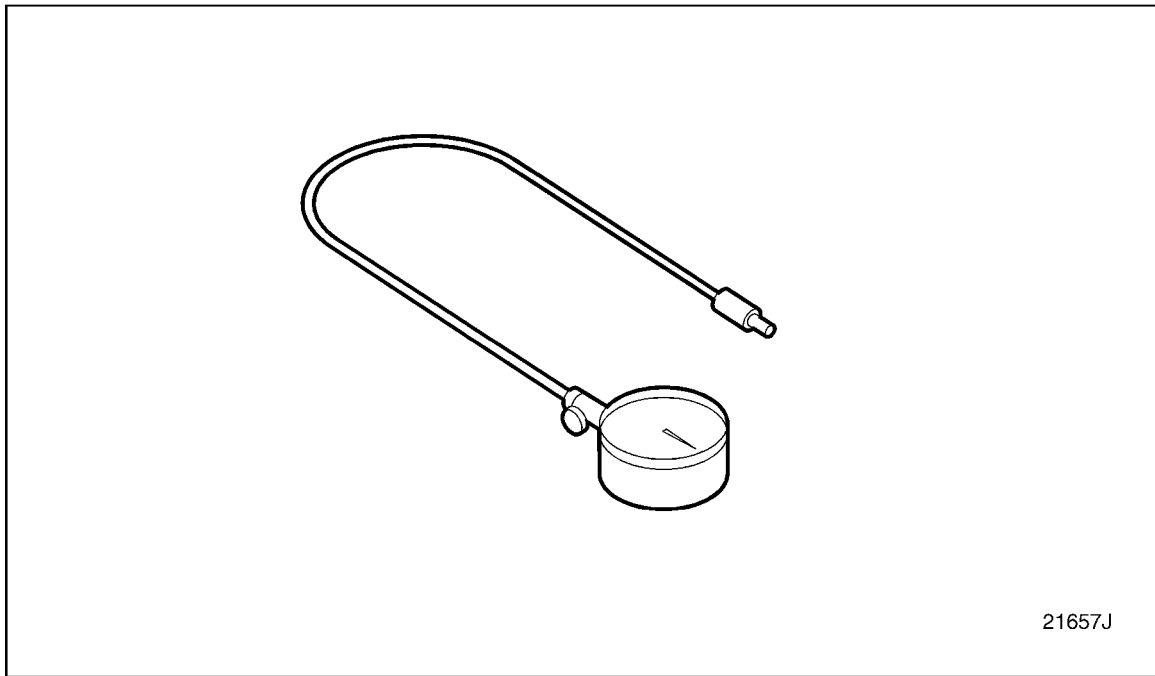


Figure 12-3 Attach Cylinder Compression Gauge J 6692-B

19. Push the pressure relief valve on the gauge several times until the highest compression reading is reached. This should be 3102-3793 kPa (450-550 psi) with no two cylinders differing by more than 276 kPa (40 psi). If compression readings are below specifications, repeat step 19 several times to be certain of the reading.
20. After testing the three cylinders, disconnect the filter to head fuel supply line at the outlet fitting on the secondary fuel filter adaptor. Place a suitable container under the line to catch the spilled fuel.

**WARNING:****EYE INJURY**

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE:

All the fuel must be removed from the cylinder head before removing the compression test adaptors. This prevents the fuel from entering the cylinder and causing cylinder wall lube oil wash down or a hydrostatic lock at startup.

21. Blow low pressure regulated air (no more than 207 kPa (30 psi) into the inlet fitting for 20 to 30 seconds or until all the fuel is purged from the head.
22. Remove bolts from the modified rocker arm shaft assembly and, using rocker arm lifter (J-35996), lift the assembly straight up and off the cylinder head. Place in a clean area on the bench.
23. Carefully remove the shaft from the rocker arm assembly, remove the three oil control sleeves, and replace the three injector rocker arms. Lubricate the shaft with clean engine oil and carefully reinstall through each rocker arm.
24. Remove the injector hold down clamps and remove the three compression test adaptors from the cylinder head. Using new seal rings, reinstall the injectors and clamps and torque bolts to specifications. For injector torque specifications, refer to appropriate service manual, engine chapter.
25. Install harness plug into injector connector making sure the locking tang clicks into place.
26. Replace the completed rocker arm shaft assembly on the engine and torque nut and bolts to specifications
27. Perform steps 2 through 26 for the three rear cylinders.
28. Check test results.
 - [a] If test results are to specifications; check radiator coolant flow, refer to section 12.10.
 - [b] If test results are not to specifications; refer to section 12.9.2.

12.9.2 Cylinder Head Gasket Replacement

Perform the following steps to replace cylinder head gasket:

1. Remove and replace cylinder head gasket; refer to appropriate service manual, engine chapter.
2. Verify new cylinder head gasket replacement; refer to section 12.9.2.1.

12.9.2.1 Test Engine with Replaced Cylinder Head Gasket

Perform the following to determine if thermo-modulated fan replacement resolved high engine coolant temperature:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
 - [a] If the engine coolant temperature is 88-96°C (190-210°F), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine coolant temperature is not 88-96°C (190-210°F), shut down the engine. Check radiator coolant flow; refer to section 12.10.

12.10 ABNORMAL RADIATOR COOLANT FLOW

To determine if abnormal radiator coolant flow is causing high engine coolant temperature, perform the following:

1. Install a sight glass with string (both ends) to the radiator outlet hose near radiator and before fill and heater return lines; see Figure 12-4.

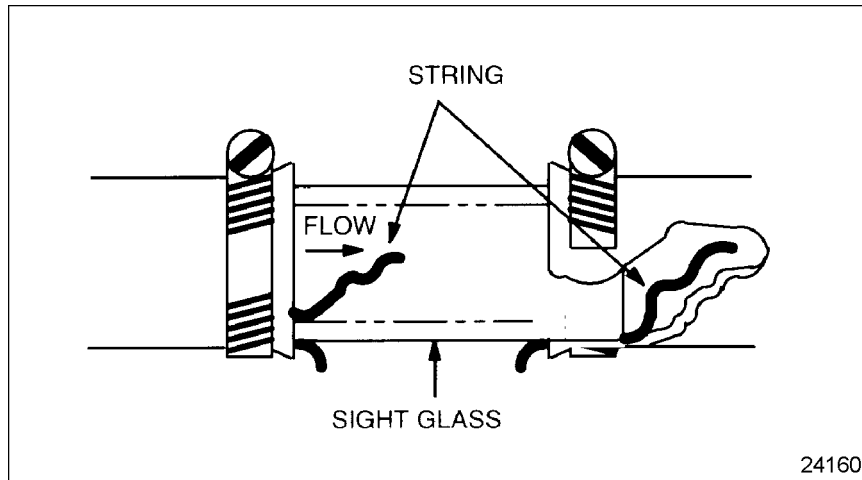


Figure 12-4 Radiator Flow Check

2. Start and run the engine at full load.
3. Observe the string for flow and direction as well as the fill and bleed lines. Continue observation while varying the engine speed between 1800 - 2100 rpm.
 - [a] If a balanced coolant flow is observed in the sight, call Detroit Diesel Customer Support Center (313-592-5800). Shut down the engine.
 - [b] If a balanced coolant flow is not observed in the sight glass, refer to section 12.10.1. Shut down the engine.

12.10.1 Abnormal Radiator Coolant Flow Resolution

Perform the following steps, as necessary, to resolve abnormal radiator coolant flow:

1. Correct bleed line size; refer to OEM guidelines.
2. Correct fill line size or connector fitting size; refer to OEM guidelines.
3. Correct restrictive top tank opening; refer to OEM guidelines.
4. Correct location of standpipe; refer to OEM guidelines.
5. Verify repairs made to correct abnormal radiator coolant flow; refer to section 12.10.1.1.

12.10.1.1 Test Engine with Resolved Radiator Coolant Flow

Perform the following to determine if thermo-modulated fan replacement resolved high engine coolant temperature:

1. Refer to section 12.10 for the exhaust caution before proceeding. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
 - [a] If the engine coolant temperature is 88-96°C (190-210°F), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine coolant temperature is not 88-96°C (190-210°F), shut down the engine. Call the Detroit Diesel Customer Support Center at 313-592-5800.

13 LOW COOLANT TEMPERATURE

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13.1 FAULTY THERMOSTATS

To determine if faulty thermostats are causing low engine coolant temperature, perform the following:

1. Remove thermostat from the thermostat housing; refer to appropriate service manual, cooling system chapter.
2. Inspect thermostat for correct operation; refer to appropriate service manual, cooling system chapter.
 - [a] If thermostat did not open at 97°C (207°F), refer to section 13.1.1.

13.1.1 Thermostat Replacement

Perform the following steps to replace thermostats:

1. Install new thermostat; refer to appropriate service manual, cooling system chapter.
2. Verify replaced thermostat; refer to section 13.1.1.1.

13.1.1.1 Test Engine with New Thermostat

Perform the following to determine if thermostat replacement resolved low engine coolant temperature:

1. Start and run the engine.
2. Run the engine through its operating range with no-load for approximately 5 minutes, allowing the engine coolant to reach normal operating range.
 - [a] If the engine coolant temperature is 88-96°C (190-210°F), no further troubleshooting is required. Shut down the engine.
 - [b] If the engine coolant temperature is not 88-96°C (190-210°F), shut down the engine. Contact DDC Customer Support Center (313-592-5800).

14 POOR FUEL ECONOMY

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14.1 SOFTWARE VERSION	14-3

14.1 SOFTWARE VERSION

The following section contains troubleshooting procedures for *Poor Engine Performance* on engines equipped with DDEC V..

14.1.1 Poor Engine Performance DDEC V Equipped Engines

To determine the cause of poor fuel economy for DDEC V equipped engines perform the following steps:

1. What version of software is DDEC V ECU running?
 - [a] If the software version is lower than Level 2 , reprogram the ECU.. Once the ECU has been reprogrammed, proceed to step 2.
 - [b] If the software is Level 2 or higher, proceed to step 2.
2. Verify that the engine hardware has been campaigned or modified to the latest version.
 - [a] If you are uncertain or unable to determine that the engine has been campaigned or modified to the latest version, please contact the Detroit Diesel Customer Support Center (313-592-5800).
 - [b] If you unable to determine that the engine has been campaigned or modified to the latest version, proceed to step 3.
3. Verify that the fuel filters are not plugged. Refer to the “Preventive Maintenance “ section of the appropriate Service Manual for inspection steps.
4. Visually inspect the air filter element for excess dirt, blocked filter elements, and damage. Refer to “Air Cleaner” section of the appropriate Service Manual for removal, inspection, and installation steps.
5. If the engine is equipped with a Exhaust Gas Recirculation (EGR) system, verify that the VPOD is connected to a dedicated air line.
 - [a] If the VPOD air line is not connected to a dedicated source, refer to OEM guidelines for a solution. Once the problem has been resolved, proceed to step 6.
 - [b] If the VPOD air line is connected to a dedicated source, proceed to step 6.
6. Perform to test the Barometric Pressure Sensor. Once the test has been completed, proceed to step 7.
7. Perform test to verify that the CAC system is not damaged.
 - [a] Once the test has been completed, verify that the reported poor engine performance problem has been resolved. If the problem has been resolved, the troubleshooting test has been completed.
 - [b] Once the test has been completed, verify that the reported poor engine performance problem has been resolved. If the problem has not been resolved, please contact the Detroit Diesel Customer Support Center (313-592-5800).

15 AIR COMPRESSOR

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15.1 AIR COMPRESSOR TROUBLESHOOTING

Troubleshooting information for the Bendix® air compressor can be found on the Bendix web site at <http://www.bendix.com> or call the Bendix Technical Assistance Center at 1-800-AIR-BRAKE, (1-800-247-2725).

16 DDEC SYSTEM

Section	Page
16.1 DDEC SYSTEM--HOW IT WORKS	16-3
16.2 CONNECTORS	16-22
16.3 WIRES AND WIRING	16-24
16.4 CONDUIT AND LOOM	16-47
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16.1 DDEC SYSTEM—HOW IT WORKS

The major components of the DDEC system consist of the Electronic Control Unit (ECM/ECU), the Electronic Unit Injectors (EUI) and the various system sensors. The purpose of the sensors is to provide information to the ECM/ECU regarding various engine performance characteristics. The information sent to the ECM/ECU is used to instantaneously regulate engine and vehicle performance.

16.1.1 Electronic Control Unit

The engine-mounted Electronic Control Unit (ECM/ECU) (see Figure 16-1) includes control logic to provide overall engine management. The ECM/ECU continuously performs self-diagnostic checks and monitors other system components. System diagnostic checks are made at ignition-on and continue throughout all engine-operating modes.

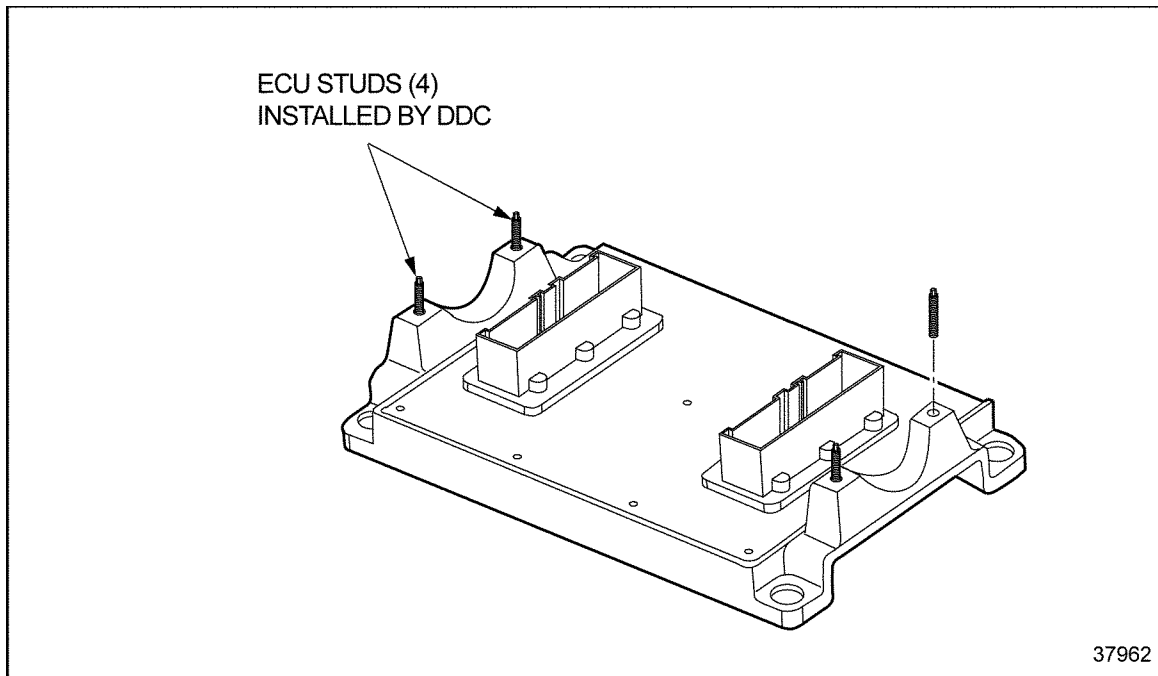


Figure 16-1 Electronic Control Unit

The DDEC V ECM/ECU has two 68-pin Tyco connectors - one for the engine and the other for the vehicle.

DDEC V supports three independent data links. There are two links on the Vehicle Interface Harness (VIH). One link is based on SAE J1708, and the second is SAE J1939. The other link, on the Engine Harness, is CAN based and will be used for proprietary communications such as multi-ECM/ECU applications and DDC factory programming.

Connector shrouds protect the two 68-pin Tyco connectors (see see Figure 16-2).

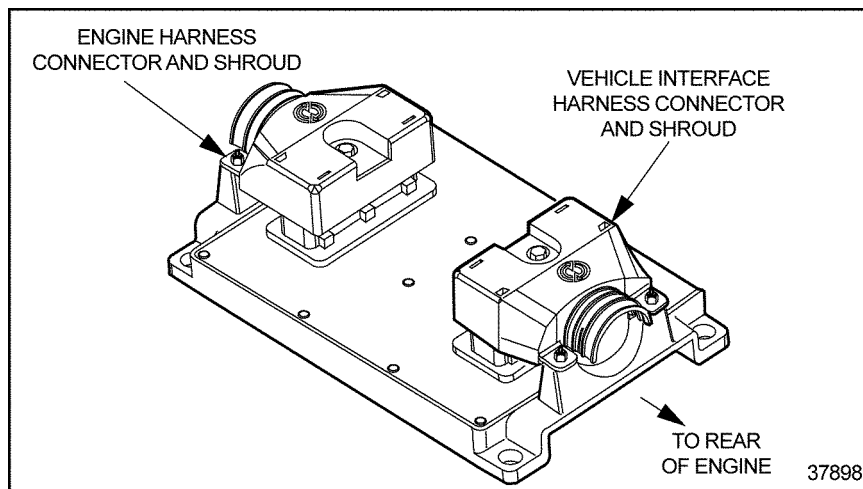


Figure 16-2 Electronic Control Unit with Connector Shrouds

See Figure 16-3 for the ECM/ECU outline and dimensions.

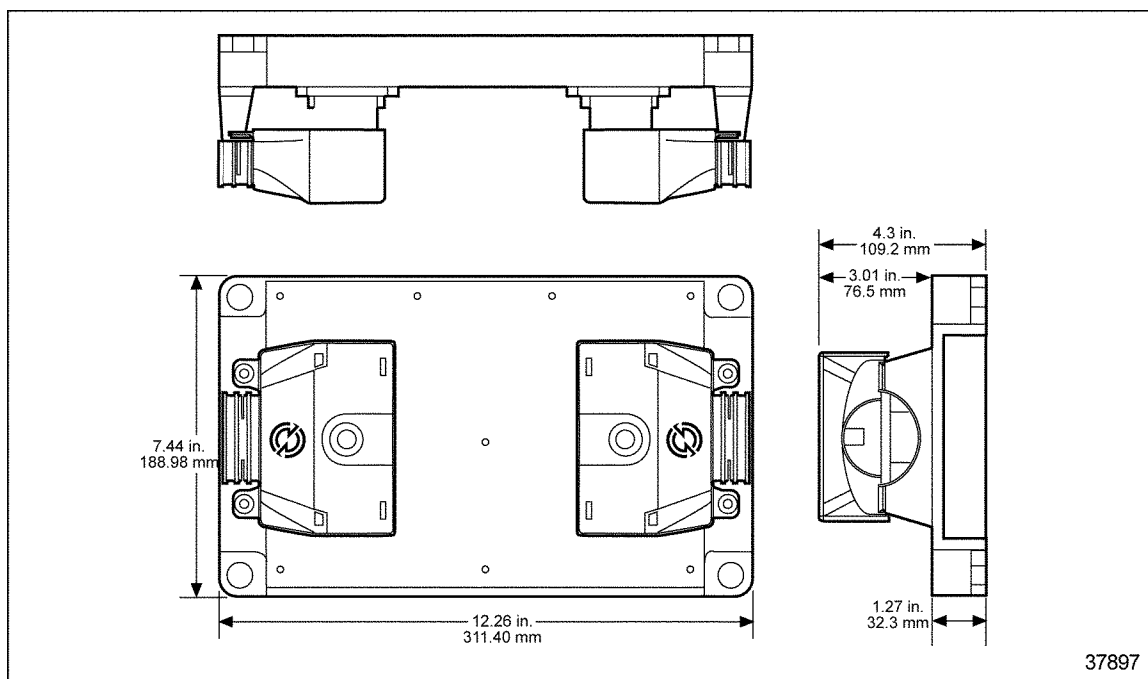


Figure 16-3 Dimensions of Electronic Control Unit with Connector Shouds

16.1.1.1 Connector Shroud

The shroud is used to protect the connectors from dirt and direct spray and to route the wires in the correct orientation. The shroud is designed for 25-30 mm conduit.

NOTE:

The shroud is REQUIRED.

Different views of the connector shroud may be seen in the next illustration (see Figure 16-4).

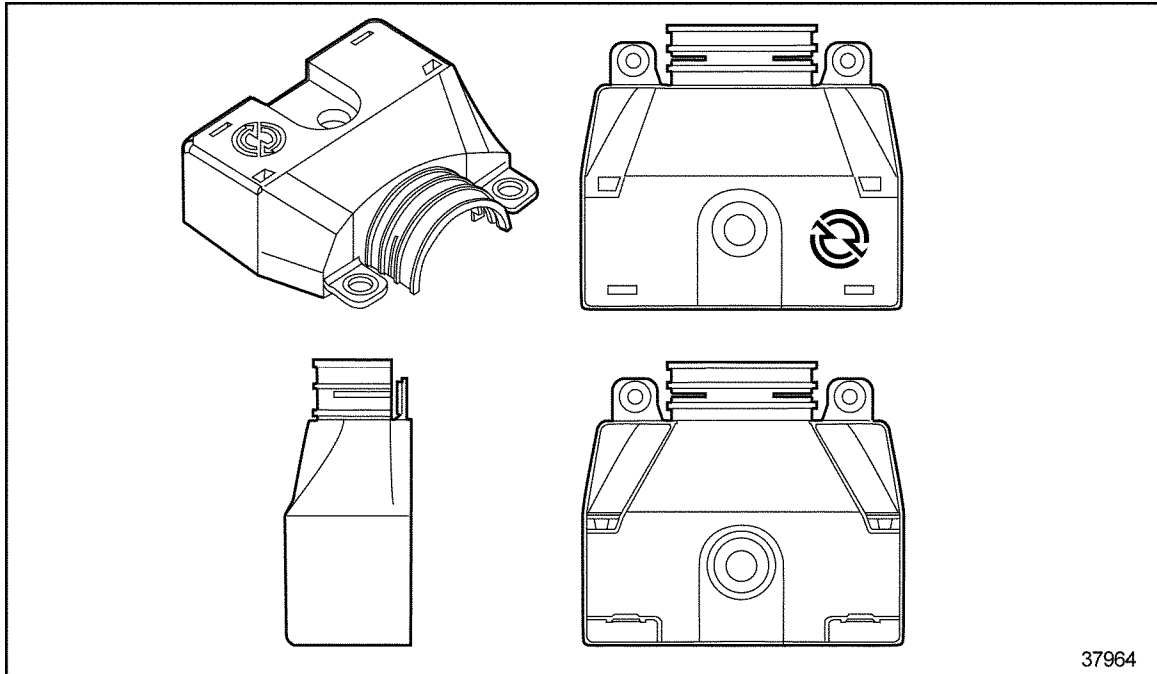


Figure 16-4 Electronic Control Unit Connector Shroud

Two screws are required to attach the shroud to the ECM/ECU. The torque specification for these screws is 50 in.·lb. (5.65 N·m).

NOTE:

Replacement oversized screws are available in case of a thread failure of the connector.

16.1.1.2 Environmental Conditions

The following environmental conditions must be considered.

Temperature

The ambient operating temperature range is -40°F (-40°C) minimum and 221°F (105°C) maximum.

Atmospheric Pressure

The engine-mounted ECM/ECU can withstand atmospheric pressures ranging from 62.0 to 120 kPa absolute that result from altitude and weather changes in the operating and non-operating conditions.

Water Intrusion

The ECM/ECU can be exposed to steam cleaning and pressure washing. Care should be taken not to pressure spray the connectors.

16.1.2 Harnesses

There are two major harness: the Engine Harness (EH) and the Vehicle Interface Harness (VIH). The Engine Harness is installed at the factory and is delivered connected to all engine sensors, the fuel injection system, and the ECM/ECU.

The OEM supplied Vehicle Interface Harness connects the ECU to other vehicle systems.

16.1.2.1 EH Connector and Typical Required Functions

The EH 68-pin Tyco connector pinout for the Series 60® is listed in Table 16-1 and Table 16-2.

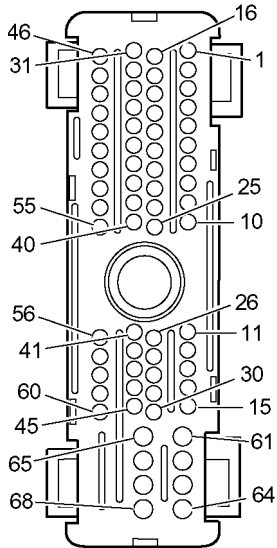
Pin	Wire Color	Signal Type	Function	Connector
E-1	Blk	PWM Output – Low Side	EGR Hydraulic Valve Control	 38483 Shroud Side of Connector
E-2	Wht	Analog Input – 1.5k Pull-up	Air Temp	
E-3	—	Analog Input – 51k Pull-down	Spare	
E-4	Blk	PWM Output – Low Side	VGT VPOD Control	
E-5	Yel	Analog Input – 1.5k Pull-up	Coolant Temp	
E-6	—	Analog Input – 51k Pull-down	Spare	
E-7	Tan	Analog Input – 1.5k Pull-up	Oil Temp	
E-8	—	PWM Output – Low Side	Spare	
E-9	Orn	Analog Input – 1.5k Pull-up	Fuel Temp	
E-10	—	Analog Input – 1.5k Pull-up	EGR Temp	
E-11	—	PWM Output – Low Side	Spare	
E-12	Gra	Sensor Supply #3	Sensor Supply	
E-13	—	Digital Output – Low Side	Spare	
E-14	Blk	Sensor Return #4	Sensor Return	
E-15	Blk	Sensor Return #3	Sensor Return	
E-16	Yel	Analog Input – 51k Pull-down	Fuel Restriction (MAS)	
E-17	Ppl	TRS (CKP) (-)	TRS (CKP) (-)	
E-18	Dk Grn	TRS (CKP) (+)	TRS (CKP) (+)	
E-19	Lt Blu	SRS (CMP) (+)	SRS (CMP) (+)	
E-20	Wht	SRS (CMP) (-)	SRS (CMP) (-)	
E-21	Dk Grn	Analog Input – 51k Pull-down	Oil Level (MAS)	
E-22	Dk Blu	Analog Input – 1.5k Pull-up	Turbo Compressor Out Temp	
E-23	—	Analog Input – 1.5k Pull-up	Spare	
E-24	—	Analog Input – 51k Pull-down	Spare	
E-25	—	Analog Input – 51k Pull-down	Spare	
E-26	Gra	Sensor Supply #4	Sensor Supply	
E-27	—	Analog Input – 1.5k Pull-up	Spare	
E-28	—	Ground Pin	Spare	
E-29	—	Ground Pin	Spare	
E-30	—	Ground Pin	Spare	
E-31	Brn	Analog Input – 51k Pull-down	Oil Pressure	
E-32	—	Frequency Input (+) — Aux 3	Spare	

Table 16-1 Series 60 Engine Harness Connector - Pins E-1 Through E-32

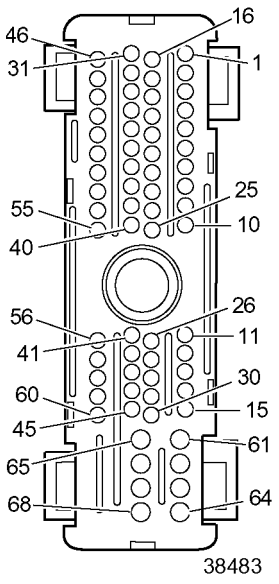
Pin	Wire Color	Signal Type	Function	Connector
E-33	—	Frequency Input (-) – Aux3	Spare	 38483 Shroud Side of Connector
E-34	Brn	Frequency Input (-) – Aux2	Turbo Speed Sensor (+)	
E-35	Blk	Frequency Input (+) – Aux2	Turbo Speed Sensor (-)	
E-36	—	Analog Input – 1.5k Pull-up	Spare	
E-37	Pnk	Analog Input – 51k Pull-down	Barometric Pressure	
E-38	—	Analog Input – 51k Pull-down	EGR Delta Pressure	
E-39	Lt Grn	Analog Input – 51k Pull-down	Turbo Boost	
E-40	Dk Blue	CAN2 (+)	CAN2 (+)	
E-41	—	Analog Input – 51k Pull-down	Spare	
E-42	Bk	Ground Pin	VGT VPOD Gnd	
E-43	Bk	Ground Pin	Spare	
E-44	—	Ground Pin	Spare	
E-45	—	Ground Pin	Spare	
E-46	Lt Grn	Digital Output – High Side	Switched Battery (+) – VGT	
E-47	—	Digital Output – High Side	Spare	
E-48	Red	Digital Output – High Side	Jake Med/High	
E-49	Orn	Digital Output – High Side	Jake Low	
E-50	—	Digital Output – High Side	Spare	
E-51	Yel	Digital Output – High Side	Switch Battery (+) — EGR	
E-52	Red	Digital Output – High Side	Spare	
E-53	—	Digital Output – High Side	Spare	
E-54	Pnk	CAN2 (-)	CAN2 (-)	
E-55	Blk	CAN2S	CAN2 Shield	
E-56	—	Analog Input – 51k Pull-down	Spare	
E-57	—	Analog Input – HWOLS	No Connection	
E-58	—	Analog Input – 1.5k Pull-up	Spare	
E-59	—	RTC BATT+	External RTC Battery (+)	
E-60	—	Ground Pin	Spare	
E-61	Wht	Injector High Common	S60 Common Cyl #1,2,3	
E-62	Wht	Injector High Common	S60 Common Cyl #4,5, 6	
E-63	Wht	Injector A – LO1	S60 Cylinder #1	
E-64	Wht	Injector A – LO2	S60 Cylinder #3	
E-65	Wht	Injector A – LO3	S60 Cylinder #2	
E-66	Wht	Injector B – LO1	S60 Cylinder #5	
E-67	Wht	Injector B – LO2	S60 Cylinder #6	
E-68	Wht	Injector B– LO3	S60 Cylinder #4	

Table 16-2 Series 60 Engine Harness Connector - Pins E-33 Through E-68

16.1.2.2 VIH Connector and Typical Required Functions

The VIH 68-pin Tyco connector pinout for the Series 60 is listed in Table 16-3 and Table 16-4.

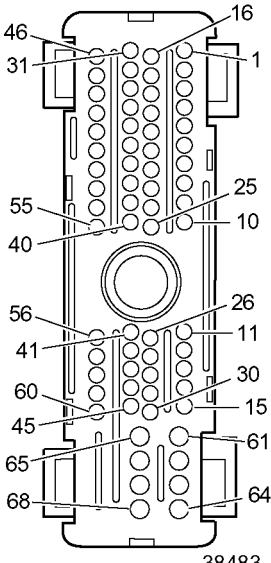
Pin	Wire Color	Signal Type	Function	Req/ Typical	Connector
V-1	Dk Grn/Blk	Digital Output - Low Side	AWL	Required	 Shroud Side of Connector 38483
V-2	Blk/Yel	Digital Output - Low Side	RSL	Required	
V-3	Wht/Dk Grn	Analog Input - 1.5k Pull-up	Service Brake Released	Required	
V-4	Blk/Lt Blu	Digital Output - Low Side	Fan Control #1	Typical: Fan	
V-5	Blk/Lt grn	Digital Output - Low Side	Top2 Shift Solenoid	Typical: Top2	
V-6	Blk/Orn	Digital Output - Low Side	Top2 Lockout Solenoid	Typical: Top2	
V-7	Blk/Wht	Digital Output - Low Side	Vehicle Power Shtdn	Typical	
V-8	Wht/Orn	Analog Input - 1.5k Pull-up	Resume/Accel	Typical: CC	
V-9	Ppl/Wht	Analog Input - 1.5k Pull-up	Cruise Enable	Typical: CC	
V-10	Lt Grn/Wht	Analog Input - 1.5k Pull-up	Clutch Released	Typical: CC	
V-11	Yel/Red	Sensor Supply #1	Sensor Supply #1	Required	
V-12	Wht/ Red	Sensor Supply #2	Sensor Supply #2	Required	
V-13	Lt Blu/Yel	Analog Input - 300k Pull-down	Throttle Position	Required	
V-14	Ppl/Yel	Analog Input - 300k Pull-down	VSG or No Function	Typical	
V-15	Pnk	Ignition	Ignition	Required	
V-16	Red/Wht	Analog Input - 1.5k Pull-up	Idle Validation	Required	
V-17	Lt Blu/ Orn	Frequency Input (+) VSS	Vehicle Speed (+)	Required	
V-18	Lt Blu/ Blk	Frequency Input (-) VSS	Vehicle Speed (-)	Required	
V-19	—	No Connection	No Connection	No Conn	
V-20	—	No Connection	No Connection	No Conn	
V-21	—	No Connection	No Connection	No Conn	
V-22	Yel/Lt Blu	Analog Input – 51k Pull-down	Air Filter Restriction	Typical: MAS	
V-23	Yel/Dk Grn	Analog Input - 1.5k Pull-up	Exhaust Temp (Bus/Coach)	Typical	
V-24	Dk Grn/Wht	Analog Input - 1.5k Pull-up	SEO/Diag Request	Required	
V-25	Grey/Wht	Analog Input - 1.5k Pull-up	A/C Status	Typical: Fan	
V-26	Yel/Lt Grn	Analog Input - 1.5k Pull-up	Engine Brake Disable	Typical	
V-27	Yel/Wht	Analog Input - 1.5k Pull-up	Turbo Compressor In Temp	Required	
V-28	—	No Connection	No Connection	No Conn	
V-29	Wht/Yel	Analog Input – 51k Pull-down	Exhaust Back Press or Water Pump Press or Air Compress Press	Typical	
V-30	—	No Connection	No Connection	No Conn	
V-31	Tan	Frequency Output	Tachometer	Typical	

Table 16-3 Series 60 VIH Connector On-highway Trucks – Pins V-1 – V-31

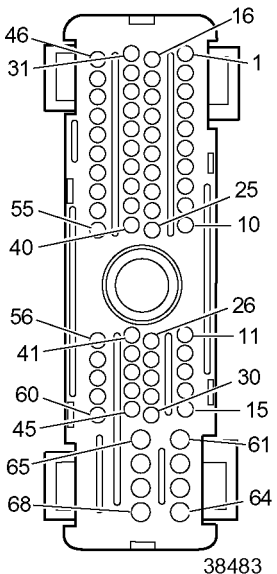
Pin	Wire Color	Signal Type	Function	Req/ Typical	Connector
V-32	Dk Blu/Orn	Frequency Input (+) Aux 1	Spare	—	 38483 Shroud Side of Connector
V-33	Dk Blu/Blk	Frequency Input (-) Aux 1	Spare	—	
V-34	—	No Connection	No Connection	No Conn	
V-35	—	No Connection	No Connection	No Conn	
V-36	—	No Connection	No Connection	No Conn	
V-37	Orn/Yel	Analog Input – 120k Pull-up	Add Coolant Level	Typical: MAS	
V-38	Lt Gr/Yel	Analog Input – 120k Pull-up	Coolant Level Shtdn	Req	
V-39	Lt Blu/Wht	Analog Input – 1.5k Pull-up	Engine Brake Low	Typical: Jake	
V-40	Orn/Blk	Digital Output – Low Side	OI Alarm	Typical: OI	
V-41	Dk Grn/Yel	Analog Input – 1.5k Pull-up	Aux Shtdn #1	—	
V-42	Grey/Yel	Analog Input – 1.5k Pull-up	OI Thermostat	Typical: OI	
V-43	Dk Blu/Red	J1939+	J1939+	Req	
V-44	Dk Blu/Yel	J1939S	J1939 Shield	Required	
V-45	—	No Connection	No Connection	No Conn	
V-46	Dk Grn/Brn	PWM Output - Low Side	Variable Speed Fan	—	
V-47	Wht/Lt Blu	Analog Input - 1.5k Pull-up	Set/Coast	Typical; CC	
V-48	Tan/ Yel	Analog Input - 1.5k Pull-up	Throttle Inhibit	Typical	
V-49	Pink/Wht	Analog Input - 1.5k Pull-up	Fan Control Override	Typical	
V-50	Tan/ Wht	Analog Input - 1.5k Pull-up	Park Brake	Typical	
V-51	Dk Blu/Wht	Analog Input - 1.5k Pull-up	Engine Brake Medium	Typical: Jake	
V-52	Dk Grn/Orn	PWM Output Low Side	Trans % Load	—	
V-53	Blk/Red	Digital Output - Low Side	Ether Start	—	
V-54	Blk/Pnk	Digital Output - Low Side	OI Starter	Typical: OI	
V-55	Lt Grn/Blk	Digital Output - Low Side	OI Active Lamp	Typical: OI	
V-56	Dk Grn/ Grey	J1587 (+)	J1587 (+)	Required	
V-57	Dk Grn	J1587(-)	J1587 (-)	Required	
V-58	Dk Blu	J1939 (-)	J1939 (-)	Required	
V-59	Dk Blu	Sensor Return #2	Sensor Return	Required	
V-60	Yel/ Blk	Sensor Return #1	Sensor Return	Required	
V-61	Red/Blk	Battery (+)	+12V / +24V	Required	
V-62	Red/ Lt Blu	Battery (+)	+12V / +24V	Required	
V-63	Brn/Blk	Battery (-)	Ground	Required	
V-64	Brn/ Lt Grn	Battery (-)	Ground	Required	
V-65	Red/ Lt Grn	Battery (+)	+12V / +24V	Required	
V-66	Red/ Pnk	Battery (+)	+12V / +24V	Required	
V-67	Brn/Wht	Battery (-)	Ground	Required	
V-68	Brn/Yel	Battery (-)	Ground	Required	

Table 16-4 Series 60 VIH Connector On-highway Trucks – Pins V-32 – V-68

16.1.3 Sensors

The DDEC V system is designed to operate with several types of sensors

The sensors integrated into the Engine Harness are factory-installed. The sensors integrated into the Vehicle Interface Harness are installed by the OEM.

16.1.4 Factory-installed Sensors

The sensors integrated into the factory-installed Engine Harness are listed in Table 16-5. Some DDEC sensors are used with optional features.

Sensor	Function
Barometric Pressure Sensor (Baro Sensor)	Senses barometric pressure.
EGR Delta Pressure Sensor	Senses EGR pressure for EGR control.
EGR Temperature Sensor	Senses EGR temperature for EGR control.
Engine Coolant Temperature Sensor (CTS/ECT Sensor)	Senses coolant temperature for functions such as engine protection, fan control and engine fueling.
Engine Oil Level (OLS/EOL Sensor)	Detects oil level at four quarts low. Used in the Maintenance Alert System.
Engine Oil Pressure Sensor (OPS/EOP Sensor)	Senses gallery oil pressure for functions such as engine protection.
Engine Oil Temperature Sensor (EOT Sensor)	Senses oil temperature for functions such as reducing variation in fuel injection and fan control.
FRS/Fuel Restriction Sensor	Detects fuel restriction for replacement of fuel filter. Used in Maintenance Alert System.
Intake Air Temperature Sensor (IAT Sensor)	Senses air temperature for functions such as fan control and engine fueling.
Intake Manifold Pressure Sensor (TBS/IMP Sensor)	Senses turbo boost for functions such as smoke control and engine protection.
Mass Air Flow Sensor (MAF Sensor)	Measures EGR flow rate.
Synchronous Reference Sensor (SRS/CMP)	Indicates a specific cylinder in the firing order.
Supply Fuel Temperature Sensor (FTS/SFT Sensor)	Senses fuel temperature for functions such as engine fueling.
Timing Reference Sensor (TRS/CKP)	Senses crankshaft position and engine speed for functions such as fuel control strategy.
Turbo Compressor Temperature Out Sensor	Senses turbo out air temperature.
Turbo Speed Sensor (TSS)	Senses turbo speed for overspeed conditions.

Table 16-5 Function of Factory-Installed Sensors

16.1.5 Barometric Pressure Sensor

The Barometric Pressure Sensor senses barometric pressure for EGR control. See Figure 16-5.

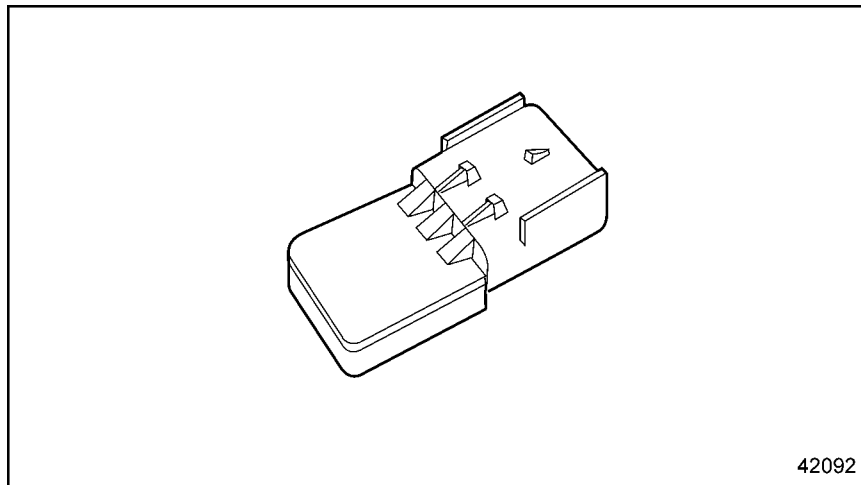


Figure 16-5 Barometric Pressure Sensor

16.1.6 EGR Delta Pressure Sensor

The EGR Delta Pressure Sensor (EGR Delta P) senses EGR pressure for EGR control. See Figure 16-6.

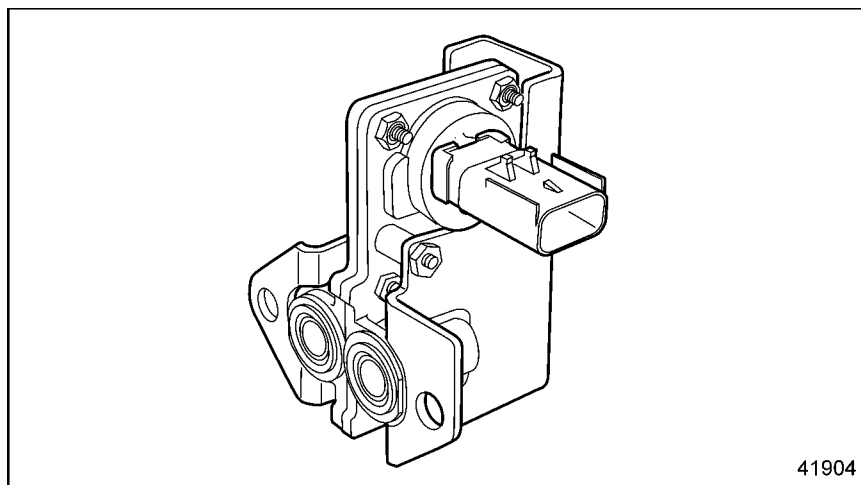


Figure 16-6 EGR Delta Pressure Sensor

16.1.7 EGR Temperature Sensor

The EGR Temperature Sensor senses EGR temperature for EGR control. See Figure 16-7.

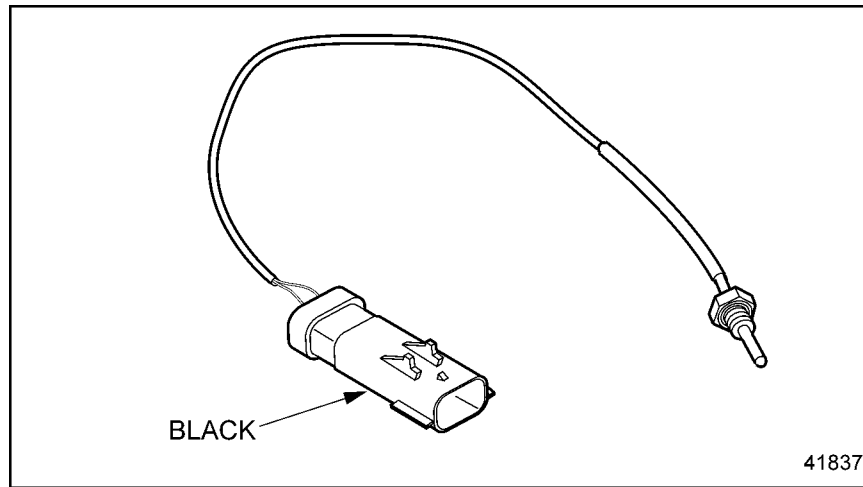


Figure 16-7 EGR Temperature Sensor

16.1.8 Engine Coolant Temperature Sensor

The Engine Coolant Temperature Sensor, ECT, is a thermistor type sensor that has a variable resistance, when exposed to different temperatures. The CTS/ECT Sensor senses coolant temperature. See Figure 16-8 for the CTS/ECT Sensor.

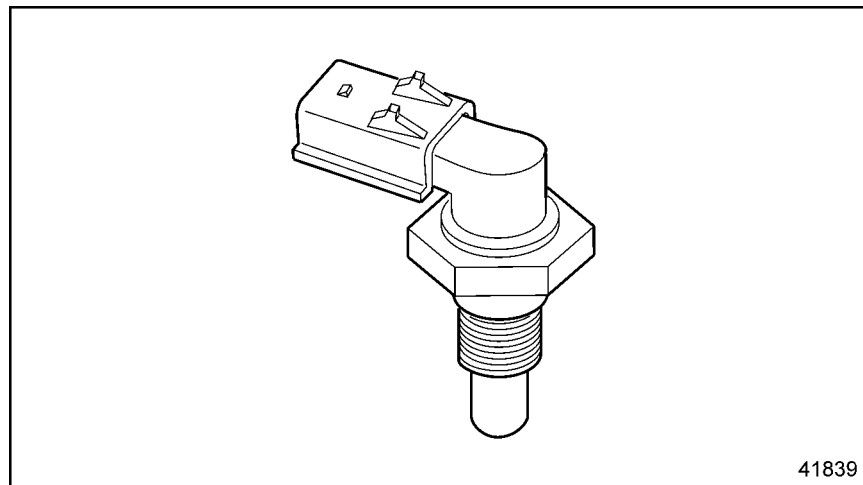


Figure 16-8 Engine Coolant Temperature Sensor

16.1.9 Engine Oil Level Sensor

The Engine Oil Level Sensor, EOL, is factory installed at DDC and is incorporated into the DDC Engine Harness for applications which have the Maintenance Alert system (MAS). See Figure 16-9.

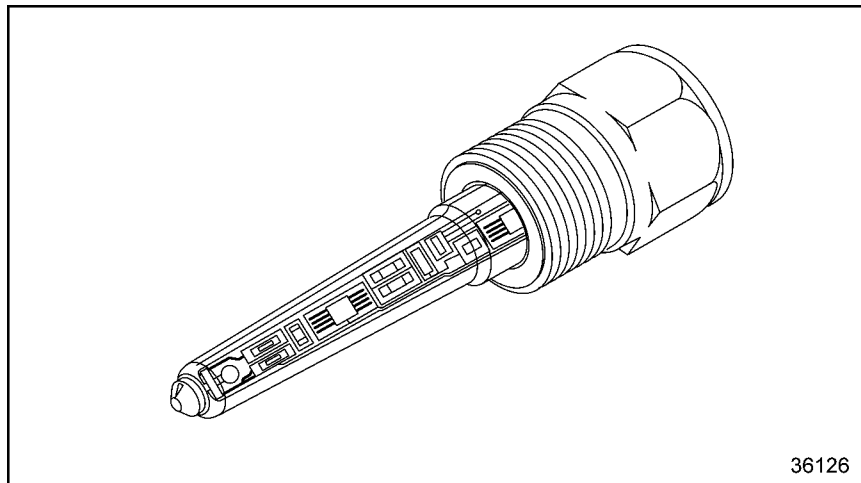


Figure 16-9 Engine Oil Level Sensor

16.1.10 Engine Oil Pressure Sensor

The Engine Oil Pressure Sensor, EOP, is a variable capacitance sensor that produces a linear analog signal, indicating engine oil pressure. See Figure 16-10.

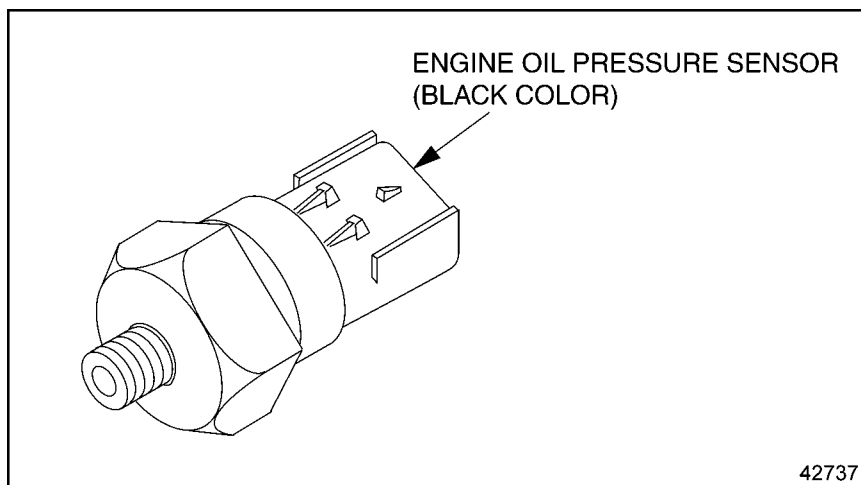


Figure 16-10 Engine Oil Pressure Sensor

16.1.11 Engine Oil Temperature Sensor

The Engine Oil Temperature Sensor, EOT, is a thermistor type sensor that has a variable resistance, when exposed to different temperatures. See Figure 16-11.

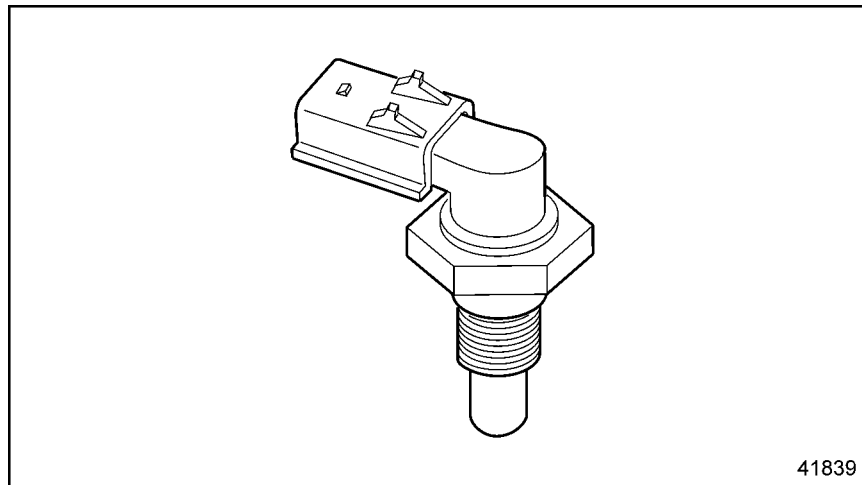


Figure 16-11 Engine Oil Temperature Sensor

The ECU uses the EOT Sensor signal to determine the quantity and timing of fuel required to optimize starting over a range of temperatures. The EOT Sensor provides a signal to vary idle speed and injection timing resulting in improved cold starts and reduced white smoke. It also activates the engine protection, if the oil temperature exceeds the specified limits.

16.1.12 FRS/Fuel Restriction Sensor

The FRS/Fuel Restriction Sensor monitors the condition of the fuel filter. The sensor is for applications which have the Maintenance Alert System (MAS). See Figure 16-12.

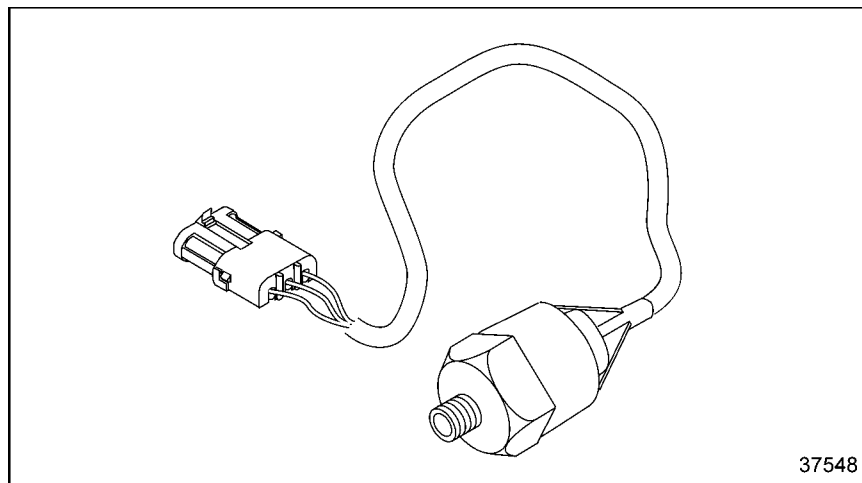


Figure 16-12 FRS/Fuel Restriction Sensor

16.1.13 Intake Air Temperature Sensor

The Intake Air Temperature ATS/IAT Sensor, , is a thermistor type sensor that has a variable resistance, when exposed to different temperatures. The ATS/IAT Sensor provides necessary input for various functions such as varying hot idle speed, fan control, and injection timing which results in improved cold starts and reduced white smoke. See Figure 16-13.

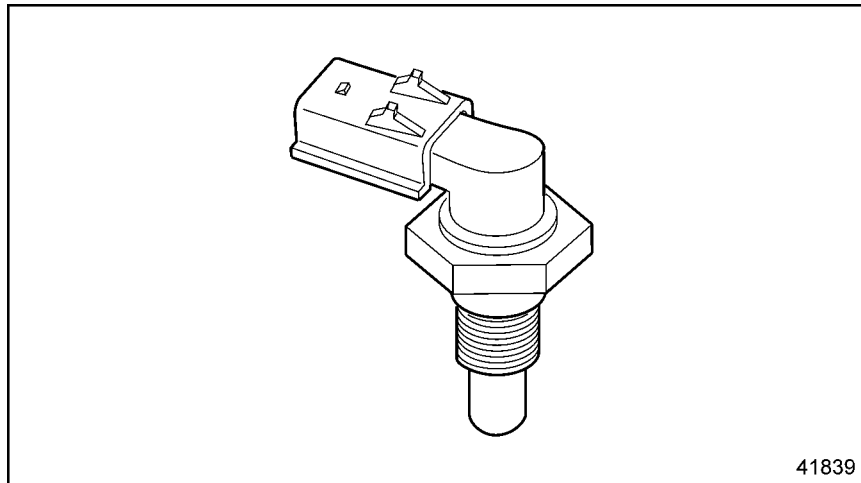


Figure 16-13 Intake Air Temperature Sensor

16.1.14 The Intake Manifold Pressure Sensor

The Intake Manifold Pressure Sensor (IMP Sensor) provides data to the ECM/ECU for use in engine fueling (smoke control). See Figure 16-14 for the sensor used in on-highway applications.

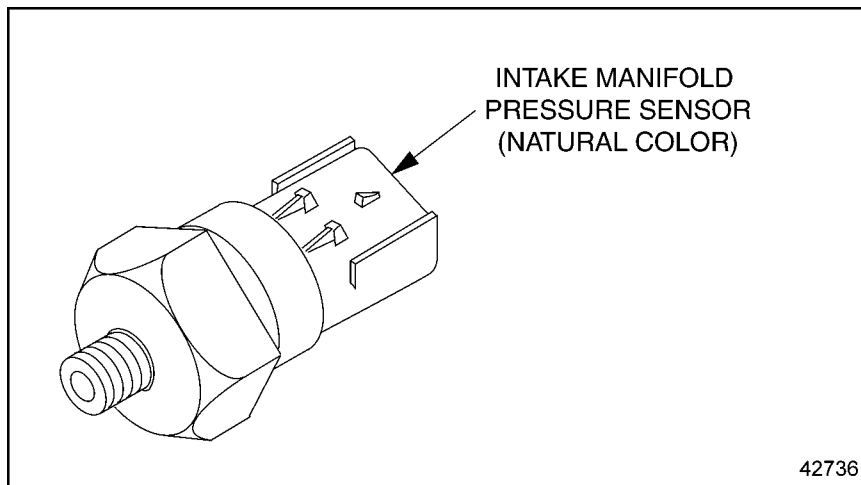


Figure 16-14 The Intake Manifold Pressure Sensor

16.1.15 Synchronous and Timing Reference Sensors

The Synchronous Reference Sensor (SRS or CMP) indicates a specific cylinder in the firing order. The Timing Reference Sensor (TRS or CKP) is a variable reluctance type sensor that indicates crank position of every cylinder. The TRS tells the ECM where the position of the crankshaft is or when to fuel each cylinder.

See Figure 16-15 for the Series 60 engine TRS and SRS.

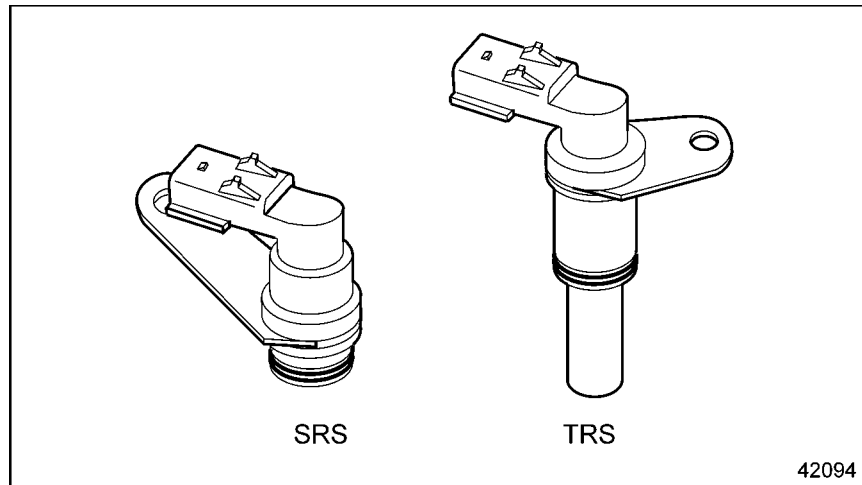


Figure 16-15 SRS and TRS

16.1.16 Supply Fuel Temperature Sensor

The Supply Fuel Temperature Sensor, SFT, is a thermistor type sensor that has a variable resistance, when exposed to different temperatures. The FTS/SFT Sensor measures fuel temperatures necessary for fuel consumption calculations and fuel input compensation. See Figure 16-16.

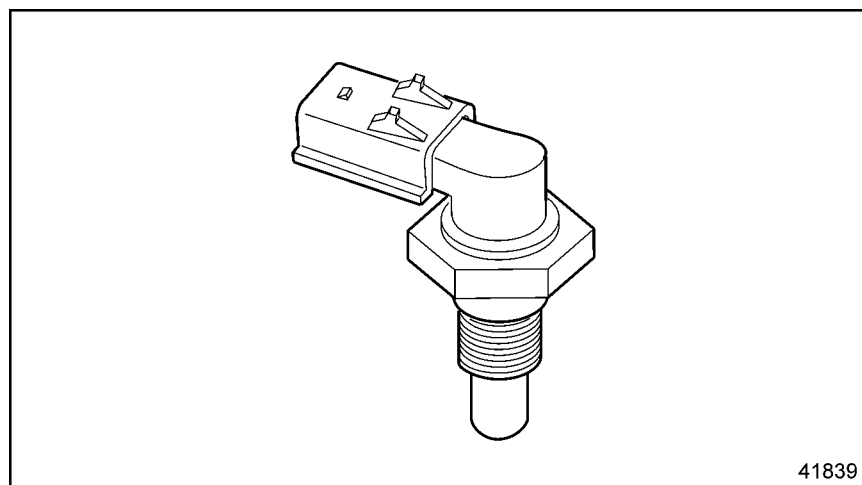


Figure 16-16 Supply Fuel Temperature Sensor

16.1.17 Turbo Compressor Temperature Out Sensor

The Turbo Compressor Temperature Out Sensor senses turbo out air temperature. See Figure 16-17 for the sensor used with the Series 60 engine.

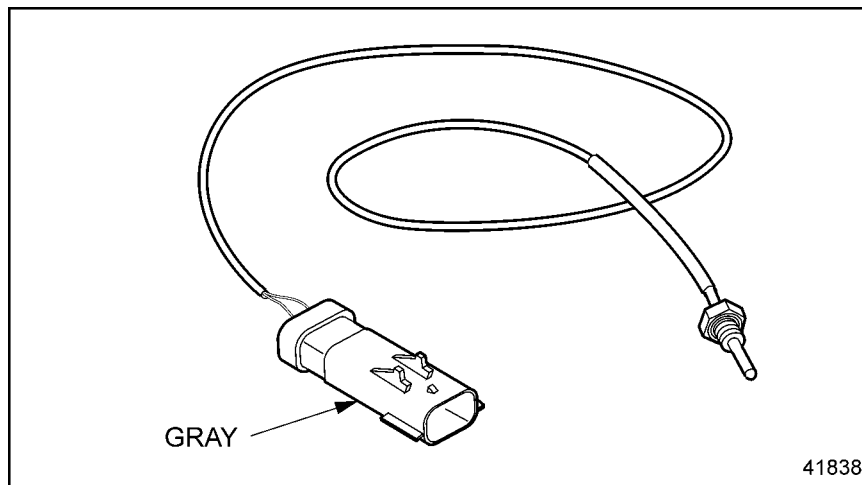


Figure 16-17 Turbo Compressor Temperature Out Sensor

16.1.18 Turbo Speed Sensor

The Turbo Speed Sensor, TSS, senses turbo speed for overspeed conditions; see Figure 16-18 for the sensor used with the Series 60 engine.

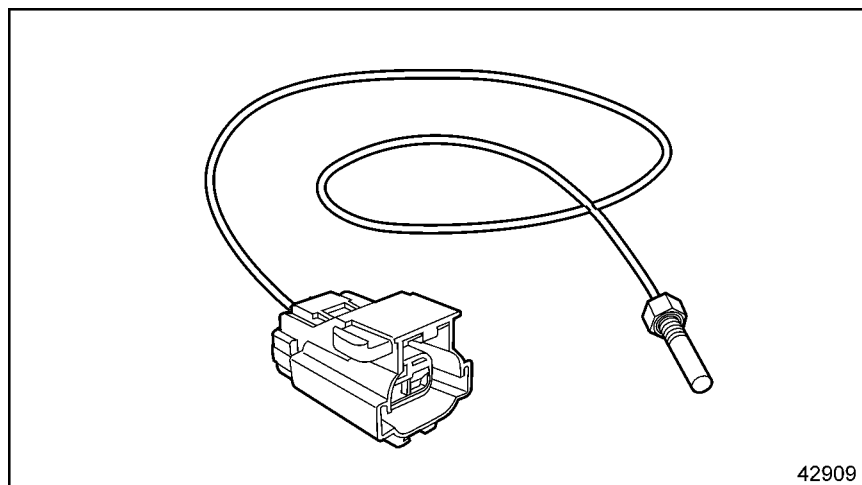


Figure 16-18 Turbo Speed Sensor

16.1.19 OEM-Installed Sensors

All sensors must be of the proper type and continuously monitor vehicular and environmental conditions, so the ECM/ECU can react to changing situations. The OEM is responsible for installing the sensors.

Sensor	Part Number	Function
Accelerator Pedal Sensor (TPS/AP Sensor)	--	Senses operator's input to the ECM/ECU for throttle input.
Add Engine Coolant Level Sensor (AECL Sensor)	23522855 23520380 23520381	Senses coolant level for engine maintenance.
Air Filter Restriction Sensor (AFRS/AFR Sensor)	23523756	Senses the condition of the air inlet filter for engine maintenance.
Engine Coolant Level Sensor (CLS/ECL Sensor)	23522855 23520380 23520381	Senses coolant level for engine protection.
Fire Truck Pump Pressure Sensor *	23520795	Senses water pump pressure to maintain a constant fire truck pump pressure.
Turbo Compressor In Temperature Sensor	23527831	Senses the temperature of the turbo compressor inlet.
Vehicle Speed Sensor (VSS)	--	Senses vehicle speed for Cruise Control and PTO Control. Total distance accumulation required for ProDriver and a speedometer.

* Available in some applications

Table 16-6 Function and Guidelines for OEM-installed Sensors

NOTE:

The OEM harness must be securely fastened every 6 in. It is required that the harness be fastened within 6 in. of the sensor.

16.1.20 Accelerator Pedal Sensor

The Accelerator Pedal contains the TPS/AP Sensor which converts the operator's hand throttle and/or foot pedal input into a signal for the ECM/ECU.

16.1.21 Air Filter Restriction Sensor

The Air Filter Restriction Sensor, AFRS/AFR, has two indicator points, the first indicates the air filter has approximately 50% life left, the second indicates that the filter is plugged. This sensor is only used with the Maintenance Alert System. See Figure 16-19.

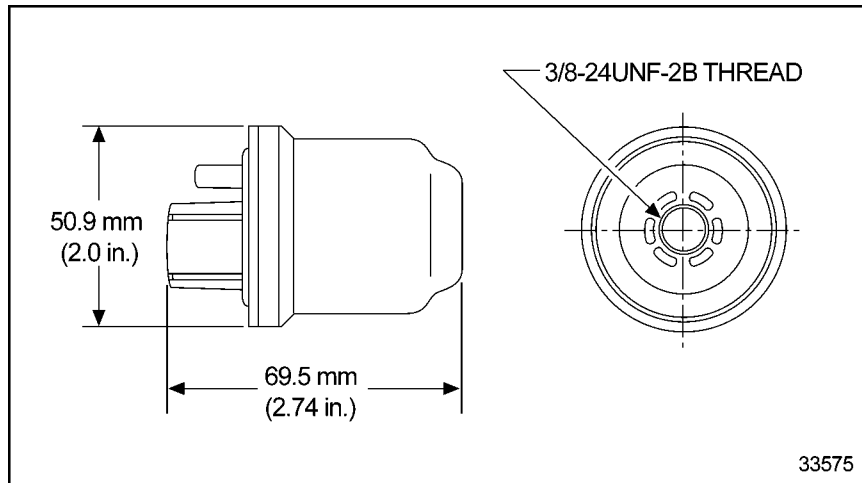


Figure 16-19 Air Filter Restriction Sensor

The AFRS/AFR Sensor is mounted downstream of the air filter and upstream of the turbocharger. The AFRS/AFR Sensor must be in a straight section of pipe or where the OEM mechanical unit is normally mounted. This sensor must be enabled with the Vehicle Electronic Programming System (VEPS) or the DDEC Reprogramming System (DRS).

16.1.22 Engine Coolant Level Sensor

The Engine Coolant Level Sensor, CLS/ECL Sensor, is required for DDEC V installations. Its purpose is to provide an input to the engine protection system and warn the operator if a low coolant level has been reached. Other non-DDC supplied engine coolant level sensors may be used but may require the use of a signal interface.

The main component of the CLS/ECL Sensor consists of a conductivity probe, that connects to the ECM/ECU; see Figure 16-20.

NOTICE:

The probe has an operational temperature range of -40 to 257°F (-40 to 125°C). Exposure to temperatures beyond this range may result in unacceptable component life, or degraded sensor accuracy.

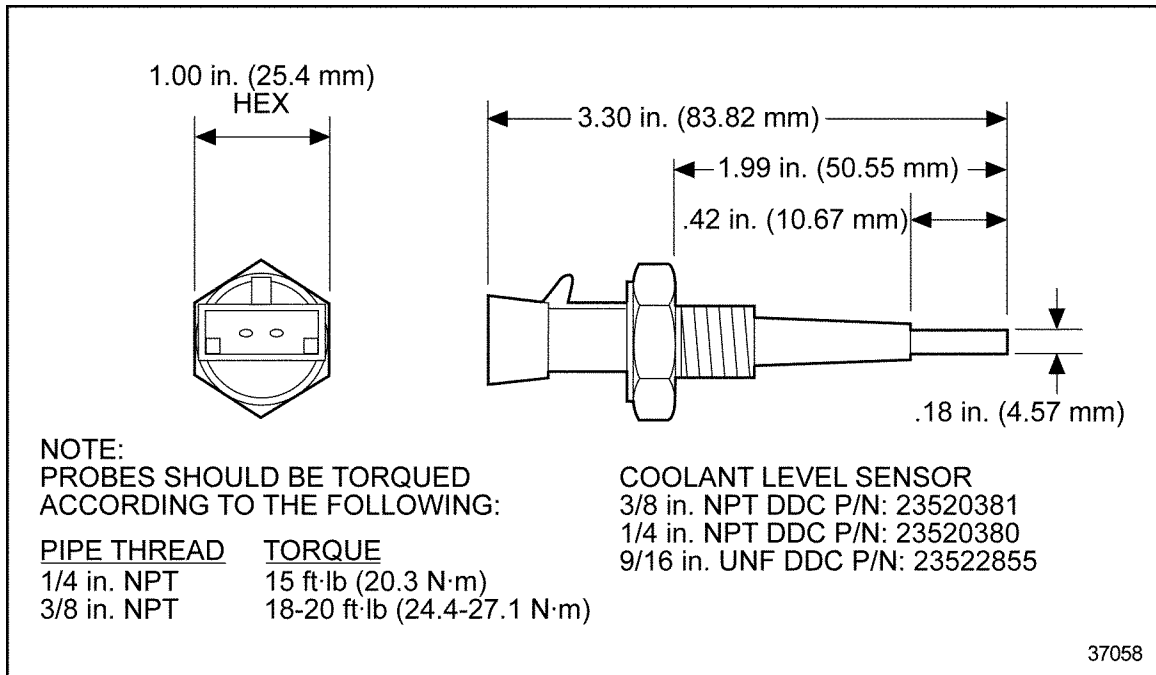


Figure 16-20 Engine Coolant Level Sensor Specifications

16.2 CONNECTORS

The DDEC V ECM/ECU has two 68-pin Tyco connectors - one for the engine and the other for the vehicle. Each connector has 60 18 AWG terminals and eight 14 AWG terminals (see Figure 16-21).

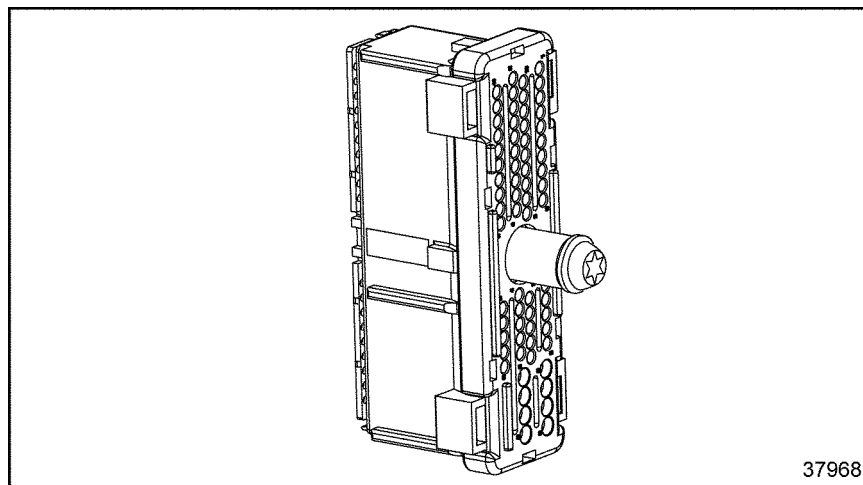


Figure 16-21 ECM/ECU 68-pin Tyco Connector

The EH 68-pin Tyco connector pinout is listed in Table 16-1 and Table 16-2.

The VIH 68-pin Tyco connector pinout is 16-3 and Table 16-4.

The 68-pin connector center screw must be torqued to 50 in·lb (5.6 N·m)

The shroud is required to protect the connectors from dirt and direct spray and to route the wires in the correct orientation.

If a replacement wire and/or terminal is required, the wires will arrive assembled with the terminals crimped on the wires (see Figure 16-22).

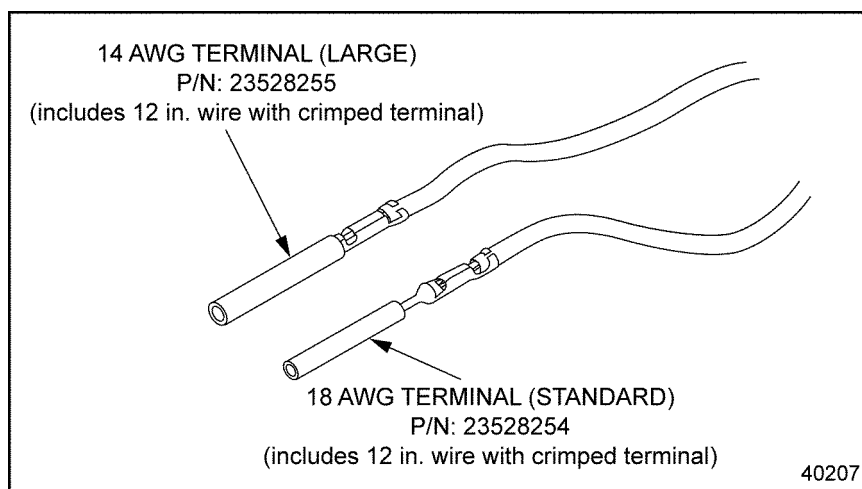


Figure 16-22 68 Pin Connector Wires and Terminals

16.2.1 Data Link Connector

The SAE J1708/J1587 nine-pin data link connector is required. DDC recommends that the OEM-supplied Data Link Connector be conveniently positioned in a well protected location facilitating subsequent DDDL usage (i.e., reprogramming, diagnostics, etc.).

The components listed in Table 16-7 are required to incorporate a SAE J1939/J1587 Data Link in a VIH for diagnostic and reprogramming devices.

Component	DDC Part Number	Deutsch Part Number
Nine-pin Deutsch Connector	23529496	HD10-9-1939P
Connector Cover	23529497	HDC 16-9
Two (2) Cavity Plugs	23507136	114017
Seven (7) Terminals	23507132	0460-202-16141

Table 16-7 Required Components to Incorporate an SAE J1939/J1587 Data Link in the VIH

The following illustration shows the wiring for the nine-pin connector (see Figure 16-23).

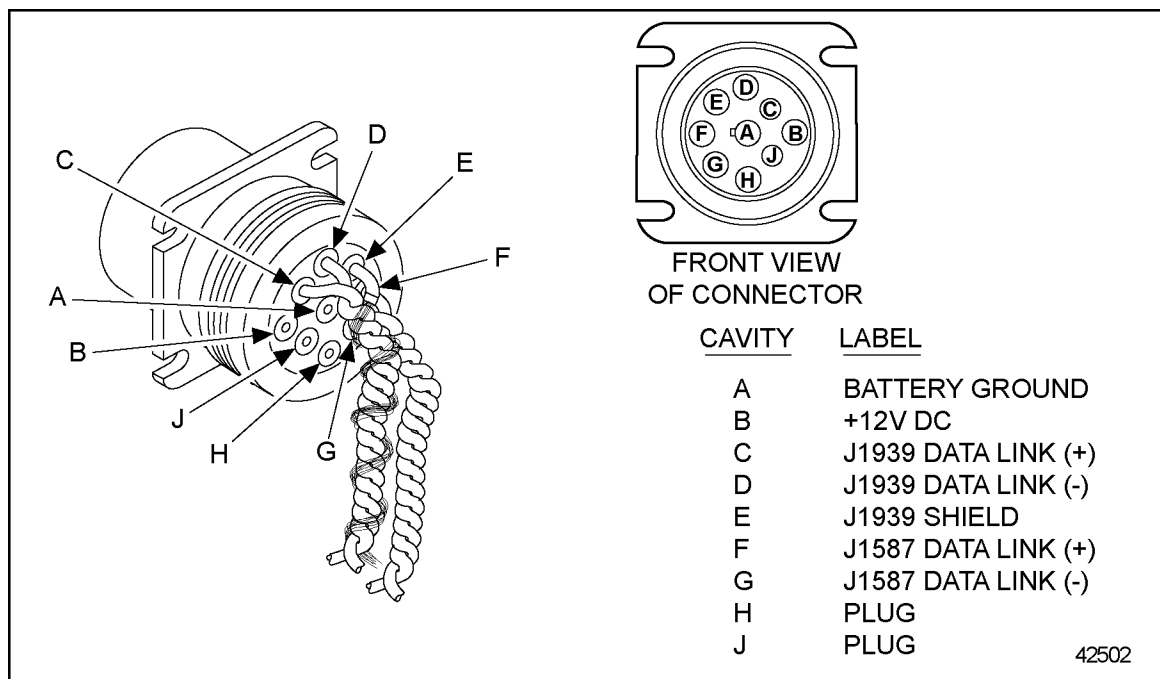


Figure 16-23 Wiring for 9-pin Data Link Connector

The maximum length for the SAE J1939 Data Link is 130 ft (40 m).

The SAE J1587/J1708 Data Link must be twisted pairs. The twists are a minimum of 12 turns per foot (305 mm). The maximum length for the SAE J1587/J1708 Data Link is 130 ft (40 m).

16.3 WIRES AND WIRING

This section contains recommendations and requirements for the VIH and EH connectors and wiring.

16.3.1 General Wire Recommendations

Detroit Diesel Corporation recommends color coding or hot stamping of wires.

NOTE:

Color code the wires as shown in the schematics. If the wires used are the same color, hot stamp the cavity number on the wires.

NOTICE:
DDC does not recommend using any type of terminal lubricant or grease compounds. These products may cause dirt or other harmful substances to be retained in the connector.

NOTICE:
Insulation must be free of nicks.

Tape, conduit, loom or a combination thereof must be used to protect the wires. Refer to sections 16.4 and 16.5. All wires must be annealed copper wire (not aluminum). All wires must comply with *SAE J1128 JAN 95 Low Tension Primary Cable*. Contact the Society of Automotive Engineers to obtain the documents.

16.3.2 Terminal installation and Removal

The method of terminal installation and removal varies, depending on the terminal/connector design. No other terminals are to be removed or installed on the Engine Harness.

16.3.2.1 Wire and Terminal Installation - Tyco ECM/ECU Connector

To install the wires and terminals into the Tyco connector:

1. Remove the Terminal Position Assurance (TPA) from the connector using a jewelers (small) screwdriver (see Figure 16-25).
2. Push the terminal into the cavity until it clicks.
3. Replace the TPA.
4. Secure the harness in the shroud neck with two tie wraps (see Figure 16-24).

NOTE:

The conduit must cover the harness wires in the neck of the shroud.

16.3.2.2 Wire and Terminal Removal - Tyco ECM/ECU Connector

Use a jewelers (small) screwdriver as your extraction tool. To remove the terminals from the connector body:

1. Cut the tie wraps holding the harness in the neck of the shroud.
2. Remove the connector from the shroud by pushing the four locking tabs (arrows) back from the connector. Use the screwdriver to push back the tabs closest to the shroud wall (see Figure 16-24).

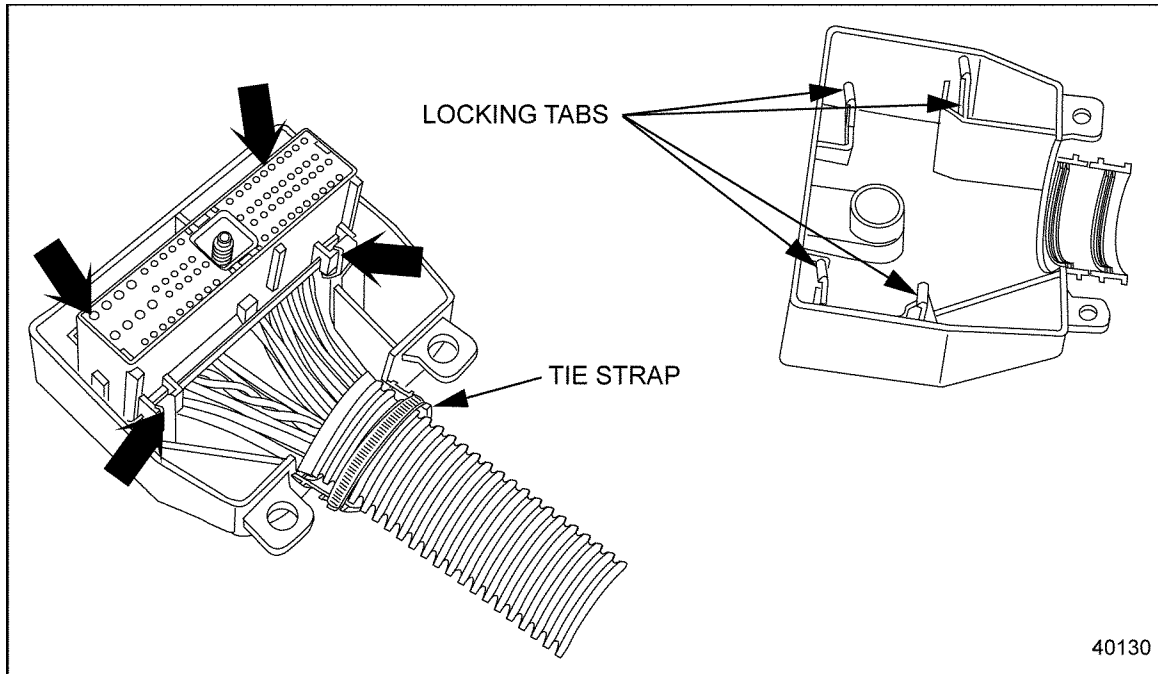


Figure 16-24 Tyco Connector and Locking Tabs

3. Use the screwdriver to remove the Terminal Position Assurance (see Figure 16-25).

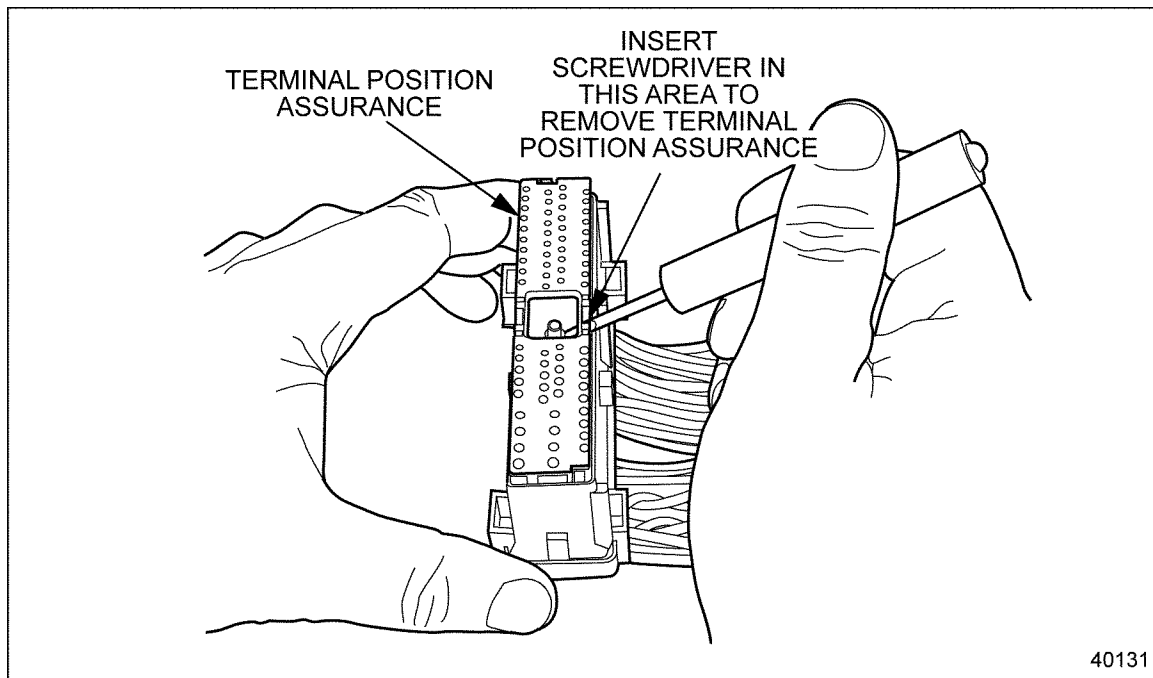


Figure 16-25 Removing the Terminal Position Assurance

4. Use the screwdriver to gently pry back the tab holding the terminal (see Figure 16-26).

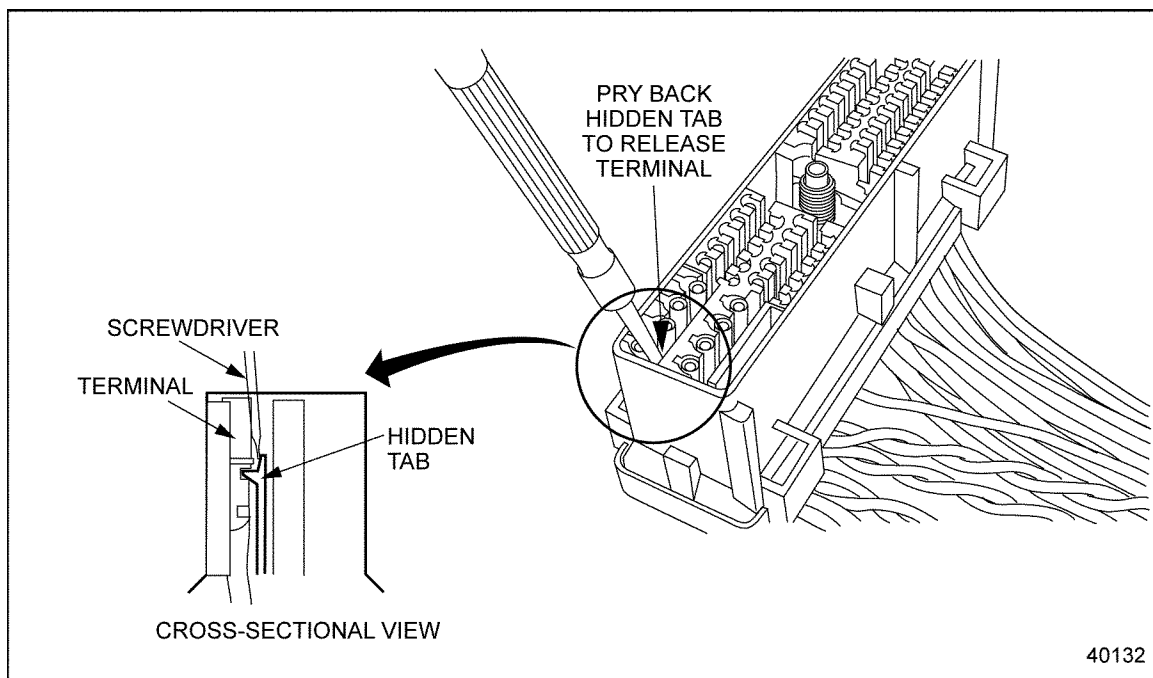


Figure 16-26 Removing the Terminal

5. While holding the tab back, carefully pull the wire and terminal out of the connector.

16.3.2.3 Deutsch Terminal Installation Guidelines

Deutsch connectors have wire seals molded into the connector. These connectors are push-to-seat connectors with cylindrical terminals.

NOTICE:
Improper selection and use of crimp tools have varying adverse effects on crimp geometry and effectiveness. Proper installation of terminals require specialized tools. Do not attempt to use alternative tools.

The crimp tool to use in Deutsch terminal installation is J 34182 (Kent-Moore part number).

NOTICE:
Terminal crimps must be made with the Deutsch crimp tool P/N: HDT-48-00 to assure gas tight connections.

NOTICE:
If a separate seal is required, be sure to install the seal onto the wire before stripping the insulation.

Use the following instructions for installing Deutsch terminals:

1. Strip approximately 1/4 in. (6 mm) of insulation from the wire.
2. Remove the lock clip, raise the wire gage selector, and rotate the knob to the number matching the gauge wire that is being used.
3. Lower the selector and insert the lock clip.

- Position the terminal so that the crimp barrel is $\frac{1}{32}$ of an inch above the four indenters. See Figure 16-27. Crimp the wire.

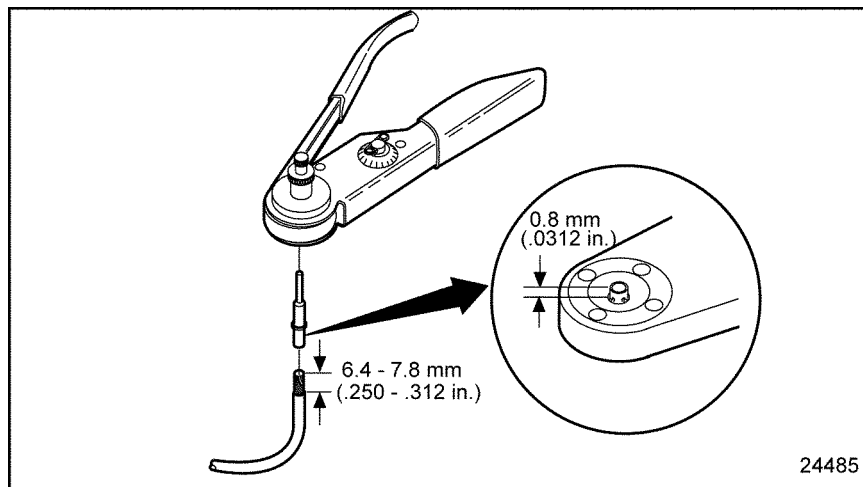


Figure 16-27 **Setting Wire Gage Selector and Positioning the Terminal**

- Grasp the terminal approximately one inch behind the terminal crimp barrel. Hold the connector with the rear grommet facing you. See Figure 16-28.

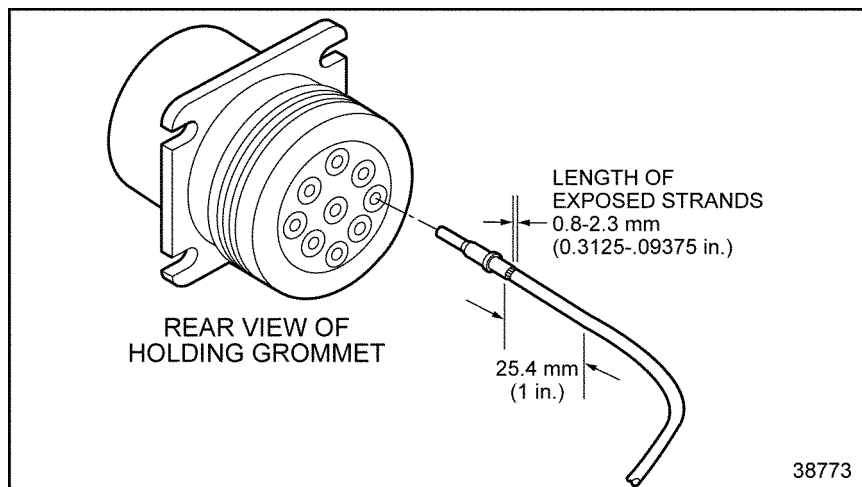


Figure 16-28 **Pushing Terminal Into Grommet**

6. Push the terminal into the grommet until a positive stop is felt. See Figure 16-28. A slight tug will confirm that it is properly locked into place. See Figure 16-29.

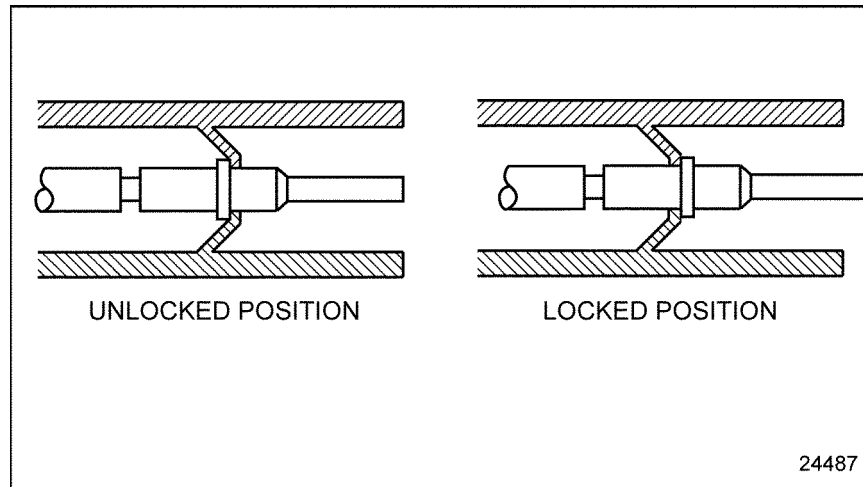


Figure 16-29 Locking Terminal Into Connector

16.3.2.4 Deutsch Terminal Removal

The appropriate size removal tool should be used when removing wires from connectors. The proper removal tools are listed in Table 16-8.

Tool	Kent-Moore Part Number
Removing (12 AWG)	J 37451
Removing (16-18 AWG)	J 34513-1

Table 16-8 Removal Tools for Deutsch Terminals

Remove Deutsch terminals as follows:

1. With the rear insert toward you, snap the appropriate size remover tool over the wire of the terminal to be removed. See Figure 16-30.

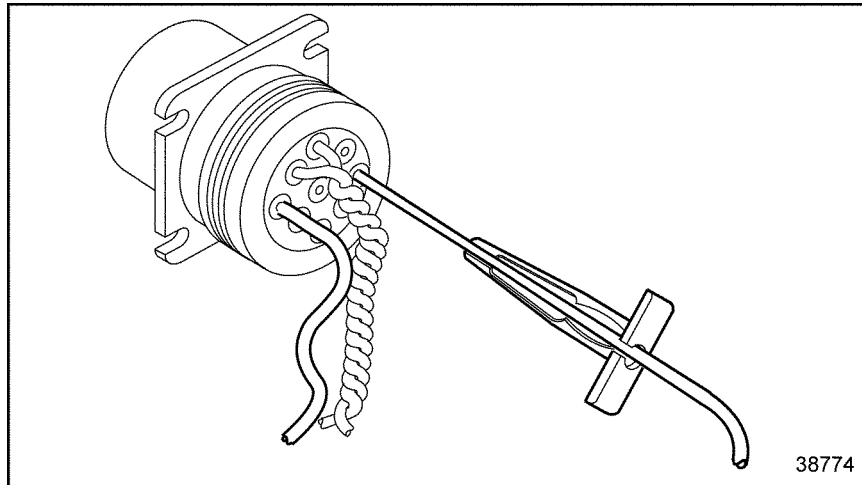


Figure 16-30 Removal Tool Position

2. Slide the tool along the wire into the insert cavity until it engages and resistance is felt. Do not twist or insert tool at an angle. See Figure 16-31.

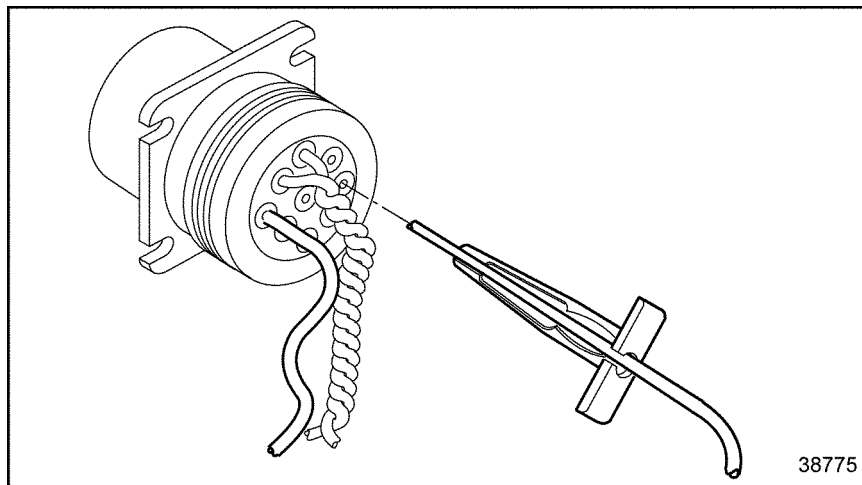


Figure 16-31 Removal Tool Insertion

3. Pull terminal wire assembly out of the connector. Keep reverse tension on the wire and forward tension on the tool.

16.3.3 ECM/ECU CONNECTOR WIRE INTO SHROUD INSTALLATION

The following procedures for using tape, ties, and conduit must be followed to ensure proper placement of the shroud over the ECM/ECU connectors:

1. Use heavy electrical tape where wires exit conduit into the shroud (see Figure 16-32, A).

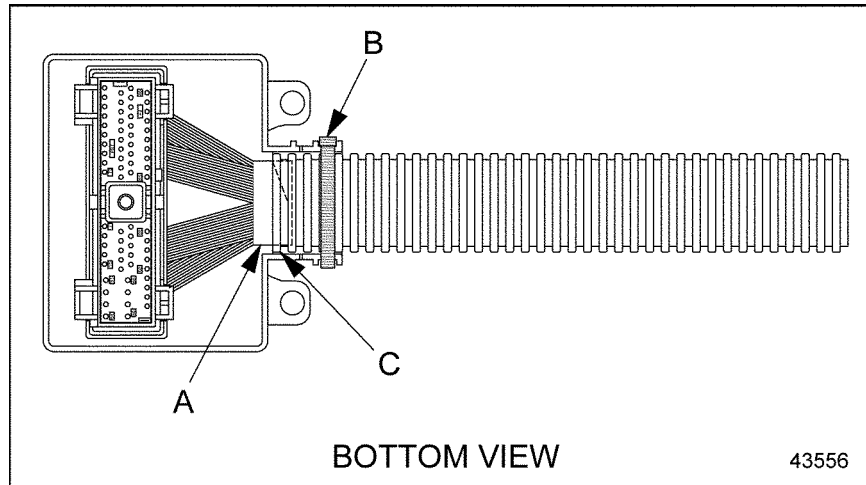


Figure 16-32 Bottom View of Shroud, ECM/ECU Connector and Conduit

2. Use a tie strap to secure the shroud to the conduit and connector (see Figure 16-32, B).
3. Check that the conduit extends past the innermost ring on the shroud inlet. The conduit **must** extend this far (see Figure 16-32, C).

4. The two locking tabs in the shroud furthest from the wire inlet must be securely latched into the connector. The two tabs closest to the wire inlet should be snapped over the connector tabs (see Figure 16-33).

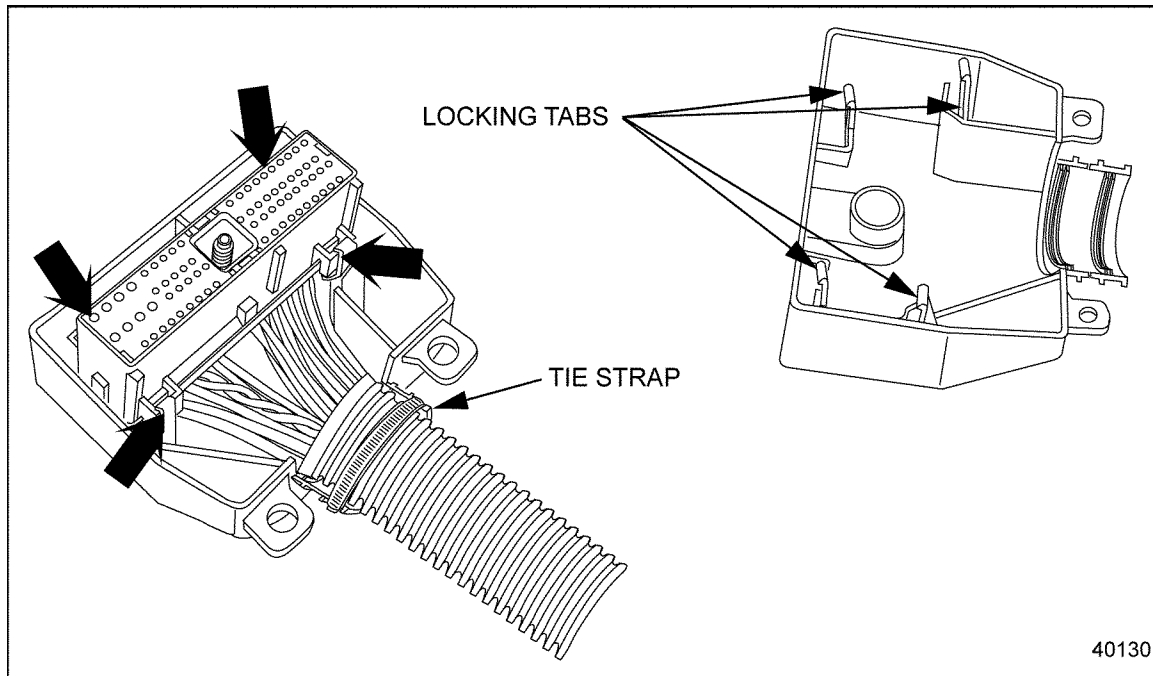


Figure 16-33 Shroud Tabs

5. Ensure that the wires are not pinched between the connector and any of the shroud's protrusions during assembly (see Figure 16-34, D).

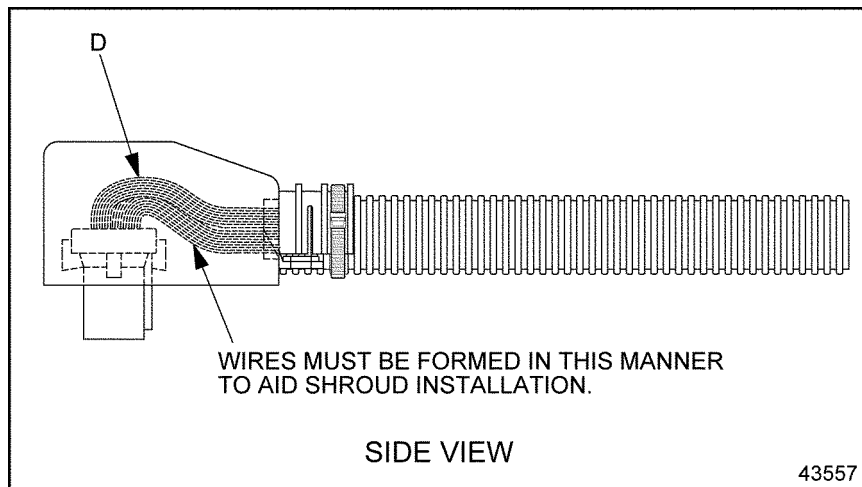


Figure 16-34 Side View of Shroud, ECM/ECU Connector and Conduit

16.3.4 FCI APEX Terminal Installation And Removal

The following sections cover FCI APEX male and female terminal installation and removal.

16.3.4.1 FCI Apex Male Terminal Installation

Install the FCI APEX male terminal as follows:

1. Determine if the connector is new or used.
 - [a] If the connector is new, the red Terminal Position Assurance (TPA) is in an unlocked position so go to step 2.
 - [b] If the connector is used, pull the TPA out (see Figure 16-35).
2. Insert the crimped terminal into the connector until it clicks (see Figure 16-35). The orientation of the terminal is not critical.

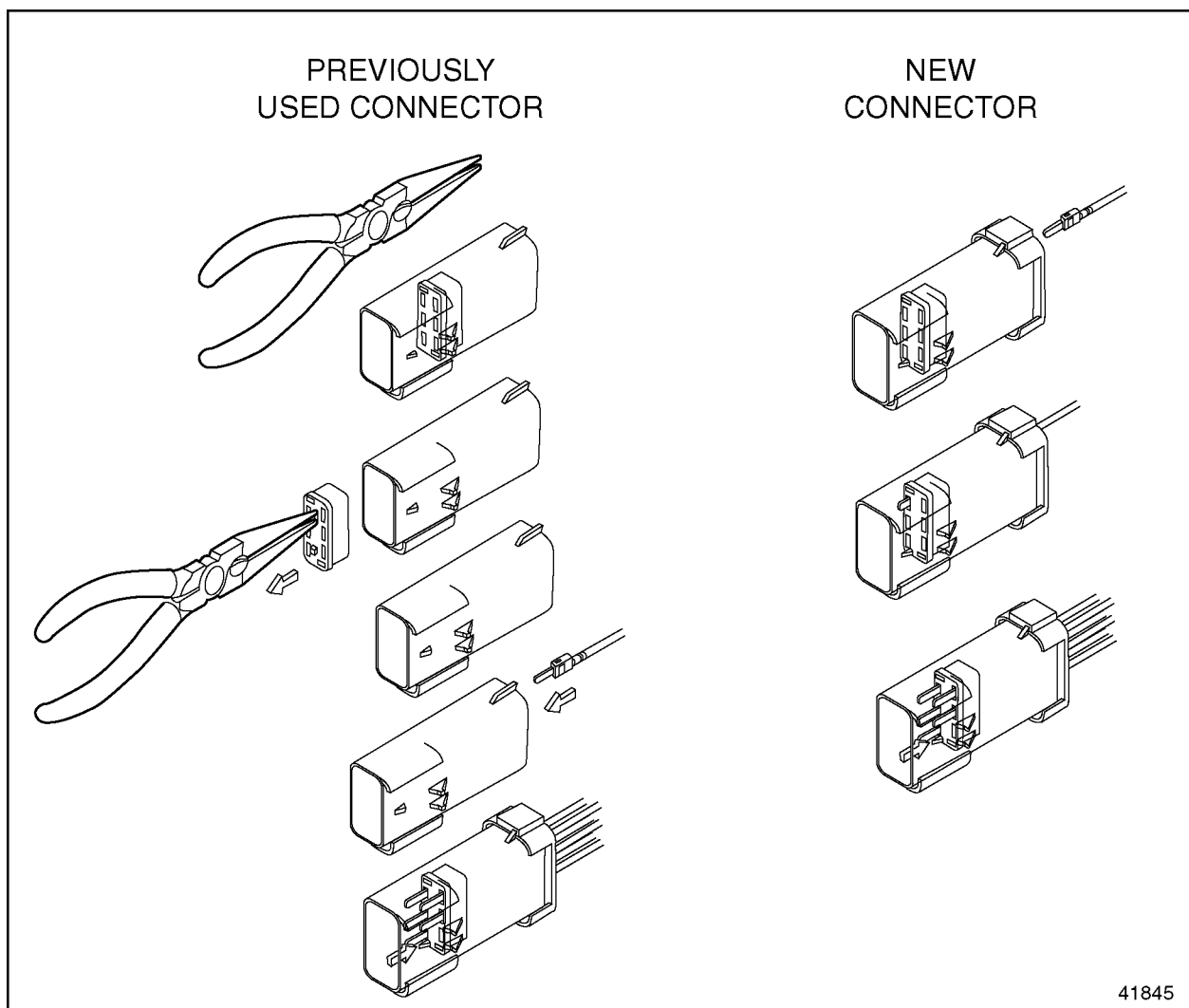


Figure 16-35 Installing the FCI Male Terminal

3. Push the TPA into the locked (fully seated) position.

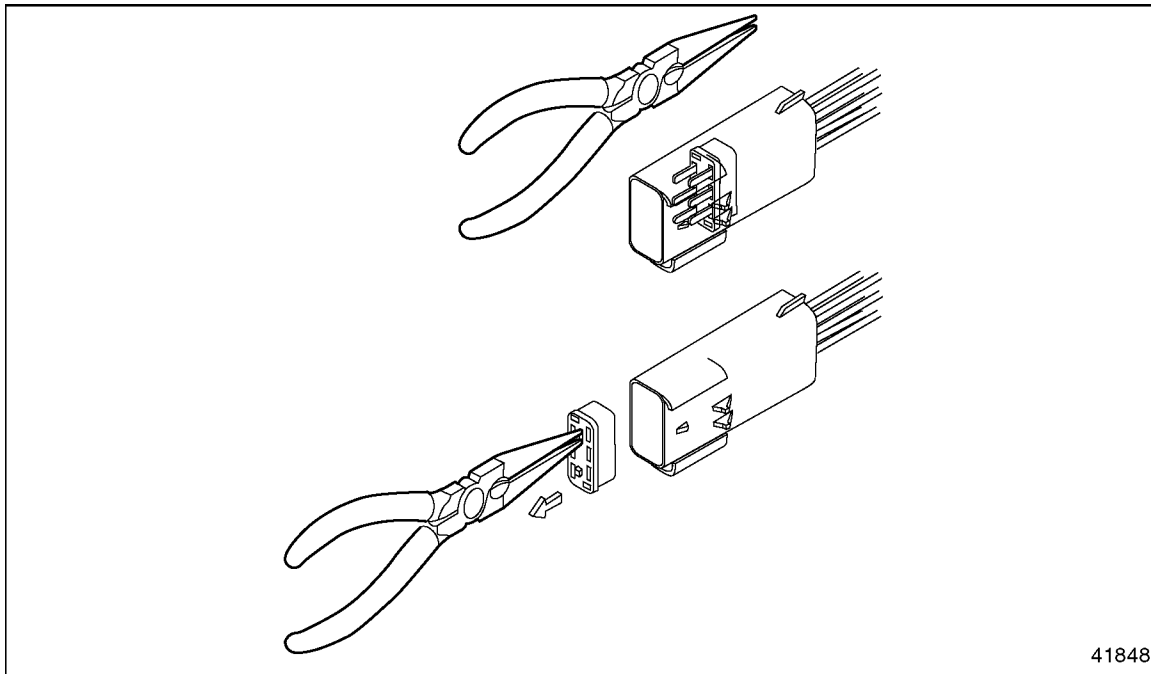
NOTE:

The TPAs will self lock when the connectors are mated.

16.3.4.2 FCI Apex Male Terminal Removal

Remove the terminal as follows:

1. Using pliers pull out the red Terminal Position Assurance (TPA) (see Figure 16-36).



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Figure 16-36 **Removing the Terminal**

2. Using a FCI APEX repair tool (P/N: 54900002) or a #2 jeweler's screwdriver, press back the terminal locking tang (see Figure 16-37).

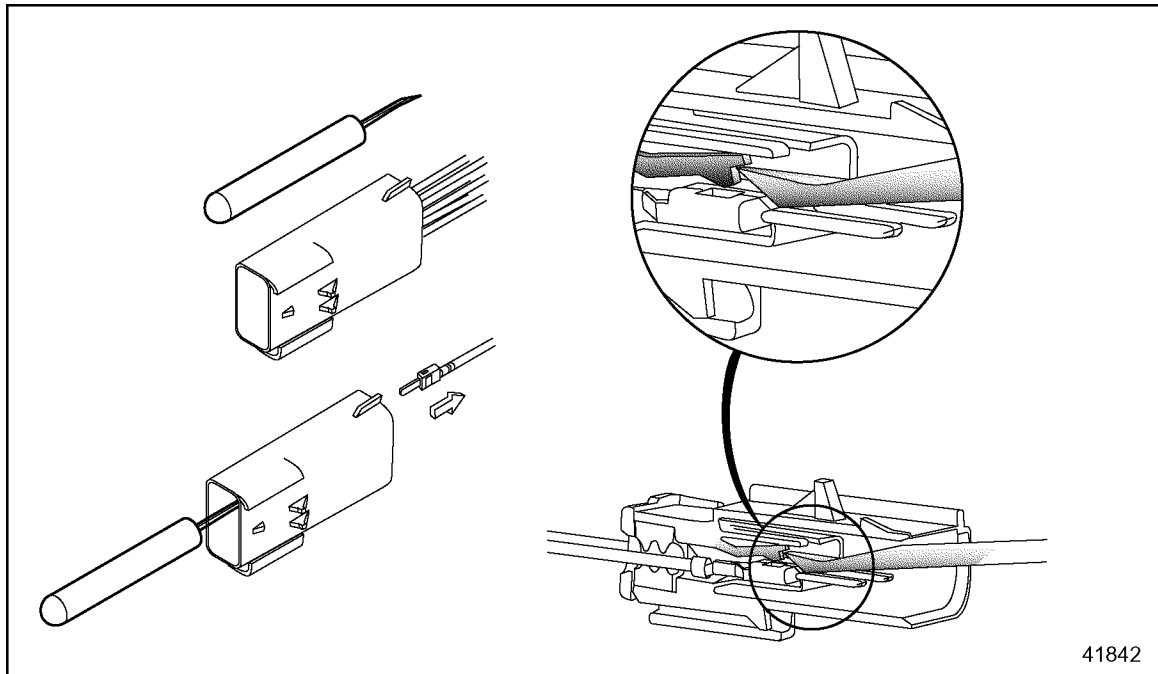


Figure 16-37 Pressing the Locking Tang

3. Pull the cable back through the connector (see Figure 16-36).

16.3.4.3 FCI Apex Female Terminal Installation

Install the terminal as follows:

1. Determine if the connector is new or used.
 - [a] If the connector is new, the blue Terminal Position Assurance (TPA) is in an unlocked position so go to 2.
 - [b] If the connector is used, pull the TPA out (see Figure 16-38).

2. Insert the crimped terminal into the connector until it clicks (see Figure 16-38).

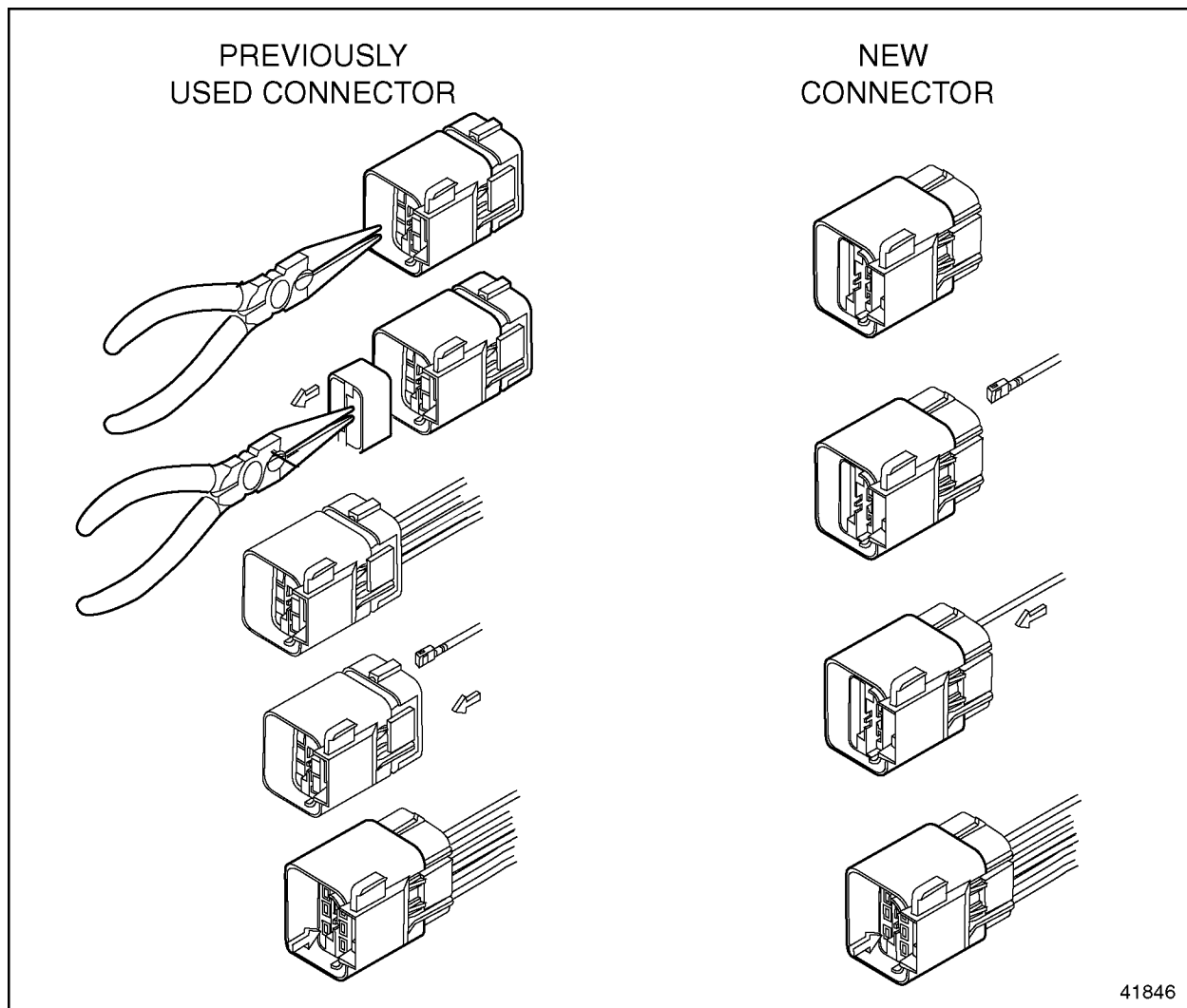


Figure 16-38 Installing the Terminal

3. Push the TPA into the locked (fully seated) position.

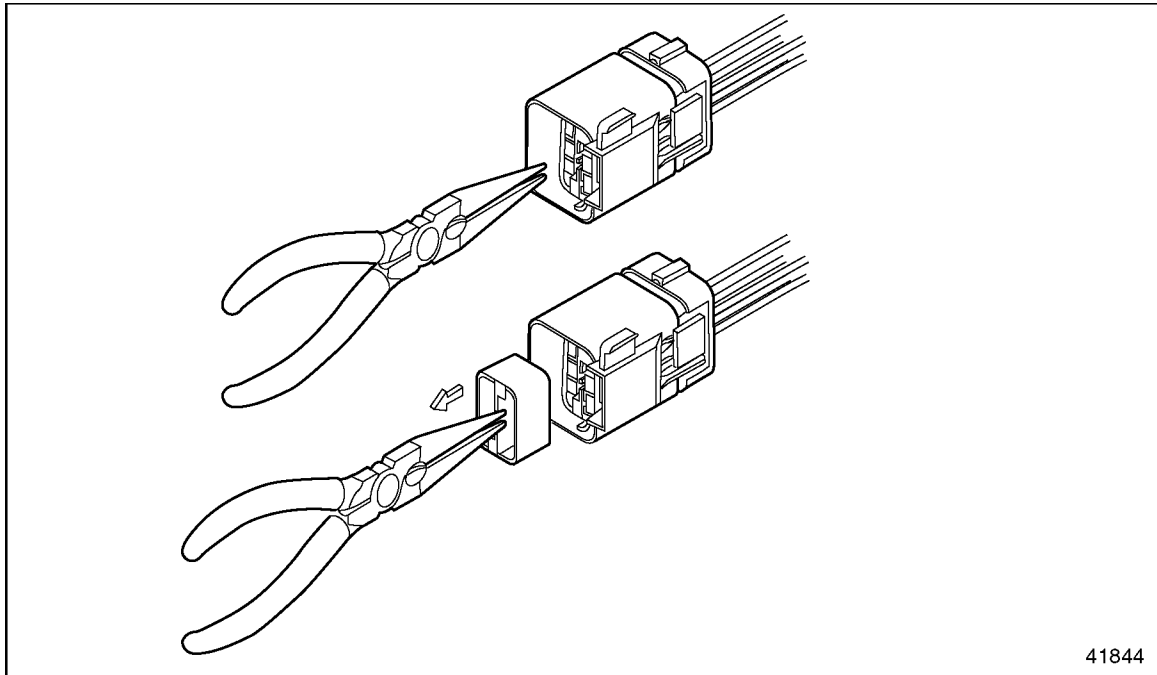
NOTE:

The TPAs will self lock when the connectors are mated.

16.3.4.4 FCI Apex Female Terminal Removal

Remove the terminal as follows:

1. Using pliers pull out the blue Terminal Position Assurance (TPA) that is located inside the connector (see Figure 16-39).



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Figure 16-39 Removing the Terminal

2. Using a FCI APEX repair tool (P/N: 54900002) or a #2 jeweler's screwdriver, press back the terminal locking tang (see Figure 16-40).

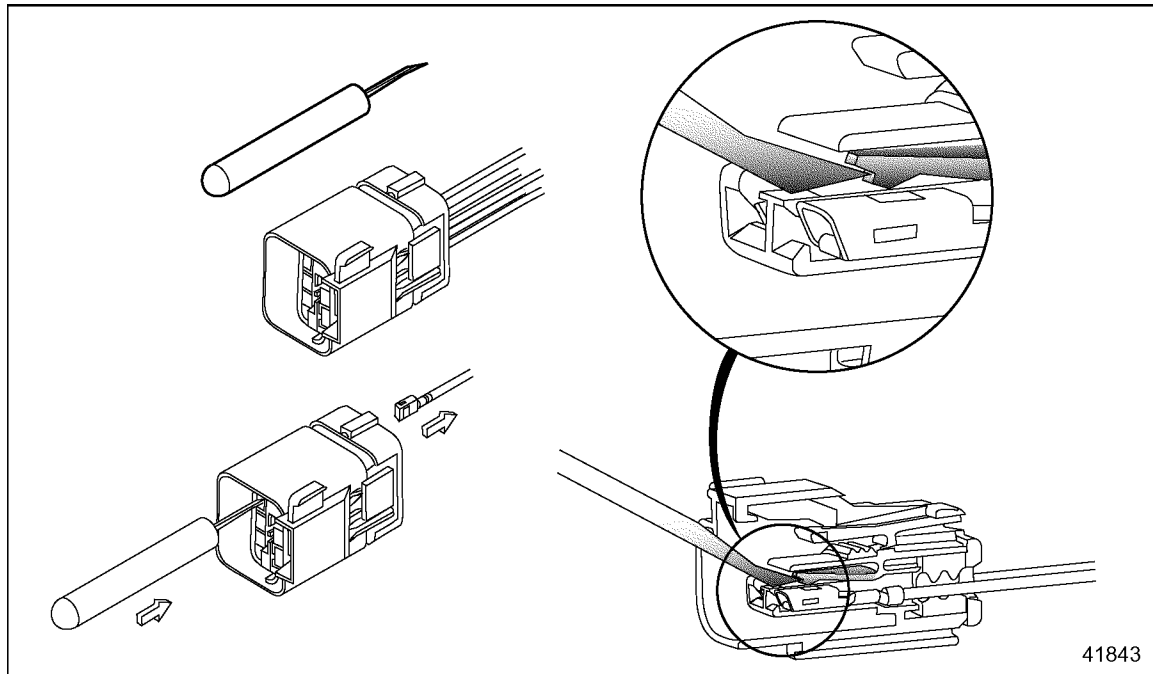


Figure 16-40 Pressing the Locking Tang

3. Pull the cable back through the connector (see Figure 16-39).

16.3.5 Splicing Guidelines

The following are guidelines which may be used for splices. The selection of crimpers and splice connectors is optional. Select a high quality crimper equivalent to the Kent-Moore tool, J 38706, and commercially available splice clips.

The recommended technique for splicing and repairing circuits (other than power and ignition circuits) is a clipped and soldered splice. Alternatively, any method that produces a high quality, tight (mechanically and electronically sound) splice with durable insulation is considered to be acceptable.

16.3.5.1 Criteria for Splicing Straight Leads

Observe the following :

- ☐ No more than one strand in a 16 strand wire may be cut or missing.
- ☐ Use Sn 60 solder with rosin core flux.
- ☐ The exposed wire must be clean before the splice is soldered.

16.3.5.2 Clipped and Soldered Splicing Method

The tools required are listed in Table 16-9.

Tool	Part Number
Heat Gun	--
Sn 60 solder with rosin core flux	--
Wire Stripper	Kent-Moore J 35615 or equivalent
Splice Clips (commercially available)	Wire size dependent
Heat Shrink Tubing	Raychem HTAT or equivalent

Table 16-9 Recommended Splicing Tools

Soldering splice connectors is optional. To solder splice connectors:

1. Position the leads, so one overlaps the other. See Figure 16-41.

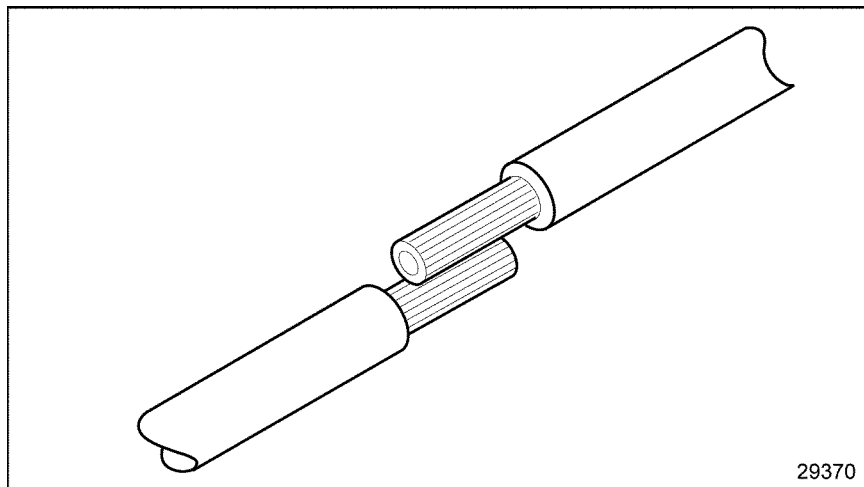


Figure 16-41 Positioning the Leads

2. Secure the leads with a commercially available clip and hand tool. See Figure 16-42.

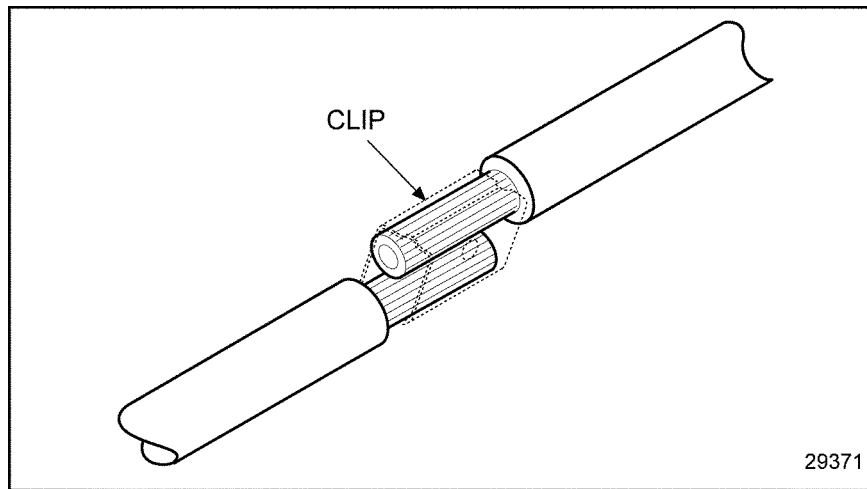


Figure 16-42 Securing the Leads With a Clip

3. Use a suitable electronic soldering iron to heat the wires. Apply the solder to the heated wire and clip (not to the soldering iron) allowing sufficient solder flow into the splice joint.
4. Pull on wire to assure crimping and soldering integrity and meet the criteria listed in Table 16-10.

Wire Gauge	Must Withstand Applied Load
14 AWG	45 lb (200 N)
16 AWG	27 lb (120 N)
18 AWG	20 lb (89 N)

Table 16-10 Applied Load Criteria for Terminals

5. Shrink wrap. Loop the lead back over the spliced joint and tape. See Figure 16-43.

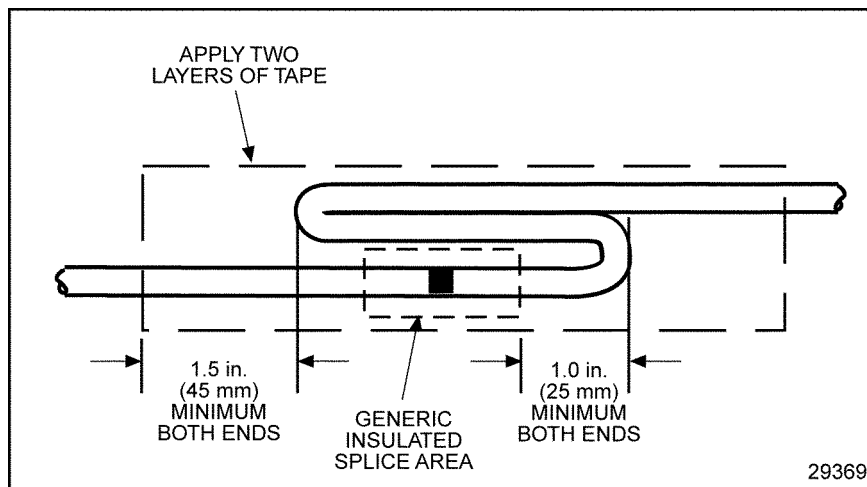


Figure 16-43 Recommended Strain Relief of Spliced Joint

16.3.5.3 Splicing and Repairing Straight Leads - Alternate Method 1

The tools required are listed in Table 16-11.

Tool	Part Number
Heat Gun	--
Wire Stripper	Kent-Moore J 35615 or equivalent
Splice Clips (commercially available)	Wire size dependent
Heat Shrink Tubing	Raychem HTAT or equivalent

Table 16-11 Recommended Splicing Tools

NOTE:

No more than one strand in a 16 strand wire may be cut or missing.

The recommended method to splice straight leads follows:

1. Locate broken wire.
2. Remove insulation as required; be sure exposed wire is clean and not corroded.
3. Insert one wire into the splice clip until it butts against the clip. Stop and crimp (see Figure 16-44, A).
4. Insert the other wire into the splice clip until it butts against the clip stop (see Figure 16-44, B).

NOTICE:

Any terminal that is cracked or ruptured is unacceptable as malfunctions may occur.

5. Visually inspect the splice clip for cracks, rupture, or other crimping damage. Remove and replace damaged clips before proceeding.
6. Pull on wire to ensure the splice integrity. The criteria listed in Table 16-12 must be met.

Wire Gage	Must Withstand Applied Load
14 AWG	45 lb (200 N)
16 AWG	27 lb (120 N)
18 AWG	20 lb (89 N)

Table 16-12 Applied Load Criteria for Terminals

7. Shrink the splice clip insulative casing with a heat gun to seal the splice (see Figure 16-44, C).

8. Loop the lead back over the spliced joint and tape. See Figure 16-43.

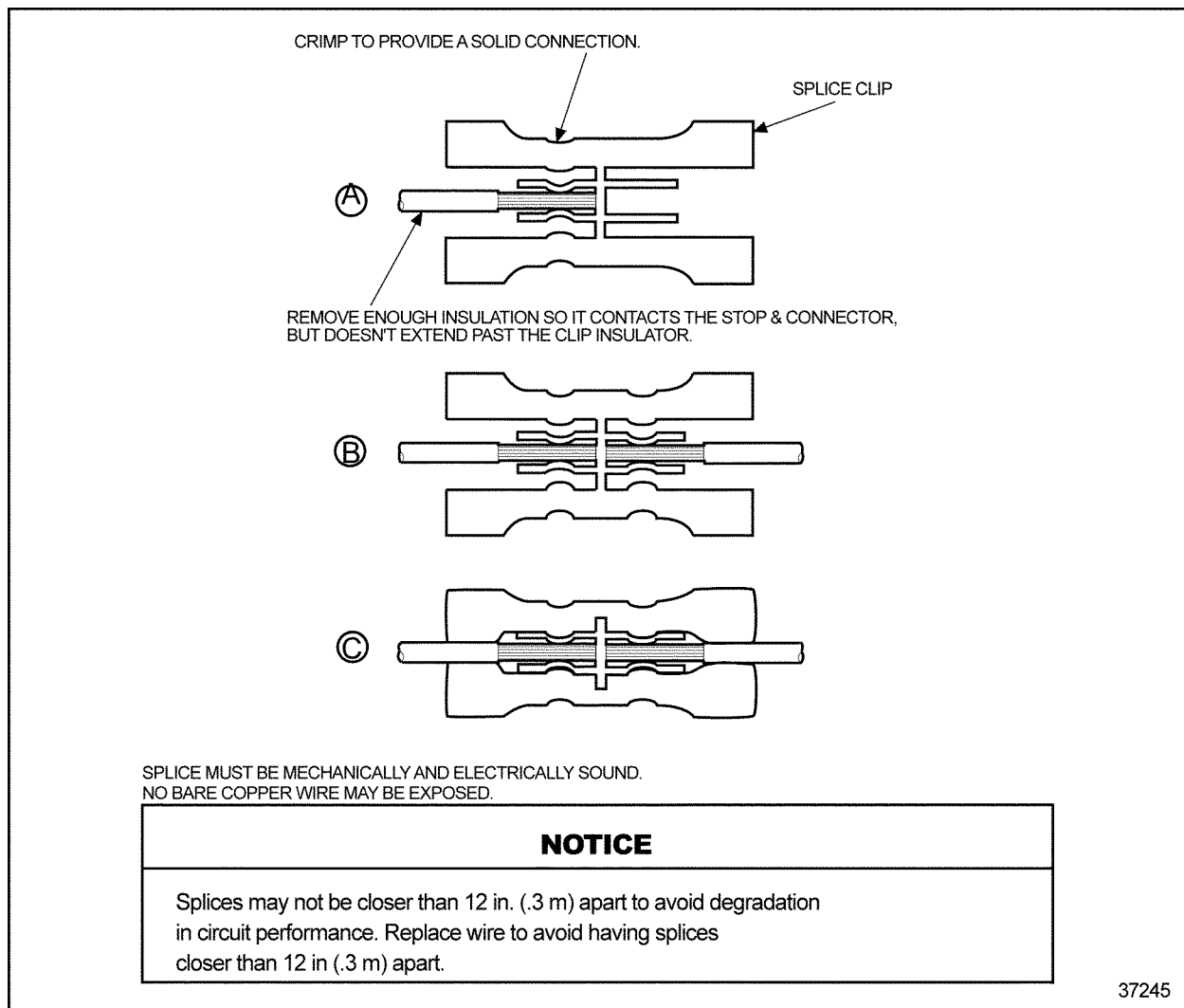


Figure 16-44 Splicing Straight Leads - Alternate Method 1

16.3.5.4 Splicing and Repairing Straight Leads - Alternate Method 2

This method is not allowed or recommended for power, ignition, or injector circuits. The tools required are listed in Table 16-13.

Tool	Part Number
Heat Gun	--
Wire Stripper	Kent-Moore J 35615 or equivalent
Splice Clips (commercially available)	Wire size dependent
Heat Shrink Tubing	Raychem HTAT or equivalent

Table 16-13 Recommended Splicing Tools

NOTE:

No more than one strand in a 16 strand wire may be cut or missing.

An acceptable option for splicing straight leads is:

1. Locate broken wire.
2. Remove insulation as required; be sure exposed wire is clean and not corroded.
3. Slide a sleeve of glue lined, shrink tubing (Raychem HTAT or equivalent) long enough to cover the splice clip on the wire and overlap the wire insulation, about ¼ in. (6 mm) on both sides (see Figure 16-45, A).
4. Insert one wire into splice clip until it butts against the splice clip. Stop and crimp (see Figure 16-45, B).
5. Insert the remaining wires into the splice clip one at a time until each butts against the splice clip; stop and crimp (see Figure 16-45, B).

NOTICE:

Any terminal that is cracked or ruptured is unacceptable as malfunctions may occur.

6. Visually inspect the terminal for cracks, rupture, or other crimping damage. Remove and replace damaged terminal before proceeding.
7. Slide the shrink tubing over the crimped splice clip (see Figure 16-45, C).
8. Shrink tubing with a heat gun to seal the splice (see Figure 16-45, D).

NOTICE:

A minimum of two layers of heat shrink tubing must be applied to splices that have more than one lead in or out.

9. Loop the lead back over the spliced joint and tape. See Figure 16-43.

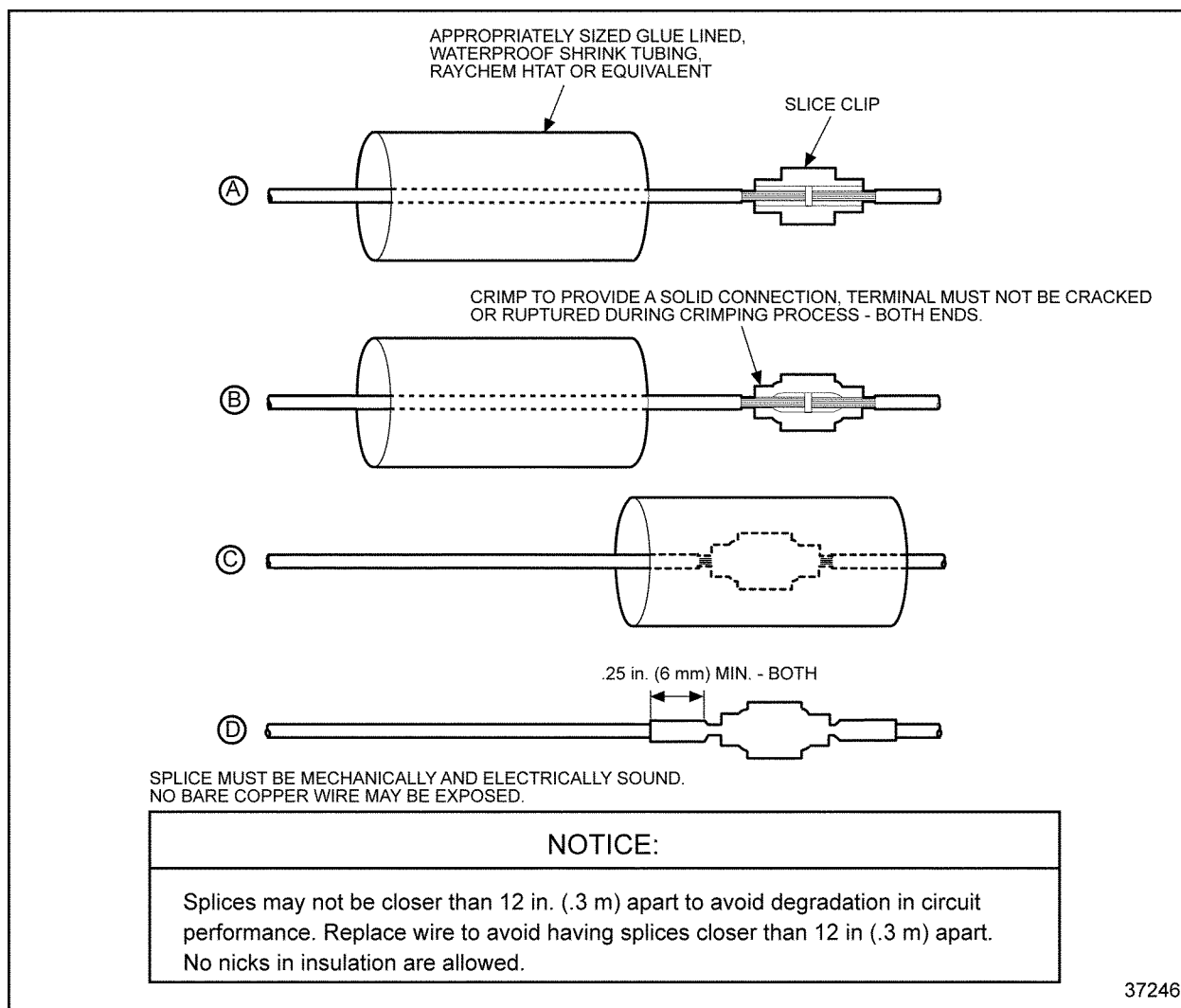


Figure 16-45 Splicing Straight Leads - Alternate Method 2

16.3.5.5 Shrink Wrap

Shrink wrap is required when splicing non insulated connections. Raychem HTAT or any equivalent heat shrink dual wall epoxy encapsulating adhesive polyolefin is required. Shrink wrap must extend at least .25 in. (6 mm) over wire insulation past splice in both directions.

To heat shrink wrap a splice:

NOTICE:
The heat shrink wrap must overlap the wire insulation about .25 in. (6 mm) on both sides of the splice.

1. Select the correct diameter to allow a tight wrap when heated.
2. Heat the shrink wrap with a heat gun; do not concentrate the heat in one location, but apply the heat over the entire length of shrink wrap until the joint is complete.
3. Repeat step 2 to apply a second layer of protection (if required by splicing guidelines).

16.3.5.6 Staggering Wire Splices

Position spliced wires properly as follows:

NOTICE:
You must stagger positions to prevent a large bulge in the harness and to prevent the wires from chafing against each other.

1. Stagger the position of each splice (see Figure 16-46) so there is at least a 2.5 in. (63.5 mm) separation between splices.

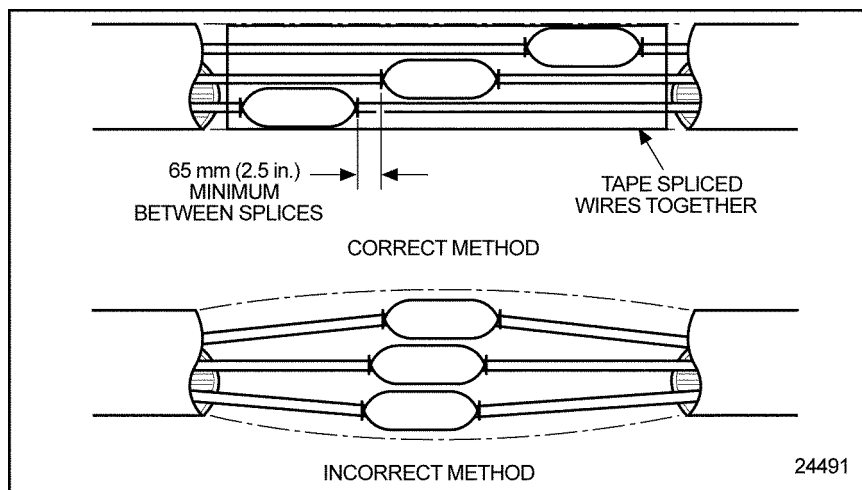


Figure 16-46 The Correct and Incorrect Method of Staggering Multiple Splices

NOTICE:
A minimum of two layers of heat shrink tubing extending 0.25 in. (6 mm) past the splice must be used to complete the splice.

2. Heat shrink a minimum of two layers of heat shrink tubing.
3. Tape the spliced wires to each other. Refer to section 16.4.

16.4 CONDUIT AND LOOM

Conduit must be used to protect the harness wires and wire splices.

NOTICE:
The conduit must not cover any connectors, switches, relays, fuses, or sensors.

The following guidelines should be used when designing a harness:

NOTICE:
Wires should be sized and cut to near equal length prior to installing conduit.

- The distance between the back of the connector or other listed devices to the end of the conduit should not exceed:
 - 1.0 in. (25.4 mm) for a single connector/device
 - 3 in. (76.2 mm) for multiple connectors/devices
- All wire breakouts and conduit ends must be secured in place with conduit outlet rings or tape.

16.4.1 Criteria for Conduit and Loom

Due to the wide variety of operating conditions and environments, it is the responsibility of the OEM to select a conduit that will survive the conditions of the specific applications. Flame retardant convoluted polypropylene conduit or equivalent may be used for most installations. Heat retardant nylon conduit or oil, water, acid, fire, and abrasion resistant non-metallic loom conforming to *SAE J562 APR86 Nonmetallic Loom (A)** is also acceptable. The diameter of conduit should be selected based on the number of wires being protected.

* If non-metallic loom is used, secure the ends with tightly wrapped nylon straps to prevent unraveling.

Conduit should cover the wires without binding and without being excessively large.

16.5 TAPE AND TAPING

Tape must be used when conduit is utilized. Be sure to follow the tape manufacturers' guidelines. The harness manufacturer may use tape under the harness covering (conduit or loom) to facilitate harness building. Tape must be tightly wrapped at all conduit interconnections with a minimum of two layers (refer to section 16.4). Be sure to firmly secure the start and finish ends of tape.

16.5.1 Tape Criteria

In applications where the temperature doesn't exceed 176°F (80°C), black vinyl electrical tape that is flame retardant and weather resistant may be used.

NOTICE:
Black vinyl electrical tape should not be used in applications where the temperature exceeds 176°F (80°C).

In applications where temperature exceeds 176°F (80°C), vinyl electrical tape should not be used. For these applications, adhesive cloth backed, flame retardant polyethylene or fiber glass tape (Delphi #PM-2203, Polikan #165 or equivalent) is recommended.

16.5.2 Taping Criteria

The tape must extend a minimum of 1 in. (25 mm) past the conduit.

The tape must be crossed over butted conduit ends.

The tape must be extended a minimum of 1 in. (25 mm) in each direction at all branches.

17 DIAGNOSTIC CODES

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17.1 DDEC DIAGNOSTIC CODES	17-3
17.2 READING THE DIAGNOSTIC CODES	17-6
17.3 FIRST STEP FOR DIAGNOSING A FAULT WITHIN THE DDEC SYSTEM	17-9
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17.1 DDEC DIAGNOSTIC CODES

The DDEC V system allows for an increased processor speed and increased memory.

NOTE:

Due to the nature of the DDEC V System always start your diagnosis by referring to section 17.3, "First Step for Diagnosing a Fault Within the DDEC System."

A diagnostic code indicates a problem in a given circuit (i.e. diagnostic Flash Code 14 indicates a problem in the oil or coolant temperature sensor circuit). This includes the oil or coolant temperature sensor, connector, harness, and Electronic Control Unit (ECM/ECU). The procedure for finding the problem can be found in Flash Code 14, refer to section 23.2. Similar sections are provided for each code. Remember, diagnosis should always begin at the start of the section. An oil or coolant temperature sensor problem will quickly lead you to section 14, but first verify the code or symptom.

Since the self-diagnostics do not detect all possible faults, the absence of a code does not mean there are not problems in the system. If a DDEC problem is suspected, even in the absence of a code, refer to section 17.3, anyway. This section can lead you to other sections that can aid in the troubleshooting process - where DDEC problems may occur, but do not generate a code.

The identifiers used by DDEC are defined and listed in Table 17-1.

Identifier	Description
Failure Mode Identifier (FMI)	The FMI describes the type of failure detected in the subsystem and identified by the PID and SID.
Message Identification Character (MID)	THE MID is the first byte or character of each message that identifies which microcomputer on DDEC J1587 serial communication link originated the information.
Parameter Identification Character (PID)	A PID is a single byte character used in DDEC J1587 messages to identify the data byte(s) that follow. PIDs identify the parameters transmitted.
Subsystem Identification Character (SID)	A SID is a single byte character used to identify field-repairable or replaceable subsystems for which failures can be detected or isolated.

Table 17-1 Identifiers Used by DDEC

17.1.1 A Bulb and System Check

As a bulb and system check, the Check Engine Light/Amber Warning Lamp (CEL/AWL) and the Stop Engine Light/Red Stop Lamp (SEL/RSL) will come on for five seconds when the ignition switch is first turned on. If the unit is programmed for the Cruise Control feature, the Cruise Active Light (if equipped) will also turn on for five seconds.

If the CEL/AWL comes on during vehicle operation, it indicates the self diagnostic system has detected a fault.

When the Diagnostic Request Switch is held, the diagnostic system will flash the yellow or red light located on the dash of the vehicle. The light will be flashing the code(s) indicating the problem areas. If the SEL/RSL comes on during vehicle operation, it indicates the DDEC System has detected a potential engine damaging condition. The engine should be shut down immediately and checked for the problem.

Active codes will be flashed on the SEL/RSL in numerical flash code order. If there are no active codes, a code 25 will be flashed.

Inactive codes will be flashed on the CEL/AWL in most recent to least recent order. If there are no inactive codes, a code 25 will be flashed.

17.1.2 Active Codes

Active codes are conditions that are presently occurring and causing the CEL/AWL to be illuminated. All current active codes will be displayed for the entire system, including single, dual and triple ECM/ECU applications. The display for each code is as follows:

Line 1: ## MID: XXX XXXXXXXX

Line 2: PID Description

Line 3: FMI Description

Line 4: ↑ A## PID: XXX FMI: XX ↓

Explanation:

##: Indicates the DDC diagnostic flash code number

MID: Message Identification Character

PID: Parameter Identification Character

FMI: Failure Mode Identifier

A##: Numerical count of active codes

↑↓: Indicates additional codes are stored in ECM/ECU memory

17.1.3 Inactive Codes

Inactive codes are faults that have occurred previously. All current inactive codes will be displayed for the entire system, including single, dual, and triple ECM/ECU applications. The display for each code is as follows:

SCREEN #1; SCREEN #2

Line 1: ## MID: XXX XXXXXX XX ; Line 5: 1st: Last:

Line 2: PID Description; Line 6: Total#:

Line 3: FMI Description; Line 7: Total Time:

Line 4: ↑ |## PID: XXX FMI: XX ↓; Line 8: Min/Max:

Explanation:

##: Indicates the DDC diagnostic flash code number

|##: Numerical Count of inactive codes

1st: First occurrence of the diagnostic code in engine hours

Last: Last occurrence of the diagnostic code in engine hours

Total#: Total number of occurrences

Total Time: Total engine seconds that the diagnostic code was active

Min/Max: Minimum/Maximum value recorded during diagnostic condition

17.1.4 Clear Codes

This feature allows diagnostic codes stored in the ECM/ECUs to be erased. An audit trail of when the codes were last erased will be displayed in engine hours.

Engine Hours of Last Clear Codes: XXXX

17.1.5 Message Identification Descriptions

MID: 128 ENGINE refers to single ECM/ECU applications

Diagnostic codes with Subsystem Identification Characters (SIDs) that reference Auxiliary Outputs # 1-8 (SIDs: 26, 40, 51, 52, 53, 54, 55, 56) will look up the parameter text description in a table to identify the function assigned to the auxiliary output channel.

Diagnostic codes with SIDs that reference PWM Outputs #1 through #4 (SIDs: 57, 58, 59 & 60) will look up the parameter text description in a table to identify the function assigned to the PWM output channel.

Injector Response Time Codes Long and Injector Response Time Codes Short will use a table of injector numbering to identify the appropriate engine cylinder number.

17.2 READING THE DIAGNOSTIC CODES

Codes can be read using the flash method, with the Diagnostic Data Reader (DDR) or with Detroit Diesel Diagnostic Link® (DDDL) software.

Codes are either active or inactive. Active codes are the codes which are currently keeping the amber or red warning lamp on. Active codes are flashed via the SEL/RSL. Inactive codes are all the codes previously logged in the ECM/ECU. These codes can be cleared by using the DDR. Inactive codes are flashed via the CEL/AWL.

NOTE:

If you are here to begin diagnosis of a problem and already know how to read codes, as well as understand active and inactive codes, refer to section 9.1.

17.2.1 Flash Codes

The following steps describe the flash method to interpret diagnostic codes:

NOTE:

The Diagnostic Request Switch reads codes on the CEL/AWL and SEL/RSL when an DDR is not available. The following steps will enable you to obtain codes.

1. Turn vehicle ignition switch ON.
2. Press and hold the Diagnostic Request Switch. As an example, observe Code 13 (active) and Code 21 (inactive) flashing out on the CEL/AWL and SEL/RSL; see Figure 17-1.

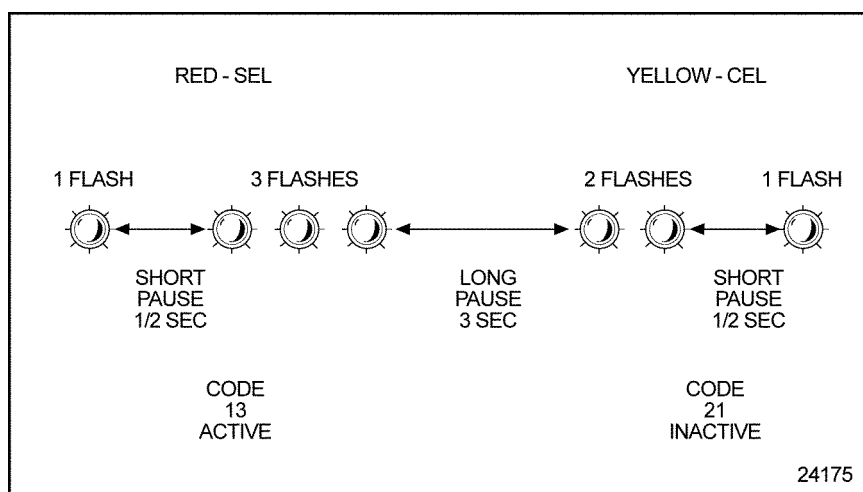


Figure 17-1 Flash Code Method

- [a] If your application has an SEO/Diagnostic Request Switch for input, press and release the switch.

[b] If your application has a Diagnostic Request Switch for input, press and hold switch.

NOTE:

Active codes are flashed in ascending numerical flash code order. Inactive codes are flashed in most recent to least recent order.

Fault codes can only be cleared using the DDR.

NOTE:

Removing the battery cables will not clear codes.

17.2.2 Reading Codes with the Diagnostic Data Reader

Flash codes are used for operator convenience to advise of an engine fault or sensor failure. SAE specific codes are read with the Diagnostic Data Reader (DDR). In some cases, one flash code may be used to cover more than one component fault. For this reason the DDR (or Diagnostic Data Link, DDL) must be used to identify the specific code.

For instructions for using the DDR or Pro-Link® 9000, (see Figure 17-2), refer to the Pro-Link Users Manual. For a list of Flash Codes and SAE Fault Codes, refer to section 17.4.

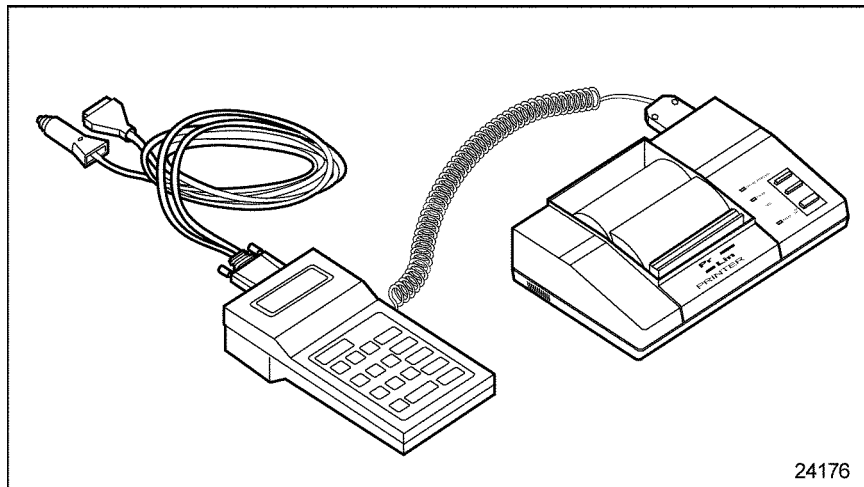


Figure 17-2 Pro-Link 9000

The Diagnostic Code Menu selections are defined as follows.

- ☐ Active codes
- ☐ Inactive codes
- ☐ Clear codes

Start with the Menu Selection screen.

To call up active codes, select ENGINE and ENTER three times.

To call up inactive codes:

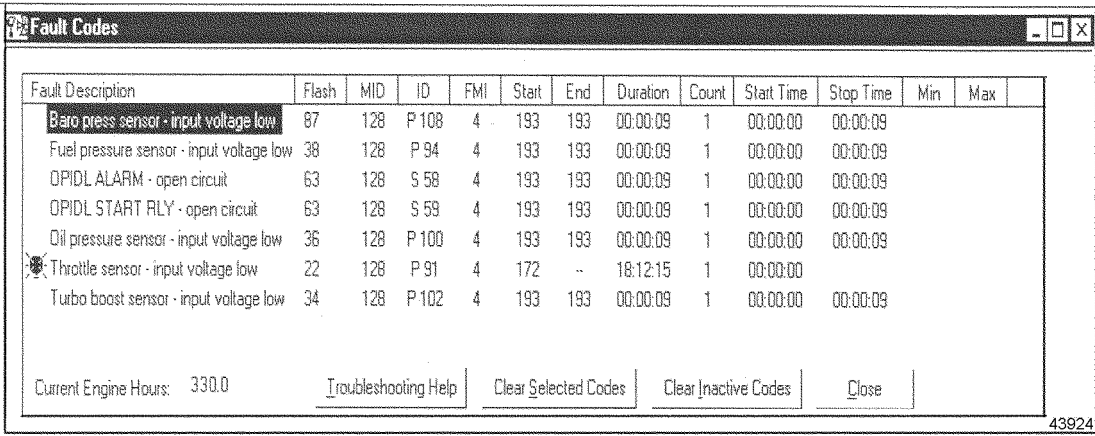
1. Select ENGINE and ENTER twice.
2. Select INACTIVE CODES and ENTER.

To clear codes:

1. Select ENGINE and push ENTER twice.
2. Go down and select CLEAR CODES and ENTER.
3. Left to YES, and ENTER.
4. Wait and then push FUNC three times.
5. Go to lines 1 and 2 of the Engine Data List, Active and Inactive Codes, and verify that both lines display NO.

17.2.3 FAULT CODES AND DDDL

The Fault Codes window is displayed when you choose “Fault Codes” from the Diagnostics menu. See Figure 17-3.



Fault Description	Flash	MID	ID	FMI	Start	End	Duration	Count	Start Time	Stop Time	Min	Max
Baro press sensor - input voltage low	87	128	P 108	4	193	193	00:00:09	1	00:00:00	00:00:09		
Fuel pressure sensor - input voltage low	38	128	P 94	4	193	193	00:00:09	1	00:00:00	00:00:09		
OPIDL ALARM - open circuit	63	128	S 58	4	193	193	00:00:09	1	00:00:00	00:00:09		
OPIDL START RLY - open circuit	63	128	S 59	4	193	193	00:00:09	1	00:00:00	00:00:09		
Oil pressure sensor - input voltage low	36	128	P 100	4	193	193	00:00:09	1	00:00:00	00:00:09		
Throttle sensor - input voltage low	22	128	P 91	4	172	..	18:12:15	1	00:00:00			
Turbo boost sensor - input voltage low	34	128	P 102	4	193	193	00:00:09	1	00:00:00	00:00:09		

Current Engine Hours: 330.0 Troubleshooting Help Clear Selected Codes Clear Inactive Codes Close

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Figure 17-3 Fault Code Window

The following fault code window information covers all DDDL versions:

- The light bulb symbol on the left indicates if the code is still active.
- The window displays both the DDEC flash code and the SAE code notation (SID or PID and the FMI). The engine hour when the code first occurred is displayed.
- If the code is historic, the engine hour when the code last appeared is displayed as well, along with the total duration time of the code for all counts logged.
- You may access the troubleshooting help guide for a particular code by highlighting the code you wish to work on with a single left mouse click and then selecting the Troubleshooting Help option.

17.3 FIRST STEP FOR DIAGNOSING A FAULT WITHIN THE DDEC SYSTEM

The following procedure is the starting point for diagnosing DDEC codes using the DDR.

17.3.1 Amber Warning Lamp

To check the CEL/AWL, turn the ignition on while at the same time observing the CEL/AWL (engine not running).

- If the CEL/AWL comes on and stays on, refer to section 17.3.2.
- If the CEL/AWL comes on for up to five seconds, and then turns off, refer to section 17.3.3.
- If the CEL/AWL does come on, but the condition of light is erratic or intermittent, refer to section 19.4.
- If the CEL/AWL does not come on, refer to section 19 and choose the appropriate symptom.

17.3.2 Read Active Codes

Perform the following steps to read the active codes.

1. Turn ignition on. Plug DDR into DDL connector. See Figure 17-4.

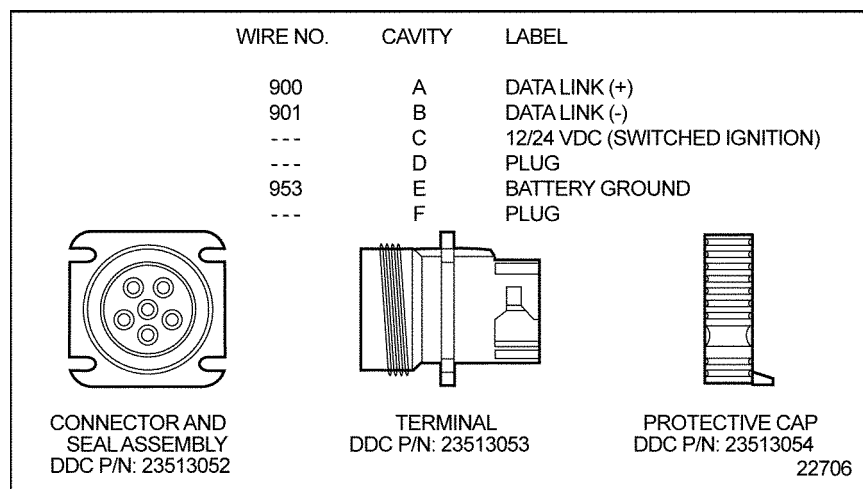


Figure 17-4 Diagnostic Connector

2. Read active codes by selecting the DIAGNOSTIC CODE MENU (ACTIVE CODES) on the DDR.
 - [a] If active codes are displayed on the DDR, follow the appropriate diagnostic procedures for the codes received.
 - [b] If the DDR display is blank or random, refer to section 19.5.
 - [c] If DDR displays NO DATA or DDEC Info not available, refer to section 19.5.
 - [d] If the DDR display reads "No Active Codes", refer to section 19.4.

17.3.3 Read Inactive Codes

Perform the following steps to read inactive codes.

1. Plug DDR into the DDL connector.
2. Read inactive codes. (Select inactive codes on the DDR.)
 - [a] If DDR displays no inactive codes, the problem may be intermittent. Refer to section 19.1.
 - [b] If DDR display is blank or random, refer to section 19.5.
 - [c] If DDR displays NO DATA or DDEC Info not available, refer to section 19.5.
 - [d] If the DDR displays any inactive codes, clear the codes and refer to section 17.3.4.

17.3.4 Attempt to Make Codes Active

Perform the following steps to read the active codes.

1. Start and run the engine for eight minutes. Warm the engine. Coolant/oil temperature must be greater than 140°F (60°C).
2. If required, perform road test with an assistant.
 - [a] If CEL/AWL or SEL/RSL illuminate, read codes and refer to the section number that matches the flash code number logged.
 - [b] If CEL/AWL or SEL/RSL do not illuminate and no codes log, return to service.
 - [c] If CEL/AWL or SEL/RSL do not illuminate but symptom occurs, refer to section 19.1, and Diagnosis by Symptom.

17.4 CODE DESCRIPTIONS

To read codes, use the DDR or press and hold the Diagnostic Request Switch with the ignition ON, engine at idle or not running. Active codes will be flashed on the SEL/RSL. Inactive codes will be flashed on the CEL/AWL. The cycle will repeat until the operator releases the diagnostic request switch. Flash codes, descriptions, and SAE faults are listed in the following chart..

DDC Code # (Flashed)	J1939	J1587		FMI	Description
	SPN	PID	SID		
—	—	—	240	2	FRAM Checksum Incorrect
—	—	—	240	13	TPU Checksum Incorrect
—	—	—	253	9	Calibration Checks Invalid
—	—	—	254	0	External RAM Failed
—	—	—	254	1	Internal RAM Failed
—	—	—	254	6	Module Forced to Boot Mode
—	—	—	254	12	Boot Mode Checksum Incorrect
11	187	187	--	4	Variable Speed Governor Sensor Voltage Low
11	187	187	--	7	Variable Speed Governor Switch System Not Responding
12	187	187	--	3	Variable Speed Governor Sensor Voltage High
13	111	111	--	4	Coolant Level Sensor Input Voltage Low
13	111	111	--	6	Add Coolant Level Sensor Input Voltage Low
13	2791		146	6	EGR Valve Current too High
14	110	110	--	3	Coolant Temperature Sensor Input Voltage High
14	175	175	--	3	Oil Temperature Sensor Input Voltage High
15	110	110	--	4	Coolant Temperature Sensor Input Voltage Low
15	175	175	--	4	Oil Temperature Sensor Input Voltage Low
16	111	111	--	3	Coolant Level Sensor Input Voltage High
16	111	111	--	5	Add Coolant Level Sensor Input Voltage High
16	2791		146	5	EGR Valve Current too Low
21	91	91	--	3	Throttle Position Sensor Input Voltage High
22	91	91	--	4	Throttle Position Sensor Input Voltage Low
23	174	174	--	3	Fuel Temperature Sensor Input Voltage High
24	174	174	--	4	Fuel Temperature Sensor Input Voltage Low
25	—	--	--	--	Reserved for "No Codes"
26	640	--	25	11	Aux. Shutdown #1 Active
26	640	--	61	11	Aux. Shutdown #2 Active
26	—	--	315	11	Aux. Shutdown #2 Active (Rel. 2.00 or later)
27	105	105	--	3	Intake Manifold Temperature Sensor Input Voltage High
27	171	171	--	3	Ambient Air Temperature Sensor Input Voltage High
27	172	172	--	3	Air Temperature Sensor Input Voltage High
28	105	105	--	4	Intake Manifold Temperature Sensor Input Voltage Low
28	171	171	--	4	Ambient Air Temperature Sensor Input Voltage Low

DDC Code # (Flashed)	J1939	J1587		FMI	Description
	SPN	PID	SID		
28	172	172	--	4	Air Temperature Sensor Input Voltage Low
29	351	351	--	4	TCI Temperature Circuit Failed Low
29	404	404	---	4	Turbo Compressor Temperature Out Sensor Input Voltage Low
31	703	--	51	3	Aux. Output #3 Open Circuit (High Side), Pin E-49
31	703	--	51	4	Aux. Output #3 Short To Ground (High Side), Pin E-49
31	703	--	51	7	Aux. Output #3 Mechanical System Fail, Pin E-49
31	704	--	52	3	Aux. Output #4 Open Circuit (High Side), Pin E-48
31	704	--	52	4	Aux. Output #4 Short to Ground (High Side), Pin E-48
31	704	--	52	7	Aux. Output #4 Mechanical System Failure, Pin E-48
31		---	260	3	Aux Output #12 Open Circuit (High Side) – Pin E-46
31		---	260	4	Aux Output #12 Short to Gnd (High Side) – Pin E-46
31		---	260	7	Aux Output #12 Mechanical System Failure – Pin E-46
31		---	261	3	Aux Output #13 Open Circuit (High Side) – Pin E-47
31		---	261	4	Aux Output #13 Short to Gnd (High Side) – Pin E-47
31		---	261	7	Aux Output #13 Mechanical System Failure – Pin E-47
31		---	262	3	Aux Output #14 Open Circuit (High Side) – Pin E-50
31		---	262	4	Aux Output #14 Short to Gnd (High Side) – Pin E-50
31		---	262	7	Aux Output #14 Mechanical System Failure – Pin E-50
31		---	263	3	Aux Output #15 Open Circuit (High Side) – Pin E-51
31		---	263	4	Aux Output #15 Short to Gnd (High Side) – Pin E-51
31		---	263	7	Aux Output #15 Mechanical System Failure – Pin E-51
31		---	264	3	Aux Output #16 Open Circuit (High Side) – Pin E-52
31		---	264	4	Aux Output #16 Short to Gnd (High Side) – Pin E-52
31		---	264	7	Aux Output #16 Mechanical System Failure – Pin E-52
31		---	265	3	Aux Output #17 Open Circuit (High Side) – Pin E-53
31		---	265	4	Aux Output #17 Short to Gnd (High Side) – Pin E-53
31		---	265	7	Aux Output #17 Mechanical System Failure – Pin E-53
32	623	--	238	3	RSL Short to Battery (+)
32	623	--	238	4	RSL Open Circuit
32	624	--	239	3	AWL Short to Battery (+)
32	624	--	239	4	AWL Open Circuit
33	102	102	--	3	Turbo Boost Pressure Sensor Input Voltage High
34	102	102	--	4	Turbo Boost Pressure Sensor Input Voltage Low
35	19	19	--	3	High Range Oil Pressure Sensor Input Voltage High
35	100	100	--	3	Oil Pressure Sensor Input Voltage High

DDC Code # (Flashed)	J1939	J1587		FMI	Description
	SPN	PID	SID		
36	19	19	--	4	High Range Oil Pressure Sensor Input Voltage Low
36	100	100	--	4	Oil Pressure Sensor Input Voltage Low
37	18	18	--	3	High Range Fuel Pressure Sensor Input Voltage High
37	94	94	--	3	Fuel Pressure Sensor Input Voltage High
37	95	95	--	3	Fuel Restriction Sensor Input Voltage High
38	18	18	--	4	High Range Fuel Pressure Sensor Input Voltage Low
38	94	94	--	4	Fuel Pressure Sensor Input Voltage Low
38	95	95		4	Fuel Restriction Sensor Input Voltage Low
39	2791	—	146	2	EGR Leak — Boost Power
39	2791	—	146	7	EGR Valve Not Responding
39	2791	—	146	12	EGR Leak — Boost Jake
39	641	—	147	2	Low or High Boost — Boost Mode VNT Vanes Not Responding (Boost Mode)
39	641	—	147	12	Low or High Boost During Jake Operation VNT Vanes Not Responding (Jake Mode)
39	641	—	147	14	EGR Flow too Low
39	641	—	147	7	Excessive EGR Flow — EGR Mode VNT Vanes Not Responding (EGR Mode)
41	636	--	21	0	Too Many SRS/CMP Sensor (missing TRS/CKP Sensor)
42	636	--	21	1	Too few SRS/CMP Sensor (missing SRS/CMP Sensor)
43	111	111	--	1	Coolant Level Low
44	105	105	--	0	Intake Manifold Temperature High
44	105	105	--	14	Engine Power Derate Due to Intake Manifold Temperature
44	110	110	--	0	Coolant Temperature High
44	110	110	--	14	Engine Power Derate Due to Coolant Temperature
44	172	172	--	0	Air Inlet Temperature High
44	175	175	--	0	Oil Temperature High
44	175	175	--	14	Engine Power Derate Due to Oil Temperature
45	19	19	--	1	High Range Oil Pressure Low
45	100	100	--	1	Oil Pressure Low
46	168	168	--	1	ECU Battery Voltage Low
46	168	168	--	14	OI Excessive Battery Time (Rel. 2.0 or later)
46	—	—	155	4	Injector V (reg) Voltage Failed Low
46	—	—	211	1	Sensor Supply Pins V-11/V-12 Low
46	—	—	212	4	Injector V (slope) Voltage Failed Low
46	1376	--	214	1	RTC Backup Battery Voltage Low, Pin V-61
46		—	221	4	Injector I (pull-in) Voltage Failed Low
46	620	--	232	1	Sensor Supply Voltage Low, Pin E-12/E-26
46	—	—	317	4	Injector V (reg) Voltage Failed Low (Rel. 2.0 or later)

DDC Code # (Flashed)	J1939	J1587		FMI	Description
	SPN	PID	SID		
47	18	18	--	0	High Range Fuel Pressure High
47	94	94	--	0	Fuel Pressure High
47	102	102	--	0	Turbo Boost Pressure High
47	102	102	--	14	Engine Power Derate Due to Turbo Boost Pressure
47	106	106	--	0	Air Inlet Pressure High
48	18	18	--	1	High Range Fuel Pressure Low
48	94	94	--	1	Fuel Pressure Low
48	106	106	--	1	Air Inlet Pressure Low
48	351	351	—	1	TCI Temperature Low
48	404	404	—	1	Turbo Compressor Temperature Out Low
48	411	411	—	1	EGR Delta Pressure Low
48	412	412	—	1	EGR Temperature Low
49	351	351	—	0	TCI Temperature High
49	404	404	—	0	Turbo Compressor Out Temperature High
49	404	404	—	14	Engine Power Derate Due to Turbo Compressor Out Temperature
51	351	351	—	3	TCI Temperature Circuit Failed High
51	404	404	—	3	Turbo Compressor Out Temperature Sensor Input Voltage High
52	—	—	254	3	ADC Reference Voltage High
52	—	—	254	4	ADC Reference Voltage Low
52	—	—	254	12	A/D Conversion Failed
53	—	—	253	2	Memory Check Failed on Startup
53	—	—	253	12	Memory Write Error — Single Location
53	—	—	253	13	Calibration Versions Invalid
53	—	—	253	14	Memory Write Error — All Locations
54	84	84	--	12	Vehicle Speed Sensor Fault
55	1484	--	216	14	Other ECU Fault (This fault is logged in conjunction with another fault to indicate missing information from another ECU.)
55	639	--	231	12	J1939 Data Link Fault
56	608	--	250	12	J1587 Data Link Fault
58	69	69	—	9	Two-speed Axle Switch Status not Responding
58	69	69	—	12	Two-speed Axle Switch Status Failed
58	92	92	--	0	Torque Overload
58	40	40	—	9	Engine Retarder Switch Status Not Responding
58	40	40	—	12	Engine Retarder Switch Status Failed
58	70	70	—	9	Park Brake/OI Switch Status Loop Not Responding
58	70	70	—	12	Park Brake/OI Switch Status Loop Failed
58	--	--	216	7	ECU Information not Responding — Mux'd IO
58	--	--	242	9	Cruise Control Resume/Accel Switch Status Not Responding
58	--	--	242	12	Cruise Control Resume/Accel Switch Status Failed

DDC Code # (Flashed)	J1939	J1587		FMI	Description
	SPN	PID	SID		
58	--	--	243	9	Cruise Control Set/Coast Switch Status Not Responding
58	--	--	243	12	Cruise Control Set/Coast Switch Status Failed
58	--	--	244	9	Cruise Control Enable Switch Status Not Responding
58	--	--	244	12	Cruise Control Enable Switch Status Failed
58	--	--	245	9	Clutch Pedal Switch Status Not Responding
58	--	--	245	9	Clutch Pedal Switch Status Failed
58	--	--	246	9	Service Brake Pedal Switch Status not Responding
58	--	--	246	12	Service Brake Pedal Switch Status Failed
61	--	--	xxx	0	Injector xxx Response Time Long
61	--	--	xxx	6	Injector xx Circuit Short to Ground
62	701	--	26	3	Aux. Output #1 Short to Battery (+), Pin V-4
62	701	--	26	4	Aux. Output #1 Open Circuit, Pin V-4
62	701	—	26	7	Aux. Output #1 Mechanical System Not Responding Properly - Pin V-4
62	702	--	40	3	Aux. Output #2 Short to Battery (+), Pin V-5
62	702	--	40	4	Aux. Output #2 Open Circuit, Pin V-5
62	702	—	40	7	Aux. Output #2 Mechanical System Not Responding Properly - Pin V-5
62	705	--	53	3	Aux. Output #5 Short to Battery (+), Pin V-6
62	705	--	53	4	Aux. Output #5 Open Circuit - Pin V-6
62	705	—	53	7	Aux. Output #5 Mechanical System Not Responding Properly - Pin V-6
62	706	--	54	3	Aux. Output #6 Short to Battery (+), Pin V-7
62	706	--	54	4	Aux. Output #6 Open Circuit - Pin V-7
62	706	--	54	7	Aux. Output #6 Mechanical System Not Responding Properly - Pin V-7
62	707	--	55	3	Aux. Output #7 Short to Battery (+), Pin V-40
62	707	--	55	4	Aux. Output #7 Open Circuit - Pin V-40
62	707	—	55	7	Aux. Output #7 Mechanical System Not Responding Properly - Pin V-40
62	708	--	56	3	Aux. Output #8 Short to Battery (+), Pin V-53
62	708	--	56	4	Aux. Output #8 Open Circuit - Pin V-53
62	708	--	56	7	Aux. Output #8 Mechanical System Not Responding Properly, Pin V-53
62	709	—	257	3	Aux Output #9 Short to Gnd — Pin V-54
62	709	—	257	4	Aux Output #9 Open Circuit — Pin V-54
62	709	—	257	7	Aux Output #9 Mechanical System Failure — V-54
62	710	—	258	3	Aux Output #10 Short to Gnd — Pin V-55
62	710	—	258	4	Aux Output #10 Open Circuit — Pin V-55
62	710	—	258	7	Aux Output #10 Mechanical System Failure — V-55
62	711	—	259	3	Aux Output #11 Short to Gnd — Pin E-13
62	711	—	259	4	Aux Output #11 Open Circuit — Pin E-13

DDC Code # (Flashed)	J1939	J1587		FMI	Description
	SPN	PID	SID		
62	711	—	259	7	Aux Output #11 Mechanical System Failure — Pin E-13
63	697	--	57	0	PWM #1 Above Normal Range, Pin V-52
63	697	--	57	1	PWM #1 Below Normal Range, Pin V-52
63	697	--	57	3	PWM #1 Short to Battery (+), Pin V-52
63	697	--	57	4	PWM #1 Open Circuit, Pin V-52
63	697	--	57	7	PWM #1 Mechanical Failure, Pin V-52
63	698	--	58	0	PWM #2 Above Normal Range, Pin V-46
63	698	--	58	1	PWM #2 Below Normal Range, Pin V-46
63	698	--	58	3	PWM #2 Short to Battery (+), Pin V-46
63	698	--	58	4	PWM #2 Open Circuit, Pin V-46
63	698	--	58	7	PWM #2 Mechanical Failure, Pin V-46
63	699	--	59	0	PWM #3 Above Normal Range, Pin E-1
63	699	--	59	1	PWM #3 Below Normal Range, Pin E-1
63	699	--	59	3	PWM #3 Short to Battery (+), Pin E-1
63	699	--	59	4	PWM #3 Open Circuit, Pin E-1
63	699	--	59	7	PWM #3 Mechanical Failure, Pin E-1
63	700	--	60	0	PWM #4 Above Normal Range, Pin E-4
63	700	--	60	1	PWM #4 Below Normal Range, Pin E-4
63	700	--	60	3	PWM #4 Short to Battery (+), Pin E-4
63	700	--	60	4	PWM #4 Open Circuit, Pin E-4
63	700	--	60	7	PWM #4 Mechanical Failure, Pin E-4
63	701	—	267	0	PWM # 5 Above Normal Range — Pin E-8
63	701	—	267	1	PWM # 5 Below Normal Range — Pin E-8
63	701	—	267	3	PWM # 5 Short to Battery — E-8
63	701	—	267	4	PWM # 5 Open Circuit — Pin E-8
63	701	—	267	7	PWM # 5 Mechanical System Failed — Pin E-8
63	702	—	268	0	PWM # 6 Above Normal Range — Pin E-11
63	702	—	268	1	PWM # 6 Below Normal Range — Pin E-11
63	702	—	268	3	PWM # 6 Short to Battery — E-11
63	702	—	268	4	PWM # 6 Open Circuit — Pin E-11
63	702	—	268	7	PWM # 6 Mechanical System Failed — Pin E-11
64	103	103	--	0	Turbo Overspeed
64	103	103	--	1	Turbo Speed Low (Rel. 2.0 or later)
64	103	103	--	8	Turbo Speed Sensor Input Failure — Abnormal Period
65	107	107	--	3	Air Filter Restriction Sensor Voltage High
65	107	107	--	4	Air Filter Restriction Sensor Voltage Low
66	99	99	--	3	Oil Filter Restriction Sensor Voltage High
66	99	99	--	4	Oil Filter Restriction Sensor Voltage Low
67	106	106	--	3	Air Inlet Pressure Sensor Input Voltage High

DDC Code # (Flashed)	J1939	J1587		FMI	Description
	SPN	PID	SID		
67	106	106	--	4	Air Inlet Pressure Sensor Input Voltage Low
67	109	109	--	3	Coolant Pressure Sensor Input Voltage High
67	109	109	--	4	Coolant Pressure Sensor Input Voltage Low
68	558	--	230	5	TPS Idle Validation Circuit Fault (open circuit)
68	558	--	230	6	TPS Idle Validation Circuit Fault (short to ground)
71	—	--	xxx	1	Injector xxx Response Time Short
72	84	84	--	0	Vehicle Overspeed
72	84	84	--	11	Vehicle Overspeed (Absolute)
73	107	107	—	0	Air Filter Restriction High
74	70	70	--	4	Optimized Idle Safety Loop Short to Ground
74	99	99	--	0	Oil Filter Restriction High
75	168	168	--	0	ECU Battery Voltage High
75	21	—	155	3	Injector V (reg) Voltage Failed High
75	21	—	211	0	Sensor Supply Pins V-11/V-12 Voltage High
75	21	—	212	3	Injector V (slope) Voltage Failed High
75	21	—	221	3	Injector V (pull-in) Voltage Failed High
75	21	—	317	3	Injector V (reg) Voltage Failed High (Rel. 2.0 or later)
75	1376	--	214	0	RTC Backup Battery Voltage High
75	620	--	232	0	Sensor Supply Voltage High. Pin E-26
76	121	121	--	0	Engine Overspeed With Engine Brake
77	19	19	—	0	High Range Oil Pressure High
77	20	20	—	0	High Range Coolant Pressure High
77	21	21	—	0	ECU Temperature Above Range
77	21	21	—	1	ECU Temperature Below Range
77	21	21	—	3	ECU Temperature Above Failed High
77	21	21	—	4	ECU Temperature Above Failed Low
77	73	73	—	1	Fire Pump Pressure Low
77	81	81	—	0	Exhaust Back Pressure High
77	81	81	—	1	Exhaust Back Pressure Low
77	81	81	—	3	Exhaust Back Pressure Sensor Voltage High
77	81	81	—	4	Exhaust Back Pressure Sensor Voltage Low
77	81	81	—	12	Exhaust Back Pressure at Rampdown Threshold
77	95	95	—	1	Fuel Filter Differential Pressure Low
77	99	99	—	1	Oil Filter Differential Pressure Low
77	100	100	—	0	Engine Oil Pressure High
77	102	102	—	1	Turbo Boost Pressure Low
77	105	105	—	1	Inlet Manifold Temperature Low
77	107	107	—	1	Air filter Restriction Pressure Low
77	108	108	—	0	Barometric Pressure High
77	108	108	—	1	Barometric Pressure Low
77	110	110	—	1	Coolant Temperature Low

DDC Code # (Flashed)	J1939	J1587		FMI	Description
	SPN	PID	SID		
77	111	111	—	0	Coolant Level High
77	171	171	—	0	Ambient Air Temperature High
77	171	171	—	1	Ambient Air Temperature Low
77	172	172	—	1	Air Inlet Temperature Low
77	174	174	—	0	Fuel Temperature High
77	174	174	—	1	Fuel Temperature Low
77	175	175	—	1	Engine Oil Temperature Low
77	222	222	—	14	Anti-Theft Fault Present
77	251	251	—	10	Clock Module Abnormal Rate of Change
77	251	251	—	13	Clock Module Failure
77	252	252	—	10	Clock Module Abnormal Rate of Change
77	252	252	—	13	Clock Module Failure
77	611	—	151	11	Service Now Lamp Fault Expiration
77	611	—	316	11	Service Now Lamp Fault Expiration (Rel 2.0 or later)
78	86	86	--	14	Cruise Control/Adaptive Cruise Control Fault
81	98	98	--	3	Oil Level Sensor Input Voltage High
81	153	153	--	3	Extended Crankcase Pressure Input Voltage High
81	173	173	--	3	Exhaust Temperature Sensor Input Voltage High
81	355	355	--	3	Engine Oil Life Circuit Failed High
81	411	411	—	3	EGR Delta Pressure Sensor Circuit Failed High
81	412	412	—	3	EGR Temperature Sensor Input Failed High
82	98	98	--	4	Oil Level Sensor Input Voltage Low
82	101	101	--	4	Crankcase Pressure Sensor Input Voltage Low
82	153	153	--	4	Extended Crankcase Pressure Input Voltage Low
82	173	173	—	4	Exhaust Temperature Sensor Input Voltage Low
82	355	355	—	4	Engine Oil Life Circuit Failed Low
82	411	411	—	4	EGR Delta Pressure Sensor Circuit Failed Low
82	412	412	—	4	EGR Temperature Circuit Failed Low
83	73	73	—	0	Pump Pressure High
83	98	98	--	0	Oil Level High
83	101	101	--	0	Crankcase Pressure High
83	153	153	--	0	Extended Crankcase Pressure High
83	173	173	—	0	Exhaust Temperature High
83	355	355	—	9	Coolant Ingress Fault Detected
83	355	355	—	14	Change Oil Now
83	411	411	—	0	EGR Delta Pressure High
83	412	412	—	0	EGR Temperature High
84	98	98	--	1	Oil Level Low
84	355	355	—	1	Change Oil Soon
85	190	190	--	0	Engine Overspeed
85	190	190	--	14	Engine Overspeed Signal

DDC Code # (Flashed)	J1939	J1587		FMI	Description
	SPN	PID	SID		
86	73	73	--	3	Pump Pressure Sensor Input Voltage High
86	108	108	--	3	Barometric Pressure Sensor Input Voltage High
87	73	73	--	4	Pump Pressure Sensor Input Voltage Low
87	108	108	--	4	Barometric Pressure Sensor Input Voltage Low
89	95	95	--	0	Fuel Restriction High
89	111	111	--	12	Maintenance Alert Coolant Level Fault

18 BASIC KNOWLEDGE REQUIRED / TESTING / SERVICE TOOLS

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18.3 SERVICING DDEC CONNECTORS	18-9
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18.1 BASIC KNOWLEDGE REQUIRED

Before using this manual, you should understand the theory of electricity and know the meaning of voltage and ohms. You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.

You should be able to use jumper wires to make circuit checks.

18.1.1 Use of Digital Volt-Ohm Meter

Before using this manual, you should be familiar with the digital volt-ohm meter (VOM). You should be able to measure voltage and resistance. You should be familiar with the controls of the meter and how to use it correctly.

For use of a typical digital volt-ohm meter, refer to section 18.1.1.1, refer to section 18.1.1.2, and refer to section 18.1.1.3.

18.1.1.1 Resistance Measurements

Perform the following steps to measure resistance:

1. Connect the red test lead to the V- Ω (Volt-Ohm) input connector and the black lead to the com input connector on the meter.
2. Set the function/range switch to the desired Ω position. If the magnitude of the resistance is not known, set the switch to the highest range, then reduce until a satisfactory reading is obtained.
3. If the resistance being measured is connected to a circuit, turn off the power to the circuit being tested. Turn off the ignition.
4. Connect the test leads to the circuit being measured. When measuring high resistance, be careful not to contact adjacent points, even if they are insulated. Some insulators have a relatively low insulation resistance which can affect the resulting measurement.
5. Read the resistance value on the digital display.

18.1.1.2 Continuity Checks

In addition to measuring the specific resistance value of a circuit, some meters will also register if a continuous electrical path exists. If a path exists, the circuit is said to have continuity. (This continuity check can be used in any section of this troubleshooting guide where the test is looking for greater than, less than, or equal to 5 ohms.) An open circuit (broken electrical path) would have ∞ resistance and would not have continuity. To utilize the continuity feature of certain meters:

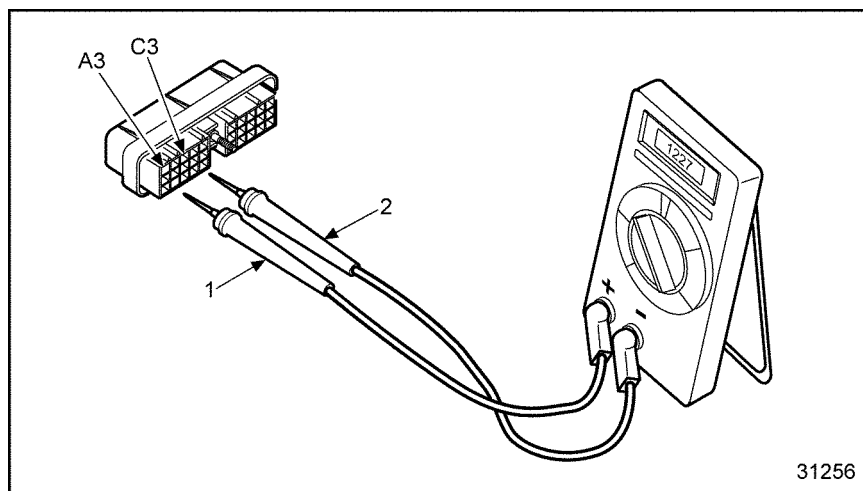
1. Place the function/range switch in any Ω range.
2. Connect the red lead to the V- Ω connector and the black lead to the com connector on the meter. With the test leads separated or measuring an out-of-range resistance, the digital display will indicate OL (over limit) Some meters show "1 +, 1, or $\uparrow$."

3. Put one test probe at one end of the wire or circuit to be tested. Use the other test lead to trace the circuit. When continuity is established, an ohm (Ω) symbol will display in the upper left corner of the digital display. If contact in the wire is maintained long enough (about 1/4 second), the OL will disappear and the resistance value of the wire or circuit will display next to the symbol.
4. If your VOM does not work in the manner described above, you must know how your VOM operates in order to use this troubleshooting guide.

18.1.1.3 Voltage Measurements

Perform the following steps to measure voltage.

1. Connect the red test lead to the V- Ω connector and the black lead to the com input on the meter. If a DC-AC switch is present, ensure it is switched to the DC position.
2. Set the function range/switch to the desired volts position. If the magnitude of the voltage is not known, set the switch to a range that will be able to read most voltages seen on a vehicle. Typically, a 20V range will do. Then, reduce the range until a satisfactory reading is obtained.
3. Connect the test leads to the circuit being measured. In the DDEC system diagnostic procedures, voltage measurements are always given as being taken at pins, sockets, battery +, or ground. Following the voltage measurement point, the color test lead to be used is given in parenthesis (red is the V- Ω connection, and black is the com connection). Example: If the procedure displays, "Take voltage reading at socket A3 (red lead) to socket C3 (black lead)", see Figure 18-1 for the hook-up.



1. Red Lead

2. Black Lead

Figure 18-1 Voltage Measurement Hook-up

18.2 BEFORE TROUBLESHOOTING

The following listed items should be checked prior to starting any troubleshooting:

- ☐ Ensure engine serial number on the ECM/ECU matches the serial number on the cylinder block.
- ☐ Walk around the vehicle. Look for obvious problems such as leaks (air or liquid).
- ☐ Inspect ECM/ECU for worn isolators, debris or bolts lodged between ECM/ECU and cylinder block.
- ☐ Broken wiring connectors.
- ☐ Fuel Supply - Full on.
- ☐ Fuel tank level.
- ☐ Vehicle damage.
- ☐ Investigate any prior repairs, if applicable.
- ☐ Check for poor mating of the connector halves or terminals not fully seated in the connector body (backed out terminals).
- ☐ Look for improperly formed or damaged terminals. All connector terminals in the problem circuit should be carefully inspected to determine proper contact tension. Use a mating terminal to test the contact tension.
- ☐ Electrical system interference caused by a defective relay, ECM/ECU driven solenoid, or a switch causing an electrical surge. Look for problems with the charging system (alternator, etc.). In certain cases, the problem can be made to occur when the faulty component is operated as in the case of a relay.
- ☐ Verify alternator grounds are clean and making good contact. Disconnect the alternator belt to test.
- ☐ Wiggle wires and harnesses to try to make the problem active, or re-occur.

18.2.1 ECM/ECU Programming

The following label is attached to the ECM/ECU. See Figure 18-2.

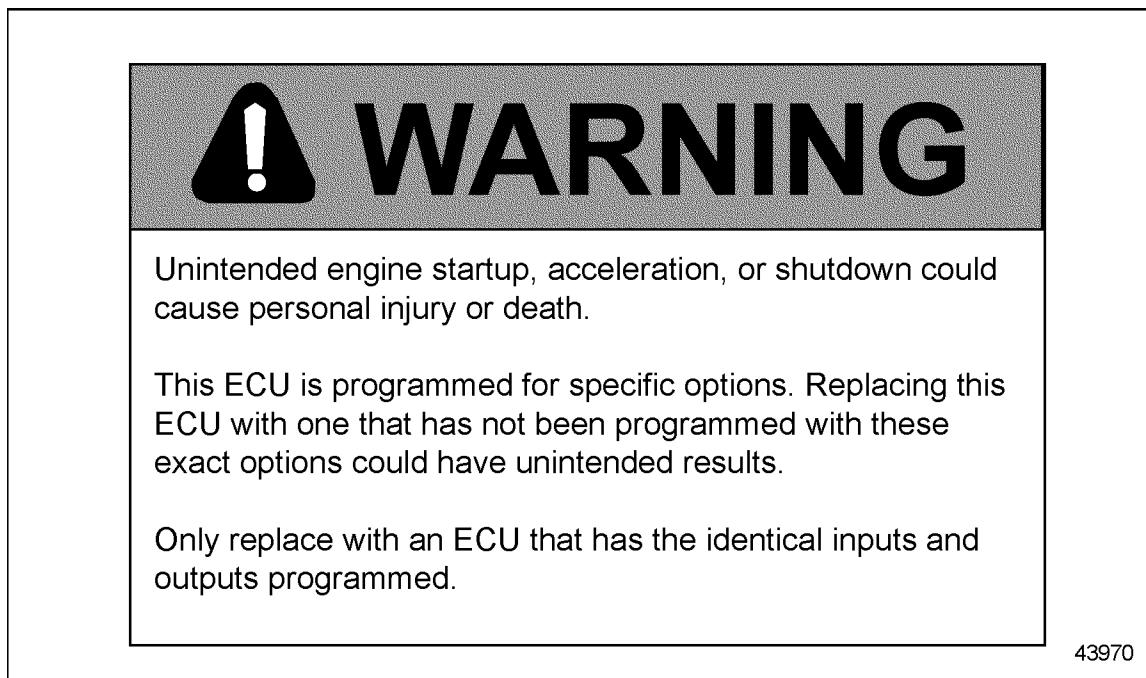


Figure 18-2 ECM/ECU Label

Every DDEC system engine serial number has its own file in the DDC Mainframe.

NOTICE:
Failure to match the serial number on the engine with the ECM/ECU programming may result in incorrect calibration results and engine damage.

ECM/ECU programming must be done to match the serial number you are currently working on. Failure to do so may result in incorrect calibration and engine damage.

Programming a DDEC V ECM/ECU must be done with an engine file set up for the DDEC V system.

18.2.2 Driver Questionnaire

Ask the driver to answer the following questions before attempting to repair an intermittent problem, or a problem with symptoms but no diagnostic codes. Be specific! Use this and the response guideline to these questions.

1. How often does the problem occur? Can you and the driver take the vehicle and demonstrate the problem in a short time?

2. Has the vehicle been to other shops for the same problem? If so, what was done there?
3. Did the radio, dash gages, or lights momentarily turn OFF when the problem occurred?
4. Does the problem occur only at specific operating conditions? If so, at what load? Is it light, medium, or heavy?
5. Does the problem occur at a specific engine operating temperature? If so, at what engine temperature?
6. Does the problem occur only when above or below specific outside temperatures? In what temperature range?
7. Does the problem occur during other conditions e.g. during or after rain, spray washing, snow?
8. Did the problem occur at a specific vehicle speed? If so, at what vehicle speed?
9. Does the problem occur at specific engine rpm? If so, at what engine rpm?

18.2.3 Questionnaire Response Guideline

The following are typical responses to the Driver Questionnaire:

1. If the problem is repeatable, take the vehicle for a drive with the DDR connected and note the conditions when the problem occurs. Be prepared to take snapshot data using the DDR. Ensure you operate the vehicle after correcting the problem and duplicate the operating conditions before releasing the unit, to verify the problem is corrected.
2. If the vehicle has been to other shops for the same problem, call the other shops and find out what has been done. Avoid replacing the same components again unless absolutely sure they are the problem! It is unlikely a component will fail again following a recent replacement.
3. If other vehicle devices are affected, this indicates there may be something wrong with the ignition wiring. Refer to section 77.1 for information on inspecting the ECM/ECU battery connections.
4. Operate the engine under similar load conditions. Check the fuel system for restrictions, primary filter, and fuel tanks for foreign objects blocking the fuel supply. Also, check the air system. Utilize the DDR snapshot feature.
5. Operate the engine at this temperature while attempting to duplicate the problem. Use the snapshot feature on the DDR.
6. If possible, troubleshoot the problem in this temperature range.
7. If the problem seems to occur during or after the engine is subjected to rain/spray washing, thoroughly inspect the connectors for moisture entry.
8. If the problem occurs at a specific vehicle speed, check the parameters affecting vehicle speed to verify they are programmed close to the vehicle speed where the problem occurs. Check Vehicle Speed and watch the DDR (snapshot) for changes to see if the pulse wheel (VSS signal) is loose.

9. If the problem occurs at a specific engine rpm, unplug the oil, coolant, and air temperature sensors, and note any changes to the problem. Gather this data and contact Detroit Diesel Customer Support Center (313-592-5800).

18.2.4 Before Troubleshooting the Electronic Controls

The following items must be read and thoroughly understood before using this manual.

- The engine and ignition should always be off before the harness connectors are disconnected or reconnected.
- When disconnecting harness connectors, ensure the pulling force is applied to the connectors themselves and not the wires extending from them.

NOTICE:
To avoid damage to the harness connectors, ensure the pulling force is applied to the connections themselves and not the wires extending from them.

- After harness connectors are reconnected to the DDEC system, the codes logged should be ignored and cleared.
- In most all areas of repair/troubleshooting, a DDR will be required.
- In diagnosing an intermittent problem, wiggling wires or harnesses may allow the fault to be repeated. This may allow a technician to better isolate the problem area.

18.3 SERVICING DDEC CONNECTORS

Newly released kits make servicing DDEC connectors and terminals easier than ever. Crimp tools are not required for simple factory approved repairs. The DDEC V connector service kit is P/N: 23533513.

Additionally, it is recommended that whenever possible, the connector and harness incorporate a “service loop” on sensor connections. To achieve this, the harness should be looped back and tie wrapped to the sensor leaving a 3–inch loop. This size loop has proved to substantially protect the mating connector terminals. See Figure 18-3.

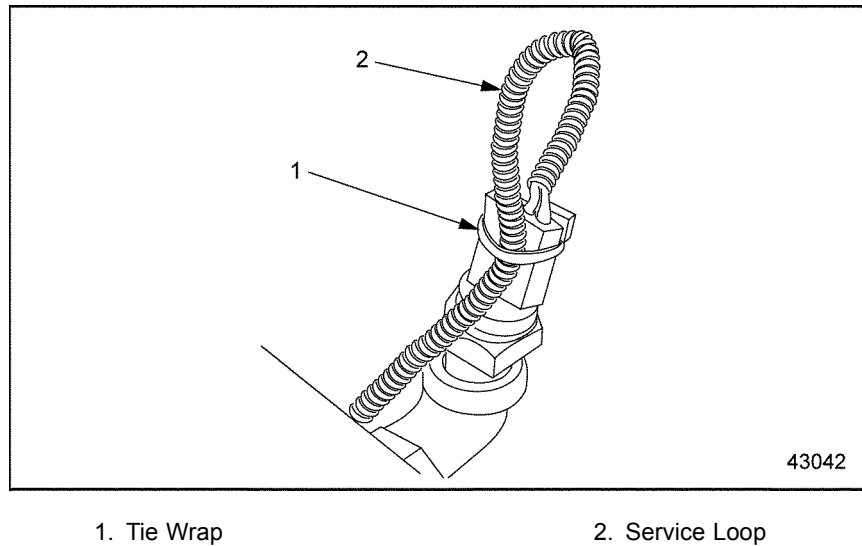


Figure 18-3 Connector Service Loop

NOTE:

Whenever a connector tie wrap is removed for testing or servicing a connection, ensure it is replaced with a new tie wrap.

18.4 SERVICE TOOLS

Listed in Table 18-1 are the service tools required to perform troubleshooting procedures for the DDEC-equipped engine.

Tool Number	Tool Name
J-47500	DDDL Kit see Figure 18-10
J-40901	DRS Interface Module (Programming ECM/ECU) see Figure 18-6
J-39299	Volt-Ohm Meter; see Figure 18-4
J-38500	Pro-Link® Diagnostic Data Reader; see Figure 18-5
J-41005	DDEC Vehicle Interface Module for III, IV & V see Figure 18-7
J-41005-5	DDEC V Adapter Harness
J-38480	Pro-Link Printer; see Figure 18-8
23516937	Digital Diesel Sensor Simulator; see Figure 18-9 (Optional Tool)
J-35751	Jumper Wire Kit

Table 18-1 Service Tools

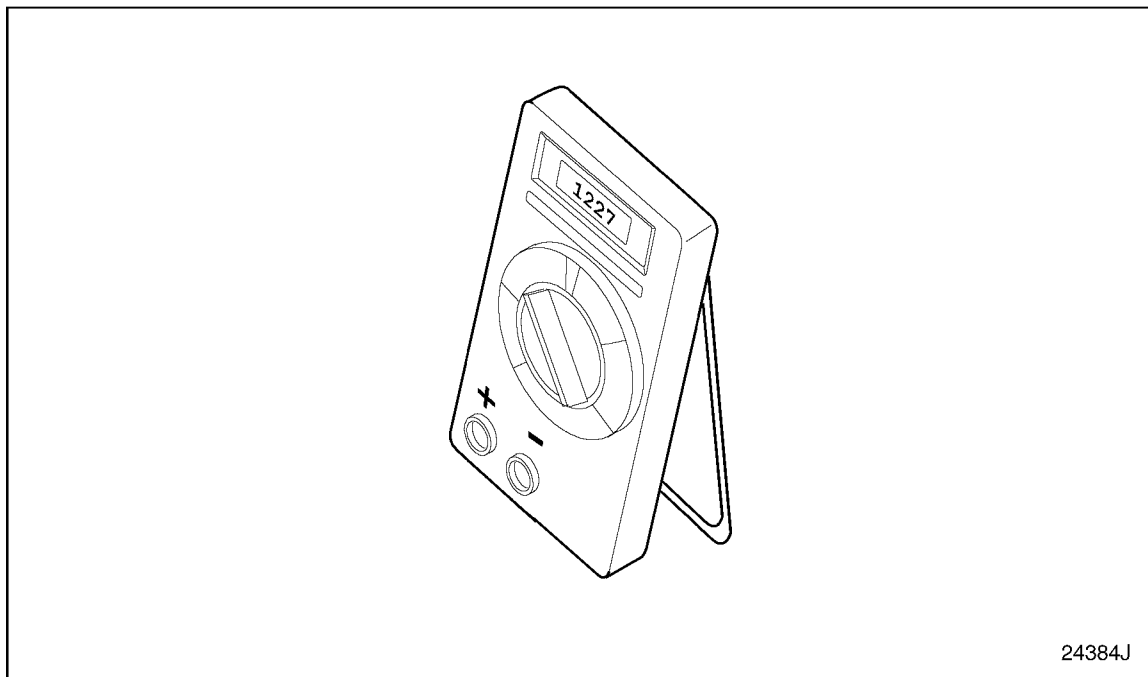


Figure 18-4 Volt-Ohm Meter, J-39299

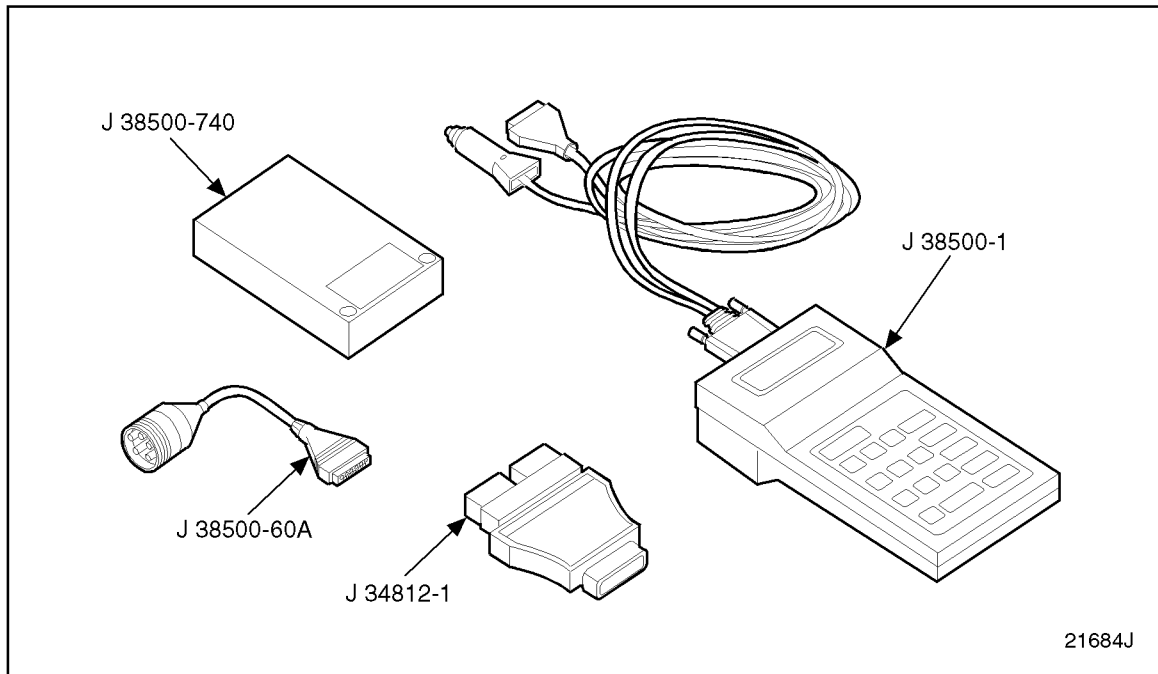


Figure 18-5 Pro-Link Diagnostic Data Reader, J-38500

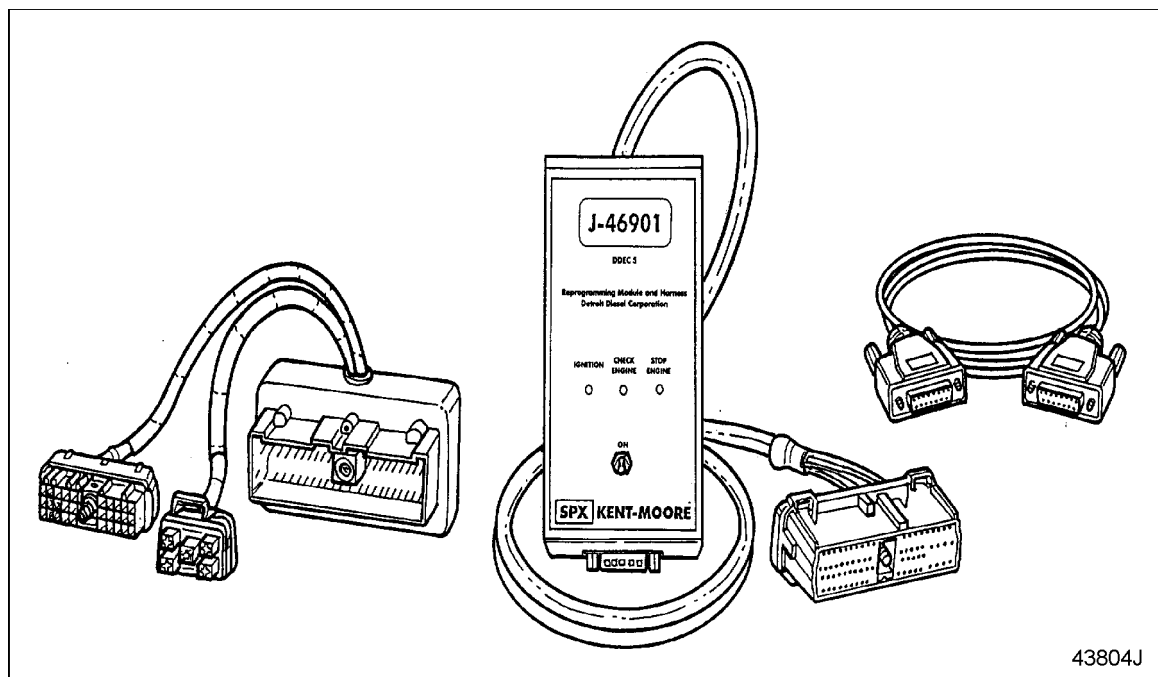
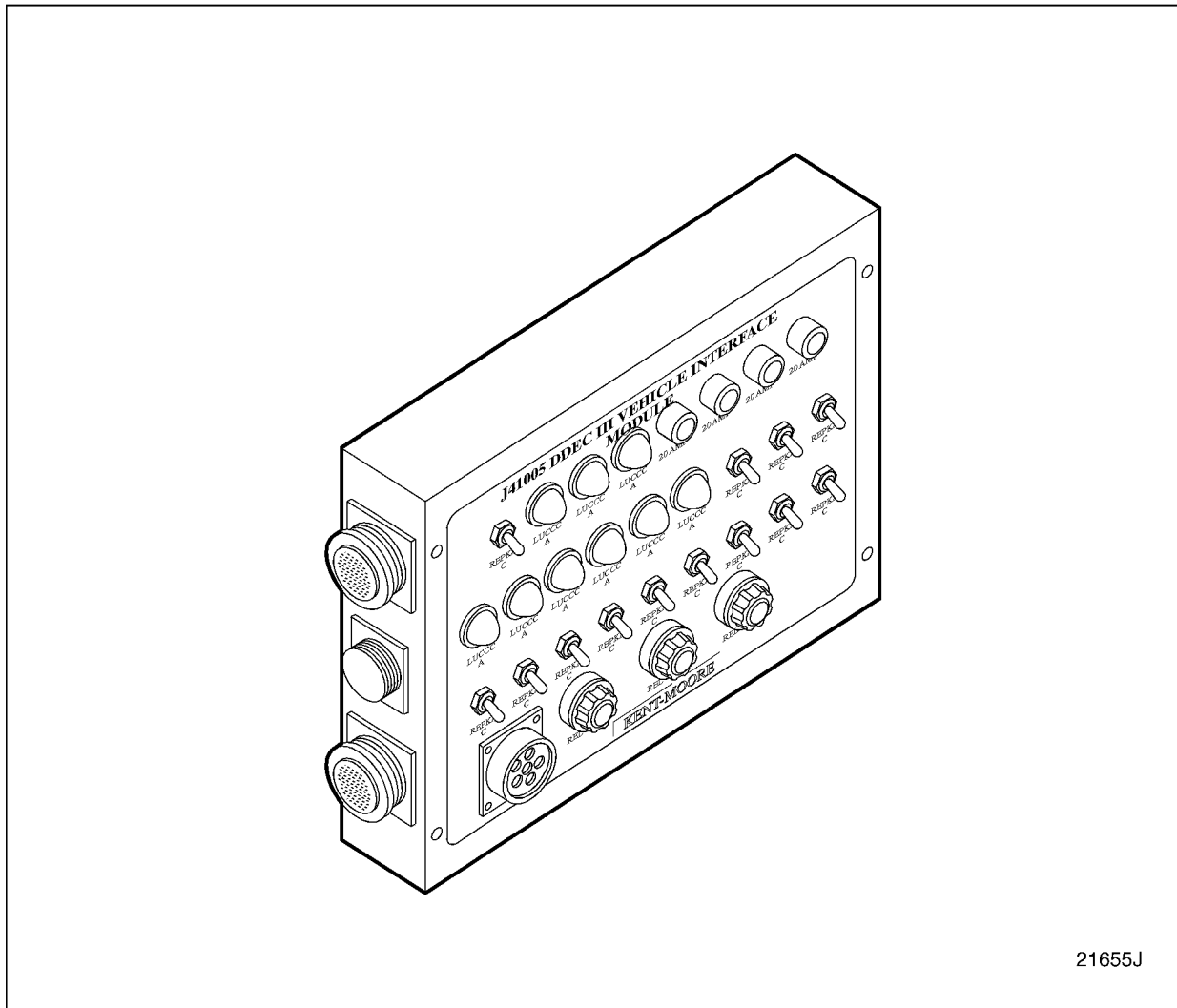


Figure 18-6 DRS Interface Module (Programming ECM/ECU) J-40901



21655J

Figure 18-7 DDEC III, IV, and V Vehicle Interface Module J-41005 (J-41005-5 DDEC V Harness Required)

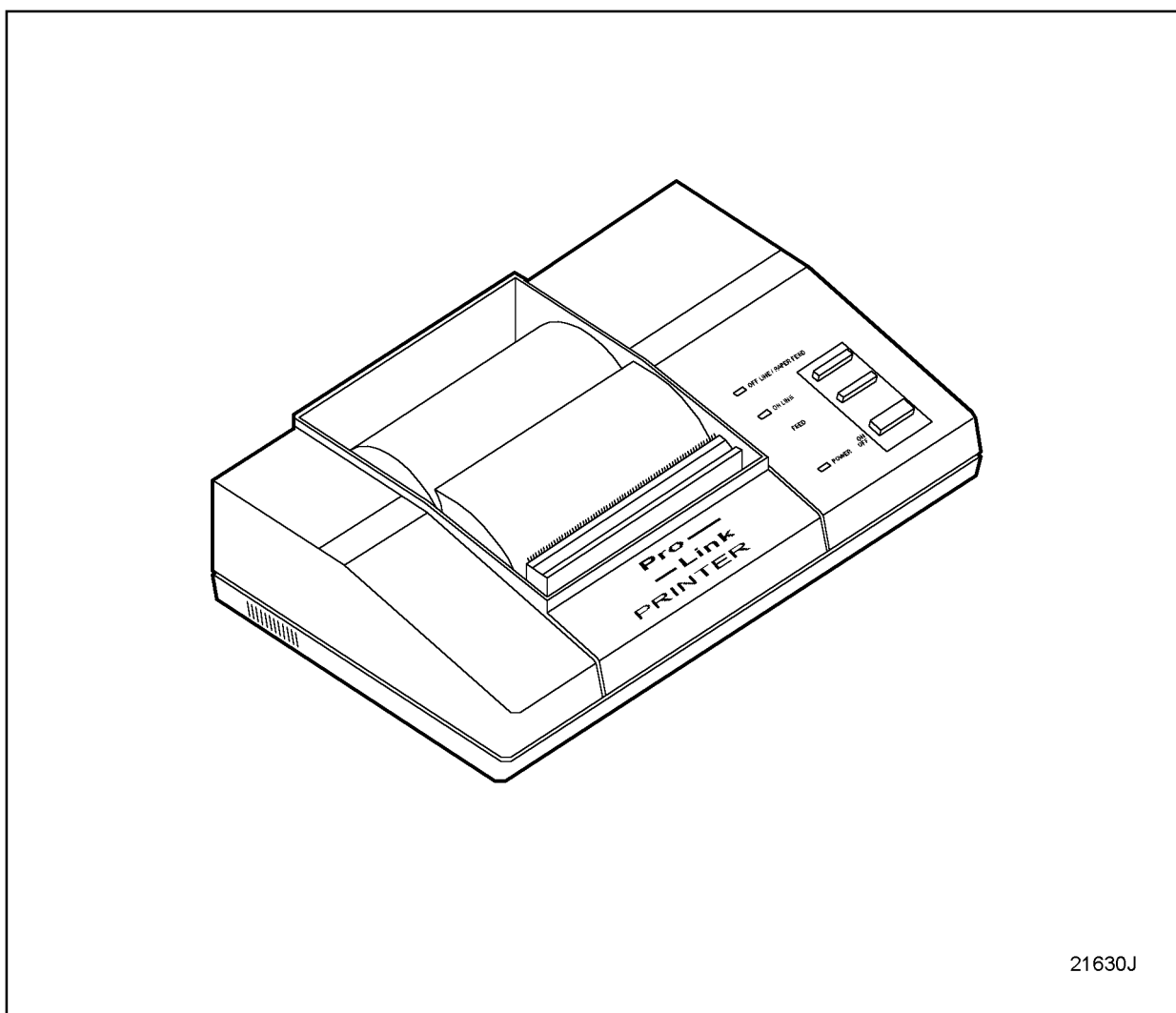
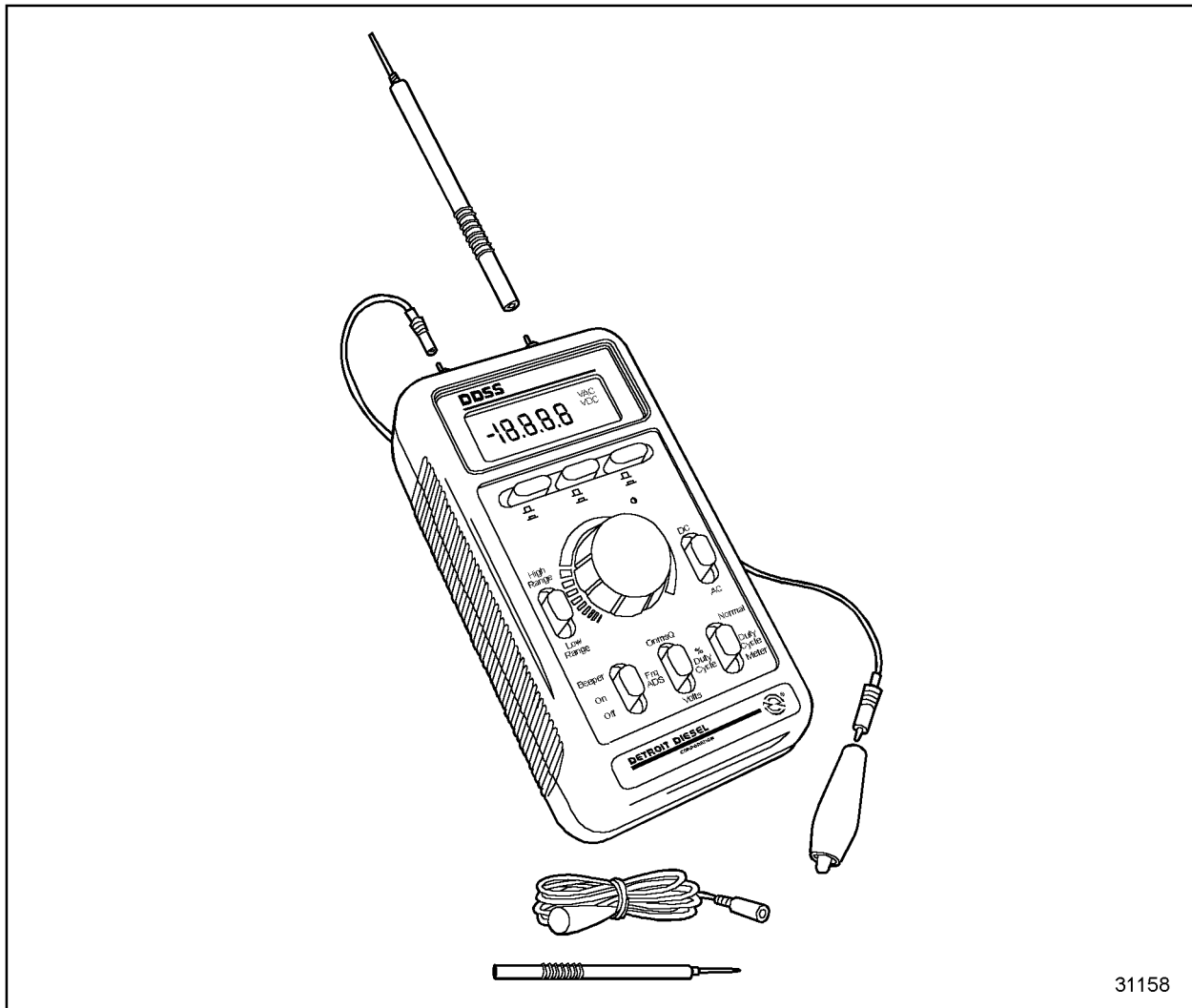


Figure 18-8 **Pro-Link 9000 Printer, J-38480**



31158

Figure 18-9 **Digital Diesel Sensor Stimulator, P/N: 23516937**

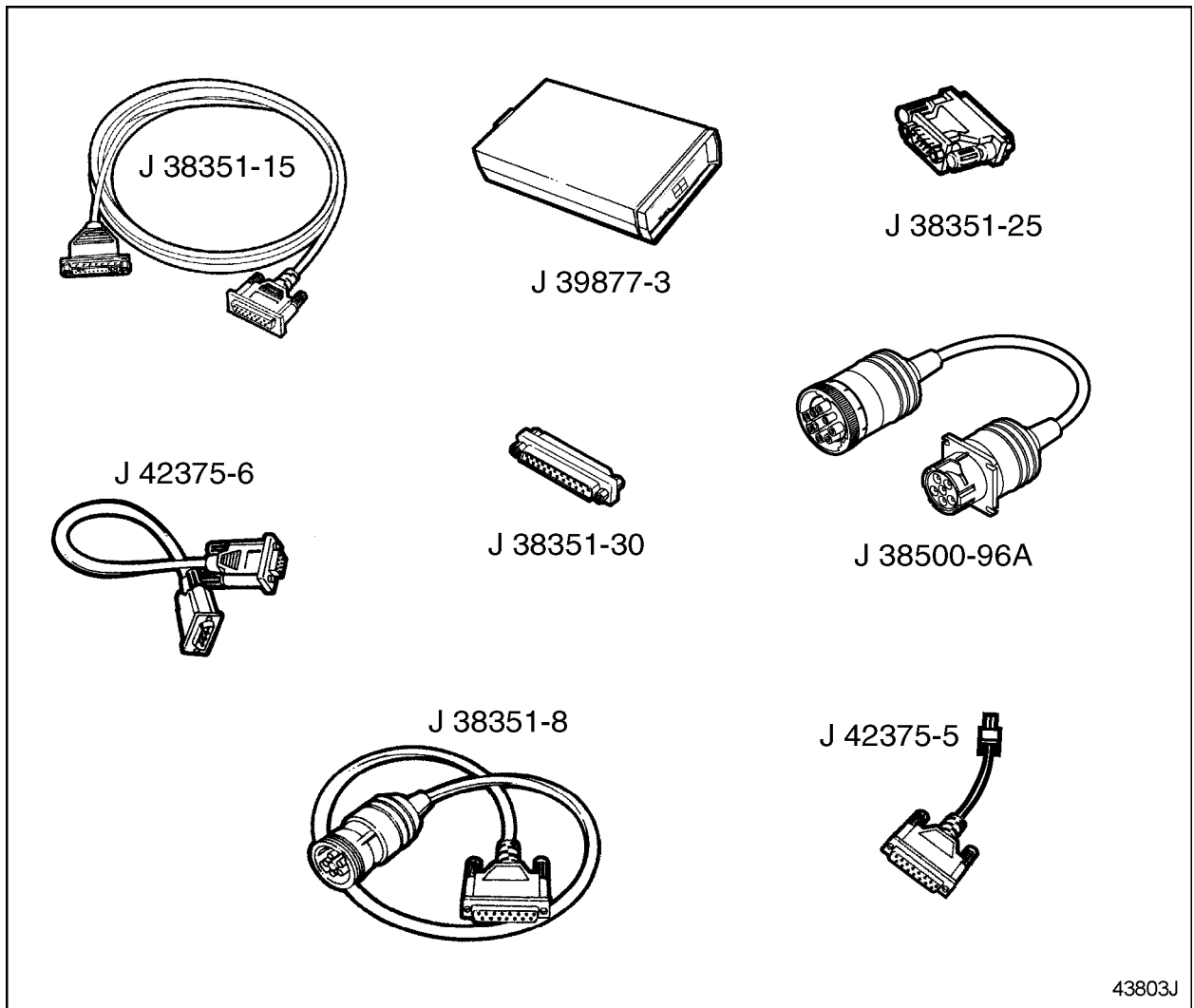


Figure 18-10 DDDL Kit J-47500

18.5 DIAGNOSTIC AND REPROGRAMMING TOOLS

Detroit Diesel Diagnostic Link (DDDL), Vehicle Electronic Programming System (VEPS), and the DDEC Reprogramming Station (DRS) are all used in reprogramming. DDDL is also used for diagnostic purposes.

18.5.1 Detroit Diesel Diagnostic Link

The DDDL Help system provides complete instructions for using the DDDL.

The DDDL is a sophisticated software package supporting the setting up, maintenance, and repair of engines using the DDEC II, DDEC III, DDEC IV, DDEC V Engine Control Modules, and also supports the MBE Engines.

DDDL functions are applicable to both DDEC and the MBE engines, although in some cases the details are different. Some functions are specific to either DDEC or the MBE engines. The Help system will make clear which type of engine a function applies to and, if it applies to both types, any differences there may be.

The capabilities of the program are as follows.

- ☐ Calibration functions.
- ☐ Diagnostic and maintenance functions.

18.5.1.1 Calibration Functions

The following calibration functions can be performed with DDDL.

- ☐ Retrieve and display the current calibration from an ECM/ECU.
- ☐ Save a calibration for the ECM/ECU in an individual truck.
- ☐ Save a single calibration with an ECM/ECU password, so that the same calibration can be used conveniently for a fleet of trucks with the same password, or can be used by a technician who has no access to the password.
- ☐ Change the engine rating of a truck.
- ☐ Set the fuel injector calibration when you replace the fuel injectors.
- ☐ Set the ECM/ECU clock automatically using the PC's internal clock.
- ☐ View an audit trail of an ECM/ECU, fuel injector calibration, ECM/ECU clock changes, and Vehicle Speed setting changes.

All operations that change the engine calibration are password protected, with more potentially damaging operations requiring higher levels of password authority.

18.5.1.2 Diagnostic and Maintenance Functions

The following diagnostic and maintenance functions can be performed with DDDL.

- ☐ Monitor a wide range of parameters while connected 'live' to the ECM/ECU.
- ☐ Select a group of parameters and plot how they have varied over the last two minutes.
- ☐ Take and save a snapshot of how the parameters vary over a period of time, so that you can replay the snapshot for detailed analysis.

- ❑ Monitor fault codes as they occur while connected live to the ECM/ECU. You can also clear any inactive fault codes stored in the ECM/ECU.
- ❑ Test for faults by checking the effect on performance of cutting out individual cylinders.
- ❑ View the ECM/ECU output functions and set them to particular values to support troubleshooting. This can be particularly useful when troubleshooting electrical problems.
- ❑ View engine and trip totals.
- ❑ View the status of a set of maintenance monitors.

18.5.1.3 Snapshots

To start a new snapshot, perform the following steps.

1. Select **New** from the Snapshot window to open the snapshot control window.

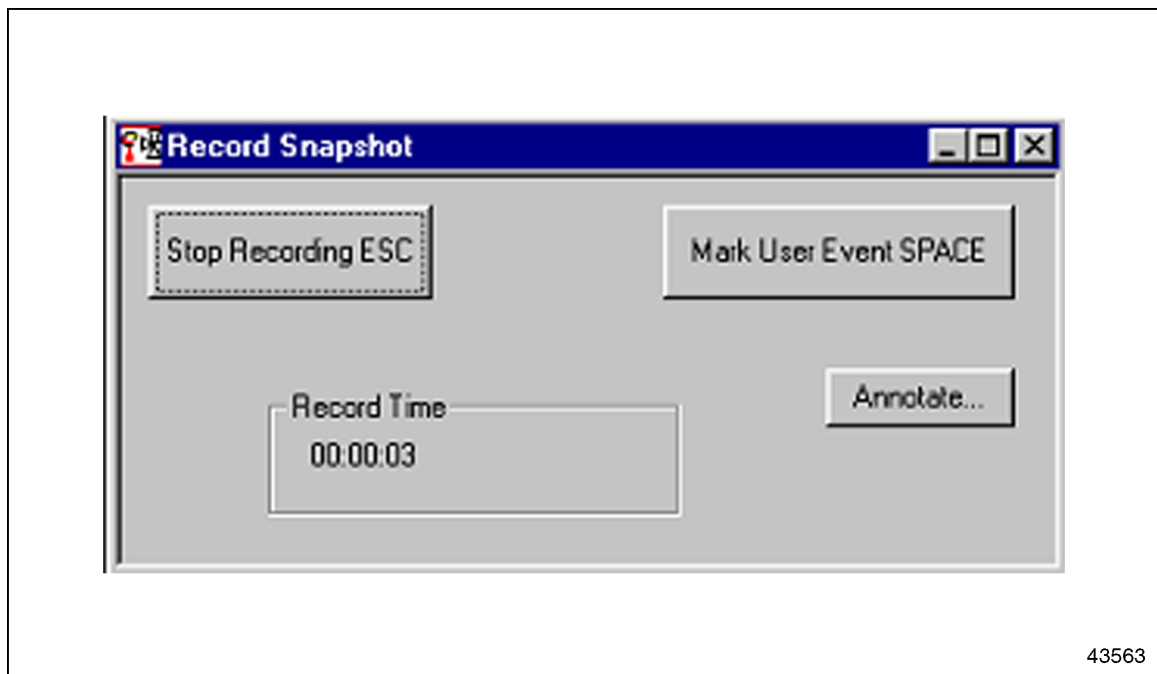
NOTE:

The snapshot feature begins immediately upon the appearance of the control window. 3. All electronic engine data transmitted during the snapshot is stored for playback. Any codes that occur during the snapshot are automatically marked. You may mark events any time during the snapshot with the user event button.

2. Click on the “Annotate” button and a window will appear allowing additional remarks about the current snapshot. See Figure 18-11.

NOTE:

Beginning with DDDL version 4.1, the user has the ability to add comments to the snapshot.



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Figure 18-11 Record Snapshot

3. Hit the stop recording button to finish your snapshot.

NOTE:

A dialog box appears giving you the opportunity to save your snapshot. At this point you may choose a name for your snapshot and the location to store it.

To open a previously saved snapshot, select the **Open** from the Snapshot drop-down menu to display an Open dialog

18.5.1.4 Instrumentation Window

The Instrumentation window is displayed when you choose “Normal Instrumentation” or “Diagnostic Instrumentation” from the Diagnostics menu. The window displays live data measurements from the ECM/ECU connected to your PC. The first graphic (see Figure 18-12) illustrates the options available from a normal window. The natural gas option was added to the diagnostic window in version 4.1. The EGR window was added in version 4.2. The List window was added in version 5.0.

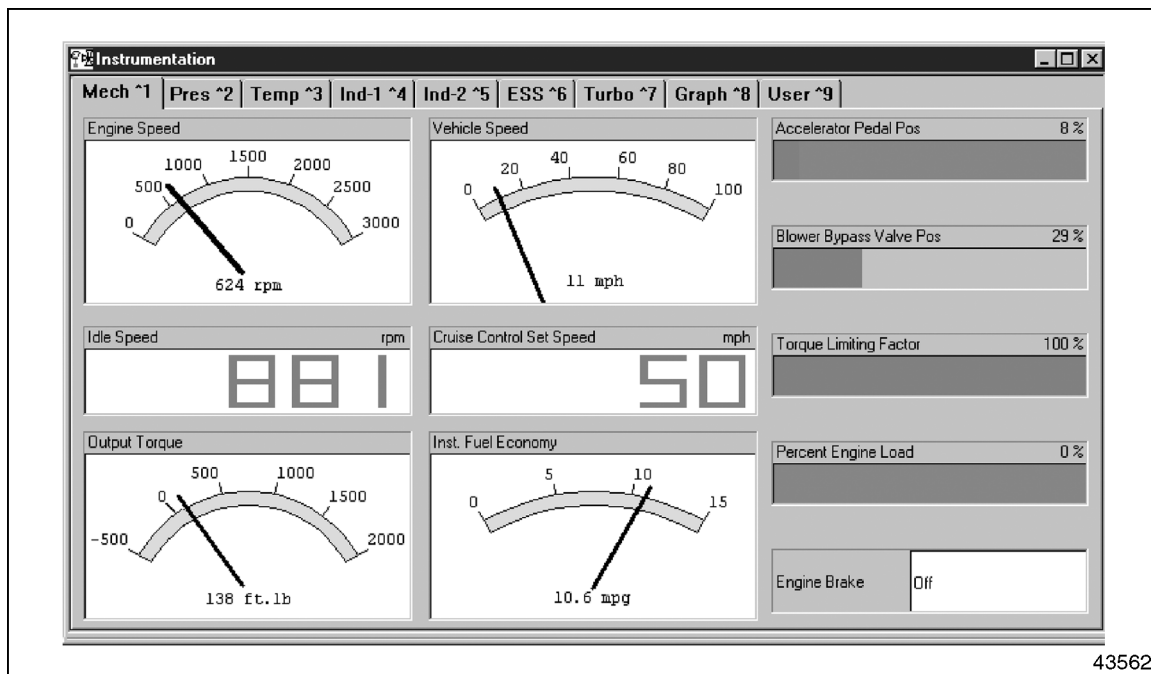


Figure 18-12 Normal Options

The normal instrumentation window is also displayed when you choose “Open” from the Snapshot menu unless the Fault Codes window is already open.

When you have an open snapshot and the Instrumentation window is selected, playback controls are added to the bottom of the Instrumentation window. You can use these to replay the snapshot. The Instrumentation window is used in the same way whether you are viewing live data or a snapshot.

Instrument Pages – The instruments in the Instrumentation window are grouped together on tabs. You can choose how they are grouped by choosing Normal Instrumentation or Diagnostic Instrumentation commands in the Diagnostics menu.

To view the different pages of data shown in the window, click on the tab labeling the page holding the data. You may also hold the “Control” key down while you press the number key shown on the tab.

NOTE:

An individual can customize the information shown in the Instrumentation window using the Graph or User pages.

Multi-ECM/ECU Engines – Provided you are using a PC display with a resolution of at least 800 X 600 (small fonts), some of the Normal Instrumentation pages show details for each of the ECM/ECUs in a multi-ECM/ECU engine.

NOTE:

Whatever the resolution of your display you can also monitor parameters in the different ECM/ECUs by assigning them to instruments on the User pages or by choosing them for display on the Graph page.

Instruments – The results of measurements are presented in a variety of ways, depending on the quantity measured.

You can tell from an instrument if the ECM/ECU is not transmitting data for that measurement. The way "No Data" is shown depends on whether the instrument is:

- ☐ A meter.
- ☐ A thermometer.
- ☐ A digital meter.
- ☐ Text.

Magnified View of Instruments – To display a magnified view of just one of the instruments on your screen, click on the instrument to enlarge it; click on it again to return it to the normal size. (this is particularly useful if you want to monitor a measurement while you are working at some distance from the display).

18.5.1.5 Using Snapshot Replay Controls

When you have opened a snapshot, replay controls will appear at the bottom of the DDDL window you opened. See Figure 18-13.

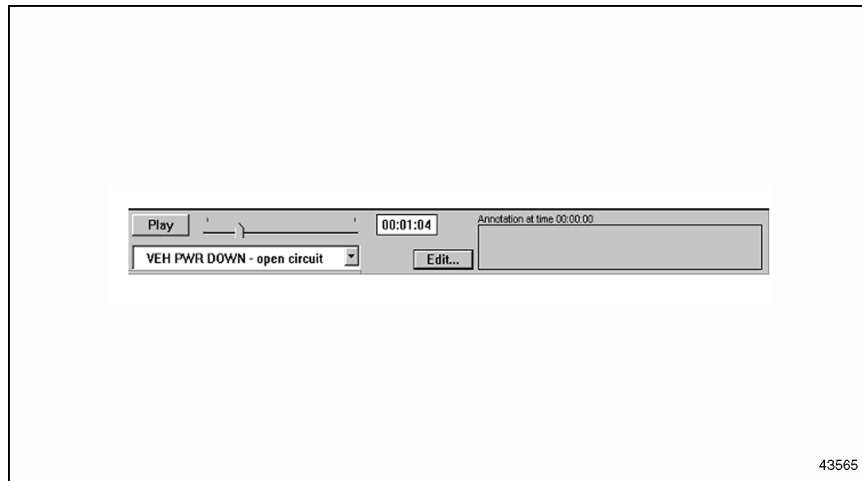


Figure 18-13 **Replay Control Window**

1. Start the replay of a snapshot by clicking on “Play.” See Figure 18-13. The play button changes to “Pause” when a snapshot is replaying. While the snapshot is replaying, the replay slider next to the Play/Pause button moves showing the progress of the replay, and the time box next to it shows the time since the beginning of the recording. When you click on “Play” the snapshot begins to play from its current position and the instruments show the appropriate readings. The event window also changes during the replay to show the most recent event.
2. Stop the replay at a particular point of interest by clicking on “Pause.” The instruments will show the values at the time the replay was stopped.
3. Beginning with DDDL 4.1, additional comments may be added to the snapshot while in replay mode. Click on the “Edit” box and a window will appear to add your remarks.
4. Move to a specific time in the replay by dragging the replay slider button. As you drag the slider, the time shown in the time box changes to reflect the position of the slider.

Or,

5. Move to a specific time in the replay by typing the time you require into the time box. Make sure you use the same format for the numbers as the box displays. Click on the “Return” key.

Or, to show the data at the time of a specific event,

6. Click on the event drop-down list box to display the list. See Figure 18-14.

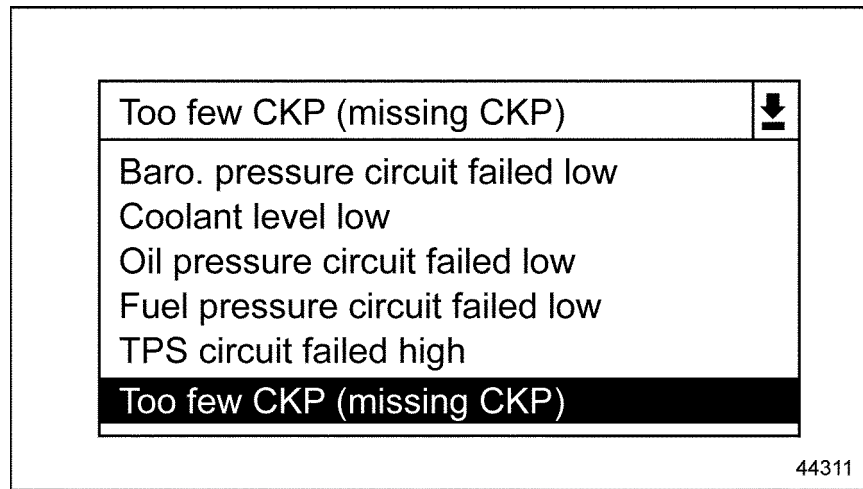


Figure 18-14 Event Drop Down Box

The box shows the events generated by the ECM/ECU and those marked by the user in the order in which they occurred. Select an event to move the replay point to the time at which the event occurred.

If the snapshot is playing when you move to a new position, it will continue playing from the new point. If the snapshot is paused when you move to a new position, the instruments will hold the data for the new position until you start playing the snapshot or move to another new position.

NOTE:

Not all DDDL windows can be activated when replaying the snapshot feature. Windows that may be activated include: the normal instrumentation window, the diagnostic instrumentation window, the graph window, the user window, and the fault codes window. You cannot access the injector response time window or the cylinder cutout window in snapshot mode.

18.5.1.6 Fault Codes

The Fault Codes window is displayed when you choose “Fault Codes” from the Diagnostics menu. See Figure 18-15.

NOTE:

The screen below shows the Fault Codes window for a DDEC V.

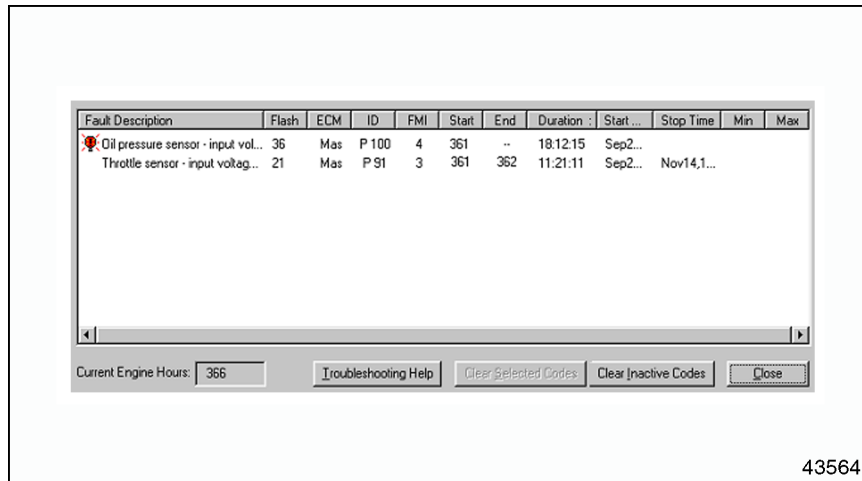


Figure 18-15 Fault Code Window

The fault code window information on all DDDL versions is the following:

- ☐ The light bulb symbol on the left indicates if the code is still active.
- ☐ The window displays both the DDEC flash code and the SAE code notation (SID or PID and the FMI). The engine hour when the code first occurred is displayed.
- ☐ If the code is historic, the engine hour when the code last appeared is displayed as well, along with the total duration time of the code for all counts logged.
- ☐ You may access the troubleshooting help guide for a particular code by highlighting the code you wish to work on with a single left mouse click and then selecting the Troubleshooting Help option.

The fault code window information for DDDL 4.1 and later is the following:

- ☐ Time stamps are included for the beginning and ending of each fault code.
- ☐ Current engine hours have been added to the Window.
- ☐ Certain parameters will display a minimum/maximum value attained during the time the code was active.

If you have opened a snapshot, the replay controls are added to the bottom of the Fault Codes window when it is selected. This way you can monitor fault codes produced during the snapshot. When the window is used for a snapshot, the Clear Selected Codes and Clear Inactive Codes buttons are hidden since these operations are only relevant when you are connected to an operating ECM/ECU.

18.5.2 Vehicle Electronic Programming System

The purpose of the DDEC Vehicle Electronics Programming System (VEPS) is to give OEMs the ability to configure many ECU parameters. This allows DDEC features to be tailored to the specific customer requirements when the vehicle is assembled. Some of the features which may be configured by VEPS are the transmission type, Cruise Control, vehicle speed limit, idle shutdown, rating switches, digital inputs, and digital outputs.

18.5.2.1 Software

The VEPS PC software package consists of the several files which are extracted when the software installation program is executed. A System Users Manual which defines the available parameters is included with the software package at the time of purchase.

The PC interface utilizes a communications driver which is defined in the TMC Recommended Practice RP1210A. The RP1210A software is used to translate the datalink signal of the ECU to the format required by Windows programs. The RP1210A communications driver is included as part of the VEPS software package.

18.5.2.2 Hardware

The hardware portion of the VEPS programming package includes the interface module and cables. The components that are included in the package are listed in Table 18-2.

Part Description	Part Number
100 Foot Cable	23512893
SAE J1708 6-Pin Dash Connector	23515957
J1708/RS-232 Translator Box	23512415
6 foot Cable	23515869

Table 18-2 VEPS Hardware

A cable kit, listed in Table 18-3, is also available.

Part Description	Part Number
Cable Kit (includes the 100 foot cable and the 6-pin dash connector)	23512980

Table 18-3 VEPS Cable Kit

A translator and cable kit, listed in Table 18-4, is also available.

Part Description	Part Number
Translator Kit (includes the J1708/RS-232 translator box, 100 foot cable and the 6-pin dash connector)	23512895

Table 18-4 VEPS Translator and Cable Kit

The VEPS software kit, listed in Table 18-5, is available.

Part Description	Part Number
Software Kit (includes the RP1202 Software and the VEPS Software)	Contact DDC Application Engineering

Table 18-5 VEPS Software Kit

18.5.3 DDEC Reprogramming Station

The DDEC Reprogramming Station (DRS) is composed of Programming Software, DDECcomm Mainframe Communications software, all the hardware required to connect a Personal Computer to the ECM, and a user manual explaining the use of the software. The DRS software is used to reprogram calibrations, modify customer calibration values, upgrade ECM software versions, update injector calibration codes, and program blank ECMs. The DDECcomm software is used to communicate via modem to the DDC Mainframe computer which stores all the DDEC Calibrations.

18.5.3.1 Requirements

The DRS and DDECcomm software require a Personal Computer which meets certain minimum requirements. These minimum requirements include a pentium microprocessor with 16 MB of RAM, a modem, and the Windows 95 Operating System. DDC also sells kits which include a Laptop PC, please contact your Detroit Diesel representative for current Laptop specifications.

18.5.3.2 DRS Welcome Screen

There are several choices on the Welcome Screen.

Program ECM – Reprogram ECMs with a customer calibration that has previously been downloaded from the DDC mainframe computer. The customer configurable parameters are retained through this type of a reprogramming.

Program Fleet ECM – Reprogram fleet units from a single customer calibration that has previously been downloaded from the DDC mainframe computer. The customer configurable parameters are retained through this type of a reprogramming.

Program ECM With Mainframe Data – Reprogram ECMs with a customer calibration that has previously been downloaded from the DDC mainframe computer. Unlike the standard Program ECM option, this option will overwrite the customer configurable parameters, resulting in a calibration exactly like the one created by the factory.

Update Calibration at DDC – This function is used to store the ECM's electronic parameters on the PC. After performing this option, the Upload History function in the DDEC Mainframe Communications Program (DDECcomm) can be used to send the ECM data to the DDC mainframe computer.

Engine Configuration Data – Displays engine and ECM data information.

Update Customer Calibration – This option allows the electronic parameters to be updated. A customer password is required to perform this function. The following groups of information, listed in Table 18-6, can be modified.

Parameters That Can Be Updated		
Air Compressor	Output Config	VSG Configuration
Auto Cruise Resume	Idle Adjustment	Vehicle Number
CLS Polarity	Idle Shutdown	Function Lockout
Cruise Control	Rating	Lockout Password
Cruise Switch VSG	Rating Password	Fan Timer
Customer Password	Progressive Shift	Engine Brakes
Droop	Transmission	Half Engine Idle
Dynamic Braking	Vehicle Spd Limiting	TOP 2 Switch
Engine Protection	Vehicle Spd Sensor	Low Gear Torque Limiting
Pressure Sensor Governor	Vehicle ID Number	Engine Overspeed
Fuel Econ Incentive	Maintenance Alert System	Cruise Speeds
Input Config	Data Pages / DDEC Data	Adaptive Cruise
PasSmart	—	—

Table 18-6 Parameters that can be Updated with the Update Customer Calibration Option

Update Injector Calibration – This option displays a graphical representation of the engine allowing the injector calibration code to be updated. An injector password is required.

Update ECM Accumulators – Update ECM with engine data such as idle hours, engine hours, cruise hours, miles, etc.

DDC Mainframe Communications – This option is used to select DDECcomm to communicate with the server.

18.5.3.3 DRS Menu Options

Other functions available from the pull-down menu at the top of the screen are listed below.

Upgrade ECM Software – New versions of DDEC ECM software may be programmed into customer's ECMs with this option. There is a nominal charge each time this function is performed.

Change Passwords – Allows changes to the customer, group lockout, or rating password.

Random Customer Password – This option creates a random customer calibration password.

Random Rating Password – This option creates a random rating password.

Random Lockout Password – This option creates a random lockout password.

ECM S/W Versions – Displays ECM software versions that are available on the PC. These versions are used to electronically upgrade ECM software for DDEC III, IV, and V.

Display Station Log File – Displays a file containing system usage information.

Display Downloaded Units – This menu item displays the Unit Numbers of the engines which have been downloaded from the mainframe and are available for programming.

Comms Setting – This option allows changes to the comms protocol, interface hardware being used, and the baud rate.

Options – This option allows entry of the application ID for connecting to the DDC server.

18.5.3.4 DDECCOMM

DDECcomm is a Win95 program which can be invoked by selecting DDC Mainframe Communications. The following menu options are available.

Download Engine Serial Calibration(s) – This option is used to download any changed or desired unit calibrations from the DDC mainframe computer. These calibrations are stored on the PC for a maximum of 14 days, after that period they are automatically deleted.

Download Fleet Calibration(s) – This option allows the download of a single "fleet" unit from the mainframe to the PC. This "fleet" unit calibration may be used to program multiple units in a fleet via the Program Fleet ECM option discussed above.

Upload History – This option takes the programming history on the PC and uploads it to the DDC mainframe. This allows DDC to maintain a current image of the calibration status should further service be required. The history file must first be created by running the Update Calibration at DDC menu option in the DRS Programming Software.

Display Available ECM S/W Versions – Displays ECM software versions that are available on the PC. These versions are used to electronically upgrade ECM software for DDEC III, IV, and V.

Display Station Log File – Displays a file containing system usage information.

Display Downloaded Units – This menu item displays the Unit Numbers of the engines which have been downloaded from the mainframe and are available for programming.

Update Logon Parameters – This option is used to configure mainframe logon and network settings. All user information may be updated when this option is selected.

18.6 EXPLANATION OF ABBREVIATIONS AND TERMS

The following abbreviations and terms listed in Table 18-7, will be used throughout the electrical flowcharts.

Abbreviations	Terms
AAT Sensor	Ambient Air Temperature — calculated via the TCI temp sensor
ABS	Anti-lock Braking System
A/C	Air Conditioning
ACG	Air Compressor Governor
AC Sensor	Air Compressor Pressure Sensor
ACS	Application Code System
A/D	Analog to Digital: The computer inside the ECM/ECU uses an A/D converter to convert a sensor voltage into a number with which the computer can work.
ACLS/AECL Sensor	Add Coolant Level Sensor/Add Engine Coolant Level Sensor
AFRS/AFR Sensor	Air Filter Restriction Sensor
AIM	Auxiliary Interface Module
LSG/ALSG	Limiting Speed Governor/Automotive Limiting Speed Governor
EFPA/AP	Electronic Foot Pedal Assembly/Accelator Pedal
TPS/AP Sensor	Throttle Position Sensor/Accelerator Pedal Sensor
ASR	Anti-Skid Regulation: Data supplied by the ECM/ECU for use with ABS (anti-lock braking system).
A/T	Automatic Transmission
ATI	Auxiliary Timed Input
CEL/AWL	Check Engine Light/* Amber Warning Lamp: Typically mounted on the instrument panel. The CEL/AWL has two functions: 1. It is used as a warning lamp to inform the operator of the vehicle that a fault has occurred and the unit should be taken in for service as soon as possible. 2. It is used by the operator or technician to "flash out inactive trouble codes to help diagnose a problem.
BAT	Battery
BOI	Beginning of Injection: The number of crank angle degrees, before top-dead-center (TDC), where the ECM/ECU is requesting the injectors be turned on.
BPS	Back Pressure Sensor
BPP Switch	Brake Pedal Position Switch
CAN	Controller Area Network: J 1939 high speed control data link.
CCPS	Crankcase Pressure Sensor
TRS/CKP	Timing Reference Sensor/Crankshaft Position Sensor
CKT	Circuit
SRS/CMP	Synchronous Reference Sensor/Camshaft Position Sensor
COM	Common
CPP Switch	Clutch Pedal Position Switch

Abbreviations	Terms
DCC	Diagnostic Connector, Cab
DDC	Detroit Diesel Corporation
DDEC	Detroit Diesel Electronic Controls
DDEC III	Third generation Detroit Diesel Electronic Controls
DDEC IV	Fourth generation Detroit Diesel Electronic Controls
DDEC V	Fifth generation Detroit Diesel Electronic Controls
DDL	Diagnostic Data Link: The lines (wires) over which the ECM/ECU transmits information that can be read by a Diagnostic Data Reader.
DDL+	Data Link, positive side: J 1587 data link.
DDL-	Data Link, negative side: J 1587 data link.
DDR	Diagnostic Data Reader: The hand held tool used for troubleshooting the DDEC system. MPSI PRO-LINK 9000.
DLC	Data Link Connector
—	Delta-P Sensor – measures a difference in pressure at a given location
DRS	DDEC Reprogramming Station
DT	Diagnostic Tool; either DDR (MPSI Pro-Link) or DDDL (PC software used in a similar manner as DDR)
DTC	Diagnostic Trouble Code
EBP Sensor	Exhaust Back Pressure Sensor
CLS/ECL Sensor	Coolant Level Sensor/Engine Coolant Level Sensor: Monitors coolant level at the radiator top tank or heat exchanger.
CPS/ECP Sensor	Coolant Pressure Sensor/Engine Coolant Pressure Sensor: Monitors coolant pressure.
CTS/ECT Sensor	Coolant Temperature Sensor/Engine Coolant Temperature Sensor: Monitors coolant temperature.
ECM/ECU	Electronic Control Module/Electronic Control Unit: The controller of DDEC V system. It reads the engine and vehicle inputs, sensors and switches, calculates injector firing and duration, and fires injectors at appropriate times.
EDM	Electronic Display Module
EEPROM	Electrically Erasable Programmable Read Only Memory.
EFC	Electronic Fire Commander
EFR Sensor	Engine FRS/Fuel Restriction Sensor
EFT Sensor	Engine Fuel Temperature Sensor
EGR	Exhaust Gas Recirculation
ESH/EH	Engine Sensor Harness/Engine Harness
OLS/EOL Sensor	Oil Level Sensor/Engine Oil Level Sensor: Monitors oil level.
EOP	Engine Over-temperature Protection
OPS/EOP Sensor	Oil Pressure Sensor/Engine Oil Pressure Sensor
OTS/EOTSensor	Oil Temperature Sensor/Engine Oil Temperature Sensor

Abbreviations	Terms
ESS	Engine Synchro Shift
ETS/ET Sensor	Exhaust Temperature Sensor
EUI	Electronic Unit Injector
FEI	Fuel Economy Incentive
FMI	Failure Mode Identifier – number used to identify a failure mode
FPS	Fuel Pressure Sensor: Monitors fuel pressure.
FRS/Fuel Restriction Sensor	FRS/Fuel Restriction Sensor
FTS/SFT Sensor	Fuel Temperature Sensor/Supply Fuel Temperature Sensor: Monitors fuel temperature.
GND	Ground
HEI	Half Engine Idle
ATS/IAT Sensor	Air Temperature Sensor/Intake Air Temperature Sensor
TBS/IMP Sensor	Trubo Boost Sensor/Intake Manifold Pressure Sensor
INJ	Injector (fuel)
ISD	Idle Shutdown: Programmable feature of the DDEC system.
IVS	Idle Validation Switch: A switch used to establish the idle speed position.
MAP	Manifold Air Pressure
MAS	Maintenance Alert System
MID	Message Identification Character
MPG	Miles Per Gallon
MPH	Miles Per Hour
N/A	Not Applicable.
OECL Sensor	Optical Engine Coolant Level Sensor
OEM	Original Equipment Manufacturer
OI	Optimized Idle
PGN	Parameter Group Number
PID	Parameter Identifier
PING	Pilot Injection Natural Gas
PSG	Pressure Sensor Governor: Regulates engine speed to maintain a selected external pump pressure.
PTO	Power Take-Off. Also, referred to as VSG (Variable Speed Governor).
PW	Pulsewidth
PWM	Pulsewidth Modulated: Modulated signal provided by the DDEC system.
RES/ACCEL	Resume/Accelerate Switch used for Cruise Control.
RFP Sensor	Rail Fuel Pressure Sensor
RH	Relative Humidity
RHS	Relative Humidity Sensor

Abbreviations	Terms
SEL/RSL	Stop Engine Light/† Red Stop Lamp: Typically mounted on the instrument panel. It has two functions: 1. It is used as warning to the operator that a potential engine damaging condition has been detected. If the DDEC system is programmed for shutdown, the engine will shutdown on its own within 30 seconds. The engine should not be run until the condition is corrected. 2. It is used by the operator or technician to "flash" out active trouble codes.
SEO	Stop Engine Override: Allows the stop engine condition to be overridden in case it is required.
SET/COAST	Set/Coast Switch: Used in Cruise Control.
SID	System Identifier – value used that identifies a sensor or a system
SNEF	Signal to Noise Enhancement Filter (Module)
TBS	Turbocharger Boost Sensor: Monitors turbo boost.
TBD	To be determined
TCI	Turbo Compressor Inlet
TCO	Turbo Compressor Outlet
TD	Tachometer Driver: An output from the ECM/ECU for electronic tachometers and or data loggers.
TDC	Top Dead Center
VEPS	Vehicle Electronic Programming System
VGT	Variable Geometry Turbocharger
VIH	Vehicle Interface Harness (OEM Wiring)
VIN	Vehicle Identification Number
VLS	Vehicle Limiting Speed
VNT	Variable Nozzle Turbine
VOM	Volt Ohm Meter
VPOD	Variable Output Pressure Device – used to accurately position the VNT and EGR valve.
VSG	Variable Speed Governor. Also, referred to as PTO (Power Take-Off).
VSS	Vehicle Speed Sensor: Used to detect vehicle speed.
VSS OC	Vehicle Speed Sensor Open Collector: An ECM/ECU input which must be used in addition to the VSS positive input when certain types of vehicle speed sensors are used. Refer to the Application and Installation manual for installation.

* As a light bulb check and system check, the check engine light will come on for about 5 seconds when the ignition is turned on. If the CEL/AWL remains on, or comes back on, the self diagnostic system has detected a problem. If the problem goes away, the light will go out, but a trouble code will be stored in the ECM/ECU as an inactive code.

† As a light bulb check and system check, the stop engine light will come on for about 5 seconds when the ignition is turned on.

Table 18-7 Abbreviations and Terms

19 INTERMITTENT FAULT

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19.1 INTERMITTENT CODE OR A SYMPTOM AND NO CODES

The following procedure will diagnose an intermittent code or symptom.

19.1.1 Diagnosis by Symptom

Many intermittent problems are caused by faulty electrical connectors or wiring. Diagnosis must include a careful inspection of the indicated circuit wiring and connectors.

NOTE:

Do not use any other procedures (except for the suggestions listed in this guide) when trying to solve an intermittent problem. Use of any other procedures for this type of problem can result in the replacement of non-defective parts.

For example, an intermittent code 35 (OPS/EOP Sensor High Voltage) would indicate a problem in the following areas associated with the EOP Sensor.

- ☐ Wires E-31 (signal line), E-12 (+5 volt line), or E-15 (ground line).
- ☐ The OPS/EOP Sensor connector or ECM/ECU connector.
- ☐ An intermittent problem in the EOP Sensor (least likely).

Use the following checklist:

- ☐ Check for poor mating of the connector halves or terminals not fully seated in the connector body (backed out terminals).
- ☐ Look for improperly formed or damaged terminals. All connector terminals in the problem circuit should be carefully inspected to determine proper contact tension. Use a mating terminal to test the contact tension.
- ☐ Electrical system interference caused by a defective relay, ECM/ECU driven solenoid, or a switch causing an electrical surge. Look for problems with the charging system (alternator, etc.). In certain cases, the problem can be made to occur when the faulty component is operated as in the case of a relay.
- ☐ Verify alternator grounds are clean and making good contact. Disconnect the alternator belt to test.
- ☐ Wiggle wires and harnesses to try to make the problem active, or occur again.

19.1.1.1 Verify Repairs

Perform the following steps to verify repairs.

1. Clear codes.
2. Confirm the CEL/AWL does not come on (except for the five second ignition ON bulb check).
3. Run the engine for one minute.
4. If the CEL/AWL stays ON, refer to section 17.3.2.

19.2 ENGINE CRANKS BUT WILL NOT START

The following procedures will diagnose engine cranks but will not start.

19.2.1 Amber Warning Lamp

Check the CEL/AWL as follows:

1. Turn on the ignition while observing the CEL/AWL.
 - [a] If the light comes on and stays on, refer to section 17.3.1.
 - [b] If the light comes on for up to five seconds, and then goes off, refer to section 19.2.2
 - [c] If the lights are off, go to step 2.
2. Check both ECM/ECU power fuses or circuit breakers.
 - [a] If both fuses are okay, refer to section 19.2.12.
 - [b] If either fuse is not okay, refer to section 19.2.20.

19.2.2 Fuel Check

Perform the following steps to check the fuel supply:

1. Disconnect the fuel return line.
2. Check for fuel flow while cranking the engine.
 - [a] If fuel flow is okay, refer to section 19.2.3.
 - [b] If fuel supply is not okay, refuel the vehicle. The system may need to be re-primed. Refer to the appropriate engine service manual.

19.2.3 White Smoke Check

Perform the following steps to check for white smoke:

1. Reconnect fuel return line.
2. Look for white smoke coming out of the exhaust stack while cranking the engine.
 - [a] If white smoke is present, refer to section 19.2.4.
 - [b] If white smoke is not present, refer to section 19.2.22.

19.2.4 Check Crankshaft Position Sensor Status

Perform the following steps to check the TRS/CKP Sensor status via a rpm readout:

1. Select engine speed and active codes on the DDR.
2. Crank the engine for ten seconds while observing DDR display. A battery voltage surge while cranking with electric starters may blank or reset the DDR.

- [a] If the display reads greater than or equal to 60 rpm, refer to section 19.2.7.
- [b] If the display reads less than 60 rpm or constantly reads 60 rpm, refer to section 19.2.5.
- [c] If code 41 is displayed, refer to section 43.2.1.
- [d] If code 42 is displayed, refer to section 44.2.1.

19.2.5 Check Crankshaft Position Sensor

Perform the following steps to check the TRS/CKP Sensor:

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector at the ECM/ECU.
3. Measure resistance between sockets E-17 and E-18 at the engine harness connector.
 - [a] If the resistance measurement is greater than 200 Ω , refer to section 43.2.3.
 - [b] If the resistance measurement is less than 100 Ω , refer to section 43.2.2.
 - [c] If the resistance measurement is between 100 and 200 Ω , go to step 4.
4. Inspect TRS/CKP mounting.
 - [a] If the sensor and mount are secure, go to step 5.
 - [b] If the sensor and mount are not secure, tighten the bolt or replace if necessary. Refer to section 19.2.22.1.
5. Inspect DDEC pulse wheel for loose wheel or chipped or missing teeth.
 - [a] If the pulse wheel is damaged, repair or replace as necessary. Refer to section 19.2.22.1.
 - [b] If the pulse wheel is not damaged, refer to section 19.2.6.

19.2.6 Check ECM/ECU Connectors

Perform the following steps to check the ECM/ECU connectors:

1. Turn vehicle ignition OFF.
2. Disconnect both connectors at the ECM/ECU.
3. Check terminals at all ECM/ECU connectors (both the ECM/ECU and harness side) for damaged, bent, corroded or unseated pins or sockets.
 - [a] If the terminals and connectors are damaged, repair them. Refer to section 19.2.22.1.
 - [b] If the terminals and connectors are not damaged, replace the ECM/ECU. Refer to section 19.2.22.1. (Try a test ECM/ECU first.)

19.2.7 Check for Good Camshaft Position Sensor Signal

Perform the following steps to check for a good SRS/CMP signal:

1. Select engine data list on DDR.
2. Crank engine while observing DDR display of SRS/CMP received. Battery voltage surges while cranking with electric starters may blank or reset the DDR.
 - [a] If the SRS/CMP RECEIVED signal is YES, refer to section 19.2.9.
 - [b] If the SRS/CMP RECEIVED signal is NO, refer to section 19.2.8.

19.2.8 Check Camshaft Position Sensor

Perform the following steps to check the SRS/CMP:

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector at the ECM/ECU.
3. Measure resistance between sockets E-19 and E-20 at the engine harness connector.
 - [a] If the resistance measurement is greater than 200 Ω , refer to section 43.2.3.
 - [b] If the resistance measurement is less than 100 Ω , refer to section 43.2.2.
 - [c] If the resistance measurement is between 100 and 200 Ω , go to step 4.
4. Inspect SRS/CMP mounting.
 - [a] If the sensor and mount are secure, go to step 5.
 - [b] If the sensor and mount are not secure, tighten the bolt or replace if necessary. Refer to section 19.2.22.1.
5. Inspect DDEC pulse wheel for loose wheel or chipped or missing teeth.
 - [a] If the pulse wheel is damaged, repair or replace as necessary. Refer to section 19.2.22.1.
 - [b] If the pulse wheel is not damaged, refer to section 19.2.6.

19.2.9 Check for Open

Perform the following steps to check if the injector return wires are open:

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM/ECU.
3. Measure resistance between the injector return pin and all the power driver pins on both harness connectors.
 - [a] If the resistance measurement is greater than 5 Ω on any reading, an open exists in one of the injector power driver or return wires. Repair the open. Refer to section 19.2.22.1.

- [b] If the resistance measurement is less than or equal to 5 Ω on any reading, refer to section 19.2.10.

19.2.10 Short to Ground

Perform the following steps to check if the injector lines are shorted to the ground:

1. Disconnect the engine harness connector at the ECM/ECU.
2. Measure resistance between a battery ground to the injector harness Pins E-61 through E-68.
 - [a] If the resistance measurement is greater than or equal to 10,000 Ω or open on all readings, refer to section 19.2.11.
 - [b] If the resistance measurement is less than 10,000 Ω on any reading, there is a short to ground on the wire where resistance was less than 10,000 Ω . Repair the short and refer to section 19.2.22.1.

19.2.11 Injector Drive Pulses

Perform the following steps to check the injector drive pulses:

1. Turn ignition OFF.
2. Reconnect all ECM/ECU connectors.
3. Remove rocker covers.
4. Disconnect injector common wire E-61 or E-62 from one injector.
5. Place a 6-volt test light across the previously disconnected injector return side and a good ground.
6. Crank engine and note the test light to see if it lights (flashes).
7. Reconnect the return wire.
8. Repeat the above procedure with all other injectors until all have been tested or until one test fails.
 - [a] If all tests pass, the problem does not appear to be in the DDEC system.
 - [b] If all tests do not pass and the test light is flashing for one or more tests, check for proper parts (e.g. bull gear) then try a test ECM/ECU. Refer to section 19.2.22.1.
 - [c] If all tests do not pass and the test light is not flashing for one or more tests, refer to section 19.2.6.

19.2.12 Battery Volts Check

Perform the following steps to check for battery volts at the 5-way connector:

NOTE:

A high resistance in these wires may prevent engine starting but measure correct voltage. Proper resistance based on wire length and size.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU. .
3. Measure voltage from socket V-61, V-62, V-65, and V-66 of the vehicle harness connector to a good ground.
 - [a] If all the voltage measurements are greater than 11.5 volts on all readings, refer to section 19.2.15.
 - [b] If the voltage measurement is less than 11.5 volts on any readings, refer to section 19.2.13.

19.2.13 ECM/ECU Power Line Check

Perform the following steps to check if the ECM/ECU power lines are open:

1. Measure voltage between battery side of one ECM/ECU fuse or circuit breaker (red lead) and a good ground (black lead).
2. Measure voltage at other ECM/ECU fuse or circuit breaker. Note that battery side does not contain Pins V-61, V-62, V-65, or V-66. See Figure 19-1.
 - [a] If the voltage measurement is less than 11.5 volts on any reading, refer to section 19.2.14.

- [b] If the voltage measurement is greater than 11.5 volts on all readings, an open exists in either power wire (Pins V-61, V-62, V-65, or V-66). Repair the open; refer to section 19.2.22.1.

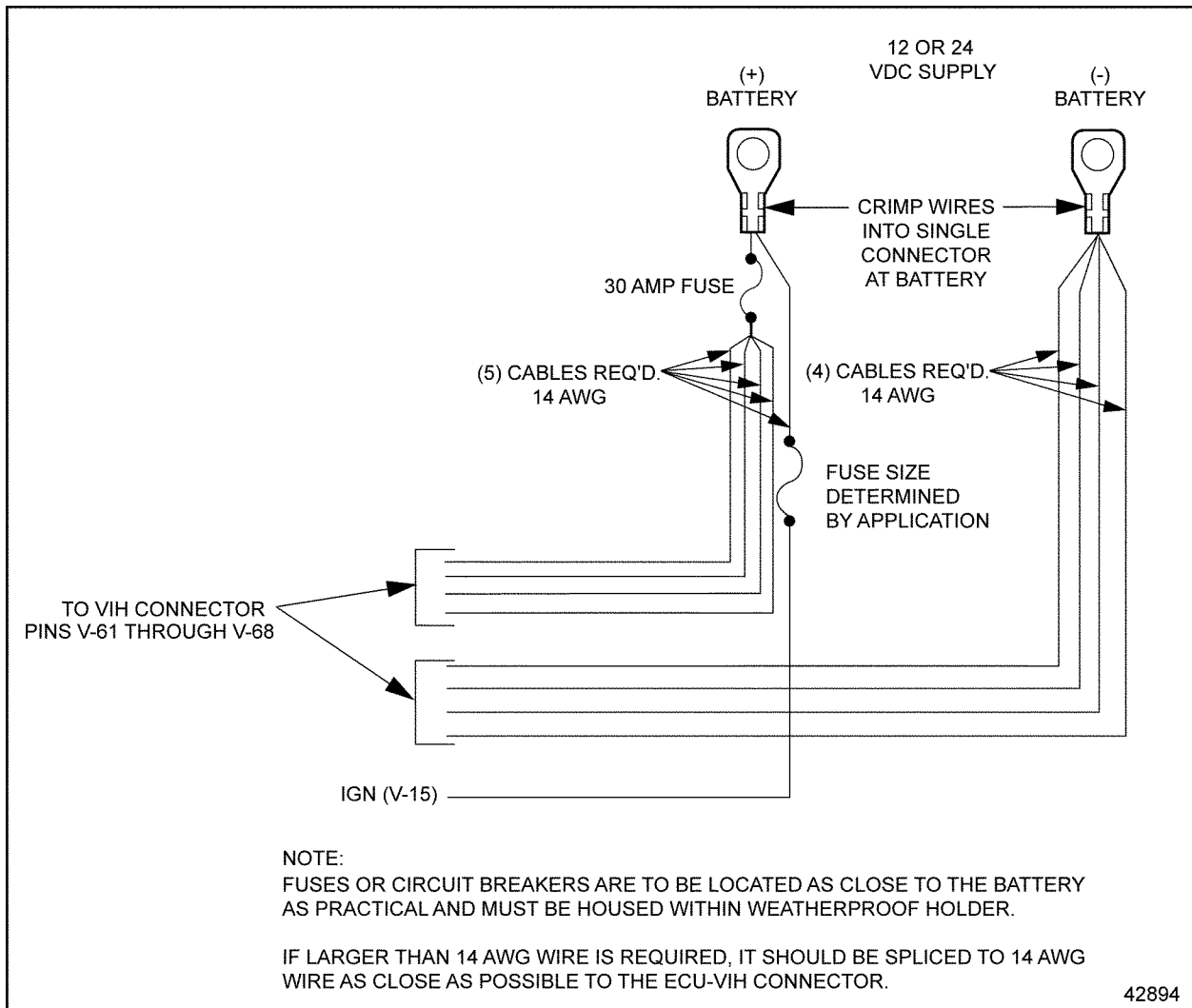


Figure 19-1 Pins V-61 through V-68 to Battery Leads

19.2.14 Check Battery

Perform the following steps to check the battery:

1. Connect all connectors.
2. Turn ignition ON.
3. Measure voltage at battery (+) terminal (red lead) to the battery (-) terminal (black lead).

- [a] If the voltage reading is less than 11.5 volts, service the discharged battery. Refer to section 19.2.22.1.

- [b] If the voltage reading is greater than or equal to 11.5 volts, an open or short to ground exists in the battery (+) line. Repair the open. Refer to section 19.2.22.1.

19.2.15 Check Volts at Ignition Wire

Perform the following steps to check for +12 or +24 volts at the ignition wire:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU. For vehicle harness schematic, see Figure 19-2.

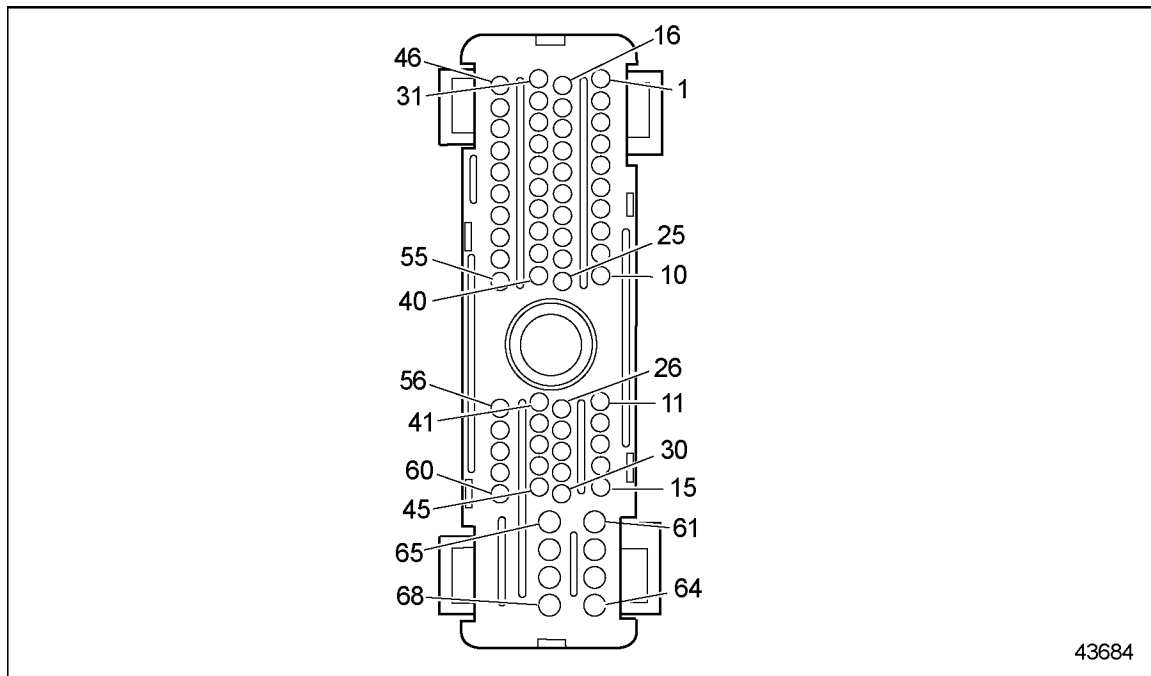


Figure 19-2 ECM/ECU Vehicle Harness Connector

3. Turn ignition ON.
4. Measure voltage between socket V-15 on the vehicle harness connector (red lead) and a good ground (black lead).
 - [a] If the voltage measurement is greater than or equal to 11.5 volts, go to step 5.
 - [b] If the voltage measurement is less than 11.5 volts, refer to section 19.2.16.
5. To check for a good ground wire, measure voltage between socket V-15 on the vehicle harness connector (red lead) and Pins V-63, V-64, V-67, or V-66 of the vehicle harness connector. For 5-way ECM/ECU power harness schematic, see Figure 19-3.
 - [a] If the voltage measurement is greater than or equal to 11.5 volts, refer to section 19.2.6.

- [b] If the voltage measurement is less than 11.5 volts, the ECM/ECU ground wire is open or has a poor connection. Repair open; refer to section 19.2.22.1.

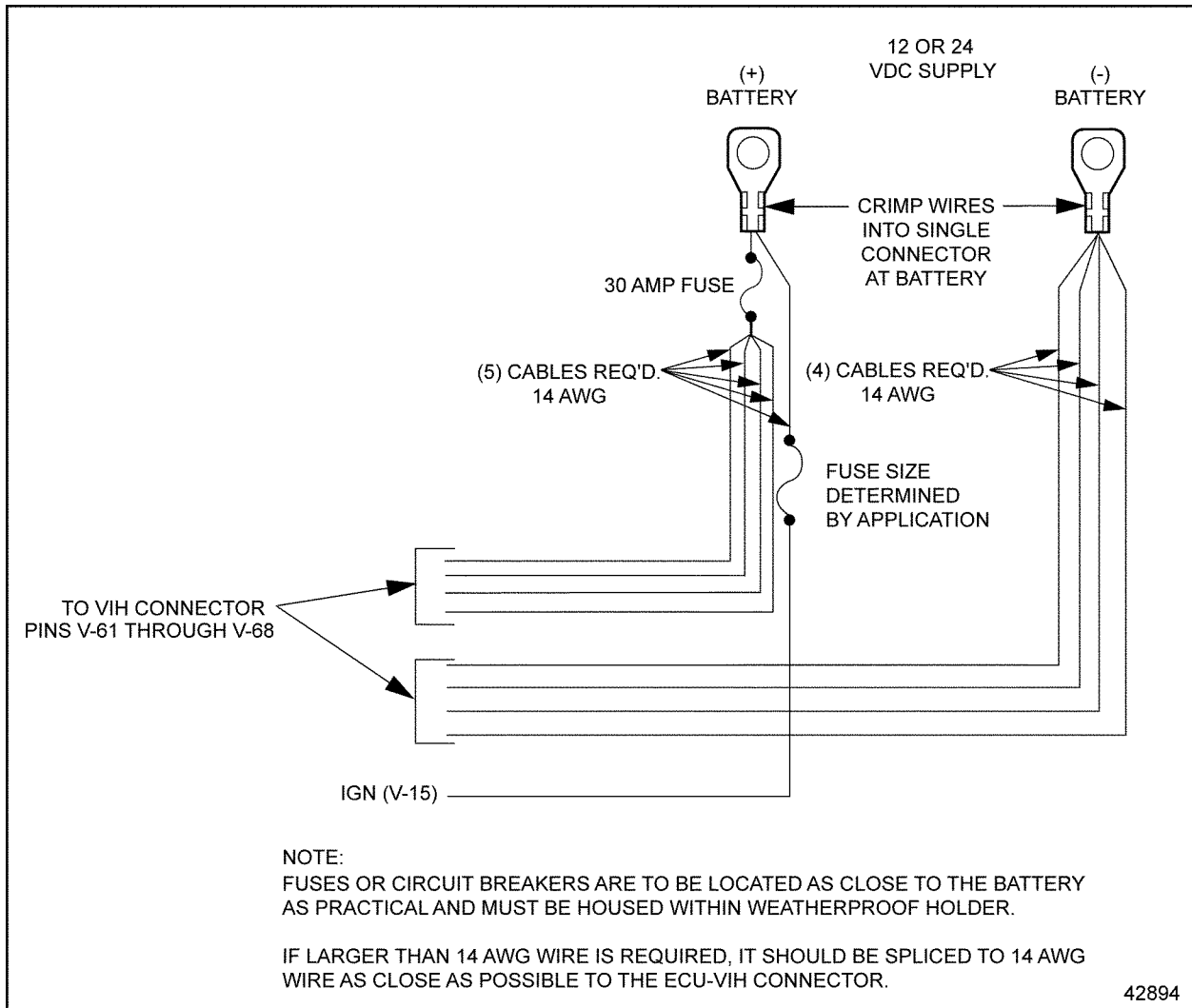


Figure 19-3 Pins V-61 through V-68 to Battery Leads

19.2.16 Check Ignition Fuse

Perform the following steps to check the ignition fuse:

1. Turn ignition OFF.
2. Check ignition fuse or circuit breaker.
 - [a] If both the fuse and circuit breaker are okay, go to step 3.
 - [b] If the fuse or circuit breaker are not okay, refer to section 19.2.17.
3. Measure voltage between battery side (hot side) of the ignition fuse (red lead) and a good ground (black lead).

- [a] If the voltage measurement is less than 11.5 volts, refer to section 19.2.19.
- [b] If the voltage measurement is greater than or equal to 11.5 volts, the ignition line (circuit V-15) is open. Repair the open; refer to section 19.2.22.1.

19.2.17 Check for Ground

Perform the following steps to check if the ignition wire is shorted to ground:

1. Replace blown fuse or reset open circuit breaker.
2. Turn ignition ON for ten seconds.
3. Run engine for one minute.
4. Turn ignition OFF.
5. Check ignition fuse or circuit breaker again.

- [a] If both the fuse and circuit breaker are okay, refer to section 19.2.18.
- [b] If the fuse and circuit breaker are not okay, the ignition line (circuit V-15) is shorted to ground. Repair the short; refer to section 19.2.22.1.

19.2.18 Check Fuse or Circuit Breaker

Perform the following steps to check if the ignition fuse or breaker is okay:

1. Reconnect all harness connectors at the ECM/ECU.
2. Start the engine.
3. Run engine for one minute.
4. Turn ignition OFF.
5. Check ignition fuse or circuit breaker again. See Figure 19-4.

- [a] If both the fuse and circuit breaker are okay, no short is currently present. Be warned of an intermittent short that could shut down the engine or blow a fuse due to reverse voltage at the battery. Refer to section 19.2.22.1.

- [b] If the fuse or circuit breaker are not okay, refer to section 19.2.6.

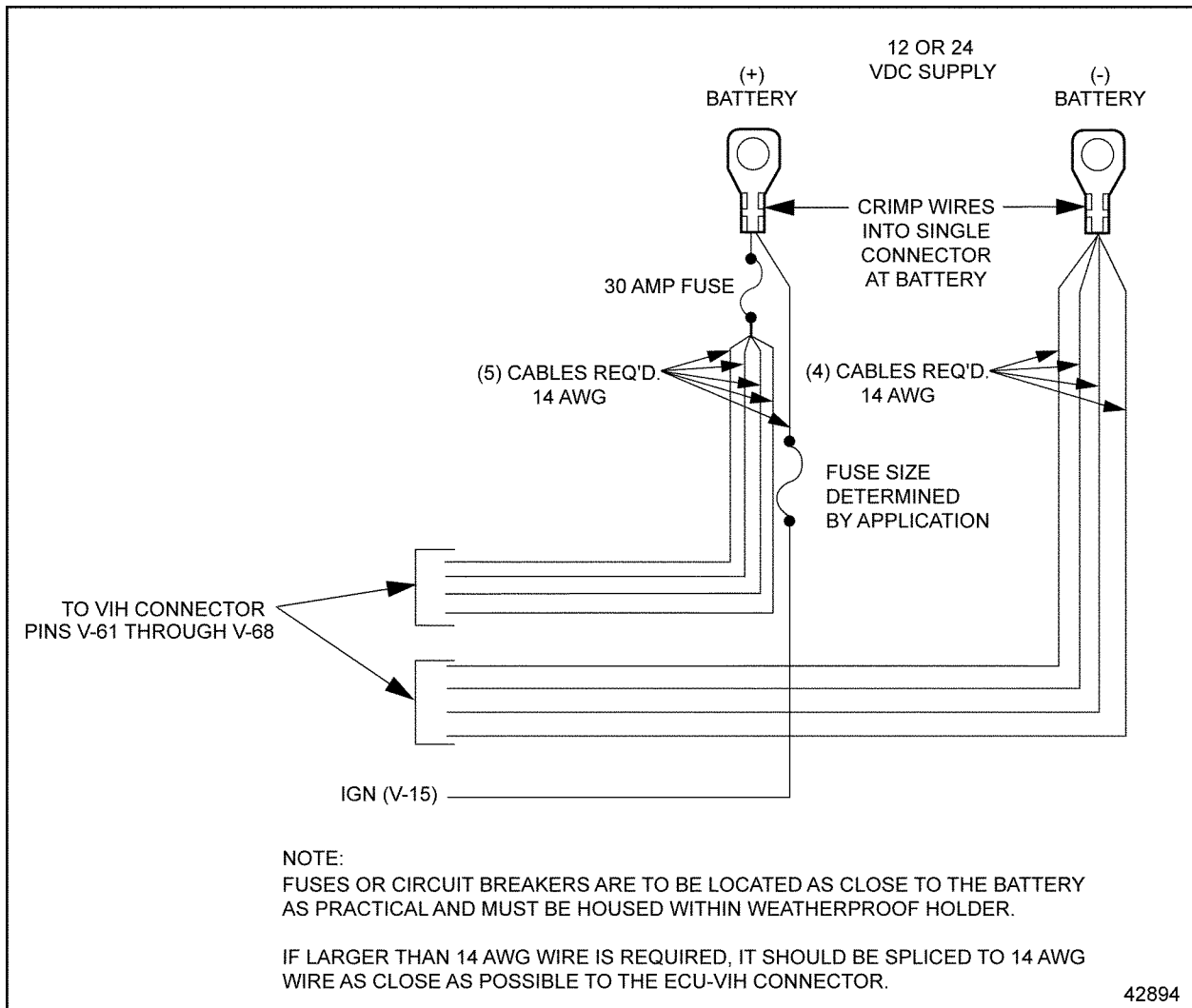


Figure 19-4 Pins V-61 through V-68 to Battery Leads

19.2.19 Check Battery

Perform the following steps to check the battery:

1. Disconnect the battery cables at the battery.
2. Measure voltage at the battery (+) terminal (red lead) to the battery (-) terminal (black lead).

- [a] If the voltage measurement is less than 11.5 volts, service the discharged battery. Refer to section 19.2.22.1.
- [b] If the voltage measurement is greater than or equal to 11.5 volts, an open or short to ground exists in unfused ignition line. Repair the open. Refer to section 19.2.22.1.

19.2.20 Check for Blown Fuses

Perform the following steps to check for blown fuses:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Replace blown fuse(s) or reset the circuit breaker(s).
4. Wait ten seconds.
5. Check whether fuse(s) or circuit breaker(s) have blown or opened up again.
 - [a] If the fuse and circuit breaker are okay, refer to section 19.2.18.
 - [b] If the fuse or circuit breaker are not okay, refer to section 19.2.21.

19.2.21 Check for Short to Ground

Perform the following steps to check for a short to ground:

1. Disconnect the batteries.
2. Measure resistance between V-61 and V-62 and a good ground (black lead).
3. Measure resistance between V-65 and V-66 and a good ground (black lead).
 - [a] If the resistance measurement is greater than or equal to 10,000 Ω on all readings, refer to section 19.2.6.
 - [b] If the resistance measurement is less than 10,000 Ω on any readings, a short to ground exists. Repair the short. Refer to section 19.2.22.1.

19.2.22 Check Fuel Filters

Perform the following steps to check fuel filters:

1. Turn ignition OFF.
2. Check primary and secondary fuel filters to be sure they are not clogged and they are filled with clean fuel.
 - [a] If the fuel filters are clean, refer to section 19.2.4.
 - [b] If the fuel filters are not clean, replace the filters. Prime the system if required. Refer to section 19.2.22.1.

NOTE:

For information concerning Fuel Filters, refer to section 29.4.11 in the appropriate service manual. For information concerning Fuel Filter Replacement, refer to section 18 in the appropriate service manual.

19.2.22.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop the engine.
7. Read inactive codes.
 - [a] If the engine starts and no codes are displayed, troubleshooting is complete.
 - [b] If the engine does not start, refer to section 19.2.1.
 - [c] If the engine starts and codes display, refer to section 17.3.

19.3 ERRATIC PERFORMANCE AND NO CODES

The following troubleshooting chart resolves erratic performance and no codes displayed. For troubleshooting procedures, refer to the appropriate engine service manual.

19.3.1 Erratic Performance and No Codes

Check the following symptoms to determine possible fault, listed in Table 19-1.

Symptom	Possible Fault
Cannot get full power.	Plugged fuel filters. Hose not connected to Turbo Boost Sensor. Verify injector calibration(s) are correct.
Cannot get full throttle.	Miscalibrated Throttle Position Sensor.
Runs rough; misses and occasionally stalls.	Improper gapping of Timing Reference and Synchronous Reference Sensor. Fuel leaks. Loose battery power, ignition or ground wires. Injector failure. Vehicle speed sensor failure. Injector harness failure.
Engine idles high after warm-up or hangs.	Incorrect calibration of the Automotive Limiting Speed Governor (LSG/ALSG) linkage or pedal problem. VSG signal wire shorted to voltage source.
Low road speed.	Determine road speed specifications for vehicle manufacturer data. If road speed is less than specified and all mechanical checks are correct, then Cruise Control calibration is suspected.
Vehicle surges or bucks.	VSS may be supplying incorrect data to the ECM/ECU.

Table 19-1 Troubleshooting Erratic Performance and No Code

19.4 AMBER WARNING LAMP AND RED STOP LAMP FAULT

Use the following steps to troubleshoot a fault with the CEL/AWL or SEL/RSL. These lights are used to alert the operator of engine faults and flash any trouble codes stored in the ECM/ECU. The lights illuminate for five seconds and then go out during a start sequence, as a bulb check.

19.4.1 Determine Fault

Perform the following to determine fault:

1. If the CEL/AWL or SEL/RSL is always on, refer to section 19.4.2.
2. If the CEL/AWL or SEL/RSL never lights, refer to section 19.4.4.

19.4.2 Display ECM/ECU Light Status

Perform the following steps to display light status:

1. While the light is lit, plug in the DDR (ignition ON).
2. Select switch light status.
3. View the displayed status for the problem light.
 - [a] If status reads OFF, refer to section 19.4.3.
 - [b] If status reads ON, go to step 4.
4. Verify the diagnostic request is not ON.
 - [a] If the diagnostic request is ON, refer to section 19.10.
 - [b] If the diagnostic request is not ON, refer to section 17.3.

19.4.3 Check for Grounded Wire

Perform the following steps to check for a grounded wire:

1. Turn ignition OFF.
2. Unplug vehicle connector.
3. Turn ignition ON.
 - [a] If the light stays on, drive (V-2 or V-1) wire is shorted to the ground. Repair or replace the wire. Refer to section 19.4.5.1.
 - [b] If the light goes off, clean the connectors of the vehicle connector and assemble again. Then, refer to section 19.4.5.1.

19.4.4 Activate Light With Diagnostic Data Reader

Perform the following steps to activate the light with the DDR:

1. Turn ignition ON.

2. Plug in DDR.
3. Select Activate Outputs.
4. Activate affected light; watch status.
 - [a] If the light stays off, go to step 5.
 - [b] If the light illuminates, the problem no longer exists. Refer to *DDEC V Application and Installation* manual, 7SA821, to review the light operation.
5. To check the bulb, turn ignition OFF and refer to OEM recommendations for checking the bulb..
 - [a] If the bulb is bad, replace the bulb and refer to section 19.4.5.1.
 - [b] If the bulb is okay, refer to section 19.4.5.

19.4.5 Check for Voltage Supply

Perform the following steps to check the voltage supply:

1. Disconnect the power supply to the light.
2. Turn ignition ON.
3. Measure voltage between the removed connection and battery ground.
 - [a] If the voltage is correct based on the system of the vehicle (12V/24V), go to step 4.
 - [b] If the voltage is too low to expect the bulb to light, refer to the OEM recommendations to resolve the problem. Refer to section 19.4.5.1.
4. To check for an open output wire, measure the resistance between the ground side of the connector of the light and the battery ground.
 - [a] If the measured resistance is 45,000 to 48,000 Ω , clean the connections. Refer to section 19.4.5.1.
 - [b] If the measured resistance is less than 45,000 Ω or greater than 48,000 Ω , the wire is shorted to voltage, or is opened. Repair wire. Refer to section 19.4.5.1.

19.4.5.1 Verify Repairs

Perform the following steps to verify repairs.

1. Ensure all removed connections are installed.
2. Turn ignition ON.
 - [a] If the light comes on for five seconds, then goes out, troubleshooting is complete.
 - [b] If the light comes on and stays on, refer to section 19.4.1.
 - [c] If the light does not turn on, all troubleshooting is complete. Review this section and contact Detroit Diesel Customer Service Center (313-592-5800).

19.5 NO DATA TO DIAGNOSTIC DATA READER

Before using this procedure, all basic mechanical checks and physical inspections should have been performed with no problem found. Also the diagnosis of the DDEC system in Section 9 referred you to this section.

19.5.1 Read Codes on the Amber Warning Lamp

Perform the following steps to read the codes on the CEL/AWL or SEL/RSL:

1. Unplug the DDR.
2. Ignition should be ON; engine not running.
3. Enable diagnostic request switch.
4. Read codes flashing on the CEL/AWL and SEL/RSL.
[a] If codes are flashing out, refer to section 19.5.3.

NOTE:

If you wish to bypass diagnosis of a potential data line of the DDR problem for now, diagnose the active code by referring to the section that matches the code number.

- [b] If CEL/AWL and SEL/RSL are not flashing out codes, refer to section 19.5.2.

19.5.2 Check Diagnostic Request Circuit

Perform the following steps to check the diagnostic request circuit:

1. Ensure ignition is ON.
2. Plug in DDR.
3. Select Calibration Configuration.
4. Determine port assigned to Diagnostic Request on the ECM/ECU input switches.
5. Go to switch light status.
6. Depress and hold the diagnostic request switch.
7. Read status of diagnostic request.
[a] If the switch reads OFF, the diagnostic request circuit (V-24) is open or the V-59 ground is poor or open. Repair the open wire or the bad ground. Refer to section 19.5.5.1.
[b] If the switch reads ON, go to step 8.
8. Check the terminals at the vehicle harness connectors (both ECM/ECU and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 19-5.
[a] If terminals and connectors are okay, replace the ECM/ECU. Refer to section 19.5.5.1.

[b] If the terminals and connectors are damaged, repair them. Refer to section 19.5.5.1.

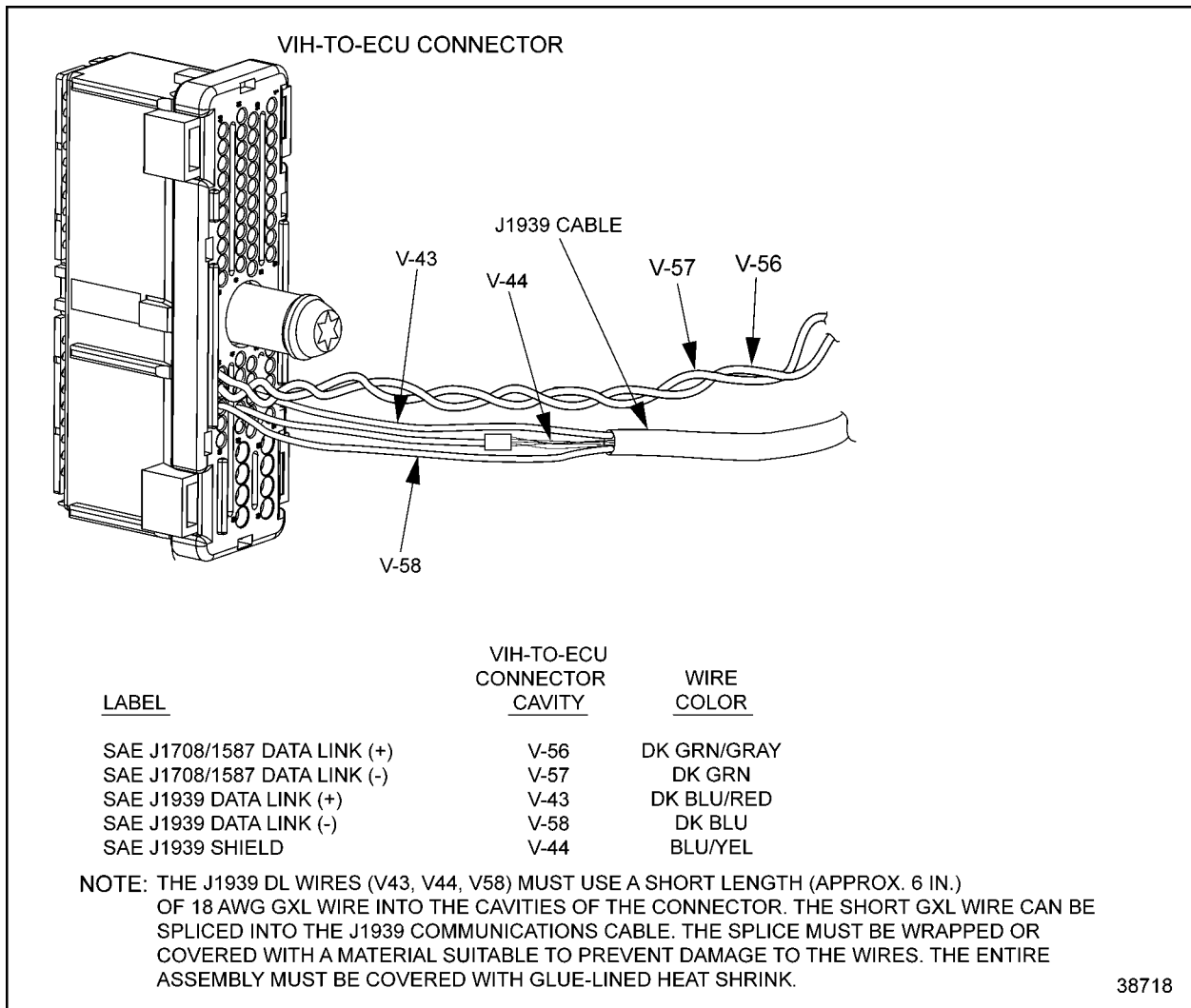


Figure 19-5 ECM/ECU Vehicle Harness Connector

19.5.3 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Place a jumper wire across pins A (V-56) and B (V-57) of the DDL connector. Unplug the vehicle harness connector and measure resistance between sockets V-56 and V-57.
3. Turn ignition ON, and again measure resistance between sockets V-56 and V-57. See Figure 19-6.

[a] If both readings are greater than 5 Ω , one or both data wires (circuit V-56 or V-57) are open. Repair the open and refer to section 19.5.5.1.

- [b] If either reading is less than 5 Ω , refer to section 19.5.4.

DIAGNOSTIC CONNECTOR		
CAVITY	DDC CONNECTOR	LABEL
-	A	GND
-	B	+12/24 V
V-43	C	J1939 DATA LINK (+)
V-58	D	J1939 DATA LINK (-)
V-44	E	J1939 SHIELD
V-56	F	J1587 DATA LINK (+)
V-57	G	J1587 DATA LINK (-)
-	H	PLUG
-	J	PLUG
<u>CONNECTOR</u>		<u>CAVITY PLUG</u>
DEUTSCH P/N: HD10-9-1939P		DEUTSCH P/N: 114017
DDC P/N: 23529496		DDC P/N: 23507136
<u>TERMINAL</u>		<u>CONNECTOR COVER</u>
DEUTSCH P/N: 0460-202-16141		DEUTSCH P/N: HDC16-9
DDC P/N: 23507132		DDC P/N: 23529497

43770

Figure 19-6 Diagnostic Connector

19.5.4 Check for Short

Perform the following steps to check for a short:

1. Remove the jumper wire from the DDL connector.
2. Measure resistance between Pins V-56 and V-57 of the vehicle harness connector.
 - [a] If the resistance measurement is less than 5 Ω , two data wires (V-56 or V-57) are shorted together. Repair the short and refer to section 19.5.5.1.
 - [b] If the measured resistance is greater than 5 Ω , refer to section 19.5.5.

19.5.5 Check for Short to Ignition and Ground

Perform the following steps to check for a short to ignition and ground:

1. Remove all jumpers for the DDL connector.
2. Measure resistance between Pins V-56 and C (ignition), A (V-56) and E (ground), B (V-57) and E (ground), and B (V-57) and C (ignition switch) of the DDL connector.
 - [a] If the measured resistance is less than 5 Ω on any reading, a short exists between the data wires and ignition or ground. Repair the short and refer to section 19.5.5.1.
 - [b] If the measured resistance is greater than 5 Ω , check the DDR on another engine. Go to step 3.
3. Connect the DDR to another engine and read any parameter in the menu.
 - [a] If the procedure worked okay, refer to section 19.5.5.1.
 - [b] If the procedure did not work, the DDR is probably defective. Refer to the DDR instruction manual for repair.

19.5.5.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Turn ignition OFF.
6. Turn ignition ON.
7. Note status of CEL/AWL.
8. Start and run the engine for one minute.
9. Read inactive codes.
 - [a] If the DDR display reads NO DATA BEING RECEIVED FROM DATA LINK or DDEC SYSTEM NOT RESPONDING, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 19.5.1.
 - [b] If the engine starts and no codes are read on the DDR, repairs are complete.
 - [c] If the engine starts and code displays, refer to section 17.3.

19.6 DIAGNOSTIC REQUEST SWITCH INOPERATIVE

Before using this procedure, all basic mechanical checks and physical inspections should have been performed with no problem found.

19.6.1 Check Diagnostic Request Circuit

Perform the following steps to check the diagnostic request circuit:

1. Turn ignition ON; engine not running.
2. Plug in DDR.
3. Select Switch/Light Status.
4. Depress and hold diagnostic request switch.
5. Observe the Diagnostic Request Status on the DDR.
 - [a] If the display reads ON, refer to section 19.6.2.
 - [b] If the display reads OFF, the diagnostic request line (V-25) is open, or is not being grounded when the switch is depressed. Check the V-24 wire and ground for diagnostic request switch. Repair the problem; refer to section 19.6.3.1.
 - [c] If no diagnostic request on the DDR input list, the ECM/ECU is not configured for diagnostic request operation. Refer to the *DDEC V Application and Installation* manual, 7SA821.

19.6.2 Check Red Stop Lamp and Amber Warning Lamp Bulbs

Perform the following steps to check the SEL/RSL and CEL/AWL bulbs:

1. Turn ignition OFF.
2. Remove CEL/AWL and SEL/RSL bulbs. Check to see if either is burned out or damaged.
 - [a] If the bulbs are okay, refer to section 19.6.3.
 - [b] If the bulbs are defective, replace the bulbs. Refer to section 19.6.3.1.

19.6.3 Check 12V / 24V Ignition Line

Perform the following steps to check the 12V/24V ignition line:

1. Turn ignition ON.
2. Disconnect vehicle harness connector at ECM/ECU.
3. Measure voltage at cavity V-15.
 - [a] If voltage measurement is less than 11.5V, ignition fuse or circuit breaker is blown, and the ignition line could be open or shorted to ground.
 - [b] If the voltage measurement is greater than 11.5V, the circuit V-1 or V-2 is open. Repair the open. Refer to section 19.6.3.1.

19.6.3.1 Verify Repairs

Perform the following steps to verify repairs:

1. Reconnect all connectors.
2. Turn ignition ON.
3. Press diagnostic request switch.
 - [a] If codes flash, the system is working. Repairs are complete. If any other problems exist, refer to section 17.3.
 - [b] If the system does not function, all system diagnostics are complete. Review this section to find the error. Refer to section 19.6.1.

19.7 CRUISE CONTROL INOPERATIVE

Before using this procedure, all basic mechanical checks and physical inspections should have been performed with no problem found.

NOTE:

Some ECM/ECU software on newer engines will require that the ECM/ECU 'detects' activity on a brake, clutch and cruise active circuits. Following each ignition on cycle the ECM/ECU will require the brake, clutch and cruise activate (circuit goes open and close or message sent to the ECM/ECU) before cruise will be allowed to operate.

19.7.1 Determine Type of Cruise Control System

Perform the following to determine the type of Cruise Control system:

1. Check that this is a DDEC Cruise Control system.
2. Turn ignition ON.
3. Plug DDR into DDL connector.
4. Select calibration configuration (Cruise Control).
5. Is Cruise Control enabled?
 - [a] If Cruise Control is enabled, refer to section 19.7.3.
 - [b] If cruise is not enabled, refer to *DDEC V Installation and Application Manual*, 7SA821, for Cruise Control installation requirements.

19.7.2 Check ECM/ECU Connectors

Perform the following to check the ECM/ECU connectors:

1. Disconnect the vehicle harness connector at the ECM/ECU.
2. Check the terminals at the ECM/ECU vehicle harness connector (both ECM/ECU and harness side) for damaged, corroded, or unseated pin or sockets.
 - [a] If terminals and connectors are not damaged, reprogram the ECM/ECU. Refer to section 19.7.15.1.
 - [b] If the terminals or connectors are damaged, repair them. Refer to section 19.7.15.1.

19.7.3 Check Pin Assignments

Perform the following to check pin assignments:

1. Turn ignition ON.
2. Plug in the DDR.
3. Select calibration configuration (ECM/ECU Ins/Outs).
4. Write/print pin assignments.

- [a] An example listed in Table 19-2 shows pins, wires and functions. Refer to section 19.7.4.

Pin/Wire	Function
V-47	Set/Coast On
V-09	Cruise Enable
V-03	Svc Brk Rel
V-10	Clutch Rel
V-08	Res/Accel On

Table 19-2 Pin Assignments

- [b] If the functions are not assigned, reprogram the ECM/ECU. Refer to section 19.7.15.1.

19.7.4 Checking Out of Cruise Control Switch and Wiring

To speed up the checking out of Cruise Control switches, quick check tables have been developed. These tests are to be run with the ignition ON, and the engine not running. A DDR must be plugged into the connector. All three quick check tables must be gone through to completely check out the Cruise Control wiring and switches.

For Example: Listed in Table 19-3, step 2, you would do the following:

1. Ignition ON; engine not running; DDR plugged in.
2. Turn the Cruise Enable Switch to ON.
3. Select switch/light status on the DDR.
4. Note the DDR display; if ON, check out brake and clutch switch as listed in Table 19-4.

Step	Cruise Enable Switch	Set / Coast Switch	Res / Accel Switch	DDR Readout Being Looked At	DDR Display	Okay	Go To
1.	Off	Off	Off	Cruise Enable	Off On	Yes No	Refer to step 2; Refer to section 19.7.5
2.	On	Off	Off	Cruise Enable	Off On	No Yes	Refer to section 19.7.6; Listed in Table 19-4, step 1

Table 19-3 Cruise Control Quick Check Table I, Check Out Cruise Enable Switch and Wiring (Ignition ON Not Running)

Step	Cruise Enable Switch	Brake Pedal	Clutch Pedal	DDR Readout Being Looked At	DDR Display	Okay	Go To
1.	On	Released	Released	Service Brake Release	On Off	Yes No	Refer to step 2 Refer to section 19.7.7
2.	On	Pressed	Released	Service Brake Release	On Off	No Yes	Refer to section 19.7.8 Refer to step 3
3.	On	Released	Released	Clutch Release	On Off	Yes No	Refer to step 4 Refer to section 19.7.9
4.	On	Released	De-pressed	Clutch Release	On Off	No Yes	Refer to section 19.7.10; Listed in Table 19-5, step 1

Table 19-4 Cruise Control Quick Check Table II, Check Out Brake and Clutch Switch and Wiring (Ignition ON Not Running)

Step	Cruise Enable Switch	Set / Coast Switch	Res / Accel Switch	DDR Readout Being Looked At	DDR Display	Okay	Go To
1.	On	Off	Off	Set/Coast On	Off On	Yes No	Refer to step 2 Refer to section 19.7.11
2.	On	On	Off	Set/Coast On	Off On	No Yes	Refer to section 19.7.12 Refer to step 3
3.	On	Off	Off	Res/Accel On	Off On	Yes No	Refer to step 4 Refer to section 19.7.13
4.	On	Off	On	Res/Accel On	Off On	No Yes	Refer to section 19.7.14 Refer to section 19.7.15

Table 19-5 Cruise Control Quick Check Table III, Check Out Set/Coast and Resume/Accel Switches and Wiring (Ignition ON Not Running)

19.7.5 Check for Short at the Cruise Enable Circuit

Perform the following steps to check for a short at the cruise enable circuit:

1. Turn ignition ON.
2. Turn cruise engage switch to off.
3. Disconnect the vehicle harness connector at the ECM/ECU.
4. Measure resistance between the cruise enable cavity (V-9) on the vehicle harness connector and a good ground.

- [a] If the resistance measurement is less than or equal to 10,000 Ω , reconnect the vehicle harness. Turn the ignition on. Then run steps listed in Table 19-4; and listed in Table 19-5. If any DDR display received is not okay, refer to the indicated step. If all steps listed in Table 19-4 and listed in Table 19-5, pass, then the cruise engage wire is shorted to the ground. Repair the short, or replace the switch. Refer to section 19.7.15.1.
- [b] If the resistance measurement is greater than 10,000 Ω , refer to section 19.7.2.

19.7.6 Check for Open at the Cruise Enable Circuit

Perform the following steps to check for an open at the cruise enable circuit:

1. Turn ignition ON.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Turn cruise enable switch to ON.
4. Measure resistance between the cruise enable cavity (V-9) on the vehicle harness connector and a good ground.
 - [a] If the resistance measurement is greater than 5 Ω , or open, the cruise engage switch is bad, circuit V-59 is open or the cruise enable wire is open. Repair the open or replace the switch. Refer to section 19.7.15.1.
 - [b] If the resistance measurement is less than or equal to 5 Ω , refer to section 19.7.2.

19.7.7 Check for Open or Miswired Brake Switch

Perform the following steps to check for an open or miswired brake switch:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Ensure the service brake is not engaged.
4. Measure resistance between the service brake cavity (V-3) on the vehicle harness connector and a good ground.
 - [a] If the resistance measurement is greater than 5 Ω , or open, the brake switch is miswired or faulty, circuit V-59 is open or the ground is bad. Repair the open, rewire or replace the switch. Refer to section 19.7.15.1.
 - [b] If the resistance measurement is less than or equal to 5 Ω , refer to section 19.7.2.

19.7.8 Check for Short at the Brake Switch or Circuit

Perform the following steps to check for a short at the brake switch or circuit:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.

3. Engage the service brake.
4. Measure resistance between the service brake cavity (V-3) on the vehicle harness connector and a good ground.
 - [a] If the resistance measurement is less than or equal to 10,000 Ω , the brake switch is miswired or the service brake circuit is shorted to ground. Rewire, repair the short or replace the switch. Refer to section 19.7.15.1.
 - [b] If the resistance measurement is greater than 10,000 Ω , or open, refer to section 19.7.2.

19.7.9 Check for Open or Miswired Clutch Switch

Perform the following steps to check for an open or miswired clutch switch:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Ensure the clutch is not engaged.
4. Measure resistance between the clutch cavity (V-10) on the vehicle harness connector and a good ground.
 - [a] If the resistance measurement is greater than 5 Ω , or open, the clutch switch is miswired or faulty, circuit V-59 is open, or there is a bad battery ground. Rewire, repair the short or replace the switch. Refer to section 19.7.15.1.
 - [b] If the resistance measurement is less than or equal to 5 Ω , refer to section 19.7.2.

19.7.10 Check for Short at the Clutch Service/Circuit

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Engage the clutch.
4. Measure resistance between the clutch cavity (V-10) on the vehicle harness connector and a good ground.
 - [a] If the resistance measurement is less than or equal to 10,000 Ω , the clutch switch is miswired or faulty, or the clutch circuit is shorted to ground. Rewire, repair the short or replace the switch. Refer to section 19.7.15.1.
 - [b] If the resistance measurement is greater than 10,000 Ω , or open, refer to section 19.7.2.

19.7.11 Check for Short at the Set/Coast Circuit

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Measure resistance between the set/coast cavity (V-47) and a good ground.
 - [a] If the resistance measurement is less than or equal to 10,000 Ω , the set/coast switch is shorted, or a short to ground exists in the set/coast circuit (V-47). Repair the short or replace the switch. Refer to section 19.7.15.1.
 - [b] If the resistance measurement is greater than 10,000 Ω , refer to section 19.7.2.

19.7.12 Check for Open at the Set/Coast Circuit

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Find a means to press and hold the set/coast switch.
4. Measure resistance between the set/coast cavity (V-47) and a good ground.
 - [a] If the resistance measurement is greater than 5 Ω , or open, the set/coast switch is open or miswired, circuit V-59 is open, or there is a bad battery ground. Rewire, repair the short or replace the switch. Refer to section 19.7.15.1.
 - [b] If the resistance measurement is less than or equal to 5 Ω , refer to section 19.7.2.

19.7.13 Check for Short at the Res/Accel Circuit

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Measure resistance between the Res/Accel cavity (V-8) and a good ground.
 - [a] If the resistance measurement is less than or equal to 10,000 Ω , the Res/Accel switch is shorted, or a short to ground exists in the Res/Accel circuit (V-8). Repair the short or replace the switch. Refer to section 19.7.15.1.
 - [b] If the resistance measurement is greater than 10,000 Ω , refer to section 19.7.2.

19.7.14 Check for Open at the Res/Accel Circuit

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Find a means to press and hold the Res/Accel switch.
4. Measure resistance between the Res/Accel cavity (V-8) and a good ground.
 - [a] If the resistance measurement is greater than 5 Ω , or open, the Res/Accel switch is open or miswired, circuit V-59 is open or the battery ground is bad. Repair the short, replace the switch, or rewire. Refer to section 19.7.15.1.
 - [b] If the resistance measurement is less than or equal to 5 Ω , refer to section 19.7.2.

19.7.15 Verify Problem Still Exists

Perform the following steps to verify the problem still exists:

1. If you were referred to this step, you have completed the switch checkout process without detecting a fault.
2. Take the vehicle for a road test and check Cruise Control operation.
 - [a] If Cruise Control operates correctly, the problem no longer exists. If any other problems exist, refer to section 17.3.
 - [b] If Cruise Control does not operate correctly, check the Vehicle Speed Sensor. Refer to section 53.

19.7.15.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Road test the vehicle.
 - [a] If Cruise Control operates correctly, troubleshooting is complete.
 - [b] If the Cruise Control does not operate correctly, all system diagnostics are complete. Review this section from the start to find the error. Refer to section 19.7.1.

19.8 FAN OPERATIONAL CONCERN (ON/OFF TYPE)

This section covers only the DDEC controlled fan operation, (fan type single, dual or two-speed). If the function is assigned, see description of DDEC fan control logic, listed in Table 19-6.

Cavity	Function	Output/Input
X#	Fan Control 1	Output - Required
X#	Aux. Fan Control	Input - Optional
X#	Fan Override	Input - Optional

Table 19-6 DDEC Fan Control Logic Description

19.8.1 Digital Fan Operation

Items used in digital fan operation include:

1. The ECM/ECU provides ground (output Fan Control 1) and should be wired such that when this cavity grounds, the fan should turn off. When the circuit goes open, the fan should turn on.
2. When Aux. Fan Control is configured (input), this wire must be connected to battery ground, or the fan will always be on. Typically, this is used with an air conditioning pressure switch. High pressure opens this circuit, and turns the fan on for a minimum time that can be set with the programming station on later ECM/ECU software versions.
3. Fan Override - Grounding this wire will turn the fan on. This would normally be an OEM supplied switch on the dash.

Other than these items, the ECM/ECUs fan control output opens, turning the fan on due to engine temperatures that are above the programmed limits. Once a fan output turns the fan on for whatever reason, all fan off temperatures must be met before the fan will turn off.

Temperatures for most highway applications are listed in Table 19-7.

Fan Control	Actual Fan Status	Coolant Temp	Oil Temp	Air Temp
Fan Control - 1	Fan ON	96°C / 204°F	110°C / 230°F	66°C / 150°F
Fan Control - 2	Fan ON	98°C / 208°F	113°C / 235°F	N/A
—	Fan OFF	92°C / 197°F	104°C / 219°F	49°C / 120°F

Table 19-7 Highway Application Temperatures

These temperature limits are only changeable in the base calibration.

19.8.2 Check Output Status

Perform the following steps to troubleshoot a fan operation problem:

1. Start engine and ensure the air conditioning of the vehicle is OFF..
2. Run engine for at least three minutes.
3. Plug in DDR and select switch/light status.
4. Check the status of the Fan Control #1 while noting the actual fan status as listed in Table 19-8.

Input	Status	Status	Status	Status	Status
Fan Control #1	ON/GND	OFF/OPN*	OFF/OPN	ON/GND	OFF/OPN
Actual Fan State	OFF Refer to section 19.8.3	ON Refer to section 19.8.3	ON Refer to section 19.8.4	ON Refer to section 19.8.7	OFF Refer to section 19.8.8

* Hot engine

Table 19-8 Troubleshooting Fan

19.8.3 Fan Information

The steps that led to this procedure do not indicate a problem with the fan control logic in the ECM/ECU. The fan operation is normal if the steps that you checked led you to this section.

The fan status is correct according to what the ECM/ECU is requesting.

If you believe the fan state should be different, review the *DDEC V Application and Installation* manual, available on the DDC extranet, for information on fan control configuration.

19.8.4 Check Input Status

Read the status of the inputs used for fan operation listed in Table 19-9. (Note both together.)

Input	Status	Status	Status
Aux. Fan Control	OFF/OPN	ON/GRD	ON/GRD
Fan Override	OFF/OPN Refer to section 19.8.5	ON/GRD Refer to section 19.8.9	OFF/OPN Refer to section 19.8.3

Table 19-9 Input Status

19.8.5 Check Auxiliary Fan Control Request

Perform the following tests to check the auxiliary fan control switch:

1. Turn A/C OFF and ignition ON.
2. Is the auxiliary fan control status ON?
 - [a] If the auxiliary fan control is on, the fan should not be on; this is normal. If the fan was already on it may remain on for up to three minutes after auxiliary fan control is turned on.
 - [b] If the auxiliary fan control is off, check that a normally open pressure switch is not installed; then refer to section 19.8.6.

19.8.6 Check for Input Open

Perform the following tests to check for an open:

1. Turn ignition OFF.
2. Disconnect vehicle connector at the ECM/ECU.
3. Turn ignition ON.
4. Measure resistance between auxiliary fan control wire V-25 and a good ground.
 - [a] If the measured resistance is greater than 1,000 Ω , an open exists in the auxiliary fan control wire, or auxiliary fan control is configured and not wired, or the switch is bad. Repair open or replace the switch if an auxiliary fan control is used. If this feature is not to be used, disable the auxiliary fan control with the programming station. Refer to section 19.8.10.1.
 - [b] If the measured resistance is less than or equal to 1,000 Ω , refer to section 19.8.10.

Perform the following steps to troubleshoot fan always on. The steps that led to this procedure do not indicate a problem with the fan control logic in the ECM/ECU. The fan operation is normal if the steps that you checked led you to this section.

19.8.7 Check for Output Open

Perform the following steps to check for an output open:

1. With ignition off, locate OEM supplied wire used for Fan Control #1.
2. Determine where the wire terminates. (e.g. fan solenoid, relay, data module, etc.)
3. Disconnect the Fan Control #1 wire at the solenoid/relay.
4. Turn ignition ON.
5. Measure resistance between the fan control #1 (V-4) wire and a good ground, battery (-).
 - [a] If the measured resistance is greater than 48,000 Ω or open, an open exists in the FC#1 wire. Repair the open. Refer to section 19.8.10.1.

- [b] If the measured resistance is less than or equal to 48,000 Ω , refer to section 19.8.10.

19.8.8 Check for Output Short

Perform the following steps to check for an output short:

1. With ignition off, locate OEM supplied wire used for Fan Control #1 (V-04).
2. Determine where the wire terminates. (e.g. fan solenoid, relay, data module, etc.)
3. Disconnect the Fan Control #1 wire at the solenoid/relay.
4. Measure resistance between the fan control #1 wire and a good ground, battery (-).

- [a] If the measured resistance is greater than 1,000 Ω or open, refer to section 19.8.10.

- [b] If the measured resistance is less than or equal to 1,000 Ω , the output wire is shorted to ground, keeping the fan off. Repair the short or replace the wire. Refer to section 19.8.10.1.

19.8.9 Check Override Request

If the fan override is on, and the fan override is requesting fan on, this is normal. If the fan override is not on, the fan override wire is shorted to ground, repair the short or re-configure the input if this is an error in programming. Refer to section 19.8.10.1.

19.8.10 Check Connectors

Check the connectors for damaged, bent, or corroded terminals. If the pins and terminals are not damaged, the problem may be due to the solenoid, ECM/ECU, or OEM device that operates the fan. Contact the OEM for further information or instructions.

If the pins or terminals are damaged, repair or replace them. Refer to section 19.8.10.1.

19.8.10.1 Verify Repairs

Perform the following steps to verify repairs:

1. Connect any removed connectors and start the engine.
2. Operate engine under conditions that brought you to this section.
3. Check fan operation.

- [a] If the fan operates correctly, troubleshooting is complete.

- [b] If the fan does not operate correctly, review this section from the first step to find the error.

19.9 FAN OPERATIONAL CONCERN (VARIABLE SPEED TYPE)

The DDEC system via a Pulsewidth Modulation (PWM) signal will go to a high voltage (7-8 volts on a 12-volt system) on a cold engine for a low speed, and to a low voltage (0.8 - 1.0 volts on a 12-volt system) for a high speed.

Fan speed is ramped up as temperatures increase, as listed in Table 19-10. Calibrations can vary. The table is provided only as a guide.

Coolant Temperature	Speed
up to 197°F (92° C)	Low speed
about 203°F(95° C)	Medium speed
208°F (98° C) and above	High speed

Table 19-10 Fan Speed vs Temperature

19.9.1 Verify Correct DDEC Configuration

Perform the following steps to verify the configuration:

1. Turn ignition ON.
2. Plug in DDR.
3. Select "View Calibration" (ECM/ECU Ins/Outs).
4. Review PWM functions to determine correct pin assignment for PWM fan.
 - [a] If the cavity is assigned to PWM Fan, refer to section 19.9.2.
 - [b] If the cavity is not programmed, reprogram the ECM/ECU and refer to section 19.9.5.1.

19.9.2 Check for Signal

Perform the following steps to check for signal:

1. Start and run the engine at idle.
2. Plug in DDR.
3. Review engine data list and watch the pulse width modulation number x wire = # of fan assignment (normally PWM#4).
4. Verify coolant, oil and air temperatures are cooler, less than 150 ° F (66° C). Verify the air conditioning input is grounded (On).
 - [a] If the PWM value is 80 to 90% and the fan is at Low Speed, refer to section 19.9.3.
 - [b] If the PWM value is 80 to 90% and the fan is at High Speed, refer to section 19.9.4.

19.9.3 Check Signal Engine Hot

Perform the following steps to check the signal status:

1. Start engine and warm up. Road test (until coolant temp is about 200°F (93° C)).
2. View DDR data list display, Coolant Temp/PWM # (normally #4).
 - [a] If PWM % decreases as the temperature increases, all checks appear normal. If this is an intermittent high speed operation, check A/C Freon pressure switch or wiring for an intermittent open. Refer to section 19.9.5.1.
 - [b] If PWM % decreases as the temperature increases, but the fan speed stays low, refer to section 19.9.5.

19.9.4 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Unplug PWM wire at the fan control valve.
3. Install a jumper between the PWM wire and the battery (-).
4. Unplug the engine harness connector.
5. Measure resistance between the PWM cavity and the battery (-).
 - [a] If the measured resistance is greater than 1,000 Ω , the wire is open. Repair the open and refer to section 19.9.5.1.
 - [b] If the measured resistance is less than 1,000 Ω , the valve or wiring (voltage supply) to the valve is defective. Replace.

19.9.5 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Unplug the engine harness connector.
3. Measure resistance between the PWM cavity and several ground sources (battery, chassis, etc.).
 - [a] If the measured resistance is greater than 1,000 Ω , go to step 4.
 - [b] If the measured resistance is less than 1,000 Ω at any time, the wiring is shorting. Replace the wire and refer to section 19.9.5.1.
4. Check for damaged, bent or corroded connectors, pins, and terminals.
 - [a] If the connectors, pins, and terminals are not damaged, contact the OEM or fan valve supplier for instructions on further troubleshooting. If the ECM/ECU and wiring to

the component appear to be okay, the problems could be with the control valve or battery and wiring.

- [b] If the connectors, pins or terminals are damaged, repair or replace them and refer to section 19.9.5.1.

19.9.5.1 Verify Repairs

Perform the following steps to verify repairs:

1. Connect all removed connectors, etc.
2. Start and run the engine from cold to hot, while watching the fan speed operation.
 - [a] If the operation is normal, troubleshooting is complete.
 - [b] If the operation is not normal, all system diagnostics are complete. Review this section to find the error. Refer to section 19.9.1.

19.10 ENGINE BRAKE INOPERATIVE

Perform the following steps to troubleshoot an inoperative engine brake:

1. Turn ignition ON. Plug in DDR.
2. View Diagnostic Data List to see if the correct application is programmed into the ECM/ECU.
3. Next to Engine Brake, the display should read ON or OFF. If it reads N/A, the DDC mainframe must be changed and the ECM/ECU must be reprogrammed after the change is made.
4. If the ECM/ECU is correctly configured, go to the view calibration area with the DDR and check to ensure that the two required inputs (Engine Brake Low and Engine Brake Medium) are configured.
5. If the inputs are not configured, or incorrectly configured, this must be corrected using the DDEC reprogramming station.
6. If the inputs are configured correctly, print or write down the inputs and outputs for future reference. Refer to section 19.10.1. Refer to the appropriate Application and Installation manual for engine brake operation.

19.10.1 Check Switches

Perform the following steps to troubleshoot the switches:

1. Turn ignition ON. Plug in DDR.
2. Select Switch Light status - Inputs.

3. View DDR display of Eng Brk Low and Eng Brk Med as listed in Table 19-11.

NOTE:

Set brake dash switch position on low.

Eng Brk Low	Eng Brk Med	Action
On	Off	Go to step 5.
On	On	Medium and low inputs are shorted to each other. Repair. Refer to section 19.10.6.1.
Off	On	Input wires are reversed. Correct and refer to section 19.10.6.1.
Off	Off	Refer to section 19.10.2

Table 19-11 Engine Brake Low and Engine Brake Medium with the Brake Dash Switch Position on Low

4. If you have an Engine Brake Disable Switch, during Engine Brake operation it must read Open or Off.
 - [a] If the input reads Grounded or On, the input is shorted to ground, incorrectly configured, or used with an automatic transmission and is in a position where the engine brake should not be engaged. Once the error is found and repaired if necessary, refer to section 19.10.6.1.
 - [b] If the input reads Open or Off, go to step 5.
5. Turn brake enable dash switch on.

NOTE:

Set brake dash switch position on medium.

6. View DDR display of Eng Brk Low and Eng Brk Med as listed in Table 19-12.

Eng Brk Low	Eng Brk Med	Action
Off	On	Refer to section 19.10.3
On	On	Medium and low inputs are shorted to each other. Repair. Refer to section 19.10.6.1.
On	Off	Input wires are reversed. Correct and refer to section 19.10.6.1.
Off	Off	Refer to section 19.10.2.

Table 19-12 Engine Brake Low and Medium with Brake Dash Switch Position on Medium

19.10.2 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Turn engine brake switch to low.
3. Measure resistance between the engine brake low switch and a good ground (ECM/ECU side).
4. Set switch to Med. Measure resistance between medium input and a good ground.
 - [a] If the measured resistance is less than 10,000 Ω , either the switch is bad or the wire from the switch to the battery ground is bad. Replace the switch or repair the open.
 - [b] If the measured resistance is greater than 10,000 Ω , or open, an open exists in the input wire. Repair the open. Refer to section 19.10.6.1.

19.10.3 View Calibration - Engine Configuration

Perform the following steps to view calibration - engine configuration:

1. Go to View Cal-Eng Configuration.
2. Check status of Eng Brk Serv Brk and Eng Brk mph. If Eng Brk Serv Brk indicates YES, or Eng Brk Min mph has number other than "0", check with the operator to ensure he or she understands how these functions operate.
 - [a] If the Eng Brk Serv Brk indicates YES, the application of service brake is required for engine brake operation.
 - [b] If the Eng Brk Min mph has a number other than "0", the brakes will not operate below this mph.

NOTE:

These two functions may work separately or together.

- [c] If the Eng Brk Svc Brk indicate No, and Eng Brk Min mph indicate 0, refer to section 19.10.4.

19.10.4 Check Engine Brake Operation

Perform the following steps listed in Table 19-13 to check out the brake and clutch switch, and the wiring.

NOTE:

If table below leads to section 10.11, troubleshoot clutch and brake inputs. Then check operation of engine brake. If engine brake is still inoperative, refer to section 19.10.5.

1. Turn ignition ON. Engine must not be running.

2. Plug in DDR. Select switch/light status.

Step	Brake Pedal	Clutch Pedal	DDR Readout	DDR Display	Status OK	Reference
1	Released	Released	Service Brake (Release)	On Off	Yes No	refer to Step 2 refer to section 19.11
2	Pressed	Released	Service Brake Release	On Off	No Yes	refer to section 19.11 refer to Step 3
3	Released	Released	Clutch Release	On Off	Yes No	refer to Step 4 refer to section 19.11
4	Released	Depressed	Clutch Release	On Off	No Yes	refer to section 19.11 refer to section 19.10.5

Table 19-13 Engine Brake Operation

19.10.5 Check Brake Solenoids

Check engine brake solenoids. Refer to OEM guidelines.

- If solenoids are okay, refer to section 19.10.6.
- If solenoids are bad, repair or replace the solenoids. Refer to section 19.10.6.1.

19.10.6 Verify Conditions

Perform the following steps to verify conditions:

1. Verify proper conditions are being met to enable engine brake:
 - [a] TPS % = 0 %
 - [b] Pulse width = 0 (or less)
 - [c] Engine speed >850 rpm
 - [d] Clutch release (input) = ON (if configured)
 - [e] Engine brake disable (input) = OFF (Auto Trans)
2. Are the conditions listed in 1a through 1e met?
 - [a] If conditions are not met, correct the problem (i.e. TPS). Refer to section 19.10.6.1.
 - [b] If the conditions are met, reprogram the ECM/ECU. Contact the OEM for possible TPS repair. Then, refer to section 19.10.6.1.

19.10.6.1 Verify Repairs

Perform the following steps to verify repairs:

1. Reinstall all connectors.
2. Test drive vehicle to see if the problem is corrected.

- [a] If engine brakes operate correctly, troubleshooting is complete.
- [b] If engine brakes do not operate, all system diagnostic checks are complete. Review this section to find the error. Refer to section 19.10, or contact Detroit Diesel Customer Service Center (313-592-5800) for possible ECM/ECU replacement.

19.11 MISCELLANEOUS DIGITAL INPUT FAULT

The following procedure will cover miscellaneous input switch faults. All faults function in the same manner, allowing the same troubleshooting process to be used regardless of the function.

There are 12 digital input cavities, listed in Table 19-14, available on a DDEC ECM/ECU. Any available function can be assigned (programmed with the Programming Station) to any of the available cavities.

Input Cavities	Input Cavities
V-41	V-01
V-25	V-50
V-24	V-10
V-42	V-05
V-47	V-08
V-09	V-39

Table 19-14 Input Cavities

When a digital input wire is switched to battery ground (usually V-59), it is a request to the ECM/ECU to activate the function assigned to that wire. Available functions are listed in Table 19-15.

Functions	Functions	Functions
Engine Brake Disable	Limiting Torque Curve	Trans Retarder Status
Engine Brake Low	Diagnostic Request	Dual Throttle (LSG)
Engine Brake Med	Alt Min VSG/Fast Idle	A/C Fan Status
Aux Shutdown #1	Service Brake Release	Aux CLS/ECL Sensor
Aux Shutdown #2	Clutch Released	Fan Control Override
Park Brake / ISD	Set / Coast ON	VSG Station Change
Idle Validation	Resume / Accel ON	VSG Station Complement
Pressure / RPM Mode	Cruise Enable	Air Load Switch
Throttle Inhibit	PSG System Enable	In Neutral Switch
Rating Switch #1	SEO / DIAG Request	In Gear Switch
Rating Switch #2	Gas Valve Diagnostic	KD Brake

Table 19-15 Available Input Functions

Additional conditions may need to be met for the feature to activate. Refer to the *DDEC V Application and Installation* (7SA821) manual for these conditions. This manual is available on the DDC Extranet.

19.11.1 Verify Switch Status

Follow these steps to verify the switch status.

1. Turn ignition ON.
2. Plug in DDR.
3. Select switch light status.
4. Operate the engine or vehicle that would allow the feature to activate (e.g. activate switch, set brake, etc.).
5. Observe the status when the feature is active (or supposed to be active). See Figure 19-7.
 - [a] The feature always reads OFF. Refer to section 19.11.2.
 - [b] The feature switches from OFF to ON. Refer to section 19.11.3.
 - [c] The feature always reads ON. This indicates the input wire is shorted to ground or the switch is faulty. Repair wire or replace switch. Refer to section 19.11.3.1.

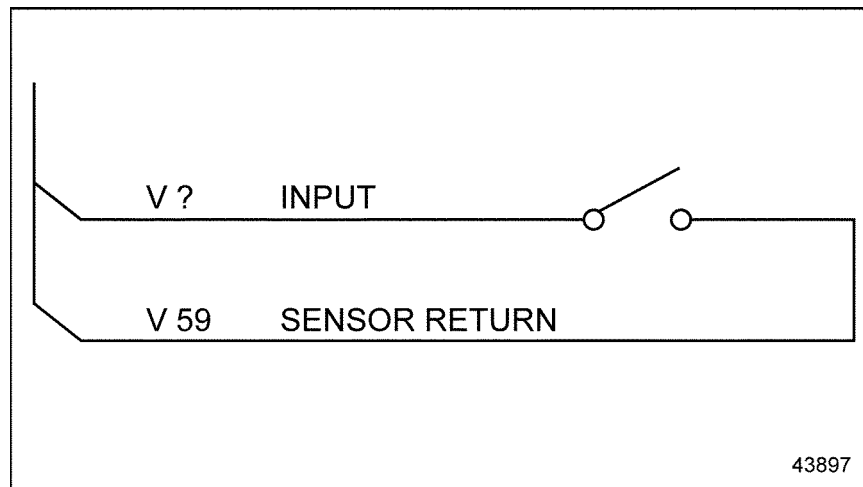


Figure 19-7 ECM/ECU-to-Input / Sensor Return

19.11.2 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Unplug the vehicle interface harness connector at the ECM/ECU.
3. Operate switch. Enable the feature.
4. Measure the resistance between the input cavity affected and the battery ground.

- [a] If the measured resistance is greater than 10,000 Ω , the input wire or ground wire is open, or the switch is bad. Repair the open or replace the switch. Refer to section 19.11.3.1.
- [b] If the measured resistance is less than 10,000 Ω , refer to section 19.11.3.

19.11.3 Review the Operation of the Feature

Perform the following steps to check the operation of the feature:

1. The step that led you here indicates the input, wire, and switch, are operating correctly. Review the intended operation of the feature to determine if any other conditions need to be met for the feature to operate. (e.g. *DDEC V Application and Installation* manual available on the DDC extranet).
2. To verify the repairs to the feature, refer to section 19.11.3.1.

19.11.3.1 Verify Repairs

Perform the following steps to verify repairs.

1. Hook up all connectors that were previously removed.
2. Operate the engine or vehicle.
3. Activate the feature.
 - [a] If the input feature operates correctly, troubleshooting is complete.
 - [b] If the input feature is not operating, contact Detroit Diesel Customer Service Center (313-592-5800) .

19.12 MISCELLANEOUS DIGITAL OUTPUT FAULT

This section is designed to diagnose an output fault (feature not functioning). Since all outputs operate in the same manner, this troubleshooting section can be used regardless of the function assigned.

19.12.1 DDEC ECM/ECU

The DDEC ECM/ECU has seventeen available digital output cavities. Nine are located at the EH connector and eight at the VIH connector. Output functions (features) are assigned (programmed with the programming station) to almost any available cavity. The ECM/ECU switches the cavity to battery (-) to allow the function to activate. Some output activation is dependent on other parameters being met. (e.g. minimum, rpm, etc.)

NOTE:

Some ECM/ECU software on newer engines will require that the ECM/ECU 'detects' activity on a brake, clutch and cruise active circuits. Following each ignition on cycle the ECM/ECU will require the brake, clutch and cruise activate (circuit goes open and close or message sent to the ECM/ECU) before cruise will be allowed to operate.

Additional outputs could be added at a later date. Available functions are listed in Table 19-16.

Functions	Functions	Functions
Fan Control #1 & Fan Control #2	Cruise Active Light	Turbo Recirc Valve
Low DDEC Volt	Deceleration Light	Optimized Idle Active
RPM Sync Active	Engine Brake Active	Shift Solenoid (Top2)
PSG Active Light	VSG Active Indication	Shift Lockout (Top2)
Vehicle Power Down	Oil Pressure Low Light	Coolant Pressure Low
Starter Lockout	Oil Temp High Light	Gas Throttle Actuator
Ext Brake Enable	Coolant Temp High Light	Fuel Supply Solenoid
Trans Retarder Enable	Air Comp Solenoid	KD Brake Solenoid
Coolant Level Low Light	Crankcase Pressure High	Ether Start

Table 19-16 Available Output Functions

19.12.2 Activate Output

Perform the following steps to attempt to activate the output:.

1. Turn ignition ON and plug in the DDR.

NOTE:

Service any other codes first.

2. Select ACTIVATE OUTPUTS and activate output associated with the fault.
 - [a] If the feature operates (e.g. light illuminates) review the application and installation manual for the designated feature operation and parameters. Refer to section 19.12.5.1.
 - [b] If the feature does not operate or cannot be activated, refer to section 19.12.3.

19.12.3 Check for Open

Perform the following steps to check for open:

1. Turn ignition OFF and locate device end of output wire (e.g. light). Disconnect wire.
2. Turn ignition ON and measure resistance between the disconnected wire and battery (-).
 - [a] If the measured resistance is less than 30,000 Ω , refer to section 19.12.4.
 - [b] If the measured resistance is greater than 30,000 Ω , the wire is open. Refer to section 19.12.5.1.

19.12.4 Check for Voltage

Check by measuring the voltage between the disconnected wire and a good ground. If voltage measurement is less than 2 volts, refer to section 19.12.5. If voltage measurement is greater than 2 volts, the output is shorted to a voltage source. Replace the wire and refer to section 19.12.5.1.

19.12.5 Check for Resistance

Perform the following steps to check for resistance at the ECM/ECU:

1. Turn ignition OFF and disconnect connector that houses the wire/function you are checking (e.g. V-49).
2. Measure resistance between the pin on the ECM/ECU and the ECM/ECU case.
 - [a] If the measured resistance is 46,000 to 48,000 Ω , contact the OEM or the feature hardware supplier.
 - [b] If the measured resistance is greater than 48,000 Ω , try a test ECM/ECU. Refer to section 19.12.5.1.

19.12.5.1 Verify Repairs

Perform the following steps to verify repairs.

1. Connect all connectors.
2. Test the vehicle and attempt to operate the feature.
 - [a] If the feature works correctly, troubleshooting is complete.
 - [b] If the feature still does not work correctly, review this section to find the error. Refer to section 19.12.2.

19.13 FIRE TRUCK PRESSURE GOVERNOR FAULT

The Pressure Sensor Governor (PSG) System is a DDEC feature, programmed to allow the engine speed to change in order to maintain a steady water pump pressure (pressure mode) or hold a steady engine speed (RPM Mode).

NOTE:

Most applications today incorporate the Detroit Diesel Electronic Fire Commander.

The following procedure will troubleshoot fire truck pressure governor fault.

19.13.1 Verify Correct Pressure Sensor Governor Configuration

Perform the following steps to verify the PSG configuration. Refer to the Application and Installation manual to ensure correct inputs and outputs are configured. Required In / Outs are listed in Table 19-17.

1. Turn ignition ON and plug in the DDR.
2. View H₂O governor enabled (engine configuration).
3. View In / Outs. Verify correct configuration.
 - [a] If the system is enabled and the in/outs are correctly configured, refer to section 19.13.2.
 - [b] If the problem was found, correct the settings and retest. Refer to the *DDEC V Application And Installation* manual, 7SA821.

Inputs		Outputs
PSG Mode, (Press / RPM)	Res / Accel	PSG Active
PSG Enable	Set / Coast	Cruise Active

Table 19-17 Required Inputs / Outputs

4. Using the DRS Select (PSG + Sensor Tab), verify that the water pump sensor has been configured correctly (V-29 – water pump pressure).
 - [a] If the water pump sensor has been configured correctly, refer to section 19.13.2.
 - [b] If the water pump sensor has not been configured correctly, configure and test.

19.13.2 Identify Problem

Use the following procedure to identify the problem with the PSG:

- ☐ Does not operate; refer to section 19.13.3.
- ☐ No pressure mode, refer to section 19.13.5.
- ☐ No increase function refer to section 19.13.6.
- ☐ No decrease function refer to section 19.13.7.

- EFC Fault Information refer to section 19.14.

19.13.3 Check System Ground

Perform the following steps to check the system ground:

1. Start engine and turn ON pump control switch.
2. Verify all interlocks are set (parking brake, transmission neutral, etc.).
3. Plug in DDR. Select Switch/Light status.
4. Observe the displays and PSG ENABLE.
 - [a] If PSG ENABLE reads OFF, the PSG ENABLE input V-09 is not grounded. Check circuit V-09 for an open between battery ground or a short to a voltage source. Repair fault and retest. Refer to section 19.13.4.
 - [b] If PSG ENABLE reads ON, refer to section 19.13.6.

19.13.4 Check Sensor Wiring

Compare pressure sensor harness wiring to the diagram. See Figure 19-8. If the EFC tests okay, refer to section 19.13.5. If the wiring is incorrect, correct the wiring and retest.

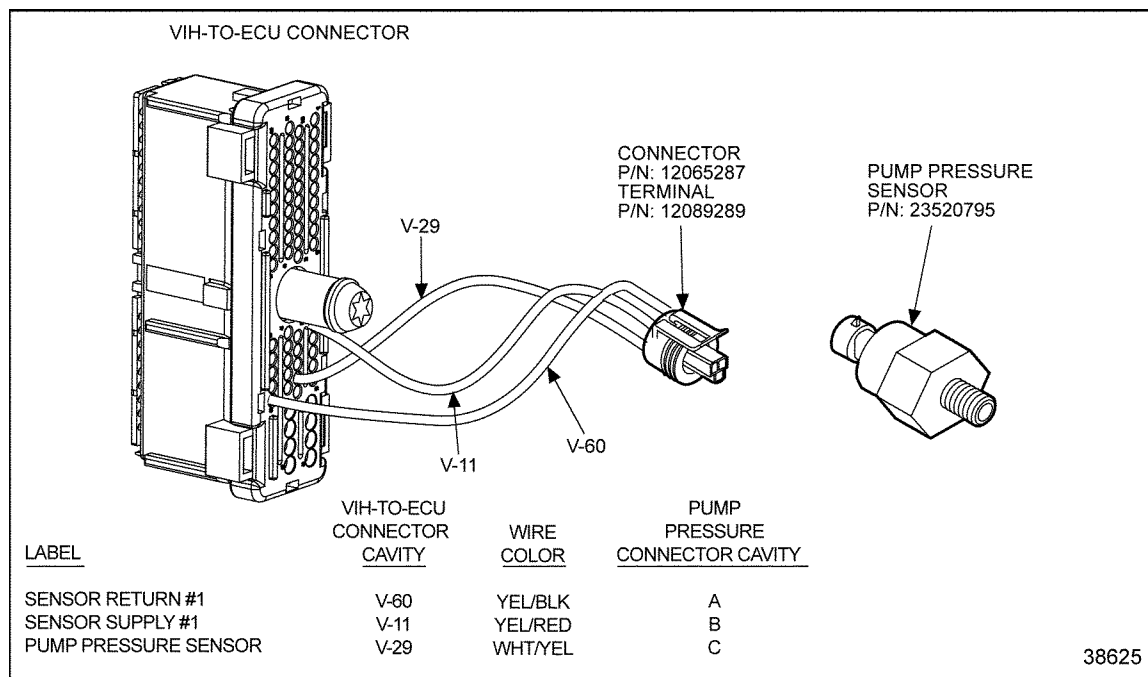


Figure 19-8 Pressure Sensor and Harness Connector

19.13.5 Verify Mode Selector Operation

Perform the following steps to identify the problem:

1. Start engine and turn ON pump control switch.
2. Verify all interlocks are set (parking brake, transmission neutral, etc.).
3. Plug in DDR. Select Switch/Light status.
4. Observe the displays and PSG MODE.
 - [a] If DDR displays ON when Pressure Mode is selected, the mode selector V-26 is functioning properly. Check for possible intermittent open or short to voltage source. Check for faulty pressure transducer. Refer to section 19.13.4. See Figure 19-8.
 - [b] If the DDR displays OFF when Pressure Mode is selected, the mode selector wire V-26 or switch is open or shorted to a voltage source. Repair the fault and retest.

19.13.6 Check Resume / Accel Switch (Increase)

Perform the following steps to identify the problem:

1. Start engine and turn ON pump control switch.
2. Verify all interlocks are set (parking brake, transmission neutral, etc.).
3. Plug in DDR. Select Switch/Light status.
4. Observe the displays and Res/Accel, while pressing the increase switch.
 - [a] If DDR displays OFF to ON when increase is pressed, check the EFC.
 - [b] If the DDR displays OFF when increase is pressed, circuit V-08 is open or shorted to a voltage source. Repair the fault and retest.

19.13.7 Check Set / Coast Switch (Decrease)

Perform the following steps to identify the problem:

1. Start engine and turn ON pump control switch.
2. Verify all interlocks are set (parking brake, transmission neutral, etc.).
3. Plug in DDR. Select Switch/Light status.
4. Observe the displays and Set/Coast, while pressing the decrease switch.
 - [a] If DDR displays OFF to ON when Set/Coast decrease is pressed, check the EFC.
 - [b] If the DDR displays OFF when decrease is pressed, circuit V-47 is open or shorted to a voltage source. Repair the fault and retest.

19.14 TROUBLESHOOTING ELECTRONIC FIRE COMMANDER

The Information Center displays DDEC ECM/ECU diagnostic codes and limited engine information as well as PSG status.

The Information Center display can be used as an aid in troubleshooting the Pressure Governor System and the Electronic Fire Commander. See Figure 19-9.

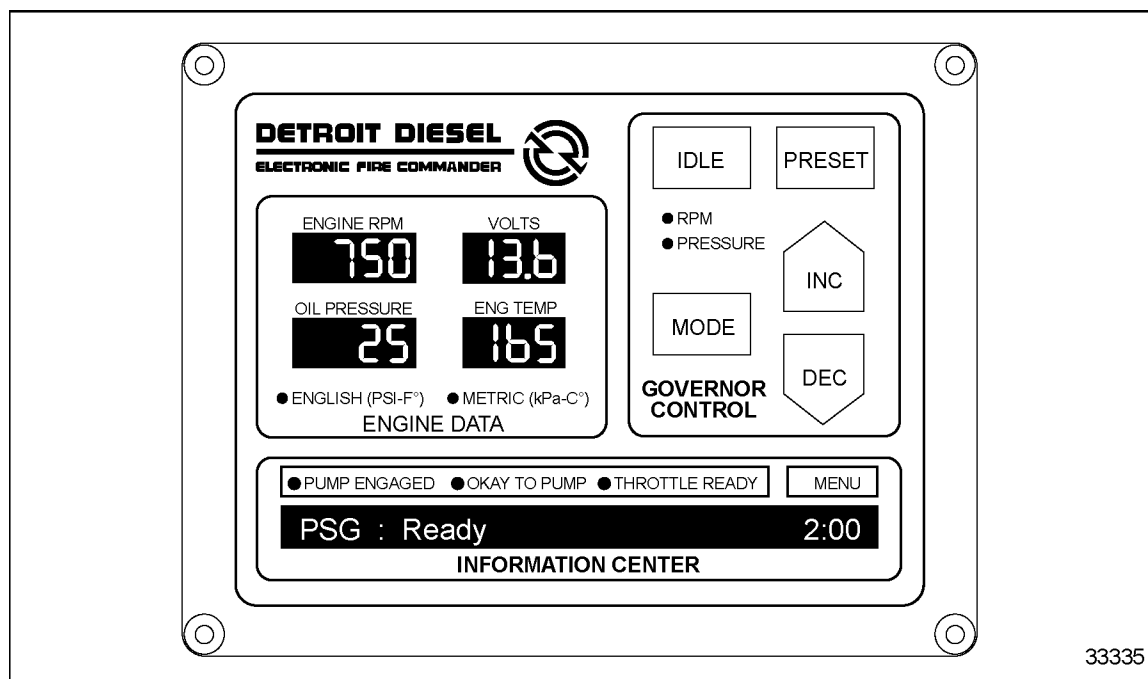


Figure 19-9 Electronic Fire Commander Panel Display

Some of the common troubles encountered during the installation and check out of the Electronic Fire Commander and suggested actions are listed in Table 19-18.

Condition	Action
EFC Will Not Light Up	Check that the necessary switches are turned on.
	Check that there is a 12 VDC between pins #1 and #2 at the EFC 4-pin connector, as listed in Table 19-19.
Throttle Will Not Increase In RPM Mode	Check that the THROTTLE READY lamp is on. The EFC will not respond in RPM mode unless the OEM safety interlock requirements that enable the throttle are met.
	Press the PRESET and then the INC buttons. Does the EFC indicate it is increasing RPM on the data display?
	Check the switch and outputs I/O test. (Accessed in the Information Center menu.)
	Re-initialize the EFC. (Remove power to the EFC; wait ten seconds and then power the unit and try again. The EFC performs a "self-test" when it is powered up. This is indicated on the EFC by a momentary lighting of all the display segments.)
Throttle Will Not Increase In Pressure Mode	Check that all three lamps: PUMP ENGAGED, OKAY TO PUMP, and THROTTLE READY are on.
	Press the INC and then the PRESET buttons to increase pump pressure.
	Check for a pump discharge pressure reading in the Menu.
	Re-initialize the EFC. (Remove power to the EFC; wait ten seconds and then power the unit and try again. The EFC performs a "self-test" when it is powered up. This is indicated on the EFC by a momentary lighting of all the display segments.)
Engine Data Display Is Showing All Zeroes	Check that the connections at pins #3 and #4 of the EFC 4-pin connector, as listed in Table 19-19, are secure.
	Check that there is continuity on the 900 and 901 circuits from the ECM/ECU connector to the EFC connector.
THROTTLE READY Lamp Will Not Turn On	Check that the parking brake is on.
	Check that the transmission is in neutral, or the hand throttle (PTO) is engaged.
	Check for 12 VDC at pin #2 of the EFC 12-pin connector as listed in Table 19-20.
	Check that all OEM safety requirements for pump operation are fulfilled. ☐ Is the parking brake on? ☐ Is the transmission in the proper range for pump operation? ☐ Is the hand throttle (PTO) engaged? ☐ Is there an OK to PUMP indication in the cab?
	Check for 12 VDC at pin #10 of the EFC 12-pin connector as listed in Table 19-20.
Mode Will Not Change From RPM to Pressure	Are the PUMP ENGAGED and OKAY TO PUMP lamps on?
	Does the MODE switch pass the I/O test? (Accessed in the Information Center menu.)
PRESET Button Doesn't Work	Check that the proper lamps are on for the mode you want to operate.
	Is there a valid preset programmed into the menu? If not, refer to section 19.14.1 and complete the steps given there.
	Does PRESET pass the I/O test? (Accessed in the Information Center menu.)

Table 19-18 Electronic Fire Commander Troubleshooting

EFC Connector Cavity	Circuit Description	ECM/ECU Circuit	EFC Input/Output
A1	DDEC Accessory Power	V-15	(+) System Power
A2	DDEC Accessory Ground	Batt (-)	(-) System Ground
A3	DDEC 1708 Data Link (+)	V-56	J1587 Serial Link
A4	DDEC 1708 Data Link (-)	V-57	J1587 Serial Link

Table 19-19 4-pin Connector, Deutsch DT06-4S, DDC P/N: 23512304

EFC Connector Cavity	Circuit Description	ECM/ECU Circuit *	EFC Input/Output
B1	DDEC PSG Mode Select	V-26	Output (ground) to DDEC
B2	OEM Interlock from OEM	—	Input (+12 VDC)
B3	Cavity plug	—	No connection
B4	DDEC PSG Mode	V-05	Input (ground) from DDEC
B5	DDEC PSG Enable	V-09	Output (ground) to DDEC
B6	DDEC PSG Increase	V-08	Output (ground) to DDEC
B7	DDEC PSG Decrease	V-47	Output (ground) to DDEC
B8	PSG Active	V-06	Input (ground) from DDEC
B9	Alarm	—	
B10	PTO Engaged	—	Input (+12 VDC) from OEM
B11	Cavity Plug	—	No connection
B12	Low fuel	—	

* DDC circuit numbers and port assignments shown are typical but can differ from application to application.

Table 19-20 12-pin Connector, Deutsch DT06-12S, DDC P/N: 23520825

19.14.1 PROGRAMMING THE ELECTRONIC FIRE COMMANDER

Program the EFC by selecting items from a menu. When the EFC is in Programming Mode only the Information Center lights will be visible.

To enter the programming menu:

1. Ensure the PTO/Pump is disengaged (i.e. 0 volts on pin B10 "PTO/Pump Engaged") and that engine speed is less than 900 RPM.
2. Press and hold the MODE and MENU buttons at the same time until "PRESS IDLE TO EXIT" is momentarily displayed on the Information Center, then release both buttons.
3. Scroll through the menu by pressing the MENU button.

4. Change a menu selection using the INC and DEC buttons.
5. Exit the programming menu in one of two ways:
 - [a] Press IDLE to exit the menu and save changes.
 - [b] Press MODE to exit the menu without saving changes.

19.14.2 EFC Programming Menu Options

As you scroll through the menu by repeatedly pressing the MENU button, the following items, listed in Table 19-21, will appear sequentially in the Information Center display.

Menu Item	Explanation	Programming	
		Button	Change
RPM Preset Point:	Preset Engine Speed	Incr/Decr	+/- 25 RPM
Pressure PRESet (PSI):	Preset PSI	Incr/Decr	+/- 25 PSI
Engine Hour meter:	Information Only	--	--
Pump Hour meter:	Information Only	--	--
Engine Temperature:	Oil or Coolant	Incr/Decr	Cycles options
Pump Pressure (PSI):	Pressure Reading if Active	--	--
DDEC Software Ver:	ECM/ECU Revision Level	--	--
EFC Software Ver:	EFC Revision Level	--	--
Fire Commander I/O Test:	Test Switches and Outputs	Any	--
Press [MODE] Test Lights:*	Tests Display Panel & Audible Alarm	Mode	--
Set Time Clock:	Set Clock	Incr/Decr	+/- 1 minute
Units of Measure:	English or Metric	Incr/Decr	Cycles options
Welcome Message:	Enable or Disable	Incr/Decr	Cycles options
Codes Currently Active:	Information Only	--	--
Connector Data:	Displays Connection Pinouts	Incr/Decr	Scroll fwd/back
SAVE? [Idle Y] [Mode N]	Exit and Save Options	--	--

* PUMP ENGAGED and THROTTLE READY will not illuminate.

Table 19-21 EFC Programming Options on Information Center Menu

19.15 OPTIMIZED IDLE FEATURE DOES NOT FUNCTION

The following procedure will troubleshoot Optimized Idle not functioning.

 WARNING:
PERSONAL INJURY
To avoid injury from accidental engine startup, replace a defective ECM with an ECM programmed with identical inputs and outputs.

NOTE:

If a replacement ECM/ECU is needed, replace the ECM/ECU with an ECM/ECU programmed with Optimized Idle.

 CAUTION:
UNEXPECTED ENGINE START
To avoid injury from an unexpected startup of an engine equipped with the Optimized Idle system, remove the starter relay from the relay holder.

19.15.1 Check Diagnostic Data Reader for Codes

Perform the following steps to check the DDR for codes.

1. Plug DDR into connector.
2. Turn ignition ON.
3. Check the active and inactive codes for any Optimized Idle codes.
4. Turn ignition OFF.

NOTE:

Service any code first.

- [a] If an Optimized Idle code 62, 63, or 74 is logged, go to the appropriate flash code section, based on Optimized Idle code logged.
- [b] If an Optimized Idle code 62, 63 or 74 is not logged, refer to section 19.15.2.

19.15.2 Heater and Air Conditioning Fans Do Not Function

Perform the following steps to troubleshoot the heater and A/C fans.

1. Check the heater and A/C blower fuse.
2. Turn ignition ON.
3. Plug in DDR.
4. Check the vehicle power down relay switch. Select switch light status (VEH PWR DOWN).
 - [a] If the output status reads ON, check the relay and relay connections for proper operation. Refer to section 19.15.3.
 - [b] If the output status does not read ON, install a test ECM/ECU. Refer to section 19.15.9.1.

19.15.3 Check Optimized Idle Active Light

The Optimized Idle active light should flash when all of the following occur:

1. Engine idling.
2. The transmission is in NEUTRAL and high-range, if equipped.
3. The hood is closed and the park brake is set.
4. The cruise switch is turned ON.
 - [a] If the active light is not flashing, refer to section 19.15.4.
 - [b] If the light is flashing, after the engine shuts down, turn the thermostat on. When the light flashes, if the alarm turns ON and the engine starts, the system is OK.
 - [c] If the light is flashing, after the engine shuts down, turn the thermostat on. When the light flashes, if the alarm does not turn ON and the engine does not start, refer to section 19.15.9 and go to step 4.

19.15.4 Check Idle Condition

Perform the following steps to troubleshoot Optimized Idle:

1. Check idle condition.
2. Verify the engine is at idle and not running on VSG. Optimized idle will not function if the engine is running on VSG, unless the idle timer is enabled on VSG.
 - [a] If the engine is not at idle, turn off the ISD on the VSG. Refer to section 19.15.9.1.
 - [b] If the engine is at idle, refer to section 19.15.5.

19.15.5 Check Idle Shutdown Enabled

Perform the following steps to troubleshoot Optimized Idle:

1. Check for idle shutdown enabled.
2. Using the DDR, view the calibration.
 - [a] If idle shutdown is not enabled, enable the idle shutdown and set a shutdown time. Refer to section 19.15.9.1.
 - [b] If the idle shutdown is enabled, refer to section 19.15.6.

19.15.6 Check Input Status

Perform the following steps to troubleshoot Optimized Idle:

1. Check for input status.
2. Using the DDR, check the park brake input status with the hood closed, the transmission in NEUTRAL (and high-range if equipped) and the park brake set.
 - [a] If the park brake status is ON, refer to section 19.15.9.
 - [b] If the park brake status is not ON, refer to section 19.15.7.

19.15.7 Check Hood Switch

Perform the following steps to troubleshoot the hood switch:

1. Check hood switch.
2. Measure the resistance across the hood switch contacts with the hood closed. See Figure 19-10.
 - [a] If the resistance measures less than 100 Ω , refer to section 19.15.8.

- [b] If the resistance measures greater than 100 Ω , replace or adjust the hood switch.
Refer to section 19.15.9.1.

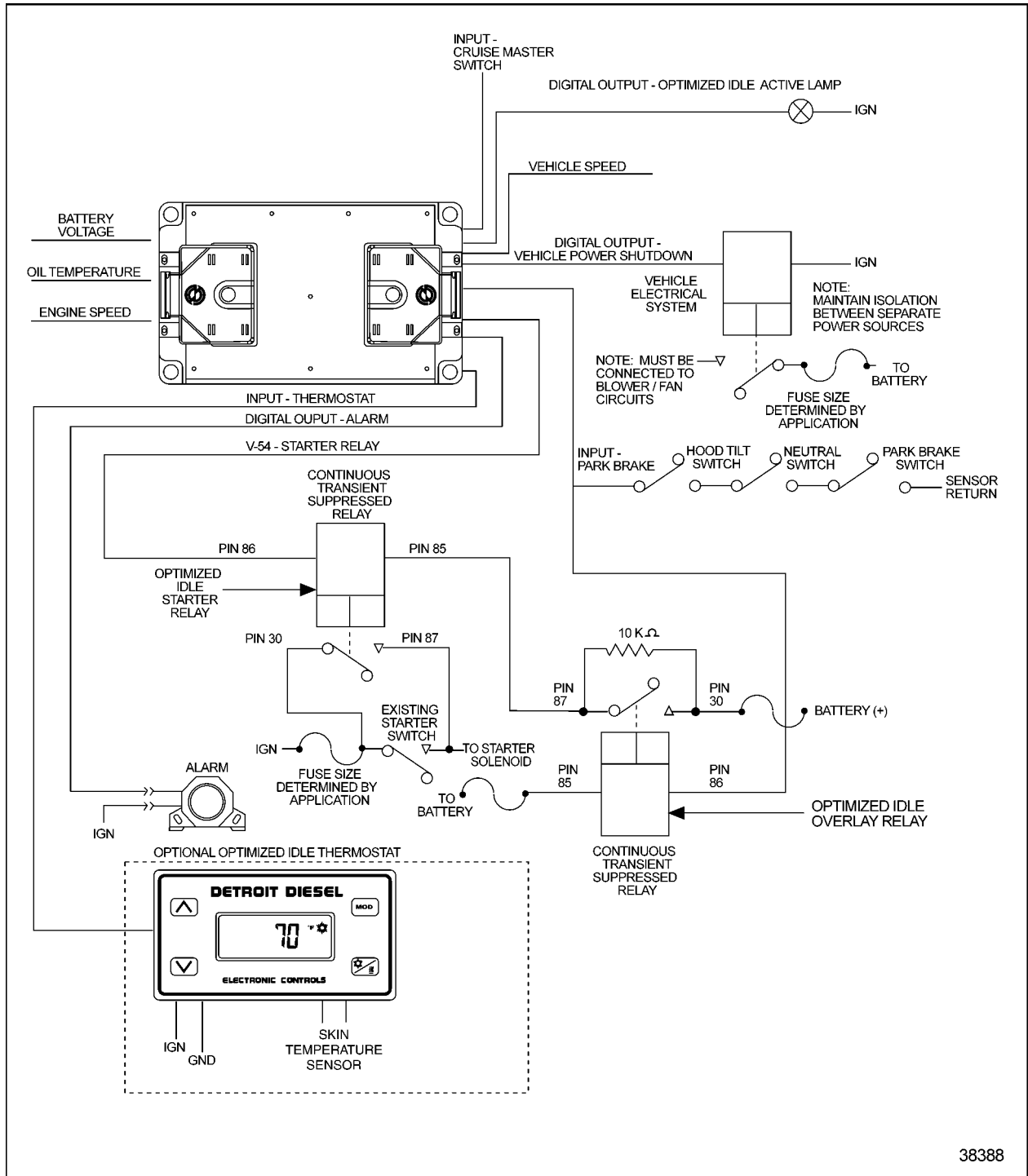


Figure 19-10 Optimized Idle Schematic

19.15.8 Check Park Brake Switch

Perform the following steps to troubleshoot the park brake switch and other OEM interlock devices.

1. Check the park brake switch and other OEM interlock devices (e.g. high-range switch).
2. Measure resistance across the park brake switch contacts with the park brake set.
 - [a] If the measured resistance is less than 100 Ω , the V-63 ground wire is open somewhere between the ECM/ECU and the switch. Repair the open. Refer to section 19.15.9.1.
 - [b] If the measured resistance is more than 100 Ω , replace the park brake switch or other OEM interlock devices. Refer to section 19.15.9.1.

19.15.9 Check the Thermostat

Perform the following steps to check the thermostat operation:

1. Turn ignition ON.
2. Plug in the DDR.
3. Select switch light status OPIDL T-STAT.
 - [a] If the display reads ON with the thermostat enabled and the alarm is turned ON and the reader shows the switch status for the starter as ON after the alarm turns OFF, check the relay and starter solenoid connections. Refer to section 19.15.9.1.
 - [b] If the display reads ON with the thermostat enabled and the alarm is turned ON and the reader does not show the switch status for the starter as ON after the alarm turns OFF, go to step 4.
 - [c] If the display reads ON with the thermostat enabled and the alarm OFF, replace the alarm. Refer to section 19.15.9.1.
 - [d] If the display does not read ON with the thermostat enabled, the thermostat input wire V-42 is open between the thermostat and the ECM/ECU. Repair the open. Refer to section 19.15.9.1.
4. Check the OTS/EOT Sensor connection.
 - [a] If the OTS/EOT Sensor connector is plugged into the oil temperature sensor, reprogram the ECM/ECU. Refer to section 19.15.9.1.
 - [b] If the OTS/EOT Sensor connector is not plugged into the OTS/EOT Sensor, plug in the OTS/EOT Sensor connector. Refer to section 19.15.9.1.

19.15.9.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Close the hood; set the park brake; put the transmission in NEUTRAL and the high-range, if equipped.
4. Start the engine.
5. Turn the cruise master switch to the ON position. If it was on before the vehicle started, turn the switch to OFF and then to ON.
6. Wait for the engine to shut down. After the idle timer expires, the engine will either shutdown or continue to run to charge the battery or keep the oil temperature between 60°F (16°C) and 104°F (40°C).
7. Turn the thermostat on, if installed. Change the set point and heating/cooling mode until the thermostat requires the engine to start. The icons will flash. If the thermostat is not installed, wait for the lube oil temperature to fall below 60°F (16°C).
8. The alarm will sound and the engine will start. Vehicle power (blower fans) will turn on approximately 30 seconds after the engine starts, due to the thermostat.
 - [a] If Optimized Idle operates properly, troubleshooting is complete.
 - [b] If Optimized Idle does not operate properly, troubleshooting is complete. Review this section from the first step to find the error. Refer to section 19.15.1.

19.16 TRANSMISSION INTERFACE FAULT

Numerous transmissions utilize the DDEC ECM/ECU to receive signals that are used to determine shift points, and/or other information.

Transmissions that currently utilize data links:

- J1587 - Allison World Transmissions
- J1939 Eaton, Allison
- Advanced Interface
- ESS TM, Rockwell - Refer to ESS Troubleshooting Manual
- Top2, Eaton - Refer to MISC Output Troubleshooting
- PWM Signal Type - DDEC provides a PWM signal that is used by the transmission or its components

19.16.1 Verify Transmission Type

Perform the following steps to check the transmission type.

1. Turn ignition ON and plug in the DDR.
2. Check transmission origination.
 - [a] If a manual transmission, Allison hydraulic, Allison Electronic, Voith, ZF, refer to section 19.16.2.
 - [b] If a J1939/autoshift, Allison WT, Rockwell RXX-X, refer to the troubleshooting manual of the transmission manufacturer to troubleshoot the fault.
 - [c] If the transmission type does not match the transmission correctly, reprogram and refer to section 19.16.2.1.

19.16.2 Review PWM #1 Signal

Perform the following steps to check the DDR for codes.

1. Perform road test with assistant.
2. Plug in DDR.
3. Watch PWM #1 signal.
 - [a] If the PWM varies with the load changes, and the ECM/ECU is programmed as Allison® Electric, Voith or ZF, the signal is normal. Review the wiring or transmission.
 - [b] If the PWM signal is 0% or 100% when the signal is programmed for Allison Hydraulic with load changes, the program is normal. Review the transmission, wiring or relay. Refer to section 19.16.2.1.

19.16.2.1 Verify Repairs

Perform the following steps to verify repairs. Start with the Menu Selection. An assistant is needed for the following procedure.

1. Perform road test.
2. Is the problem resolved?
 - [a] If YES, troubleshooting is complete.
 - [b] If NO, contact the OEM or transmission supplier. The steps that led you here do not indicate a problem with the PWM #2 output or output wire. Verify the correct configuration.

19.17 MAINTENANCE ALERT SYSTEM

The following procedures will troubleshoot the Maintenance Alert System (MAS).

19.17.1 Maintenance Alert System Troubleshooting

The following procedures will troubleshoot a Maintenance Alert System (MAS) display problem. Listed in Table 19-22 are typical faults.

Fault	Typical Fault	Refer to
No lights, blank display.	Loss of power to display module	Refer to section 19.17.2
All red LEDs flashing.	Data link wire fault	Refer to section 19.17.3
Single item LED blank.	Sensor fault Refer to sensor troubleshooting.	Refer to section 19.17.6

Table 19-22 Maintenance Alert System Faults

19.17.2 Checking for Power to Display

Perform the following steps to check for power to the display:

1. Unplug MAS display harness.
2. Check connectors for bent, corroded, or unseated pins.
 - [a] If connectors are bent, corroded or otherwise damaged, replace them and test the operation.
 - [b] If connectors are in good condition, continue the inspection.
3. Turn the ignition ON.
4. Measure the voltage between cavity A ground and cavity C (V-15) ignition. See Figure 19-11.
 - [a] If voltage is less than 10.5 volts, determine the reason for low voltage. Refer to OEM guidelines. One possibility is a battery fault.

[b] If voltage is greater than 10.5 volts, refer to Step 5.

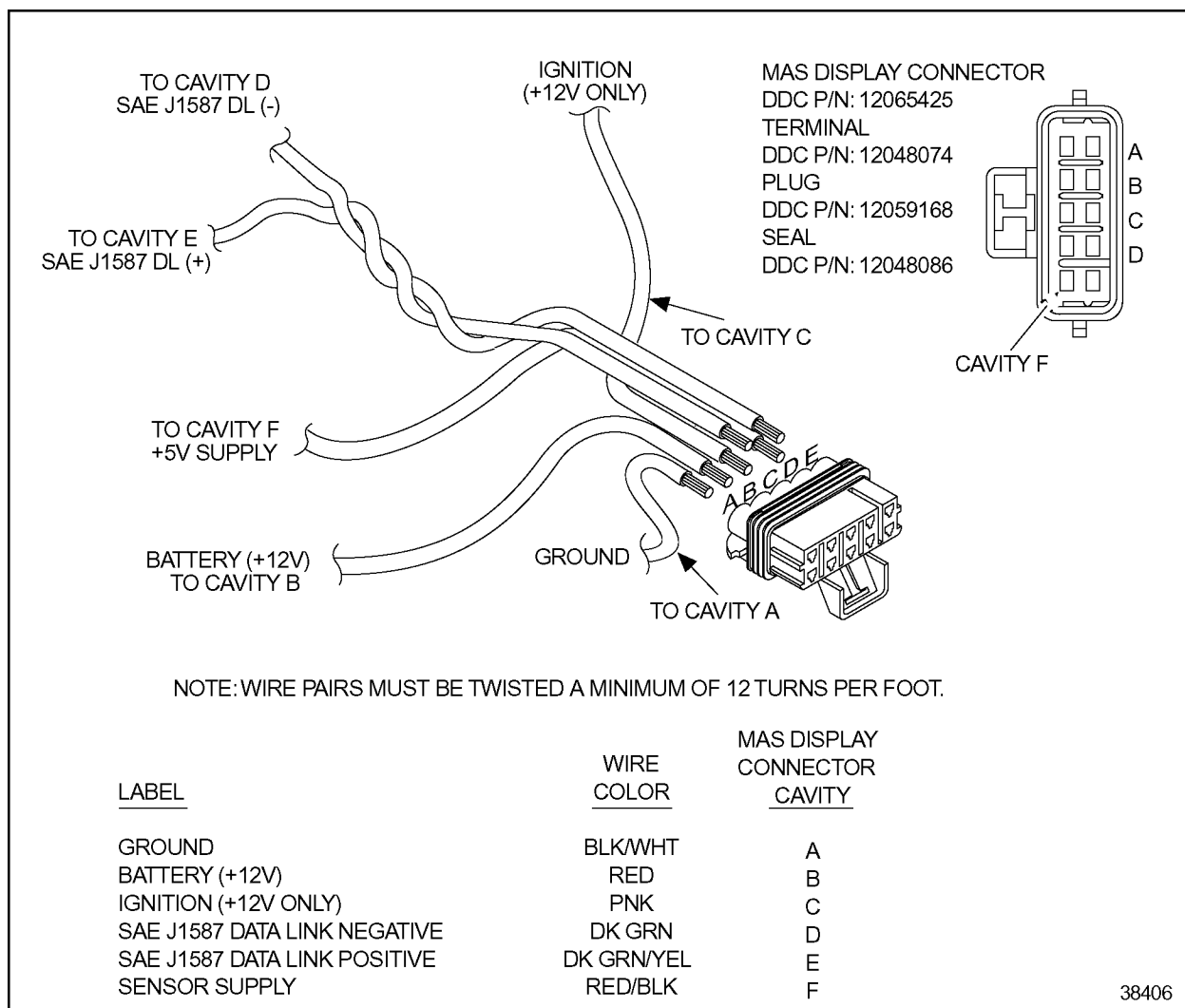


Figure 19-11 MAS Display Harness

5. Measure voltage between cavity A ground and cavity B, battery (+). See Figure 19-11.

- [a] If the measured voltage is less than 10.5 volts, charge the batteries or check for bad 12 volt wire. Refer to section 19.17.6.1.
- [b] If the voltage is greater than 10.5 volts, replace the display; verify repair. Refer to section 19.17.6.1.

19.17.3 Check for Open Data Link Wires

Perform the following steps to check for open data link wires:

1. Unplug the MAS display harness connector at the display.
2. Insert a jumper wire between cavity E (DL+) and cavity D (DL-). See Figure 19-11.

3. Unplug the vehicle interface harness at the ECM/ECU.
4. Measure resistance between cavity V-56 and V-57 of the vehicle interface harness connector. See Figure 19-12.

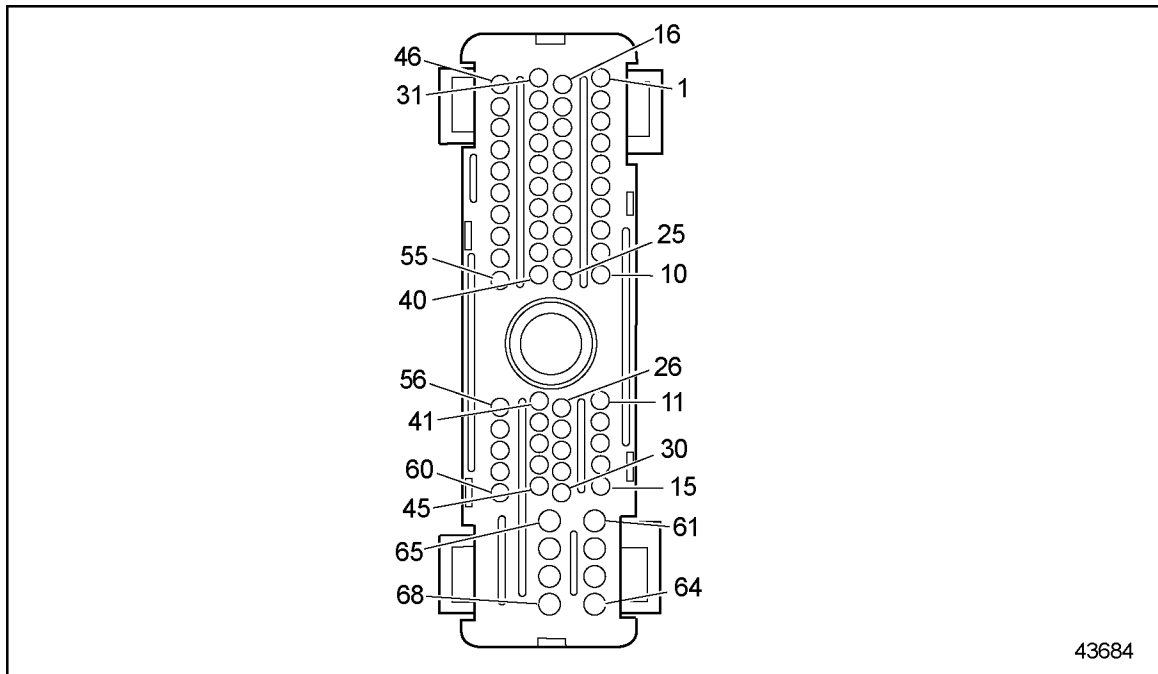


Figure 19-12 ECM/ECU Vehicle Harness Connector

- [a] If measured resistance is greater than 10 Ω , one of the data link wires are open. Locate the open and repair or replace the wire; then test. Refer to section 19.17.6.1.
- [b] If measured resistance is less than 10 Ω , proceed with the troubleshooting. Refer to section 19.17.4.

19.17.4 Check for Shorted Data Link

Perform the following steps to check for shorted data link wires:

1. Remove jumper wire.
2. Measure resistance between cavity V-56 and V-57 of the vehicle interface harness connector. See Figure 19-12.
 - [a] If the measured resistance is less than 10 Ω , the data link wires are shorted to each other. Replace wire or repair the short; test. Refer to section 19.17.6.1.
 - [b] If the measured resistance is greater than 10 Ω , proceed with the troubleshooting. Refer to section 19.17.5.

19.17.5 Check for Short to Ignition

Perform the following steps to check for a short to the ignition:

1. Measure resistance between cavity V-15 and V-57. Measure again between cavity V-15 and V-56. See Figure 19-12.
 - [a] If any of the readings are less than 10 Ω , that wire is shorted to the ignition wire where the reading was recorded. Repair the short; replace the wire; then test. Refer to section 19.17.6.1.
 - [b] If both readings are less than 10 Ω , replace the MAS display and test. Refer to section 19.17.6.1.

19.17.6 Information

A blank LED for an item indicates a fault in the sensor used for that display. If all lights (green and red) illuminate during the bulb check sequence, refer to the affected sensor troubleshooting section.

19.17.6.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition ON.
2. Observe the MAS display.
 - [a] If MAS display operates correctly, troubleshooting is complete.
 - [b] If MAS display does not operate correctly, repeat the checks. Refer to section 19.17.2.

19.18 EXHAUST GAS RECIRCULATION SYSTEM BASIC CHECKS FOR SERIES 60 ENGINES

For all EGR related concerns (may include exhaust smoke complaints) and Code 39 etc., perform the following steps. If any corrections are made as a result of these checks, test the unit again before proceeding further:

Basic checks for all Series 60 EGR engines require the following tools:

- ☐ 1,000 Ohm resistor (low watt)
- ☐ DDR suite 9 or DDDL version 6.0 or higher
- ☐ Volt Ohm Meter
- ☐ Pressure gage 0–200 psi (0-1378 kPa)
- ☐ Pressure gage 0–100 psi (0-689 kPa)
- ☐ Regulated shop air pressure (10 psi)

19.18.1 Check EGR Controls

Perform the following steps to check the EGR system components.

1. Turn ignition ON.
2. Plug in DDR/DDDL.
3. Any EGR Related codes (except Flash Code 39)?
 - [a] If codes were logged, troubleshoot the codes as necessary.
 - [b] If no codes were logged (besides Code 39), proceed to step 4.
4. Inspect system for any air leaks in the exhaust, EGR, or intake system (including charge-air-cooler).
 - [a] If leaks were detected, repair as necessary.
 - [b] If no leaks are present, go to step 5.
5. Check Delta P Counts on DDR/DDDL (counts should be between 86 and 135).

NOTE:

The ignition is set to the ON position and the engine is not running.

- [a] If the counts were between 86 and 135, refer to section 19.18.2.
- [b] If the counts were not between 86 and 135, replace the Delta P Sensor and refer to section 19.18.7.1.

19.18.2 Check VPOD Input Pressure

Follow these steps to check VPOD input pressure:

1. Measure the vehicle air supply pressure to VPOD input pressure to port 1; ensure it is between 102 – 188 psi. (703 – 1296 kPa).

- [a] If the supply pressure is not between 102 – 188 psi (703 – 1296 kPa), troubleshoot the vehicle air system until that result is obtained.
- [b] If the supply pressure is between 102 – 188 psi (703 – 1296 kPa), refer to section 19.18.3.

19.18.3 Check VPOD Output Pressure

Follow these steps to check VPOD output pressure:

1. Disconnect the air hose from the VNT (Variable Nozzle Turbocharger) actuator.
2. Install a 100 psi pressure gauge (accurate to within 1.4 kPa [0.2 psi]) at the outlet of the VNT hose.
3. Using the DDR/DDDL, activate cavity E-4 (VNT) duty cycle and monitor the output pressure from the VPOD.
4. Test: Activate the cavity to 50 % duty cycle: Pressure = 310 ± 14 kPa (45 ± 2 psi).
 - [a] If the VPOD readings are as listed above, refer to section 19.18.6.
 - [b] If the results in this step cannot be attained, or if the VPOD leaks when activated replace the VPOD.
 - [c] If the VPOD has been replaced, refer to section 19.18.4.

19.18.4 Check VPOD Supply Voltage

The following checks should be performed for the VPOD supply voltage:

1. Check VPOD label to determine if it is + 12V or + 24V compatible.
2. Unplug VPOD mating connector. A 1,000 Ohm resistor is needed for the next step. Insert the resistor between cavity 1 and 3 for ease of checking with the VOM.

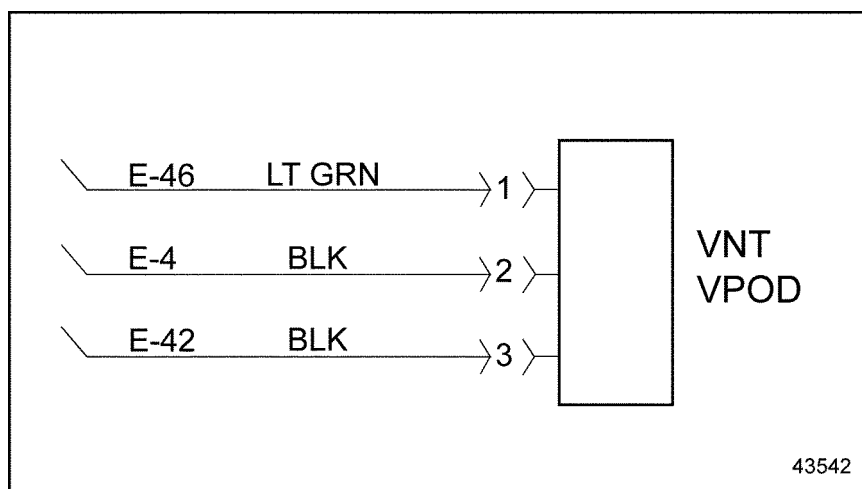


Figure 19-13 VNT/VPOD Schematic

- [a] Turn ignition switch ON.
- [b] Measure system voltage from pin 3 to pin 1. See Figure 19-13.
- [c] Plug in DDR and check ECM/ECU voltage.
- 3. Is the VPOD supply voltage, and ECM/ECU voltage correct?
 - [a] If the VPOD and system voltage are correct, refer to section 19.18.5.
 - [b] If the VPOD supply voltage and ECM/ECU voltage are not correct, contact the Detroit Diesel Customer Support Center (313-592-5800).

19.18.5 Check VPOD Wiring

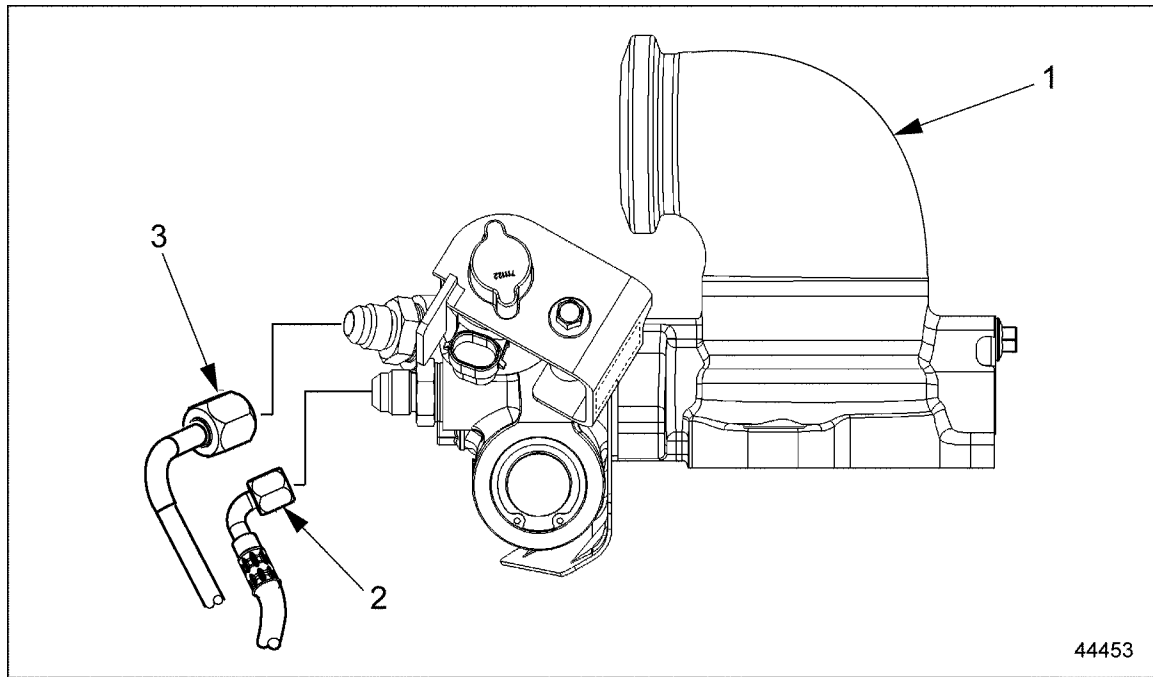
The following checks should be performed for the VPOD wiring.

1. Turn ignition switch ON.
2. Unplug the VPOD mating connector.
3. Insert a 1,000 ohm resistor between cavities #2 and #1 for the 12V version, or cavities #2 and #3 for the 24V version.
4. Connect a VOM to the VPOD connector between pin #2 and pin #3 for the 12V VPOD or pin #2 and pin #1 for the 24V VPOD.
5. Using either a DDR or DDDL, activate the VPOD used for the VNT. Ensure activating 50% duty cycle: The reading should be = 50% of the VPOD supply voltage $\pm$ 1 volt, The acceptable range will depend on the supply system voltage (e.g. voltage to VPOD = 13.8V * 0.5 = 6.9V; therefore 5.9V to 7.9V at PWM is okay.)
6. Note any air leakage when PWMs are activated to 90% and correct the leaks as needed.
 - [a] If the voltage measurements is correct, replace the VPOD.
 - [b] If the voltage measurement are incorrect, and the wiring checks are okay, try a test ECM/ECU programmed for EGR, or contact the Detroit Diesel Customer Support Center (313-592-5800).

19.18.6 Check EGR Valve

Perform the following steps to check the EGR Valve.

1. Disconnect the oil supply from the EGR valve actuator. Connect shop air to the actuator and regulate the pressure at 10 psi to the EGR actuator.



1. EGR Valve and Actuator Assembly	3. Oil Outlet Hose and Fitting
2. Oil Inlet Hose and Fitting	

Figure 19-14 EGR Valve Assembly with Oil Lines

2. Plug in the DDDL.
3. Activate the EGR Valve output (E-1) and observe the EGR Valve travel (close 0% – open 100%).

NOTE:

Do not activate more than 3 cycles.

4. Visually inspect the EGR Valve for proper movement.
5. Did the EGR Valve close (0%) when activated?
 - [a] If the EGR Valve was fully closed at 0%, refer to section 19.18.7.
 - [b] If the EGR Valve did not fully close at 0%, replace the EGR Valve. Refer to section 19.18.7.1.
6. Did the EGR Valve open (100%) when activated?
 - [a] If the EGR Valve was fully opened at 100%, refer to section 19.18.7.

- [b] If the EGR Valve did not fully open to 100%, replace the EGR Valve. Refer to section 19.18.7.1.

19.18.7 Check for Active Codes

Follow this procedure to check for active codes.

1. Turn ignition ON.
2. Plug in DDR/DDDL.
3. Read active codes.
4. Record or print codes. Ensure that PID, SID, and FMI are recorded. Refer to the proper code section of this guide to troubleshoot that code.

NOTE:

FMIs listed as 14 are diagnostic information codes and no troubleshooting is required. For example, an engine derates due to high TCO temperature; a 404/14 code will be stored. This would indicate that conditions warranted having the ECM/ECU derate the fueling to the engine. If the customer complaint was a power loss, it could be explained that loss of power was done by the ECM/ECU to protect other engine components.

5. If the issue is not related to the EGR system components, or assistance is needed, contact Detroit Diesel Customer Service Center (313-592-5800).

19.18.7.1 Test

Follow these steps to test:

1. Reassemble connectors or components.
2. Start and run the engine.
3. Perform loaded road test if this is necessary to duplicate original complaint.
 - [a] If symptoms/codes are gone, repairs are complete.
 - [b] If any codes display, review this section again; contact Detroit Diesel Customer Service Center (313-592-5800).

20 FLASH CODE 11 - VSG VOLTAGE LOW

Section	Page
20.1 DESCRIPTION OF FLASH CODE 11	20-3
20.2 TROUBLESHOOTING FLASH CODE 11, PID 187/FMI 4	20-3

20.1 DESCRIPTION OF FLASH CODE 11

The SAE J1587 equivalent code for Flash Code 11 is p 187/4, Variable Speed Governor (VSG) input low.

Flash Code 11 indicates that the VSG input to the ECM/ECU has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

20.2 TROUBLESHOOTING FLASH CODE 11, PID 187/FMI 4

This diagnostic condition is typically:

- ☐ Open sensor signal circuit (No VSG throttle control installed.)
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to the sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to sensor return circuit or to ground (This condition will result in numerous sensor codes.)

The following procedure will troubleshoot Flash Code 11.

20.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON and plug in your diagnostic tool.
2. Read active codes.
 - [a] If code p 187/4 is logged and there are no VSG controls used, call DDC with the engine serial number to determine if re-calibration is necessary.
 - [b] If code p 187/4 was logged and there are VSG controls used primarily, refer to section 20.2.2.
 - [c] If codes p 100/4 and p 91/4 were logged, refer to section 77.1.

20.2.2 Sensor Wiring Check

Perform the following steps to check the sensor and wiring:

1. Turn ignition OFF and disconnect VSG throttle sensor connector.
2. Install a jumper wire between sockets V-14 and V-11 of the VIH connector. See Figure 20-1.

NOTE:

Cavities of throttle controls may vary depending on the OEM.

3. Turn ignition ON.

4. Enable VSG throttle. Refer to OEM guidelines.

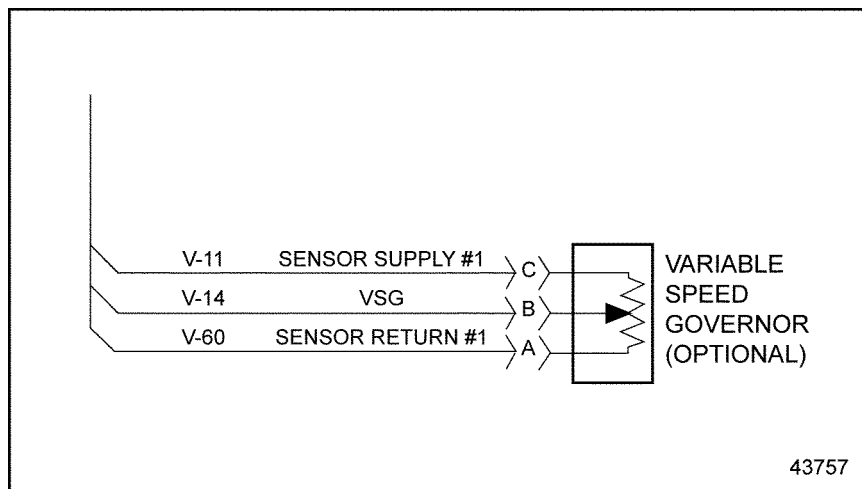


Figure 20-1 Variable Speed Governor Circuit

5. Read diagnostic tool for active codes.
 - [a] If active code p 187/3 and any other codes are logged, refer to section 20.2.3.
 - [b] If active code p 187/4 and any other codes are logged, refer to section 20.2.6.

20.2.3 Check Hand Throttle Sensor Adjustment

Perform the following steps to check the hand throttle sensor:

1. Remove jumper and reconnect hand throttle sensor.
2. Turn ignition ON and plug in the diagnostic tool.
3. Select VSG COUNTS on the diagnostic tool.
4. Enable VSG. Set to idle position.
5. Read the counts.
 - [a] If the count value set at idle (minimum throttle) is greater than 48 counts, refer to section 20.2.5.
 - [b] If the count value set at idle (minimum throttle) is less than 48 counts, refer to section 20.2.4.

20.2.4 Adjust Hand Throttle Sensor

Perform the following steps to adjust the hand throttle sensor:

1. Turn ignition OFF.
2. If a variable hand throttle sensor is installed, adjust idle position (low-speed) stops on the hand throttle sensor.

3. If fixed resistors are installed, replace with new resistors. (Minimum counts MUST be greater than 48.)
4. Turn ignition ON.
5. Read VSG counts with throttle at low-speed position.
 - [a] If the idle count reading is greater than 48 counts, refer to section 20.2.10.1.
 - [b] If the idle count reading is less than 48 counts, refer to section 20.2.5.

20.2.5 Check Hand Throttle Sensor Connectors

Perform the following steps to check the hand throttle sensor connectors.

1. Turn ignition OFF.
2. Inspect the terminals at the hand throttle sensor connectors (sensor side and harness side) for bent, corroded and unseated pins or sockets. See Figure 20-1.
 - [a] If the terminals and connectors are not damaged, replace hand throttle sensor. Refer to section 20.2.10.1.
 - [b] If the terminals and connectors are damaged, repair as necessary. Refer to section 20.2.10.1.

20.2.6 Check for +5 volts

Perform the following steps to check for +5 volts:

1. Turn ignition ON.
2. Enable VSG. Refer to OEM guidelines.
3. Measure voltage on the hand throttle sensor harness connector, socket V-11 to socket V-60.
 - [a] If the voltage reading is between 4 to 6 volts, refer to section 20.2.7.
 - [b] If the voltage reading is greater than 6 volts, 21.1.
 - [c] If the voltage reading is less than 4 volts, refer to section 20.2.9.

20.2.7 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Enable VSG. Refer to OEM guidelines.
4. Measure resistance between sockets A (V-60) and B (V-14) on the hand throttle sensor harness connector. For VSG circuit, see Figure 20-2.
 - [a] If the resistance is greater than 1,000 Ω or open, refer to section 20.2.8.

- [b] If the resistance is less than or equal to 1,000 Ω , the signal line #525 is shorted to the return line. Repair the short. Refer to section 20.2.10.1.

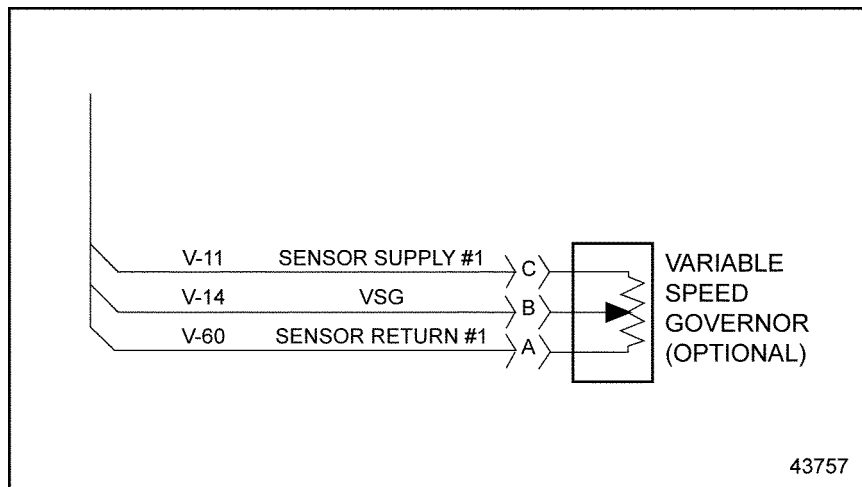


Figure 20-2 Variable Speed Governor Circuit

20.2.8 Check for Open Signal

Perform the following steps to check for open signal:

1. Install a jumper wire between sockets A and B of the hand throttle sensor harness connector. See Figure 20-2.
2. Enable VSG. Refer to OEM guidelines.
3. Measure resistance between sockets V-14 and V-60 on the vehicle harness connector.
 - [a] If the resistance is less than or equal to 5 Ω , go to step 4.
 - [b] If the resistance is greater than 5 Ω or open and the signal line V-14 or return line V-60 is open, repair the open. Refer to section 20.2.10.1.
4. Check terminals at the ECM/ECU vehicle harness connector (both the ECM/ECU and harness side) for bent, corroded, and unseated pins or sockets. See Figure 20-4.
 - [a] If the terminals and connectors are damaged, repair the terminals, connectors, or both. Refer to section 20.2.10.1.
 - [b] If the terminals and connectors are not damaged, contact DDC Customer Support Center (313-592-5800). Refer to section 20.2.10.1.

20.2.9 Check for Short to 5 Volt

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.

3. Disconnect the connector at the hand throttle sensor.
4. Measure resistance between sockets A and C on the hand throttle sensor harness connector. See Figure 20-3.
 - [a] If the resistance measurement is greater than 1,000 Ω , refer to section 20.2.10.
 - [b] If the resistance measurement is less than or equal to 1,000 Ω , the vehicle +5 volt line V-11 is shorted to the return line V-60. Repair short. Refer to section 20.2.10.1.

20.2.10 Check for Open +5 Volt Line

Perform the following steps to check for an open +5 volt line.

1. Install a jumper wire between sockets A and C of the hand throttle sensor harness connector. See Figure 20-3.

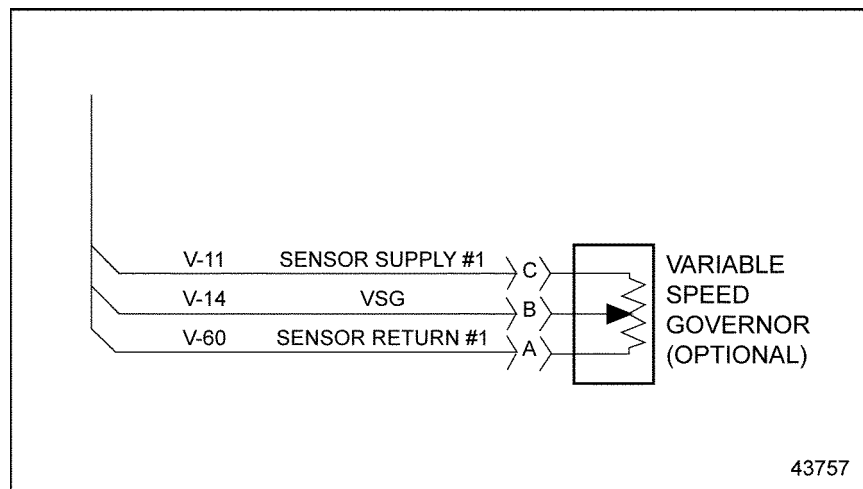


Figure 20-3 Variable Speed Governor Circuit

2. Measure resistance between sockets V-11 and V-60 on the vehicle connector.
 - [a] If the resistance measurement is less than or equal to 5 Ω , go to step 3.
 - [b] If the resistance measurement is greater than 5 Ω , or open, the vehicle +5 volt line (#916) is open. Repair open. Refer to section 20.2.10.1.

3. Check terminals at the ECM/ECU vehicle harness connector (both the ECM/ECU and harness side) for bent, corroded, and unseated pins or sockets. See Figure 20-4.

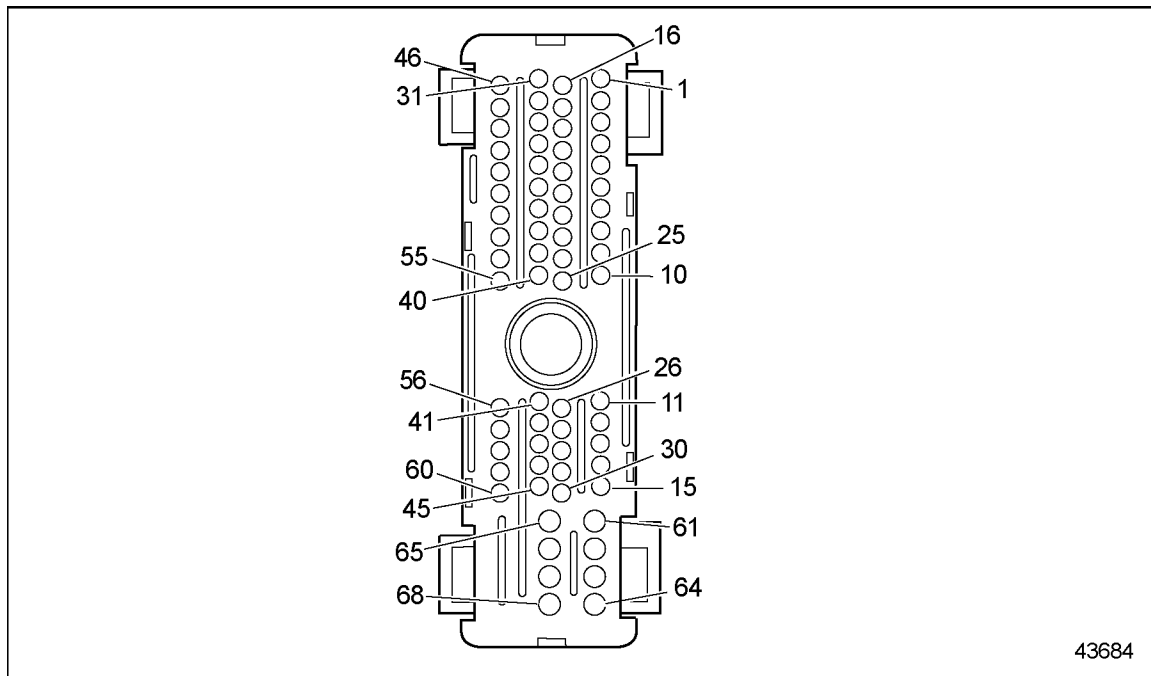


Figure 20-4 Electronic Control Unit/Vehicle Harness Connector

- [a] If the terminals and connectors are damaged, repair the terminals, connectors, or both. Refer to section 20.2.10.1.
- [b] If the terminals and connectors are not damaged, contact DDC Customer Support Center (313-592-5800). Refer to section 20.2.10.1.

20.2.10.1 Verify Repair

Perform the following steps to verify repairs:

1. Turn ignition OFF. Reconnect all connectors.
2. Turn ignition ON and clear codes.
3. Start and run the engine for one minute.
4. Stop the engine and check for logged codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code p 187/4 is not logged, and other codes are logged, refer to section 17.3.
 - [c] If code p 187/4 is logged, and other codes are logged, review this section again. Refer to section 20.2.1. If the code is still logged, call the DDC Customer Support Center (313-592-5800).

21 FLASH CODE 12 - VSG HIGH

Section	Page
21.1 DESCRIPTION OF FLASH CODE 12	21-3
21.2 TROUBLESHOOTING FLASH CODE 12, PID 187/FMI 3	21-3

21.1 DESCRIPTION OF FLASH CODE 12

The SAE J1587 equivalent code for Flash Code 12 is p 187/3, Variable Speed Governor (VSG) input high.

Flash Code 12 indicates that the Variable Speed Governor (VSG) input to the ECM/ECU has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

21.2 TROUBLESHOOTING FLASH CODE 12, PID 187/FMI 3

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply
- ☐ Throttle sensor not adjusted properly at full throttle

The following procedure will troubleshoot Flash Code 12.

21.2.1 Multiple Code Check

Perform the following steps to check for multiple codes:

1. Turn ignition ON.
2. Plug in your diagnostic tool.
 - [a] If active code p 187/3 and any other codes except 91/3 or 100/3 are logged, refer to section 21.2.2.
 - [b] If active code p 187/3 and codes p 91/3 or p 100/3 are logged, refer to section 77.1.

21.2.2 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
2. Unplug the VSG throttle connector. (For VSG circuit, see Figure 21-1.)
3. Turn ignition ON.
4. Read active codes.
 - [a] If active code p 187/4 is logged, and code p 187/3 only occurs when the throttle is moved at or near full throttle (when connected), refer to section 21.2.3.

- [b] If active code p 187/3 is logged, and the code appears when the throttle is not at or near full throttle (when connected), refer to section 21.2.4.

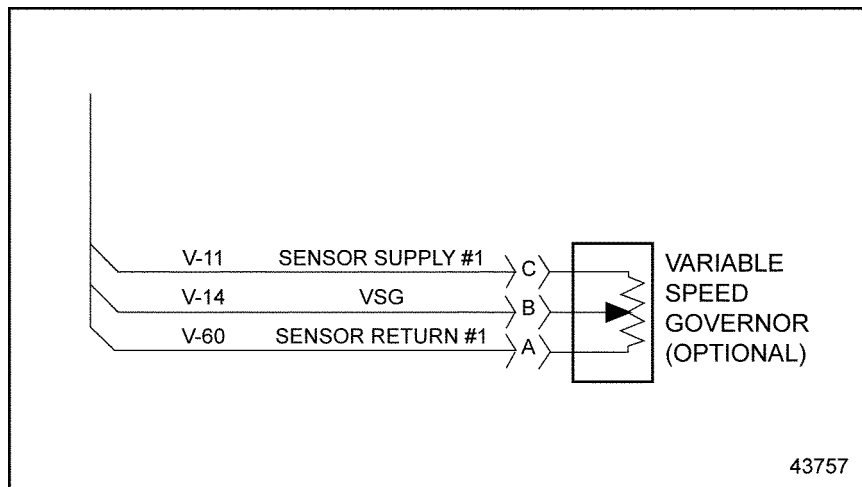


Figure 21-1 Variable Speed Governor Circuit

21.2.3 Check Calibration

Perform these additional steps to check the calibration of the sensor:

1. Plug in the VSG throttle connector.
2. Turn ignition ON.
3. Plug in the diagnostic tool.
4. Display VSG counts.
5. Dial throttle to Full Throttle.

- [a] If the VSG counts are greater than 968, adjust the maximum throttle travel. If not adjustable, replace the throttle control.
- [b] If the VSG counts are less than 968, refer to section 21.2.4.

21.2.4 Return Circuit Check

Perform these steps to check the return circuit:

1. Place the transmission in neutral.
2. Turn ignition OFF.
3. Install a jumper wire between pin A (V-60) and pin B (V-14) of the VSG throttle harness connector.
4. Disconnect the vehicle harness connector at the ECM/ECU.
5. Enable VSG control. (This may require the ignition be turned on.)

6. Measure resistance between sockets V-60 and V-14 on the vehicle harness connector. See Figure 21-2.
 - [a] If the resistance is less than or equal to 5 Ω , go to step 7.
 - [b] If the resistance is greater than 5 Ω , the return line V-60 is open, repair the open. Refer to section 21.2.6.1.
7. Inspect terminals at the VSG connectors (sensor side and harness side) for bent, corroded and unseated pins or sockets. See Figure 21-2.
 - [a] If the VSG connector terminals are damaged, repair terminals and/or connectors. Refer to section 21.2.6.1.
 - [b] If the VSG connector terminals are in good condition with no signs of damage, refer to section 21.2.5.

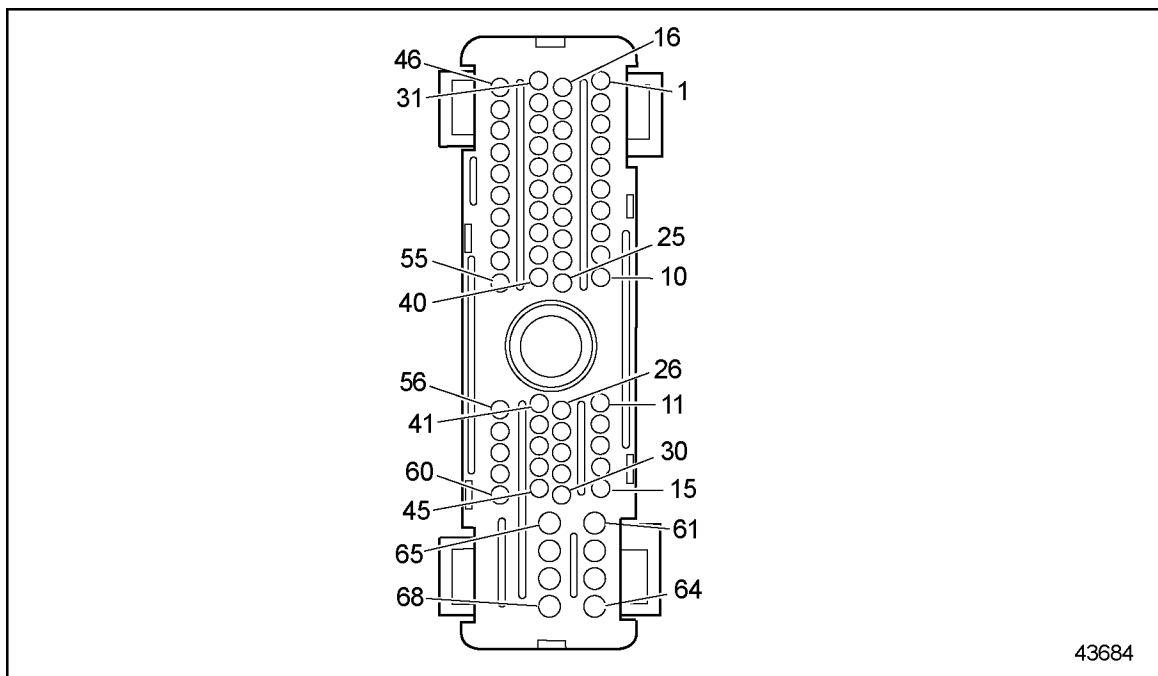


Figure 21-2 ECM/ECU Vehicle Interface Harness Connector

21.2.5 Check for Short to Battery (+)

Perform these steps to check for short to battery (+).

1. Turn ignition OFF. Unplug VSG connector.
2. Turn ignition ON. Measure voltage between V-14 and battery ground. See Figure 21-2.
 - [a] If measured voltage is less than or equal to 0.2 volts, refer to section 21.2.6.
 - [b] If measured voltage is greater than 0.2 volts, signal wire is shorted to 12/24 volt source. Repair or replace V-14 circuit. Refer to section 21.2.6.1.

21.2.6 Check for Short

To check for short, perform the following:

1. Turn ignition OFF. Unplug vehicle 68-pin connector and the VSG connector.
2. Turn ignition ON. Enable VSG. Refer to OEM guidelines.
3. Measure resistance between V-11 and V-14. See Figure 21-3.
 - [a] If resistance is greater than 5 Ω , check ECM/ECU connector. Refer to section 21.2.6.1.
 - [b] If resistance is less than 5 Ω , wire V-11 (5-volt supply) is shorted to V-11 (signal). Repair short or replace wire. Refer to section 21.2.6.1 to verify repairs.

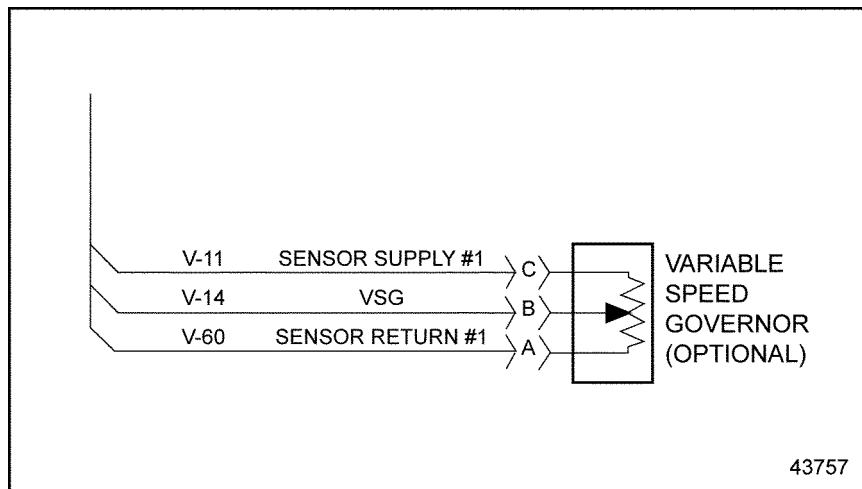


Figure 21-3 Variable Speed Governor Circuit

21.2.6.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF and reconnect all connectors.
2. Set parking brake, transmission in Neutral.
3. Turn ignition ON and clear the codes.
4. Start and run the engine for one minute then stop the engine.
5. Check the diagnostic tool for codes.
 - [a] If no codes are displayed, no further troubleshooting is required.
 - [b] If code p 187/3 is not logged, and other codes are logged, refer to section 17.3.
 - [c] If code p 187/3 is logged, and other codes are logged, review this section again. Refer to section 21.2.1. If the code is still logged, call the DDC Customer Support Center (313-592-5800).

22 FLASH CODE 13 - CLS/ECL SENSOR VOLTAGE LOW/EGR VALVE HIGH

Section	Page
22.1 DESCRIPTION OF FLASH CODE 13	22-3
22.2 TROUBLESHOOTING FLASH CODE 13, PID 111/FMI 4	22-3
22.3 TROUBLESHOOTING FLASH CODE 13, PID 111/FMI 6	22-5
22.4 TROUBLESHOOTING FLASH CODE 13, PID 146/FMI 6	22-9

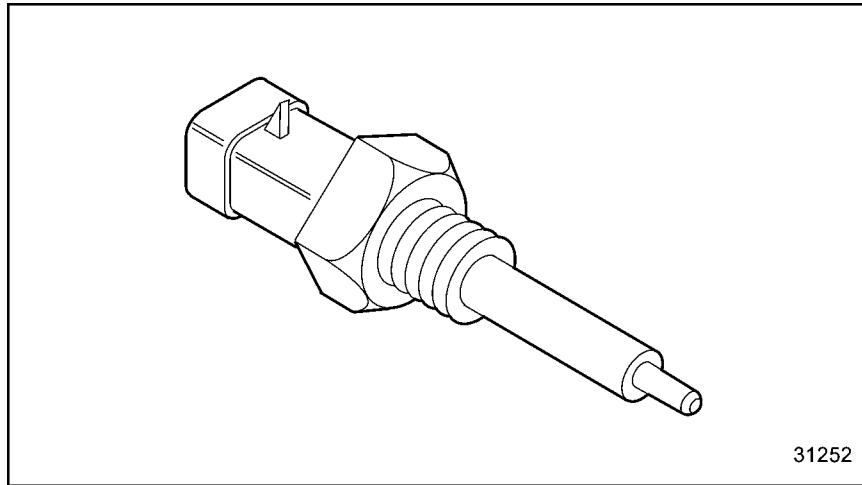


Figure 22-1 Engine Coolant Level Sensor

22.1 DESCRIPTION OF FLASH CODE 13

The SAE J1587 equivalent codes for Flash Code 13 is p 111/4, coolant level circuit low, p111/6, AECL Sensor failed low or p146/6, EGR Valve current is high.

Flash Code 13 indicates that the Engine Coolant Level Sensor (CLS/ECL Sensor) or Add Engine Coolant Level Sensor (ACLS/AECL Sensor) input to the ECU has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage. See Figure 22-1. Also this code indicates that the ECM/ECU has detected too high a current level for the Exhaust Gas Recirculation (EGR) Valve.

22.2 TROUBLESHOOTING FLASH CODE 13, PID 111/FMI 4

This diagnostic condition is typically:

- Sensor signal is shorted to the sensor return circuit or to ground
- Deteriorated coolant

22.2.1 Check Sensor and Sensor Connector

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect ECL Sensor.
3. Turn ignition ON. Start engine and read logged codes.
4. Stop engine.
 - [a] If code p 111/3 is logged, go to step 5.
 - [b] If code p 111/4 is logged, refer to section 22.2.2.
5. Inspect terminals at the CLS/ECL Sensor connector for bent, corroded and unseated pins or sockets. Ensure wires are not reversed at the CLS/ECL Sensor. See Figure 22-2.
 - [a] If terminals and connectors are damaged, repair both. Refer to section 22.2.2.1.
 - [b] If terminals and connectors are not damaged, replace the ECL Sensor. Refer to section 22.2.2.1.

22.2.2 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.

3. Measure resistance between sockets A and B on the CLS/ECL Sensor harness connector. Also measure resistance between socket A and battery ground; and socket A and chassis ground. See Figure 22-2.

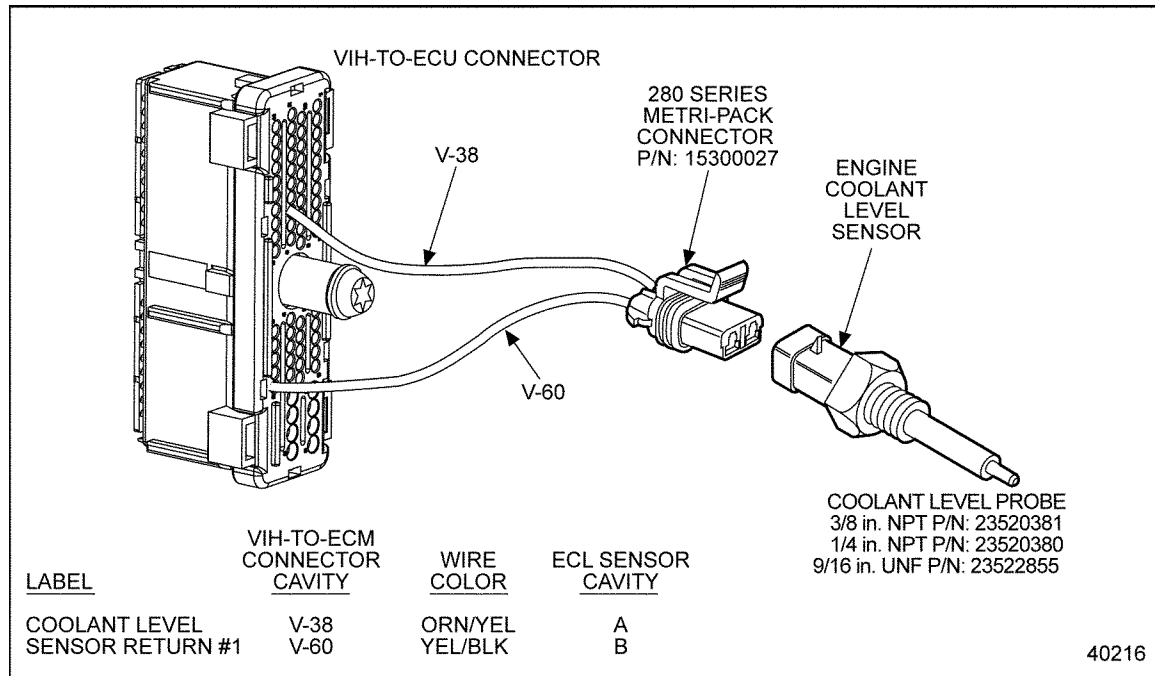


Figure 22-2 Engine Coolant Level Sensor

- [a] If the resistance is greater than 10,000 Ω or open, go to step 4.
- [b] If the resistance is less than or equal to 10,000 Ω , the signal wire V-38 is shorted to the ground V-60, or to chassis ground. Repair short; refer to section 22.2.2.1.
4. Inspect terminals at the CLS/ECL Sensor connector for bent, corroded and unseated pins or sockets. Ensure wires are not reversed at the CLS/ECL Sensor. See Figure 22-2.
 - [a] If terminals and connectors are damaged, repair both. Refer to section 22.2.2.1.
 - [b] If terminals and connectors are not damaged, replace the ECL Sensor. Refer to section 22.2.2.1.

22.2.2.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors. Turn ignition ON.
3. Clear diagnostic tool codes.
4. Start and run the engine for one minute. Stop the engine.
5. Check diagnostic tool for codes.

- [a] If no codes are displayed, troubleshooting is complete.
- [b] If code 111/4 is not logged, and other codes are logged, refer to section 17.3.
- [c] If code 111/4 is logged, refer to section 22.2.3.

22.2.3 Code 111/4 Logged

Perform the following steps to troubleshoot Code 111/4.

1. Remove CLS/ECL Sensor.
2. Plug opening.
3. Place the sensor probe in clean water.
4. Start and run the engine for one minute.
5. Check diagnostic tool for codes.

- [a] If code 111/4 is logged, review this section to find the error. Refer to section 22.2.1.
- [b] If code 111/4 is not logged, reprogram the ECM/ECU and replace the coolant with new. Repeat the test. Refer to section 22.2.2.1.

22.3 TROUBLESHOOTING FLASH CODE 13, PID 111/FMI 6

The flash codes for Add Engine Coolant Level Sensor (ACLS/AECL Sensor) problems are listed in Table 22-1.

Flash Code	PID/FMI	Description	Typical Cause
13	111/6	ACLS/AECL Sensor failed low	Signal wire (#906) shorted low (ground)
16	111/5	ACLS/AECL Sensor failed high	Open or poor ground; open signal wire
43	111/1	Coolant level low (ACLS/AECL Sensor)	Coolant level below probe
89	111/12	ACLS/AECL Sensor Fault	Coolant reported low on main ECL Sensor, with AECL Sensor okay

Table 22-1 Troubleshooting Add Engine Coolant Level Sensor

22.3.1 Check Sensor

Perform the following steps to check the sensor.

1. Unplug the ACLS/AECL Sensor. Start the engine.
2. Plug in the diagnostic tool. Read codes.
 - [a] If code 13 (111/6) displays, refer to section 22.3.2.
 - [b] If code 16 (111/5) displays, replace the AECL Sensor and test the results. Refer to section 22.3.4.1.

22.3.2 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF and unplug the ACLS/AECL Sensor module.
2. Measure the resistance between cavities A and B of the ACLS/AECL Sensor connector.
See Figure 22-3.
 - [a] If the measured resistance is greater than 10 Ω , refer to section 22.3.3.
 - [b] If the measured resistance is less than 10 Ω , V 37 and ground wires are shorted.
Repair or replace the wires and test. Refer to section 22.3.4.1.

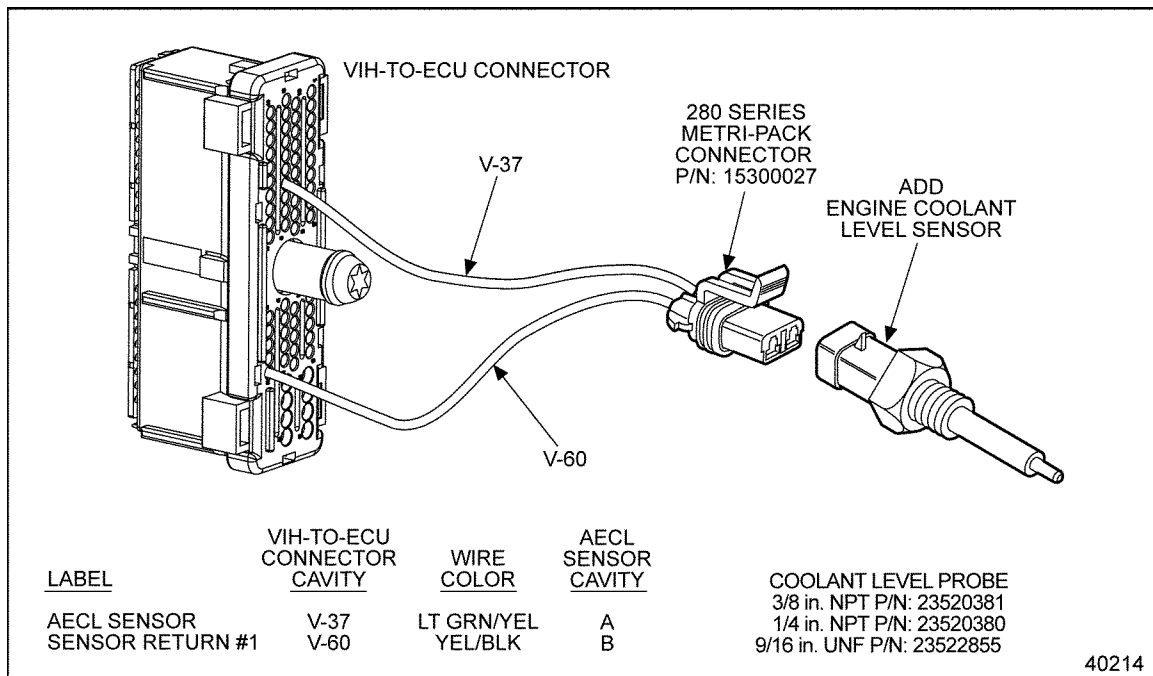


Figure 22-3 Add Engine Coolant Level Sensor Installation

22.3.3 Check for Voltage

The ACLS/AECL Sensor probe is connected to a separate module when used for a Coolant Level Low Lamp. The module provides an output to drive an indicator light on the dash.

Perform the following steps to check for voltage:

1. Turn ignition ON.

2. Measure voltage between cavities E and C of the ACLS/AECL Sensor module connector. See Figure 22-4.

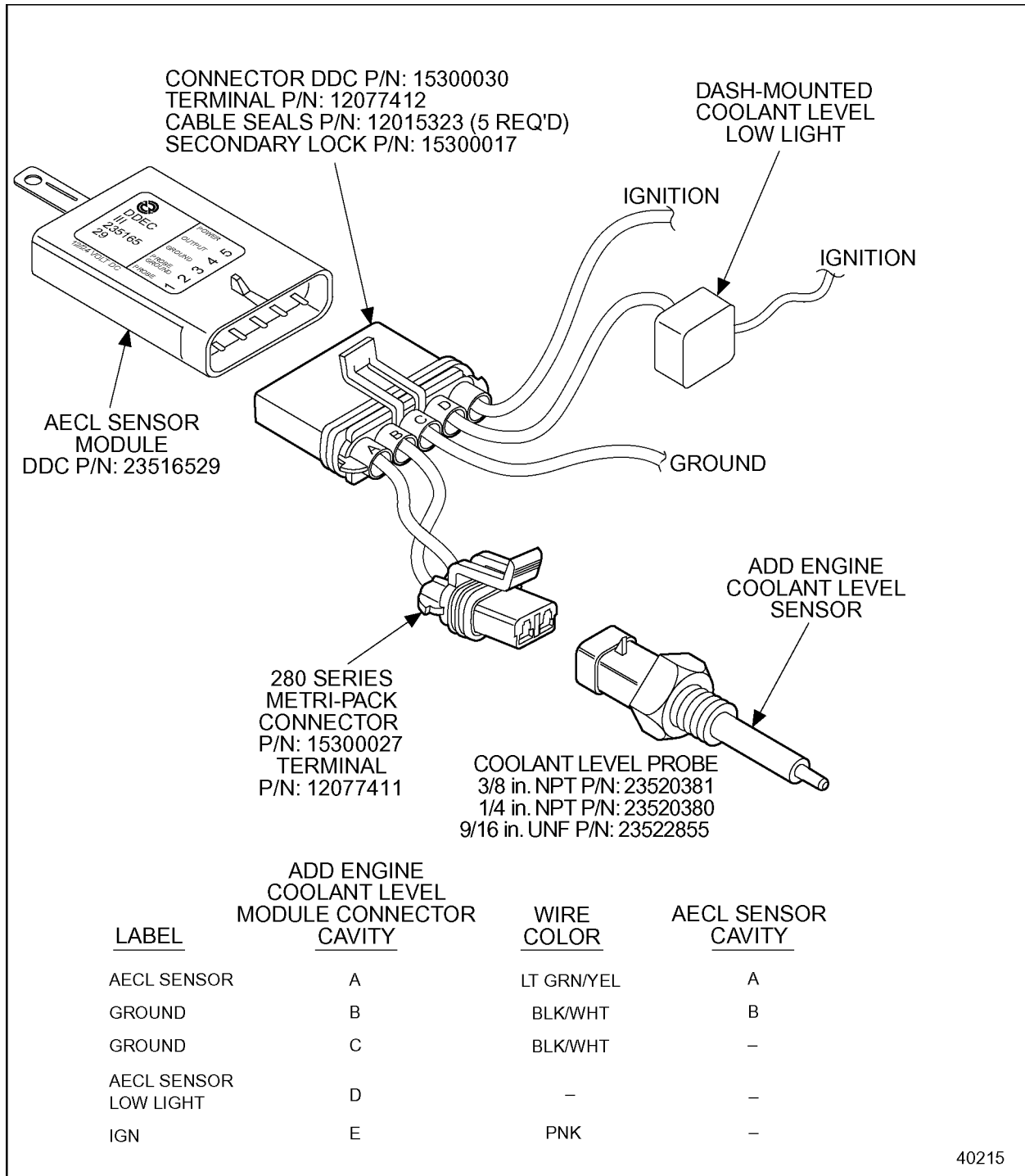


Figure 22-4 Add Engine Coolant Level Sensor with Dash-mounted Lamp

[a] If the measurement is 11.0 volts or greater, refer to section 22.3.4.

- [b] If the measurement is less than 11.0 volts, determine the reason for the loss of ignition voltage.

22.3.4 Check for Open Signal

Perform the following steps to check for open signal:

1. Turn ignition OFF.
2. Unplug the engine harness connector.
3. Measure resistance between cavities D and G of the ACLS/AECL Sensor module. See Figure 22-4.
 - [a] If the measured resistance is greater than 10 Ω , replace the ACLS/AECL Sensor module; then, refer to section 22.3.4.1.
 - [b] If the measured resistance is less than 10 Ω , the signal wire is shorted to the battery ground wire. Repair the short; replace the wire. Refer to section 22.3.4.1.

22.3.4.1 Verify Repair

Perform the following steps to test the repair:

1. Connect all the removed connectors.
2. Start and run the engine for 5 minutes.
3. Plug in the diagnostic tool.
4. Read the active codes.
 - [a] If no codes display, the repairs are complete.
 - [b] If code 13 displays, troubleshooting is complete; review these steps to find the error.
 - [c] If any codes other than code 13 display, refer to section 17.3.

22.4 TROUBLESHOOTING FLASH CODE 13, PID 146/FMI 6

Flash code 13 also indicates that the ECM/ECU has detected too high a current level for the Exhaust Gas Recirculation (EGR) Valve. The following procedure will troubleshoot problem.

22.4.1 Short Circuit

Perform the following steps if the EGR Valve current is high.

1. To check for a short circuit, disconnect harness connector at actuator control valve coil. Measure coil resistance between pins A and B. Allowed ranges are listed in Table 22-2. Also, see Figure 22-5.

Coil Temperature °C	Coil Temperature °F	Allowed Ranges (ohms)
22	71	3.4 - 4.2
50	122	3.7 - 4.6
100	212	4.4 - 5.4

Table 22-2 Ranges Allowed (ohms)

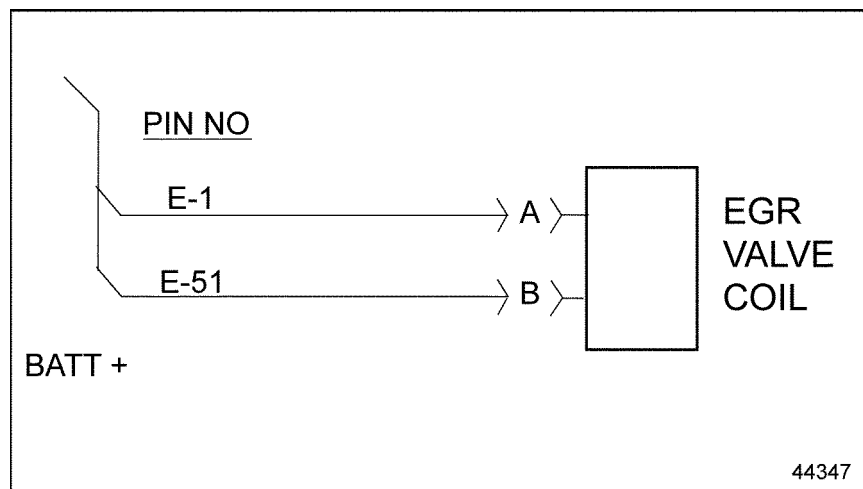


Figure 22-5 EGR Valve Coil Wiring

- [a] If coil resistance is too low replace the actuator assembly.
- [b] If coil resistance is okay go to step 2.
2. Disconnect engine harness at the ECU and at the coil and measure resistance across the two pin connector pins.
 - [a] If resistance is less than 100 Ω , the two wires are shorted to each other.
 - [b] If the resistance is greater than 100 Ω , try a test ECU or contact the Detroit Diesel Customer Service Center (313-592-5800).

22.4.1.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Start and run engine.
5. Check DDR/DDDL codes.
 - [a] If no codes are displayed, no further troubleshooting is required.
 - [b] If any other codes are logged. Refer to section 19.18 .
 - [c] If code p 146/6 returns contact Detroit Diesel Customer Service Center (313-592-5800).

23 FLASH CODE 14 - COOLANT OR OIL TEMP SENSOR HIGH

Section	Page
23.1 DESCRIPTION OF FLASH CODE 14	23-3
23.2 TROUBLESHOOTING FLASH CODE 14, PID 110/FMI 3	23-3
23.3 TROUBLESHOOTING FLASH CODE 14, PID 175/FMI 3	23-5

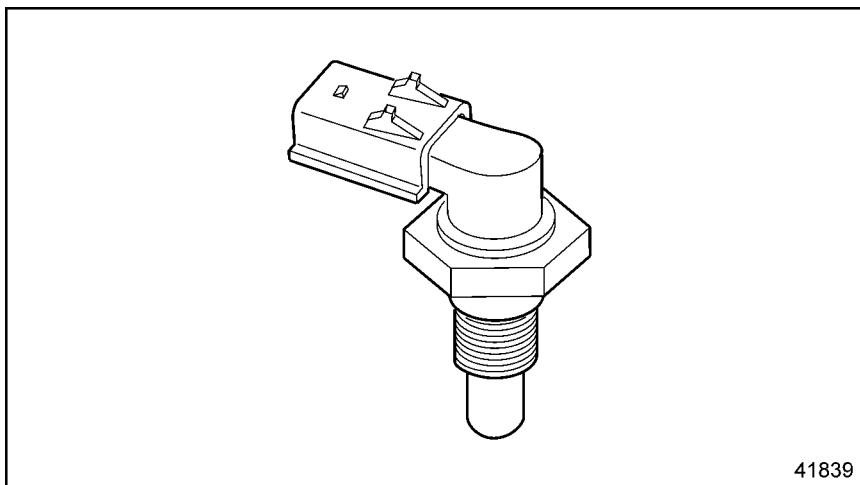


Figure 23-1 Engine Coolant Temperature Sensor or Engine Oil Temperature Sensor — Series 60

23.1 DESCRIPTION OF FLASH CODE 14

The SAE J1587 equivalent codes for Flash Code 14 is p 110/3 - coolant temperature circuit high or p 175/3 - oil temperature circuit high.

Flash Code 14 p 110/3 or p 175/3 indicates that the Engine Coolant Temperature Sensor (CTS/ECT Sensor) or the Engine Oil Temperature Sensor (OTS/EOT Sensor), see Figure 23-1, input to the ECM/ECU has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

23.2 TROUBLESHOOTING FLASH CODE 14, PID 110/FMI 3

This diagnostic condition is typically an open sensor signal or return circuit for the Engine Coolant Temperature Sensor.

NOTE:

This code will only be logged during warm engine operation.

23.2.1 Engine Coolant Temperature Sensor Check

Perform the following steps to check the Engine Coolant Temperature Sensor (CTS/ECT Sensor).

1. Turn vehicle ignition OFF.
2. Disconnect CTS/ECT Sensor and install a jumper between the CTS/ECT Sensor connector sockets 1 and 2. See Figure 23-2.

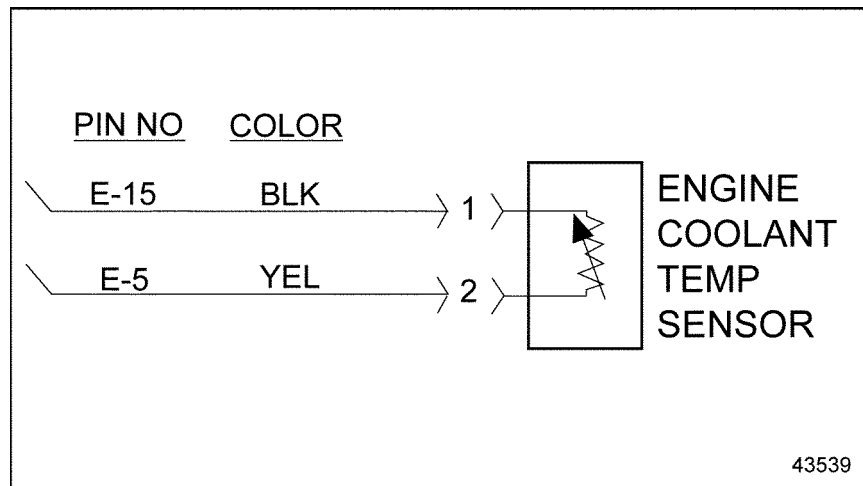


Figure 23-2 Engine Coolant Temperature Sensor Circuits

3. Turn vehicle ignition ON.
4. Read active codes.
 - [a] If code p 110/4 or any other codes except p 110/3 are logged, refer to section 23.2.2.
 - [b] If code p 110/3 is logged and any codes except code p 110/4 are logged, refer to section 23.2.3.

23.2.2 Check for Signal Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn ignition OFF. Remove jumper wire.
2. Disconnect the Engine Harness connector at the ECM/ECU.
3. Measure resistance between sockets E-5 and E-26, E-5 and E-12 on the Engine Harness connector. See Figure 23-3.

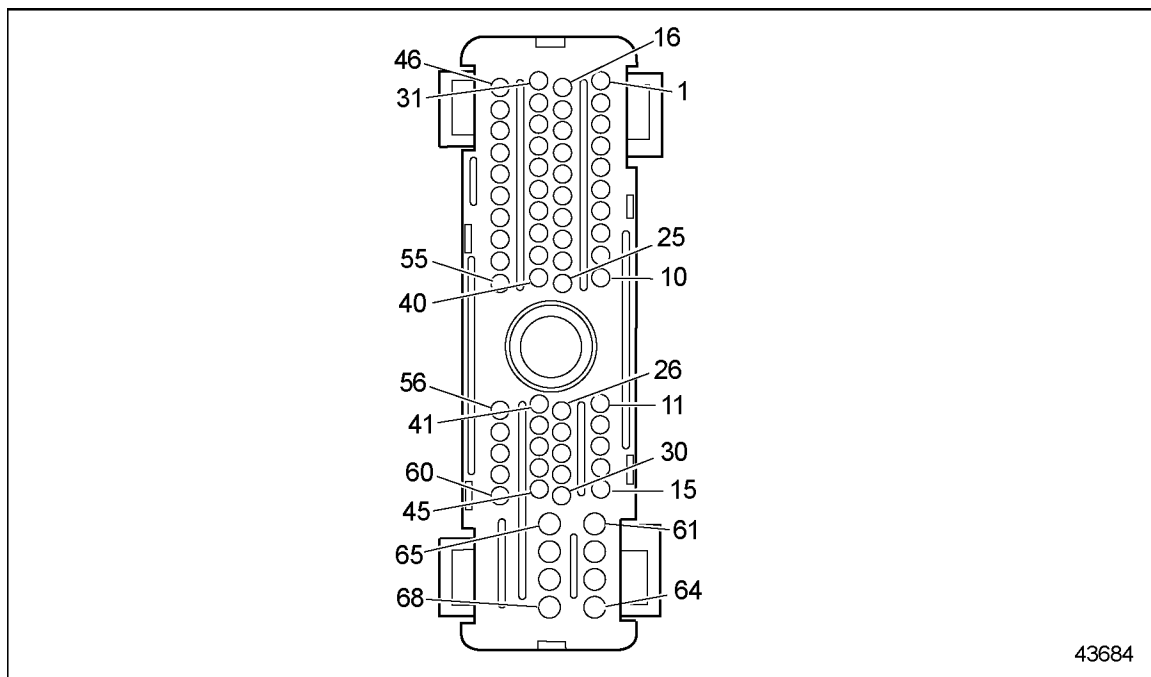


Figure 23-3 ECM/ECU Engine Harness Connector

- [a] If the resistance measurement is greater than 5 Ω or open, go to step 4.
- [b] If the resistance measurement is less than or equal to 5 Ω , the signal line E5 is shorted to the engine +5 volt line E-26 or E-12. Repair the short and refer to section 23.2.3.1.
4. Check terminals at the CTS/ECT Sensor connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure 23-2.
 - [a] If terminals and connectors are in good condition, replace the CTS/ECT Sensor. Refer to section 23.2.3.1.
 - [b] If the terminals and connectors are damaged, repair them. Refer to section 23.2.3.1.

23.2.3 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the Engine Harness connector at the ECM/ECU. Leave the jumper wire between A and B of the temperature sensor connector.
3. Measure resistance between sockets E5 and E-15 on the Engine Harness connector. See Figure 23-3.
 - [a] If the resistance measurement is less than or equal to 5 Ω , go to step 4.
 - [b] If the resistance measurement is greater than 5 Ω or open, the signal line E-5 or return line E-15 is open. Repair the open. Refer to section 23.2.3.1.
4. Check terminals at the ECM/ECU Engine Harness connector (both ECM/ECU and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 23-3.
 - [a] If terminals or connectors are damaged, repair them. Refer to section 23.2.3.1.
 - [b] If terminals and connectors are not damaged, replace the temperature sensor.

23.2.3.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF. Reconnect all connectors.
2. Turn vehicle ignition ON. Clear codes.
3. Start and run the engine for eight minutes. Stop the engine.
4. Check diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code p 110/3 or p 175/3 and any other codes are logged, review this section to find the error. Refer to section 23.2 for p 110/3 and section 23.3 for p 175/3.
 - [c] If any codes except code p 110/3 or p 175/3 are logged, refer to section 17.3.

23.3 TROUBLESHOOTING FLASH CODE 14, PID 175/FMI 3

This diagnostic condition is typically an open sensor signal or return circuit for the Engine Oil Temperature Sensor.

NOTE:

This code will only be logged during warm engine operation.

23.3.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in diagnostic tool and determine which code is logged.
 - [a] If codes PID 110/FMI 3 is logged, refer to section 23.2.1.
 - [b] If codes PID 175/FMI 3 is logged, refer to section 23.3.2.

23.3.2 Engine Oil Temperature Sensor Check

Perform the following steps to check the Engine Oil Temperature Sensor (OTS/EOT Sensor).

1. Turn vehicle ignition OFF.
2. Disconnect OTS/EOT Sensor and install a jumper between OTS/EOT Sensor connector sockets 1 and 2. See Figure 23-4.

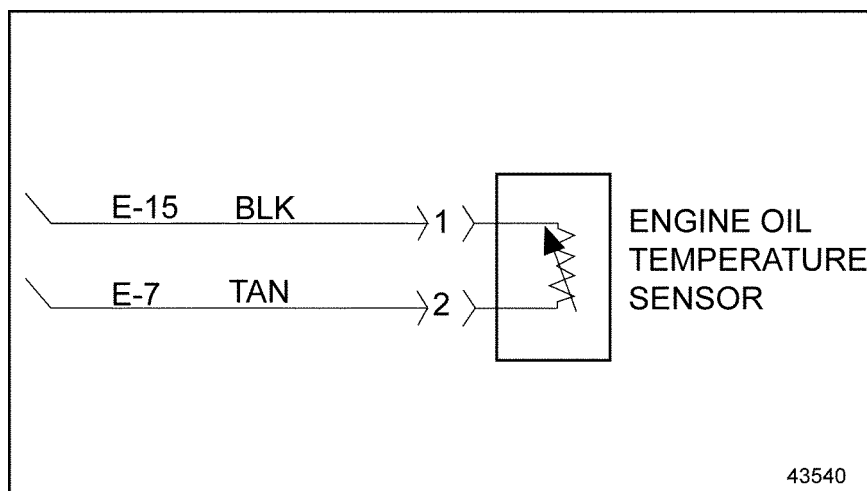


Figure 23-4 Engine Oil Temperature Sensor Circuits

3. Turn ignition ON.
4. Read active codes.
 - [a] If code p 175/4 is logged, refer to section 23.3.4.
 - [b] If code p 175/3 is logged and any codes except code p 175/4 are logged, refer to section 23.3.3.

23.3.3 Check for Signal Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn vehicle ignition OFF.
2. Remove jumper wire.
3. Disconnect the Engine Harness connector at the ECM/ECU.

4. Measure resistance between sockets E-7 and E-12, E-7 and E-26 on the Engine Harness connector. See Figure 23-5.

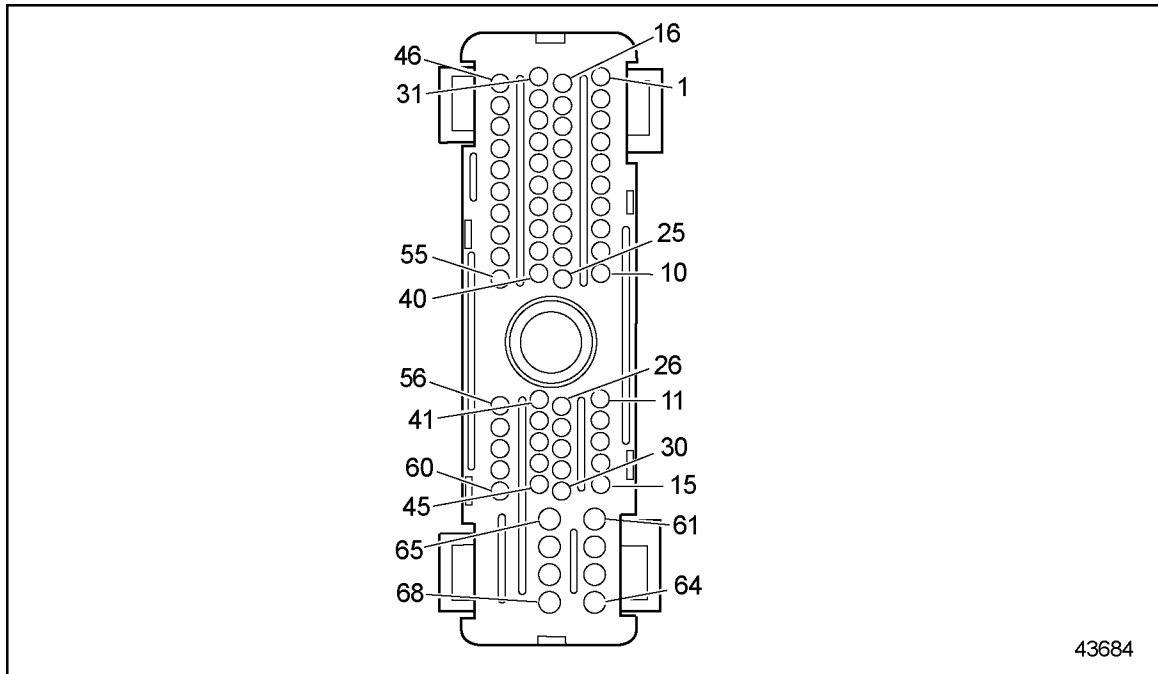


Figure 23-5 Engine Harness Connector

- [a] If the resistance measurement is greater than or equal to 5 Ω , go to step 5.
- [b] If the resistance measurement is less than 5 Ω , the signal line E-7 is shorted to the engine +5 volt line E-12 or E-26. Repair the short and refer to section 23.3.4.1.
5. Check terminals at the OTS/EOT Sensor connector (both sensor and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 23-4.
 - [a] If terminals or connectors are damaged, repair them. Refer to section 23.3.4.1.
 - [b] If terminals and connectors are not damaged, replace the OTS/EOT Sensor. Refer to section 23.3.4.1.

23.3.4 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the Engine Harness connector at the ECM/ECU. Leave the jumper wire between A and B of the temperature sensor connector.
3. Measure resistance between sockets E-7 and E-15 on the Engine Harness connector. See Figure 23-5.
 - [a] If the resistance measurement is less than or equal to 5 Ω , go to step 4.

- [b] If the resistance measurement is greater than 5 Ω or open, the signal line E-7 or return line E-15 is open. Repair the open. Refer to section 23.3.4.1.
- 4. Check terminals at the ECM/ECU Engine Harness connector (both ECM/ECU and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 23-5
 - [a] Check terminals at the ECM/ECU Engine Harness connector (both ECM/ECU and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 23-5
 - [b] If terminals and connectors are not damaged, replace the temperature sensor.

23.3.4.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON. Clear codes.
4. Start and run the engine for eight minutes. Stop the engine.
5. Check diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code p 110/3 or p 175/3 and any other codes are logged, review this section to find the error. Refer to section 23.3.1.
 - [c] If any codes except code p 110/3 or p 175/3 are logged, refer to section 17.3.

24 FLASH CODE 15 - COOLANT OR OIL TEMP SENSOR LOW

Section	Page
24.1 DESCRIPTION OF FLASH CODE 15	24-3
24.2 TROUBLESHOOTING FLASH CODE 15, PID 110/FMI 4	24-3
24.3 TROUBLESHOOTING FLASH CODE 15, PID 175/FMI 4	24-5

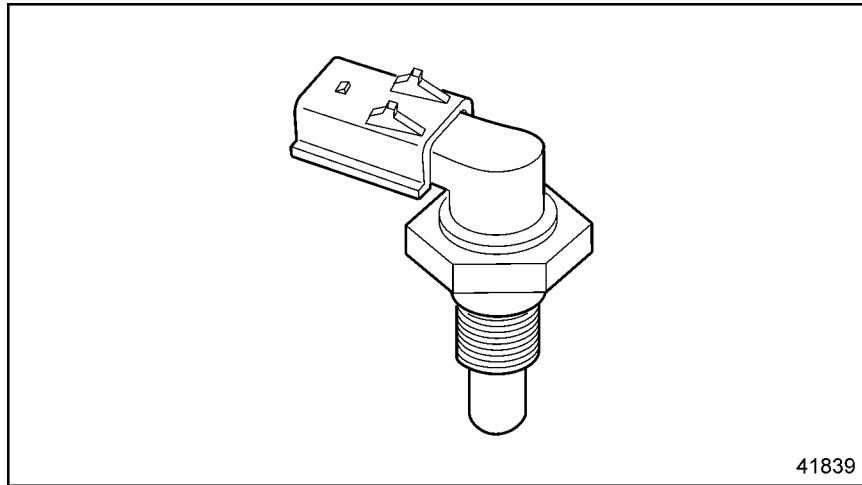


Figure 24-1 Engine Coolant Temperature Sensor or Engine Oil Temperature Sensor — Series 60

24.1 DESCRIPTION OF FLASH CODE 15

The SAE J1587 equivalent codes for Flash Code 15 is p 110/4 - coolant temperature circuit low.

The SAE J1587 equivalent codes for Flash Code 15 is p 175/4 - oil temperature circuit low.

24.2 TROUBLESHOOTING FLASH CODE 15, PID 110/FMI 4

The diagnosis for this PID is coolant temperature circuit low.

The following procedure will troubleshoot Flash Code 15, p 110/4.

24.2.1 Coolant Temperature Sensor Check

Perform the following steps to check the Engine Coolant Temperature Sensor (CTS/ECT Sensor).

1. Turn vehicle ignition OFF.
2. Disconnect (unplug) CTS/ECT Sensor connector. See Figure 24-2.

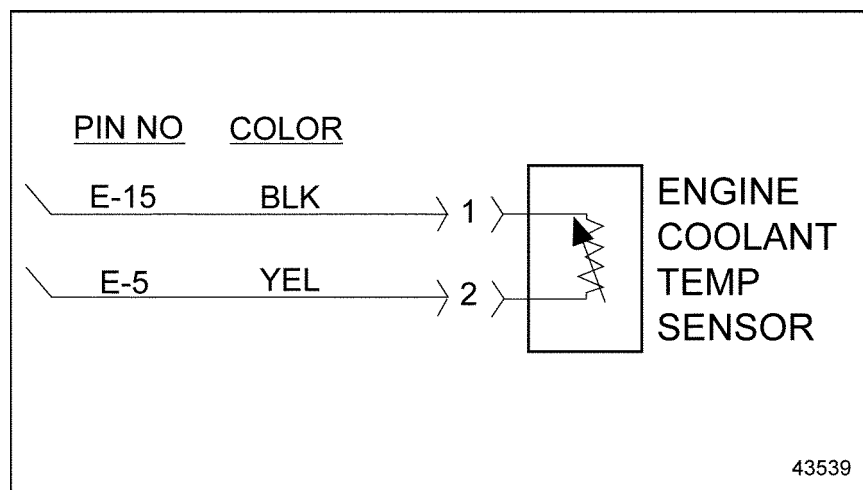


Figure 24-2 Engine Coolant Temperature Sensor Circuits

3. Start and run the engine for eight minutes.
4. Read active codes with engine still running.
 - [a] If code p 110/4 or any other codes are logged, go to step 5.
 - [b] If any codes except code p 110/4 are logged, refer to section 24.2.2.
5. Check terminals at the CTS/ECT Sensor connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure 24-2.
 - [a] If terminals and connectors are in good condition, replace the CTS/ECT Sensor. Refer to section 24.2.2.1.
 - [b] If the terminals and connectors are damaged, repair them. Refer to section 24.2.2.1.

24.2.2 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM/ECM/ECU.
3. Measure resistance between sockets E-5 and E-15 on the Engine Harness connector. See Figure 24-3.
4. Measure resistance between socket E-5 and a good ground.
 - [a] If the resistance measurement between sockets E-5 and E-15, or E-5 and battery ground, is less than or equal to 5 Ω , the signal line E-5 is shorted to the return line E-15 or battery ground. Repair the short. Refer to section 24.2.2.1.
 - [b] If the resistance measurement between sockets E-5 and E-15 is greater than 5 Ω or open, and the resistance measurement between sockets E-5 and a good ground is greater than or equal to 5 Ω or open, go to step 5.
5. Check terminals at the ECM/ECU/engine harness connector (both ECM/ECU and harness side) for damage: bent, corroded and unseated pins or sockets. Check terminals E-5 and E-15 of the ECM/ECU connector.
 - [a] If terminals or connectors are damaged, repair them. Refer to section 24.2.2.1.
 - [b] If terminals and connectors are not damaged, reprogram the ECM/ECU. Refer to section 24.2.2.1.

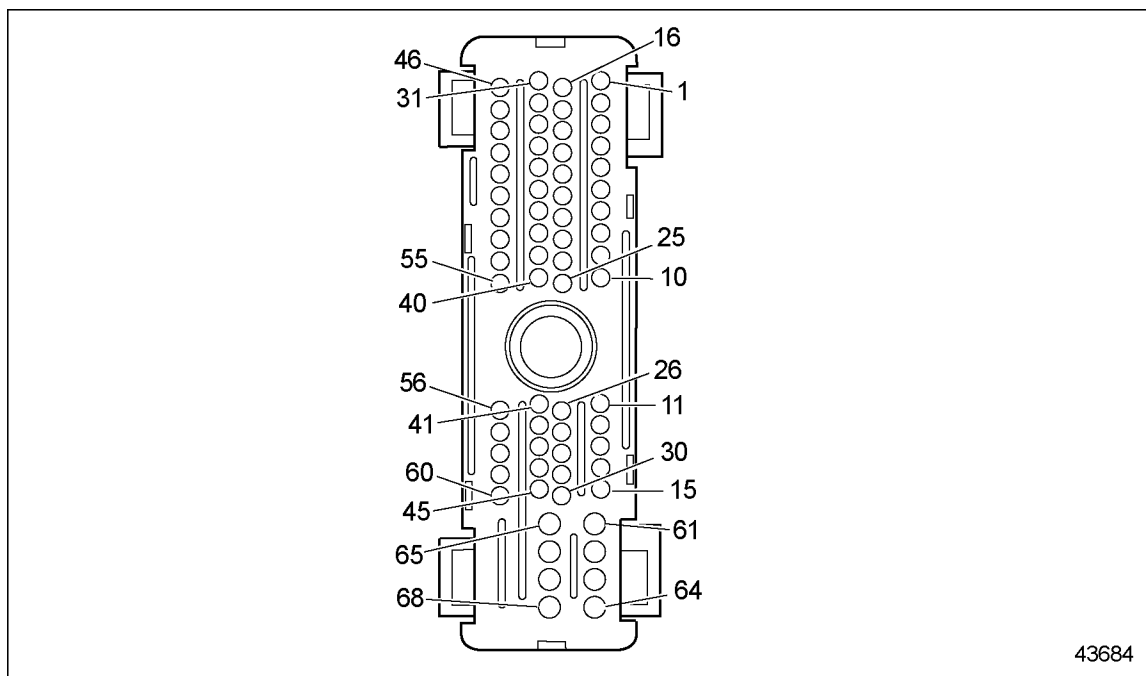


Figure 24-3 ECM/ECM/ECU Engine Harness Connector

24.2.2.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF and reconnect all connectors.
2. Turn vehicle ignition ON and clear codes.
3. Start and run the engine for one minute. Stop the engine.
4. Check diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code p 110 or p 175/4 and any other codes are logged, review this section to find the error. Refer to section 24.2.1.
 - [c] If any codes except code p 110 or p 175/4 are logged, refer to section 17.3.

24.3 TROUBLESHOOTING FLASH CODE 15, PID 175/FMI 4

The diagnosis for this PID is oil temperature circuit low.

24.3.1 Engine Oil Temperature Sensor Check

Perform the following steps to check the Engine Oil Temperature Sensor (OTS/EOT Sensor).

1. Turn vehicle ignition OFF.
2. Disconnect OTS/EOT Sensor connector. See Figure 24-4.

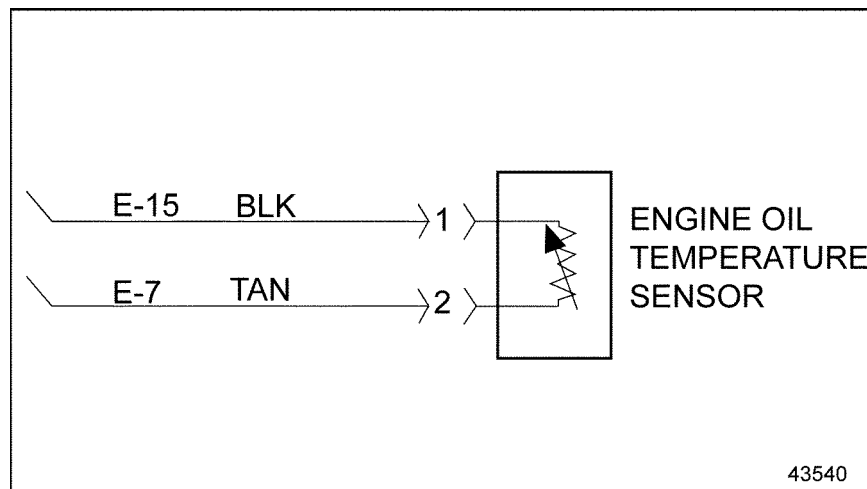


Figure 24-4 Engine Oil Temperature Sensor

3. Start and run the engine for eight minutes.
4. Read active codes with engine running.
 - [a] If code p 175/4 is logged, refer to section 24.3.2.

- [b] If any codes except code p 175/4 are logged, go to step 5.
- 5. Check terminals at the OTS/EOT Sensor connector (both sensor and harness side) for damage: bent, corroded and unseated pins or sockets.
 - [a] If terminals or connectors are damaged, repair them. refer to section 24.3.2.1.
 - [b] If terminals and connectors are not damaged, replace the OTS/EOT Sensor. Refer to section 24.3.2.1.

24.3.2 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM/ECM/ECU.
3. Measure resistance between sockets E-7 and E-15 on the Engine Harness connector. See Figure 24-5.

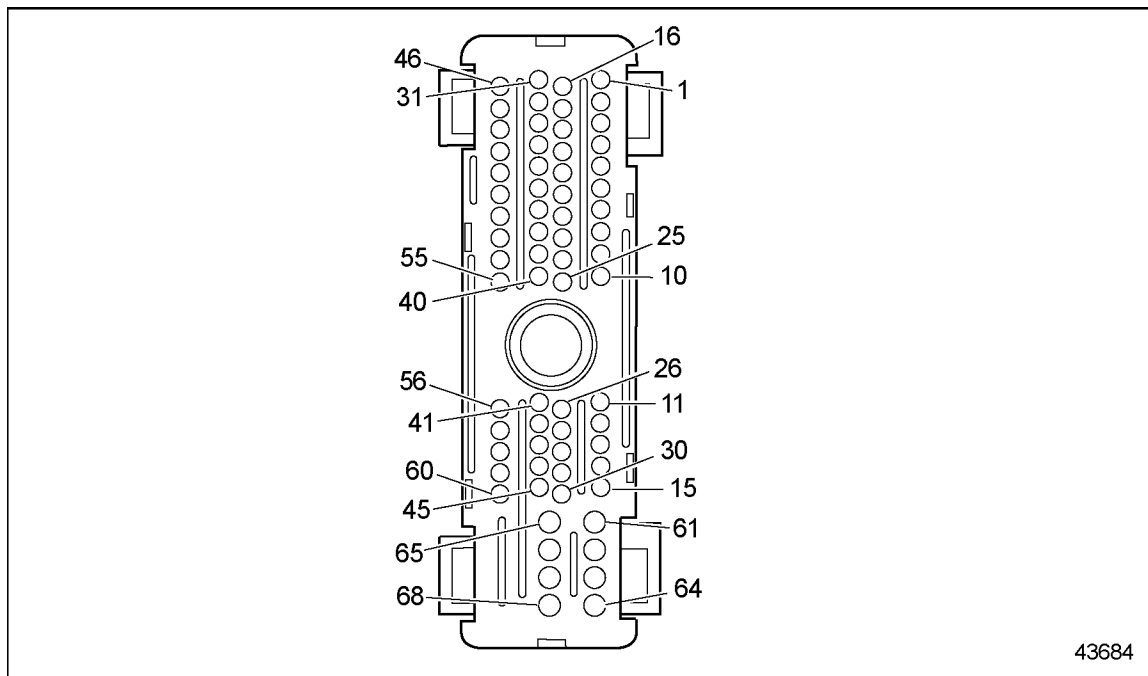


Figure 24-5 ECM/ECM/ECU Engine Harness Connector

4. Measure resistance between socket E-7 and a good ground.
 - [a] If the resistance measurement between sockets E-7 and E-15, or E-7 and battery (-) is less than or equal to 5 Ω , the signal line E-7 is shorted to the return line E-15 or battery ground. Repair the short. Refer to section 24.3.2.1.
 - [b] If the resistance measurement between socket E-7 and E-15 is greater than 5 Ω or open, and the resistance measurement between socket E-7 and a good ground is greater than or equal to 5 Ω or open, go to step 5.

5. Check terminals at the ECM/ECU engine harness connector (both ECM/ECU and harness side) for damage: bent, corroded and unseated pins or sockets. Check terminals E-7 and E-15 of the ECM/ECU connector. See Figure 24-5.
 - [a] If terminals or connectors are damaged, repair them. Refer to section 24.3.2.1.
 - [b] If terminals and connectors are not damaged, reprogram the ECM/ECU. Contact Detroit Diesel Customer Support Center (313-592-5800).

24.3.2.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF and reconnect all connectors.
2. Turn vehicle ignition ON and clear codes.
3. Start and run the engine for one minute.
4. Stop the engine and check the diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code p 175/4 and any other codes are logged, review this section to find the error. Refer to section 24.3.1.
 - [c] If any codes except code p 110/4 or p 175/4 are logged, refer to section 17.3.

25 FLASH CODE 16 - CLS/ECL SENSOR VOLTAGE HIGH

Section	Page
25.1 DESCRIPTION OF FLASH CODE 16	25-3
25.2 TROUBLESHOOTING FLASH CODE 16, PID 111/FMI 3	25-3
25.3 TROUBLESHOOTING FLASH CODE 16, PID 111/FMI 5	25-6
25.4 TROUBLESHOOTING FLASH CODE 13, PID 146/FMI 5	25-8

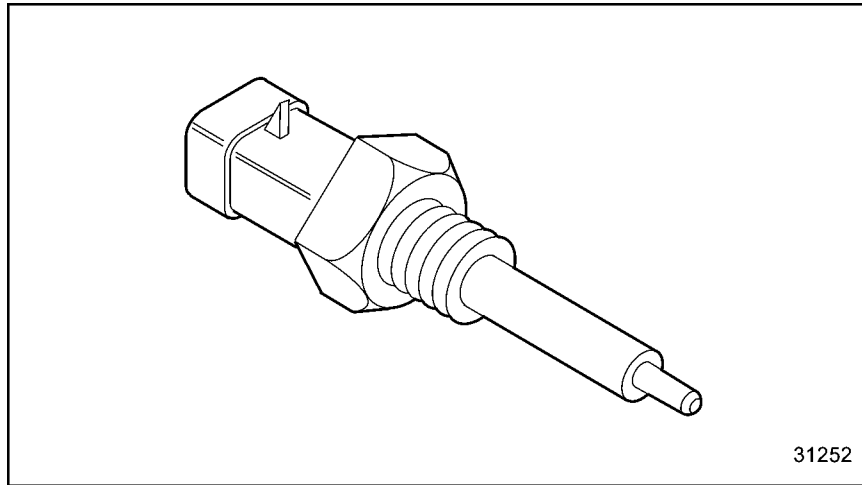


Figure 25-1 Engine Coolant Level Sensor

25.1 DESCRIPTION OF FLASH CODE 16

The SAE J1587 equivalent code for Flash Code 16 is p 111/3, coolant level circuit high (refer to section 25.2), p 111/5 ACLS/AECL Sensor circuit high (refer to section 25.3) and p 146/5. Flash Code 16 p146/5 indicates the ECM/ECU has detected too low a current measured from the Exhaust Gas Recirculation (EGR) valve, refer to section 25.4.

25.2 TROUBLESHOOTING FLASH CODE 16, PID 111/FMI 3

Flash Code 16 indicates that the Engine Coolant Level Sensor (CLS/ECL Sensor), see Figure 25-1, input to the ECM/ECU has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor ground circuit

25.2.1 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Disconnect the CLS/ECL Sensor connector and install a jumper between sockets A and B of the CLS/ECL Sensor harness connector.
3. Attempt to start and run engine at idle.
4. Read diagnostic tool for active codes.
 - [a] If active code 111/3 and any other codes except code 111/4 are logged, refer to section 25.2.2.
 - [b] If active code 111/4 and any other codes are logged, refer to section 25.2.3.
5. Stop engine.

25.2.2 Signal Circuit Check

Perform the following steps to check the signal circuit.

1. Turn ignition OFF.
2. Disconnect the CLS/ECL Sensor.
3. Disconnect the vehicle harness connector.
4. Measure resistance between socket H3 (#115) on the vehicle harness connector and A (#115 signal) of the CLS/ECL Sensor connector.
 - [a] If the resistance measurement is less than or equal to 5 Ω , go to step 5.
 - [b] If the resistance measurement is greater than 5 Ω , or the signal line #115 is open, repair the open. Refer to section 25.2.4.1.

5. Measure resistance between cavity B (battery ground) of the ECL Sensor connector and battery ground.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 25.2.3.
 - [b] If the resistance measurement is greater than 5 Ω , or open, the ground circuit is open. Repair and refer to section 25.2.4.1.

25.2.3 Signal Short to Ignition Check

Perform the following steps to check for a signal short to ignition.

1. Disconnect the vehicle harness connector at the ECM/ECU.
2. Remove the jumper wire at the CLS/ECL Sensor harness connector.
3. Turn ignition ON.
4. Measure voltage at cavity V-38 of the CLS/ECL Sensor connector and battery ground. See Figure 25-2.
 - [a] If the voltage measurement is less than or equal to 6 volts, go to step 5.
 - [b] If the voltage measurement is greater than 6 volts, the CLS/ECL Sensor signal line V-38 is shorted to the 12/24 volt DC line. Repair the short or replace the V-38 wire. Refer to section 25.2.4.1.

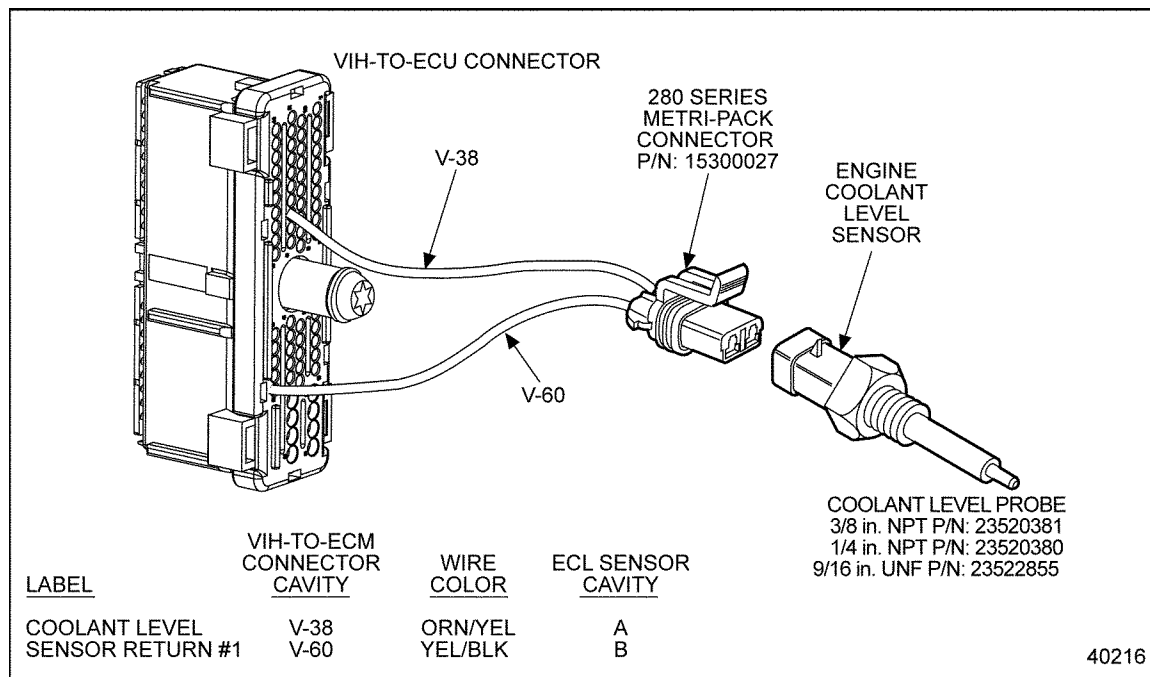


Figure 25-2 Engine Coolant Level Sensor and Circuits

5. Inspect terminals at the vehicle harness connector (both the sensor and harness side) for bent, corroded and unseated pins or sockets. Check terminal and pin V-38 at the ECM/ECU and all terminals and pins in the CLS/ECL Sensor connector. See Figure 25-3.

- [a] If terminals and connectors are not damaged, replace the CLS/ECL Sensor. Refer to section 25.2.4.1. If this is a repeated failure of the CLS/ECL Sensor, refer to section 25.2.4.
- [b] If terminals and connectors are damaged, repair both. Refer to section 25.2.4.1.

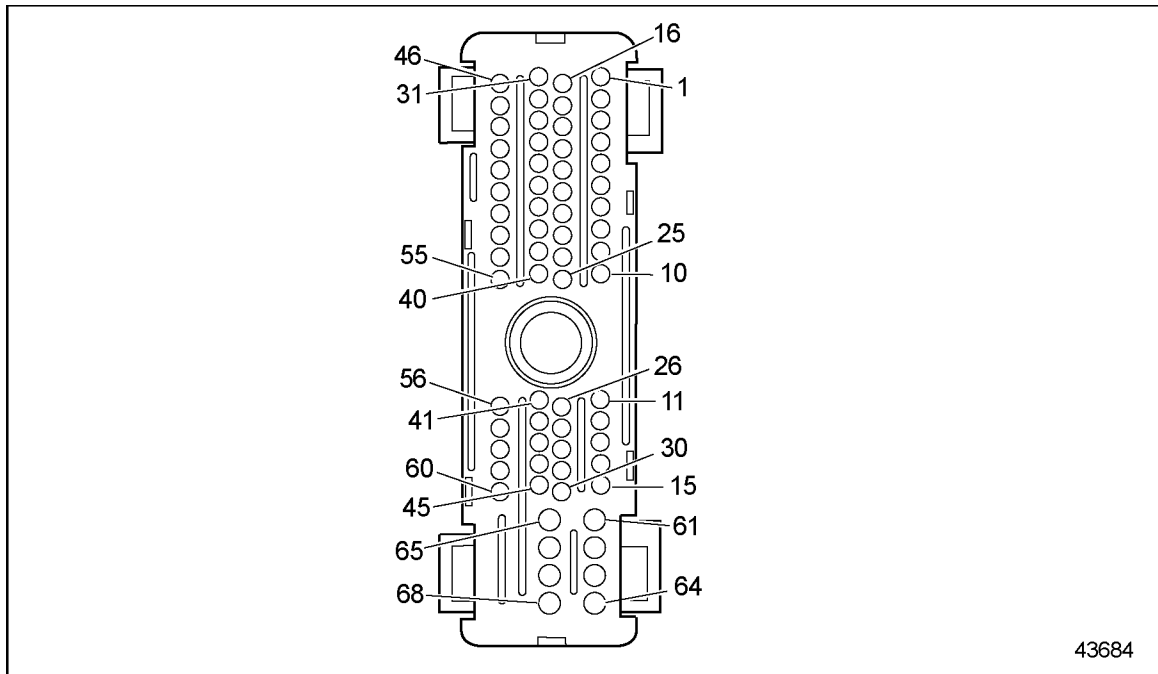


Figure 25-3 Vehicle Harness Connector

25.2.4 Alternator Ground Check

Perform the following steps to check the alternator ground.

1. Connect all connectors.
2. Remove alternator belt or disable alternator from charging.
3. Start and run the engine.
4. Read logged codes.

- [a] If no codes are logged, repair the alternator ground circuit. Refer to section 25.2.4.1.
- [b] If codes are logged, replace CLS/ECL Sensor. Refer to section 25.2.4.1.

25.2.4.1 Verify Repairs

Perform the following steps to verify the repairs.

1. Turn ignition OFF. Reconnect all connectors.
2. Turn ignition ON. Clear diagnostic tool codes.
3. Start and run the engine for one minute.

4. Stop the engine.
5. Check diagnostic tool for codes.
 - [a] If no codes are displayed, troubleshooting is complete.
 - [b] If code 111/3 is not logged, and other codes are logged, refer to section 17.3.
 - [c] If code 111/3 is logged, and other codes are logged, refer to section 25.2.1, and perform tasks.

25.3 TROUBLESHOOTING FLASH CODE 16, PID 111/FMI 5

Flash Code 16 indicates that the Add Engine Coolant Level Sensor (CLS/AECL Sensor), part of the Maintenance Alert System (MAS) see Figure 25-4, input to the ECM/ECU has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor ground circuit

Listed in Table 25-1, are the flash codes for ACLS/AECL Sensor problems.

Flash Code	PID FMI	Description	Typical Cause
13	111/6	ACLS/AECL Sensor failed low	Signal wire (#906) shorted low (ground)
16	111/5	ACLS/AECL Sensor failed high	Open or poor ground. Open signal wire
43	111/1	Coolant level low (ACLS/AECL Sensor)	Coolant level below probe
89	111/12	ACLS/AECL Sensor Fault	Coolant reported low on main CLS/ECL Sensor, with ACLS/AECL Sensor okay

Table 25-1 Troubleshooting Add Engine Coolant Level Sensor

25.3.1 Check Sensor

Follow these steps to check the sensor:

1. Unplug the ACLS/AECL Sensor.
2. Insert a jumper between cavities A and B of the sensor connector.
3. Start the engine.
4. Plug in the diagnostic tool. Read the codes displayed.

- [a] If code 13, (111/5) displays, replace the ACLS/AECL Sensor. Go to test. Refer to section 25.3.3.1. See Figure 25-4.

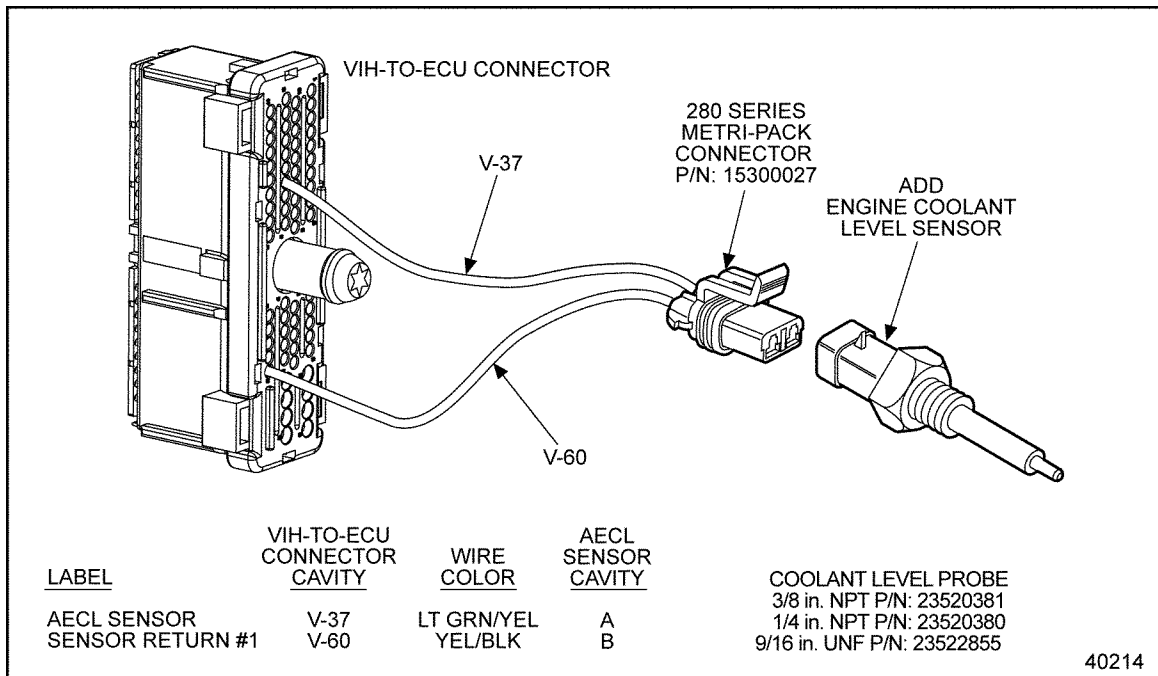


Figure 25-4 Add Coolant Level Sensor – Maintenance Alert System

- [b] If code 16 (111/6) displays, go to the next procedure. Refer to section 25.3.2.

25.3.2 Check for Open

Perform the following steps to check for open:

1. Insert a jumper wire between cavities A and B of the ACLS/AECL Sensor module connector. See Figure 25-4.
2. Measure resistance between cavities A and B of the sensor connector.
 - [a] If measured resistance is greater than 10 Ω , the ground wire of the V-37 wire is open. Repair the open and go to test. Refer to section 25.3.3.1.
 - [b] If measured resistance is less than 10 Ω , refer to section 25.3.3.

25.3.3 Check for Open Signal

Perform the following steps to check for open signal:

1. Turn the ignition OFF.
2. Unplug the engine harness 30-pin connector.
3. Insert a jumper wire between cavity V-37 and battery ground.

4. Measure resistance between cavities A and B of the ACLS/AECL Sensor module connector.
 - [a] If the measured resistance is greater than 10 Ω , the V-37 wire or the battery ground wire is open between the ACLS/AECL Sensor module connector and the engine harness 30-pin connector. Repair the open; replace the wire and go to test. Refer to section 25.3.3.1.
 - [b] If the measured resistance is less than 10 Ω , replace the ACLS/AECL Sensor module; go to test. Refer to section 25.3.3.1.

25.3.3.1 Verify Repair

Perform the following steps to test the repair:

1. Connect all removed connectors.
2. Start and run engine for five minutes.
3. Plug in diagnostic tool.
4. Read active codes.
 - [a] If no codes display, repairs are complete. Return the unit to service.
 - [b] If code 16 displays, troubleshooting is complete. Review the above steps to find the error.
 - [c] If any other codes are logged, refer to section 17.3.

25.4 TROUBLESHOOTING FLASH CODE 13, PID 146/FMI 5

Flash Code 16 p146/5 indicates the ECM/ECU has detected too low a current measured from the Exhaust Gas Recirculation (EGR) valve.

Perform the following steps if the EGR valve current is low.

25.4.1 Check for Power Supply or Open Circuit

Check for a power supply issue or open circuit as follows:

1. Turn ignition ON.
2. Disconnect harness connector at the actuator control valve coil.

3. Check electrical power supply. With ignition on, check voltage at pin B to battery ground, it should be battery voltage. See Figure 25-5 .

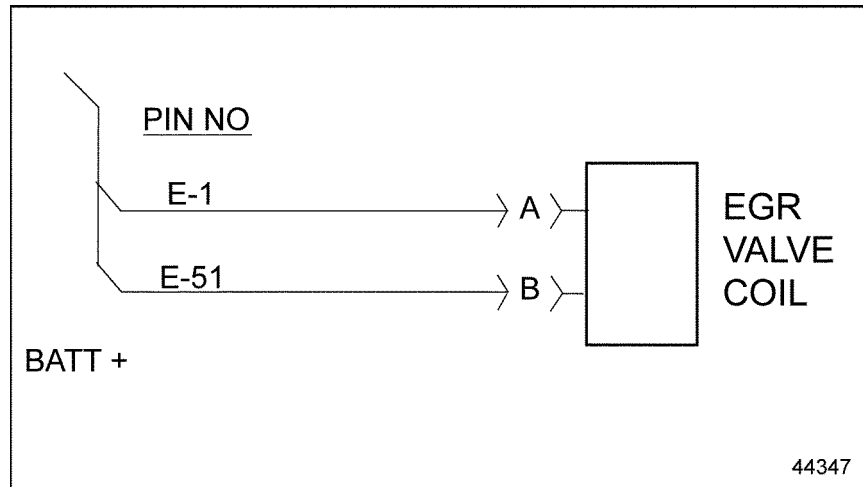


Figure 25-5 EGR Valve Coil Wiring

- [a] If battery voltage was read, refer to section 25.4.2.
- [b] If battery voltage was not read, replace the actuator. After replacement, refer to section 25.4.3.1.

25.4.2 Check Actuator Control Valve Coil Resistance

Check the actuator control valve coil resistance as follows:

1. Turn ignition OFF.
2. Disconnect engine harness connector at the ECM/ECU.
3. Insert a jumper wire between pins E-51 and E-1. See Figure 25-5.
4. Measure resistance between pins A and B at the EGR valve coil connector.
 - [a] If resistance is greater than 100 Ω this indicates E-51 or E-1 is open. Repair wire or replace harness and refer to section 25.4.3.1.
 - [b] If resistance is less than 100 Ω , refer to section 25.4.3.

25.4.3 Resistance at the EGR Valve Coil

Measure resistance at the EGR valve coil as follows:

1. Measure resistance at the EGR valve coil between pins A and B.
2. Compare the resistance read with values shown in Table 25-2 .
 - [a] If the resistance is too high or is open, replace the actuator. Once the actuator is replaced, refer to section 25.4.3.1.

[b] If the resistance was within specification, reprogram the ECM/ECU.

NOTE:

Coil varies with temperature. It is 3.8 ohms $\pm$ 10% at 22 °C and varies. See Table 25-2

Coil Temperature °C	Coil Temperature °F	Allowed Ranges (ohms)
22	71	3.4 - 4.2
50	122	3.7 - 4.6
100	212	4.4 - 5.4

Table 25-2 Ranges Allowed (ohms)

25.4.3.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Start and run engine.
5. Check DDR/DDDL codes.

[a] If no codes are displayed, no further troubleshooting is required.

[b] If any other codes are logged. Refer to section 19.18 .

[c] If code 146/5 returns contact the Detroit Diesel Customer Service Center (313-592-5800).

26 FLASH CODE 21 - TPS/AP SENSOR HIGH

Section	Page
26.1 DESCRIPTION OF FLASH CODE 21	26-3
26.2 TROUBLESHOOTING FLASH CODE 21, PID 91/FMI 3	26-3

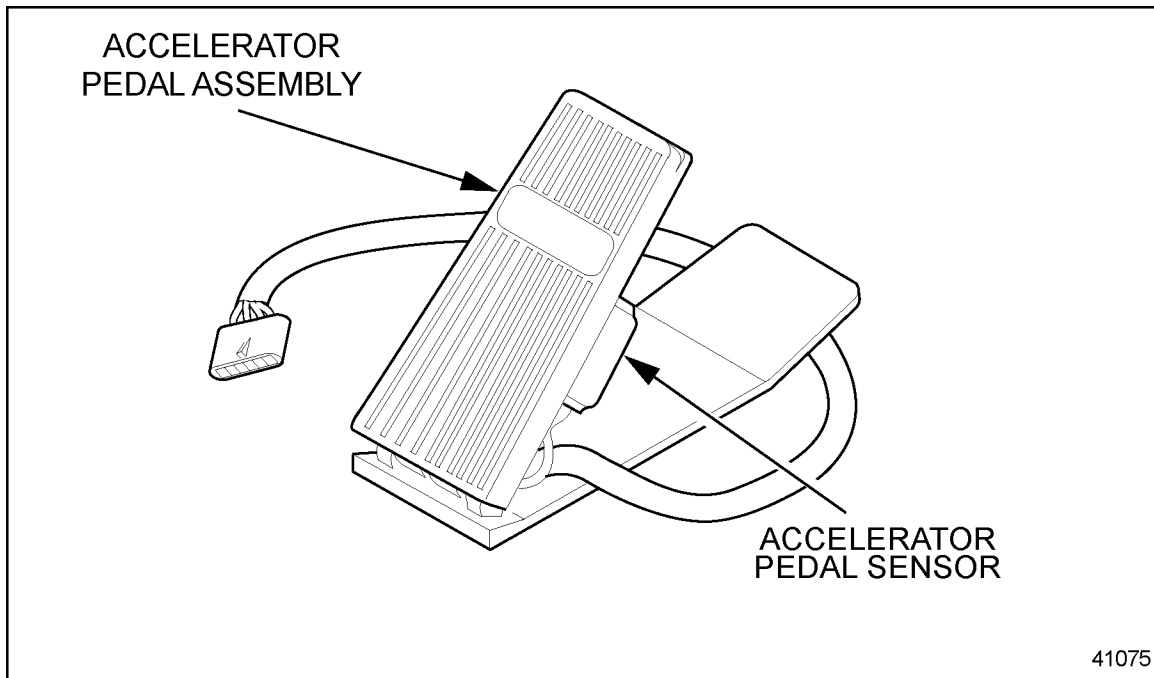


Figure 26-1 **TPS/AP Sensor**

26.1 DESCRIPTION OF FLASH CODE 21

The SAE J1587 equivalent code for Flash Code 21 is p 91/3, TPS/AP Sensor circuit high.

Flash Code 21 indicates that the Throttle Position Sensor (TPS)/AP Sensor, see Figure 26-1, input to the ECM/ECU has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

26.2 TROUBLESHOOTING FLASH CODE 21, PID 91/FMI 3

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply

Refer to section 26.2.1 for general throttle information. Refer to section 26.2.2 to begin troubleshooting.

26.2.1 General Throttle Information (Automotive Limiting Speed Governor)

The correct TPS/AP Sensor counts for DDEC V engines at idle should be 64 - 205 counts.

- ☐ Typical DDEC foot pedals today, at idle, provide 90–175 counts.
- ☐ The DDEC system will log a TPS/AP Sensor low volt code (PID 091, FMI 4, Flash Code 22) if the TPS/AP Sensor counts go below 48.
- ☐ The DDEC system will log a TPS/AP Sensor high volt code (PID 091, FMI 3, Flash Code 21) if the TPS/AP Sensor counts go above 968 counts.
- ☐ In order to go from 0% to 100% throttle, the counts have to increase 546 above the idle count, or 100 counts, whichever is greater.
- ☐ If an idle validation switch (IVS) is configured, to go from 0% to 100% throttle, the counts have to increase 546 above the counts at which the IVS opens or 100 counts, whichever is greater.
- ☐ If 0% throttle is attained with the foot off the pedal, and if 100% throttle is attained with the pedal to the floor, then the pedal should not be considered a factor for low power complaints.

26.2.2 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in diagnostic tool and read the active codes.
 - [a] If active code 91/3 and no other active codes are logged, refer to section 26.2.3.
 - [b] If any or all of the following codes are logged, p 91/3, p 91/4, p 187/3, p 100/3, refer to section 77.1.
 - [c] If any codes except p 91/3 are logged, refer to section 26.2.4.

26.2.3 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Unplug the TPS/AP Sensor connector.
3. Turn ignition ON.
4. Read for active codes.
 - [a] If active code p 91/3 and any other codes are logged, refer to section 26.2.8.
 - [b] If code p 91/4 is logged, refer to section 26.2.4.

26.2.4 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn ignition OFF.
2. Install a jumper wire between pin A (return #952) and pin B (signal #417) of the TPS/AP Sensor harness connector.
3. Disconnect the vehicle harness connector at the ECM/ECU.
4. Measure resistance between sockets V-60 and V-13 on the vehicle harness connector. For Throttle Position Sensor schematic, See Figure 26-2.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 26.2.5.
 - [b] If the resistance measurement is greater than 5 Ω , and the return line V-60 is open, repair the open and refer to section 26.2.9.1.

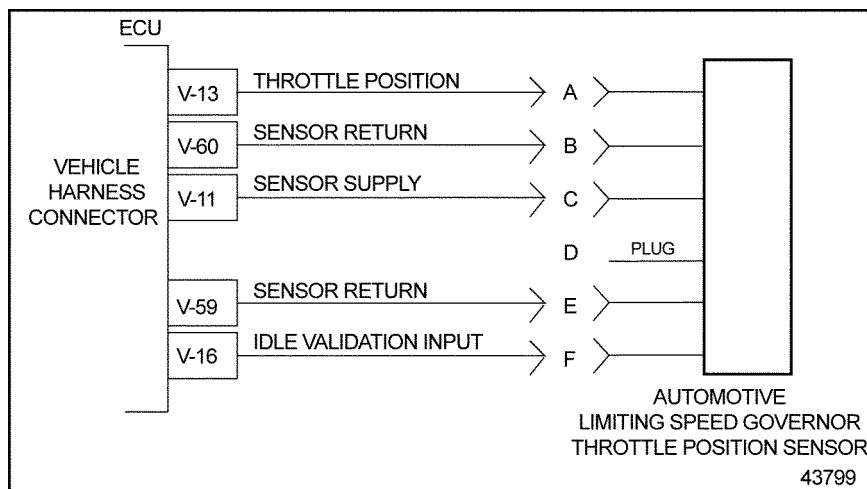


Figure 26-2 Throttle Position Sensor

26.2.5 Check Throttle Position Sensor Adjustment

Perform the following steps to check for TPS/AP Sensor adjustment.

1. Reconnect vehicle harness connector and plug in the TPS/AP Sensor.
2. Hook up your diagnostic tool and select Throttle Sensor Display.
3. Measure Throttle Counts at both no throttle and full throttle. Take several readings.
 - [a] If TPS/AP Sensor counts are ever greater than 968 counts, refer to section 26.2.6.
 - [b] If TPS/AP Sensor counts stay less than 968 counts, refer to section 26.2.7.

26.2.6 Throttle Position Sensor Adjustment

Perform the following steps to attempt TPS/AP Sensor adjustment.

1. Check for pedal or linkage interferences.
2. Loosen the TPS/AP Sensor screws and attempt to adjust for the correct throttle reading (64 - 205 counts). Do not attempt to adjust by bending the pedal mechanism.
3. Recheck counts at idle and at full throttle.
 - [a] If the throttle counts are not correct, refer to section 26.2.7.
 - [b] If the throttle counts are now correct, refer to section 26.2.9.1.

26.2.7 Check Throttle Position Sensor Connectors

Perform the following steps to check the TPS/AP Sensor connectors.

1. Check terminals at the TPS/AP Sensor connector (both sensor and harness side) for bent, corroded and unseated pins or sockets. See Figure 26-3.

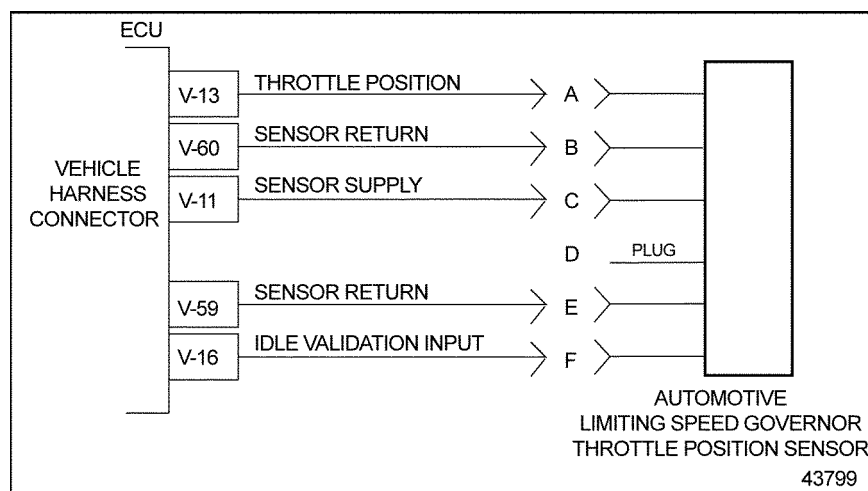


Figure 26-3 Throttle Position Sensor

- [a] If the terminals or connectors are damaged, repair both and refer to section 26.2.9.1.
- [b] If the terminals or connectors are not damaged, replace the TPS/AP Sensor; refer to section 26.2.9.1.

26.2.8 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU. Unplug the TPS/AP Sensor connector.
3. Read resistance between sockets V-13 and V-11 on the vehicle harness connector. For ECM/ECU vehicle harness connector, see Figure 26-4.
 - [a] If the resistance is greater than 100 Ω or open, refer to section 26.2.9.
 - [b] If the resistance is less than or equal to 100 Ω , the signal line (V-13) is shorted to the vehicle +5 volt line (V-11). Repair the short and refer to section 26.2.9.1.

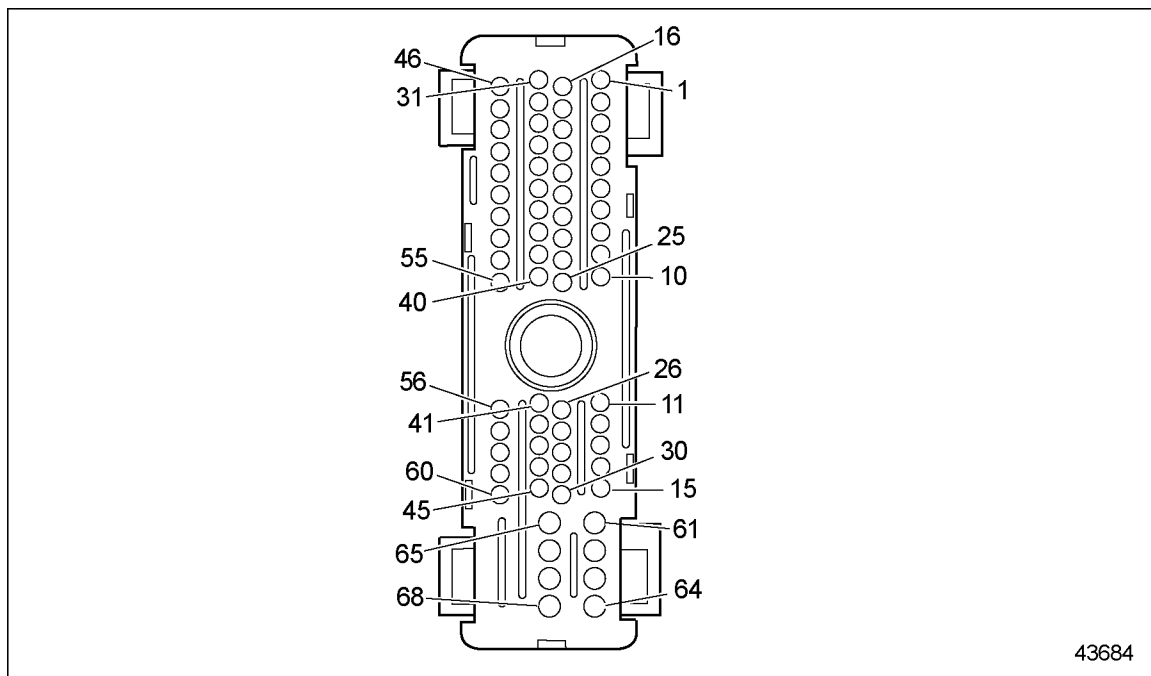


Figure 26-4 ECM/ECU Vehicle Harness Connector

26.2.9 Check for Short to Battery

Perform the following steps to check for a short to the battery.

1. Remove both fuses to the ECM/ECU.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Measure resistance between socket V-13 on the vehicle harness connector and the power sockets V-61 and V-65. See Figure 26-5.
 - [a] If the resistance is greater than 100 Ω , go to step 4.
 - [b] If the resistance is less than or equal to 100 Ω , a short exists between sockets where less than 100 Ω resistance was read. Repair short and reinsert fuses. Refer to section 26.2.9.1.

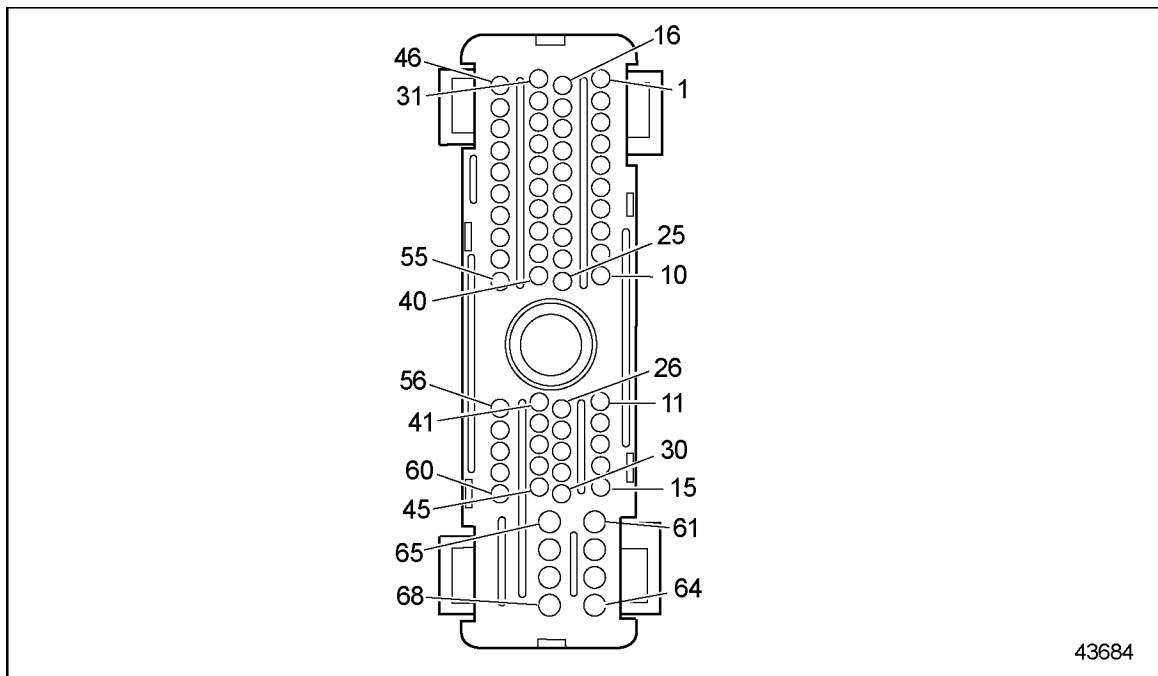


Figure 26-5 ECM/ECU Vehicle Harness Connector

4. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for bent, corroded and unseated pins or sockets. See Figure 26-5.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 26.2.9.1.
 - [b] If terminals and connectors are not damaged, refer to section 26.2.2, to review this section. If review leads back here, install a test ECM/ECU or contact Detroit Diesel Customer Support Center (313-592-5800).

26.2.9.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF and reconnect all connectors.
2. Turn ignition ON and clear diagnostic tool codes.
3. Start and run the engine for one minute. Check idle position and full throttle.
4. Stop engine.
5. Check diagnostic tool for codes.
 - [a] If no codes are displayed, troubleshooting is complete.
 - [b] If code p 91/3 is not logged, and other codes are logged, refer to section 17.3.
 - [c] If code p 91/3 is logged, and other codes are logged, all system diagnostics are complete. If a problem still exists, review this section from the first step to troubleshoot the error, refer to section 26.2.2.

27 FLASH CODE 22 - TPS/AP SENSOR LOW

Section	Page
27.1 DESCRIPTION OF FLASH CODE 22	27-3
27.2 TROUBLESHOOTING FLASH CODE 22, PID 91/FMI 4	27-3

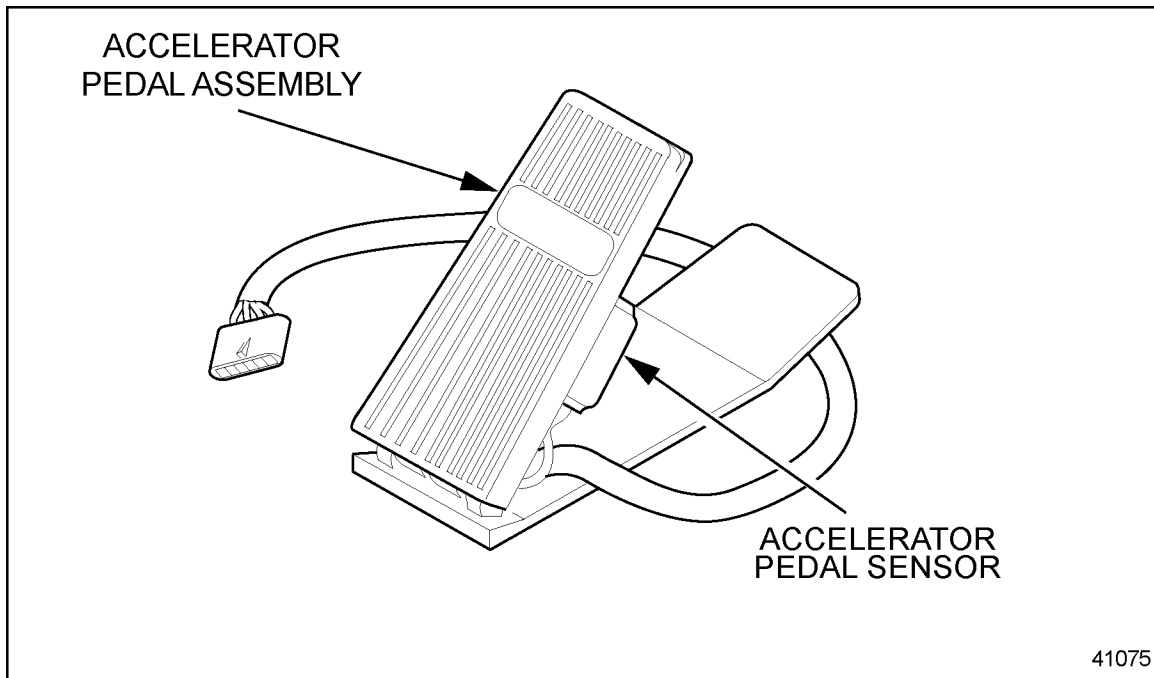


Figure 27-1 Throttle Position Sensor/Accelerator Pedal Sensor

27.1 DESCRIPTION OF FLASH CODE 22

The SAE J1587 equivalent code for Flash Code 22 is p 91/4, TPS/AP Sensor circuit low.

Flash Code 22 indicates that the Throttle Position Sensor (TPS)/Accelerator Pedal Sensor (AP Sensor), see Figure 27-1, input to the ECM/ECU has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

27.2 TROUBLESHOOTING FLASH CODE 22, PID 91/FMI 4

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground

Refer to section 27.2.1 for general throttle information, refer to section 27.2.2 to begin troubleshooting Flash Code 22.

27.2.1 General Throttle Information (Automotive Limiting Speed Governor)

The correct TPS/AP Sensor counts for DDEC engines at idle should be 64 - 205 counts.

- ☐ Typical DDEC V foot pedals today, at idle, provide 90–175 counts.
- ☐ The DDEC system will log a TPS/AP Sensor low volt code (PID 91, FMI 4, Flash Code 22) if the TPS/AP Sensor counts go below 48.
- ☐ The DDEC system will log a TPS/AP Sensor high volt code (PID 91, FMI 3, Flash Code 21) if the TPS/AP Sensor counts go above 968 counts.
- ☐ In order to go from 0% to 100% throttle, the counts have to increase 546 above the idle count, or 100 counts, whichever is greater.
- ☐ If an idle validation switch (IVS) is configured, to go from 0% to 100% throttle, the counts have to increase 546 above the counts at which the IVS opens or 100 counts, whichever is greater.
- ☐ If 0% throttle is attained with the foot off the pedal, and if 100% throttle is attained with the pedal to the floor, then the pedal should not be considered a factor for low power complaints.

27.2.2 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in diagnostic tool.
3. Read active codes.

[a] If active code p 91/4 and no other active codes are logged, refer to section 27.2.3.

- [b] If code p 91/4 and any or all of the following codes are logged, p 91/3, p 187/4, or p 100/4, refer to section 77.1.
- [c] If codes other than the above are logged, refer to section 17.3.

27.2.3 Check for Device

Perform the following steps to check for device.

1. If there is a throttle (Automotive Limiting Speed Governor [ALSG]) wired to use the V-13 (ALSG) circuit, refer to section 27.2.4.
 2. If there is no throttle (ALSG) wired to use the V-13 (ALSG) circuit, contact Detroit Diesel Customer Support Center (313-592-5800), for possible change to the calibration.
- [a] If required, reprogram the ECM/ECU after the mainframe is changed and refer to section 27.2.13.1.

27.2.4 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
 2. Disconnect the TPS/AP Sensor connector.
 3. Install a jumper wire between sockets A and V-13, C and V-11. See Figure 27-2.
 4. Turn ignition ON.
 5. Read active codes.
- [a] If code p 91/4 and any other codes are logged, refer to section 27.2.7.
- [b] If code p 91/3 and any other codes are logged, refer to section 27.2.5.

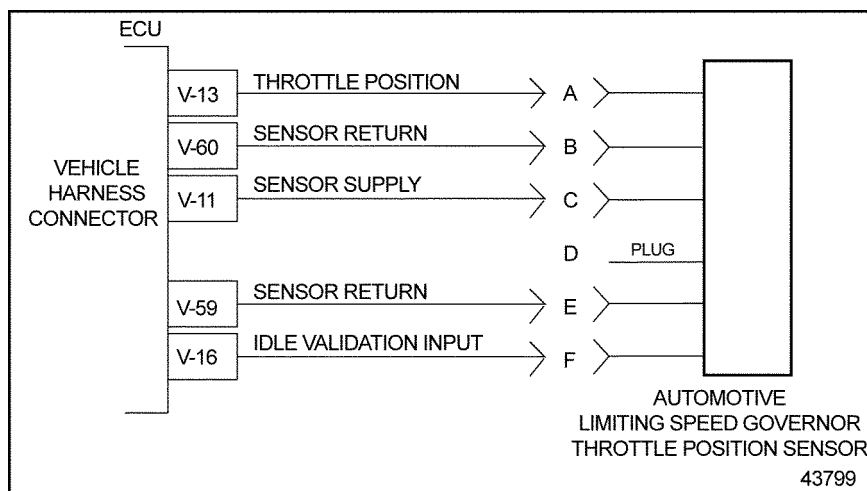


Figure 27-2 Throttle Position Sensor

27.2.5 Check Throttle Position Sensor Adjustment

Perform the following steps to check the TPS/AP Sensor adjustment:

1. Remove jumper and reconnect TPS/AP Sensor.
2. Hook up diagnostic tool and select TPS/AP Sensor - Counts.
3. Read Throttle Counts at both no throttle and full throttle positions. Take several readings.
 - [a] If at any time counts go lower than 49 counts, refer to section 27.2.6.
 - [b] If counts never go lower than 49 counts, go to step 4.
4. Check terminals at the TPS/AP Sensor connector (both sensor and harness side) for bent, corroded, and unseated pins or sockets.
 - [a] If the terminals or the connectors are damaged, repair them. Refer to section 27.2.13.1.
 - [b] If the terminals and connectors are not damaged, replace the TPS/AP Sensor and refer to section 27.2.13.1.

27.2.6 Attempt Throttle Position Sensor Adjustment

Perform the following steps to attempt a TPS/AP Sensor adjustment:

1. Check for pedal or linkage interferences.
2. Loosen the TPS/AP Sensor screws and attempt to adjust for the correct throttle reading (normal range - 64-205 counts). Do not attempt to adjust by bending the pedal mechanism.
3. Recheck counts at idle and at full throttle.
 - [a] If the throttle count has been corrected, refer to section 27.2.13.1.
 - [b] If the problem could not be corrected, go to step 4.
4. Check terminals at the TPS/AP Sensor connector (both sensor and harness side) for bent, corroded, and unseated pins or sockets.
 - [a] If the terminals or the connectors are damaged, repair them. Refer to section 27.2.13.1.
 - [b] If the terminals and connectors are not damaged, replace the TPS/AP Sensor and refer to section 27.2.13.1.

27.2.7 Check for +5 Volts

Perform the following steps to check for +5 volts:

1. Remove jumper wire.
2. Turn ignition ON.
3. Measure voltage on TPS/AP Sensor harness connector, socket C and V-11 (red lead) to socket B and V-60.

- [a] If measured voltage is greater than 6 volts, refer to section 27.2.12.
- [b] If measured voltage is less than 4 volts, refer to section 27.2.10.
- [c] If measured voltage is between 4 and 6 volts, refer to section 27.2.8.

27.2.8 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Measure resistance between sockets B and V-60, A and V-13 at the TPS/AP Sensor harness connector. See Figure 27-3.
4. Measure resistance between socket A and V-13 and a good ground (battery ground and chassis ground).
 - [a] If resistance measurement is less than or equal to 100 Ω , the signal line V-13 is shorted to the return line V-60 or battery ground. Repair short. Refer to section 27.2.13.1.
 - [b] If resistance measurement on both readings is greater than 100 Ω or open, refer to section 27.2.9.

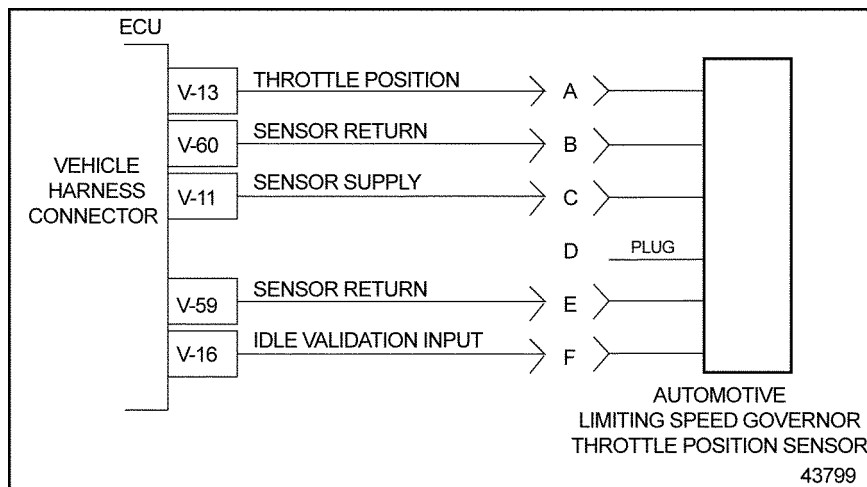


Figure 27-3 Throttle Position Sensor

27.2.9 Check for Signal Open

Perform the following steps to check for signal open:

1. Install a jumper wire between sockets A and V-13, B and V-60 of the TPS/AP Sensor harness connector.
2. Measure resistance between sockets V-13 and V-60 on the vehicle connector.
 - [a] If the resistance is less than or equal to 5 Ω , go to step 3.

- [b] If the resistance is greater than 5 Ω or open, the signal line V-13 or return line V-60 are open, repair the open. Refer to section 27.2.13.1.
- 3. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for bent, corroded, and unseated pins or sockets. See Figure 27-4.

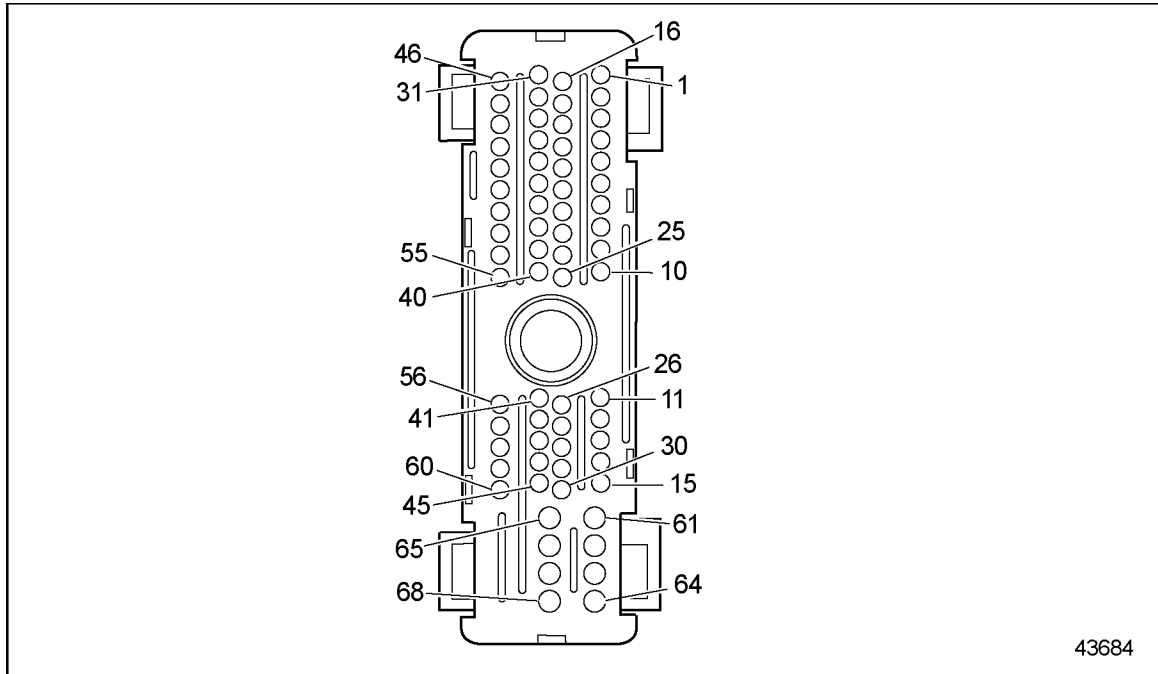


Figure 27-4 ECM/ECU Vehicle Harness Connector

- [a] If terminals and connectors are damaged, repair them. Refer to section 27.2.13.1.
- [b] If terminals and connectors are not damaged, call Detroit Diesel Customer Support Center (313-592-5800) for assistance.

27.2.10 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF and disconnect the vehicle harness connector at the ECM/ECU.
2. Measure resistance between sockets B and V-60, C and V-11 on the TPS/AP Sensor harness connector. See Figure 27-4.
 - [a] If resistance between sockets A and C is greater than 1,000 Ω or open, refer to section 27.2.11.
 - [b] If resistance between sockets A and C is less than or equal to 1,000 Ω , the 5V wire (V-11) is shorted to the return (V-60). Repair the short and refer to section 27.2.13.1.

27.2.11 Check for Open +5 Volt Line

Perform the following steps to check for an open +5 volt line:

1. Install a jumper wire between sockets B and V-60 and C and V-11 on the TPS/AP Sensor harness connector.
2. Measure resistance between sockets V-11 and V-60 on the vehicle harness connector. See Figure 27-5.
 - [a] If resistance between sockets V-11 and V-60 is less than or equal to 5 Ω , go to step 3.
 - [b] If resistance between sockets V-11 and V-60 is greater than or equal to 5 Ω or open, the vehicle +5 volt line (V-11) is open. Repair the open. Refer to section 27.2.13.1.

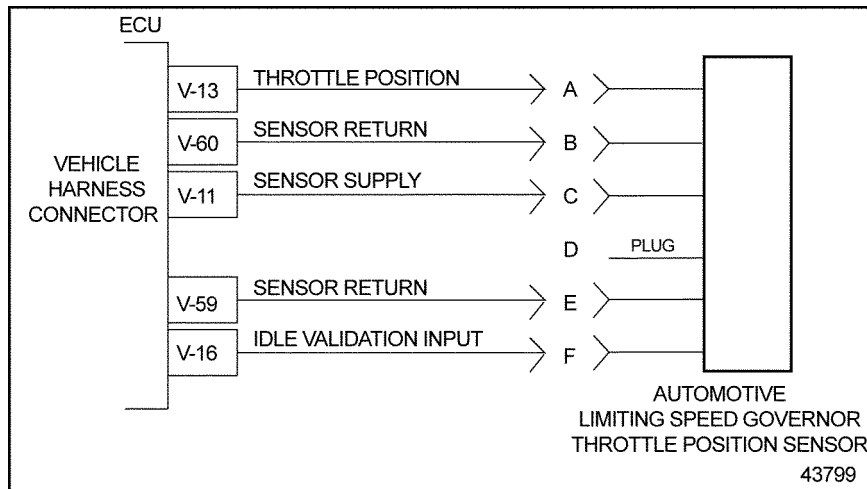


Figure 27-5 Throttle Position Sensor

3. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for bent, corroded, and unseated pins or sockets. See Figure 27-4.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 27.2.13.1.
 - [b] If terminals and connectors are not damaged, call Detroit Diesel Customer Support Center (313-592-5800) for assistance.

27.2.12 Check for Short to Battery +

Perform the following steps to check for a short to the battery +:

1. Turn ignition OFF.
2. Remove both fuses to ECM/ECU.
3. Disconnect the vehicle connector at the ECM/ECU.
4. Measure resistance between socket V-13 on the vehicle harness connector and socket V-61 and V-65. See Figure 27-6.

- [a] If measured resistance is greater than 100 Ω or open, refer to section 27.2.13.
- [b] If measured resistance is less than or equal to 100 Ω , a short exists between sockets where resistance was measured. Repair short and reinsert fuses; refer to section 27.2.13.1.

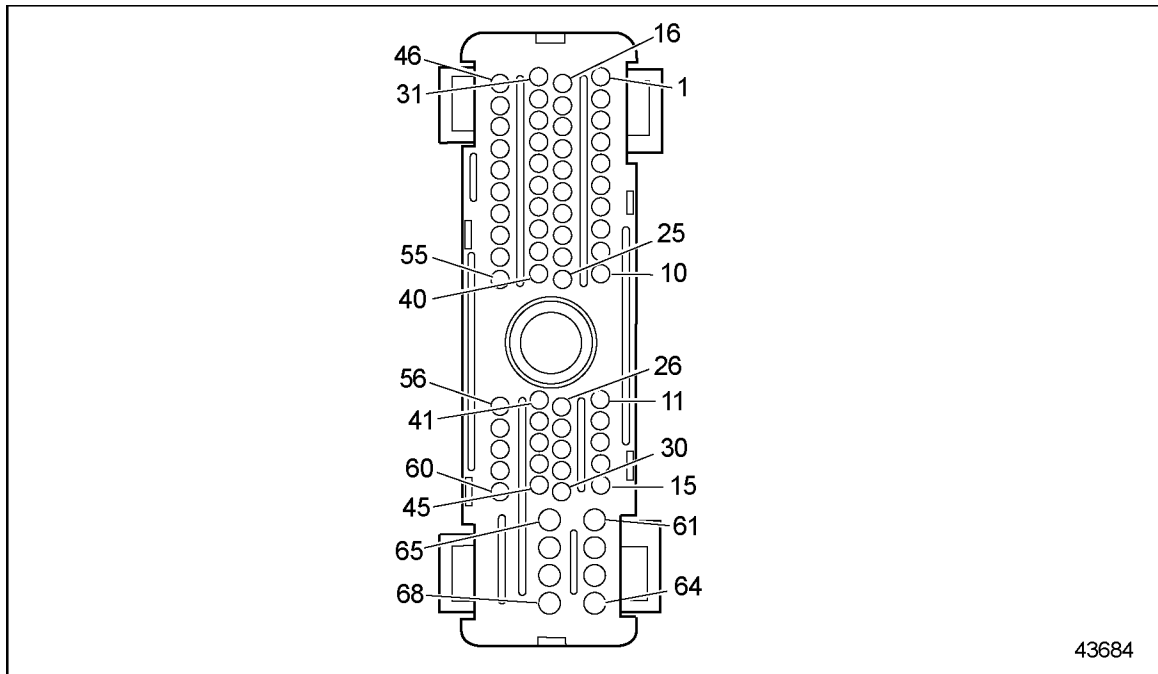


Figure 27-6 ECM/ECU Vehicle Harness Connector

27.2.13 Check for Outside DDEC Battery +

Perform the following steps to check for outside DDEC battery +:

1. Turn ignition OFF.
2. Remove ECM/ECU vehicle harness connector.
3. Turn ignition ON.
4. Measure voltage V-11 (red lead) to battery ground.
5. Measure voltage V-60 (red lead) to battery ground.
 - [a] If measured voltage is less than 0.2 volts, go to step 6.
 - [b] If measured voltage is greater than 0.2 volts, outside power is spliced/shorted into either line V-60 or line V-11. Remove the splice/short. Refer to section 27.2.13.1.
6. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for bent, corroded, and unseated pins or sockets. See Figure 27-4.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 27.2.13.1.
 - [b] If terminals and connectors are not damaged, call Detroit Diesel Customer Support Center (313-592-5800) for assistance.

27.2.13.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with diagnostic tool.
5. Start and run the engine for one minute at all throttle positions.
6. Stop engine.
7. Read active codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code 91/4 and any other codes are logged, all system diagnostics are complete.
Review this section from the first step to find the error. Refer to section 27.2.2.
 - [c] If code 91/4 is not logged, but other codes are logged, refer to section 17.3.

28 FLASH CODE 23 - SUPPLY FUEL TEMP SENSOR HIGH

Section	Page
28.1 DESCRIPTION OF FLASH CODE 23	28-3
28.2 TROUBLESHOOTING FLASH CODE 23, PID 174/FMI 3	28-3

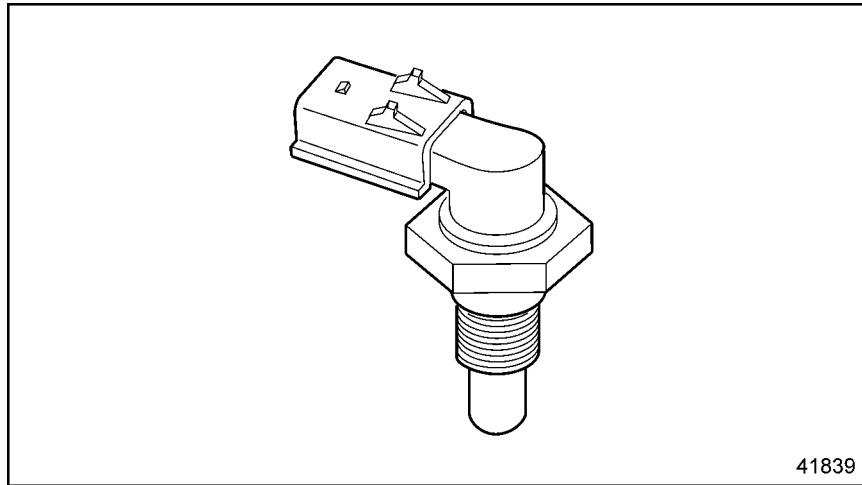


Figure 28-1 Supply Fuel Temperature Sensor – Series 60

28.1 DESCRIPTION OF FLASH CODE 23

The SAE J1587 equivalent code for Flash Code 23 is p 174/3, fuel temperature circuit high.

Flash Code 23 indicates that the Fuel Temperature Sensor (FTS)/Supply Fuel Temperature Sensor (SFT Sensor), see Figure 28-1, input to the ECM/ECU has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

28.2 TROUBLESHOOTING FLASH CODE 23, PID 174/FMI 3

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor circuit return
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply

NOTE:

This code will only be logged during warm engine operation.

The following procedure will troubleshoot Flash Code 23.

28.2.1 Sensor Check

Perform the following steps to check the FTS/SFT Sensor:

1. Turn ignition OFF.
2. Disconnect the FTS/SFT Sensor connector.
3. Install a jumper wire between sockets 1 and 2 of the FTS/SFT Sensor harness connector. see Figure 28-2.

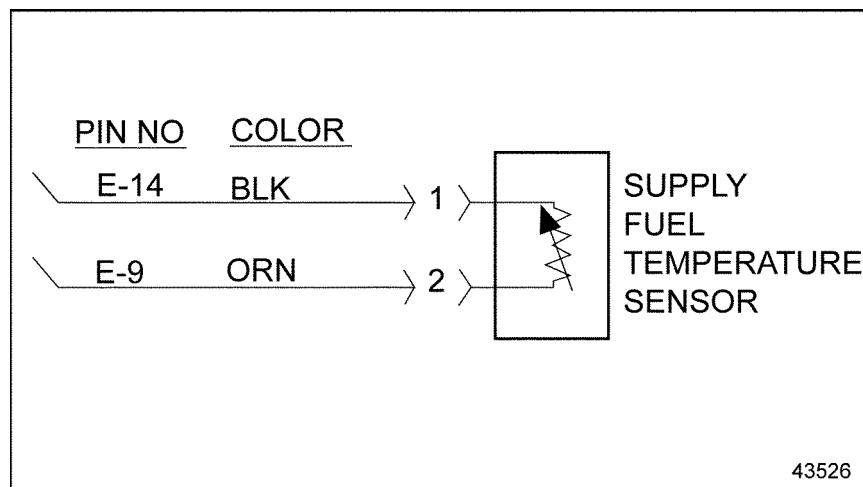


Figure 28-2 Supply Fuel Temperature Sensor

4. Turn ignition ON.

5. Read active codes.

[a] If code p 174/4 and any other codes except code p 174/3 are logged, refer to section 28.2.2.

[b] If any code except p 174/4 is logged, refer to section 28.2.3.

28.2.2 Check for Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn ignition OFF.

2. Remove jumper wire.

3. Disconnect the Engine Harness connector at the ECM/ECU.

4. Measure resistance between sockets E-9 and E-14 on the Engine Harness connector. See Figure 28-3.

[a] If the measured resistance is greater than 100 Ω or open, go to step 5.

[b] If the measured resistance is less than or equal to 100 Ω , the signal line E-9 is shorted to the engine +5 volt line. Repair the short; refer to section 28.2.3.1.

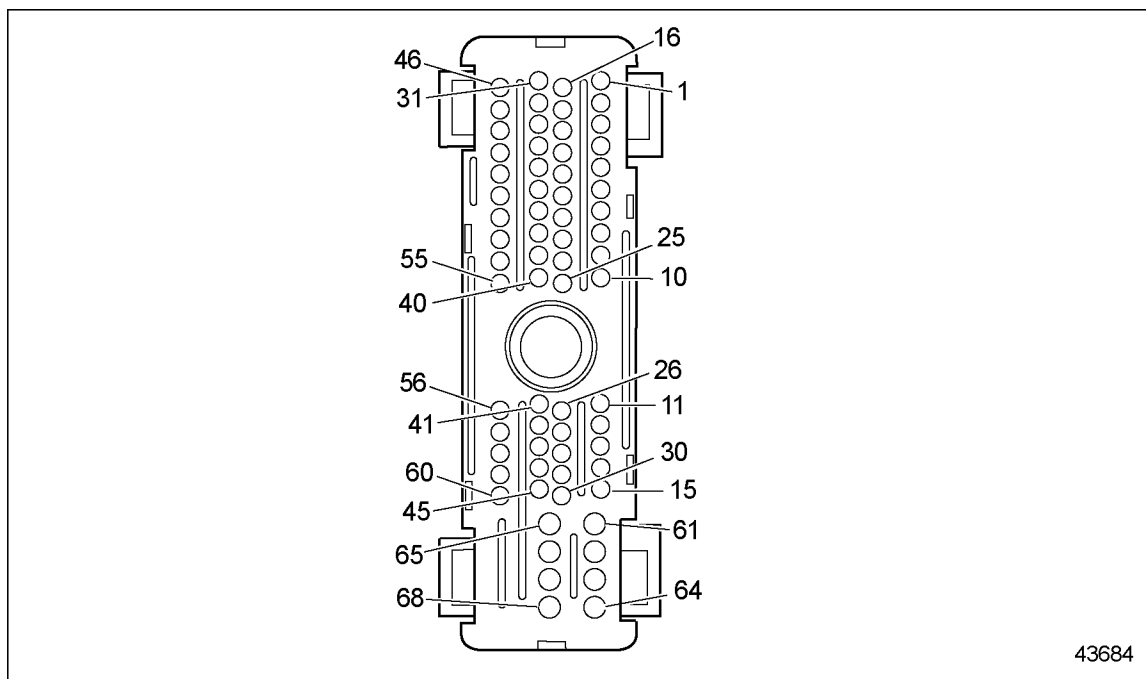


Figure 28-3 ECM/ECU Engine Harness Connector

5. Check terminals at the FTS/SFT Sensor harness connector (both sensor and harness side) for bent, corroded, and unseated pins or sockets. See Figure 28-4.

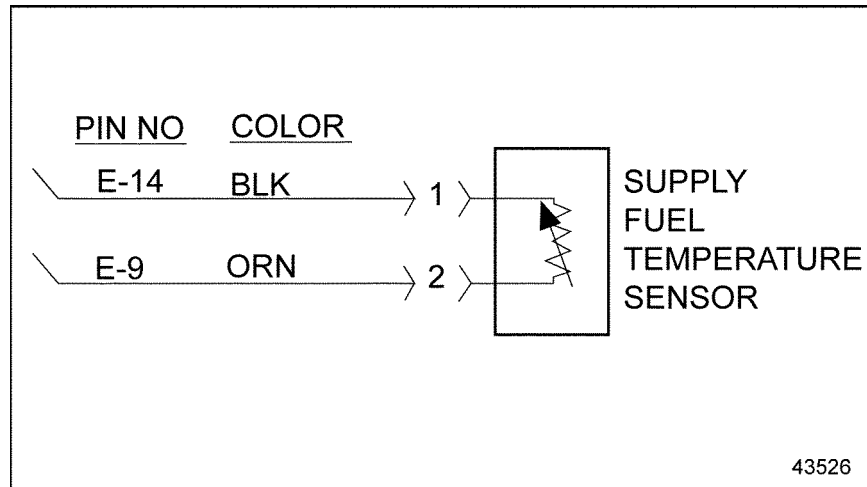


Figure 28-4 Supply Fuel Temperature Sensor

- [a] If terminals and connectors are damaged, repair them. Refer to section 28.2.3.1.
- [b] If terminals and connectors are not damaged, replace the FTS/SFT Sensor. Refer to section 28.2.3.1.

28.2.3 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the Engine Harness connector at the ECM/ECU. The jumper wire is still in place at the FTS/SFT Sensor connector.
3. Measure resistance between sockets E-9 and E-14 on the Engine Harness connector. See Figure 28-5.
 - [a] If the measured resistance is greater than 5 Ω or open, the signal line E-9 or return line E-14 is open. Repair the open; refer to section 28.2.3.1.
 - [b] If the measured resistance is less than or equal to 5 Ω , go to step 4.

4. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for bent, corroded, and unseated pins or sockets. See Figure 28-5.

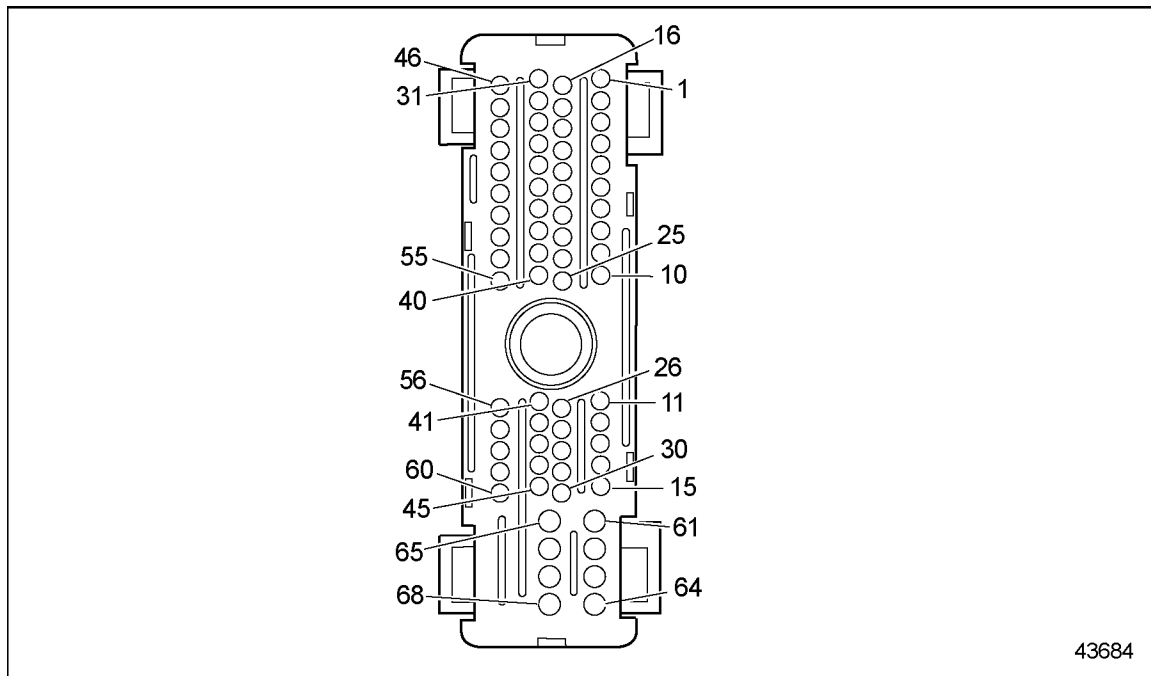


Figure 28-5 ECM/ECU Engine Harness Connector

- [a] If terminals and connectors are damaged, repair them. Refer to section 28.2.3.1.
- [b] If terminals and connectors are not damaged, install a test ECM/ECU. Refer to section 28.2.3.1.

28.2.3.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF and reconnect all connectors.
2. Turn ignition ON and clear codes with the diagnostic tool.
3. Start and run the engine for eight minutes.
4. Stop engine.
5. Read codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code p 174/3 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 28.2.1.
 - [c] If code p 174/3 is not logged, but other codes are logged, refer to section 17.3.

29 FLASH CODE 24 - SUPPLY FUEL TEMP SENSOR LOW

Section	Page
29.1 DESCRIPTION OF FLASH CODE 24	29-3
29.2 TROUBLESHOOTING FLASH CODE 24, PID 174/FMI 4	29-3

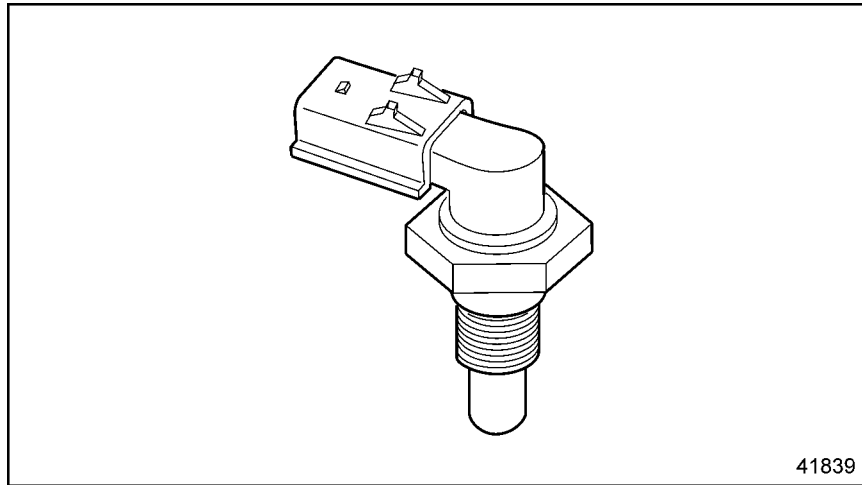


Figure 29-1 Supply Fuel Temperature Sensor – Series 60

29.1 DESCRIPTION OF FLASH CODE 24

The SAE J1587 equivalent code for Flash Code 24 is p 174/4, fuel temperature circuit low.

Flash Code 24 indicates that the engine Fuel Temperature Sensor (FTS)/Supply Fuel Temperature Sensor (SFT Sensor), see Figure 29-1, input to the ECM/ECU has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

29.2 TROUBLESHOOTING FLASH CODE 24, PID 174/FMI 4

This diagnostic condition is typically sensor signal circuit is shorted to sensor return circuit or to ground.

The following procedure will troubleshoot Flash Code 24.

29.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in diagnostic tool.
3. Read active codes.
 - [a] If active code p 174/4 and no other active codes are logged, refer to section 29.2.2.
 - [b] If any or all of the following codes are logged, p 110/3, p 175/3, p 174/3, or p 102/3, refer to section 77.1.
 - [c] If codes other than the above are logged, refer to section 29.2.2.

29.2.2 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
2. Disconnect the FTS/SFT Sensor connector.
3. Start and run engine for eight minutes.
4. Read active codes with engine still running.
 - [a] If code p 174/4 and any other codes are logged, refer to section 29.2.4.
 - [b] If code p 174/3 and any other codes except p 174/4 are logged, refer to section 29.2.3.

29.2.3 Check Fuel Temperature Sensor Connectors

Check terminals at the FTS/SFT Sensor connector (both sensor and harness side) for bent, corroded, and unseated pins or sockets. See Figure 29-2.

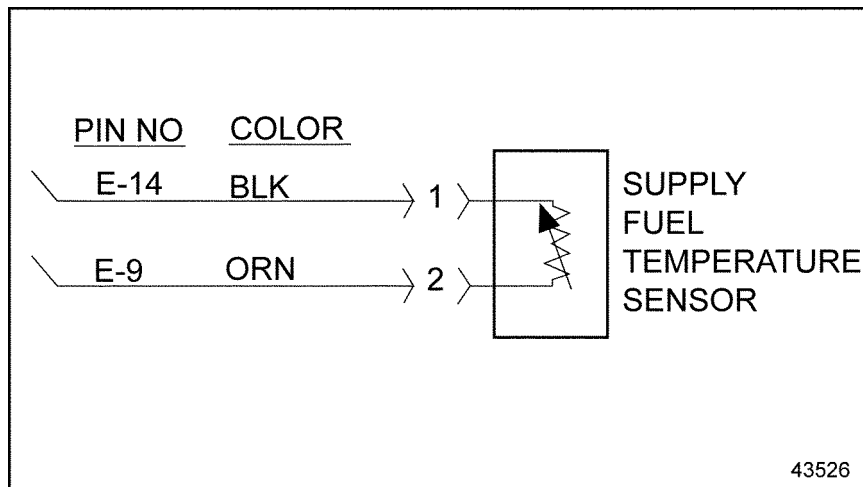


Figure 29-2 Supply Fuel Temperature Sensor

If terminals and connectors are damaged, repair them. Refer to section 29.2.5.1.

If terminals and connectors are not damaged, replace the FTS/SFT Sensor. Refer to section 29.2.5.1.

29.2.4 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM/ECU.
3. Measure resistance between sockets E-9 and E-14 on the engine harness connector. See Figure 29-3.
4. Measure resistance between socket E-9 and a good ground (battery ground and chassis ground).
 - [a] If resistance between sockets E-9 and E-14, or E9 and battery ground, is less than or equal to 10,000 Ω , the signal line (E-9) is shorted to the return line (E-14) or battery ground. Repair short. Refer to section 29.2.5.1.

- [b] If resistance between sockets E-9 and E-14 is greater than 10,000 Ω or open, and resistance between socket 2 and a good ground is greater than 10,000 Ω or open, refer to section 29.2.5.

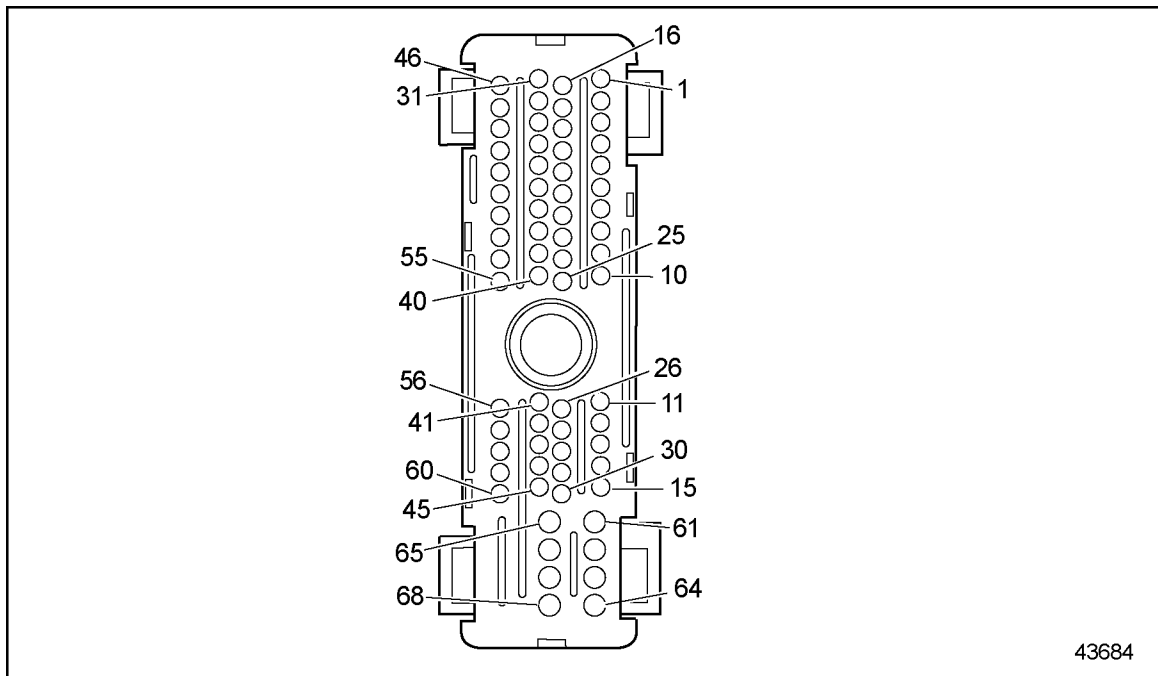


Figure 29-3 ECM/ECU Engine Harness Connector

29.2.5 Check ECM/ECU Connectors

Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for bent, corroded, and unseated pins or sockets. See Figure 29-3.

If terminals and connectors are damaged, repair them. Refer to section 29.2.5.1.

If terminals and connectors are not damaged, contact Detroit Diesel Customer Support Center (313-592-5800). Refer to section 29.2.5.1.

29.2.5.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with diagnostic tool.
5. Start and run the engine for eight minutes.
6. Stop engine.

7. Read active codes.

- [a] If no codes are logged, troubleshooting is complete.
- [b] If code p 174/4 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 29.2.1.
- [c] If code p 174/4 is not logged, but other codes are logged, refer to section 17.3.

30 FLASH CODE 26 - AUXILIARY SHUTDOWN ACTIVE

Section	Page
30.1 DESCRIPTION OF FLASH CODE 26	30-3
30.2 TROUBLESHOOTING FLASH CODE 26, SID 25, 61/FMI 11	30-3

30.1 DESCRIPTION OF FLASH CODE 26

The SAE J1587 equivalent codes for Flash Code 26 are:

- s 25/11 - auxiliary shutdown #1 active
- s 61/11 - auxiliary shutdown #2 active

Flash Code 26 s 25/11 indicates that the Auxiliary Engine Shutdown #1 switch input to the ECM/ECU is active.

Flash Code 26 s 61/11 indicates that the Auxiliary Engine Shutdown #2 switch input to the ECM/ECU is active.

30.2 TROUBLESHOOTING FLASH CODE 26, SID 25, 61/FMI 11

The active switch input represents a low (grounded) external input circuit to the ECM/ECU.

The following procedure will troubleshoot Flash Code 26.

30.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON. Start and run the engine.
2. Plug in diagnostic tool.
3. Read active codes.
 - [a] If codes s 25/11 or s 61/11 are logged, refer to section 30.2.2.
 - [b] If codes s 25/11 and s 61/11 are not logged, refer to section 17.3.

30.2.2 Check Calibration Configuration

Perform the following steps to check the calibration configuration:

1. Select ECM/ECU input/output configuration.
2. Determine cavity and wire number that is causing code to be logged.
3. Select switch/light status.
4. Determine status of that wire/cavity.
 - [a] If the switch reads OFF, refer to section 30.2.3.
 - [b] If the switch reads ON, the OEM supplied switch/relay is grounding the wire or a short to ground exists. Determine OEM supplied device or repair the short. Refer to section 30.2.3.1.
 - [c] If no OEM device is used, remove the wire from the connector and plug, or use programming station to disable the function.

30.2.3 Confirm Switch Status

Perform the following steps to confirm switch status:

1. Start and run the engine for one minute.
2. Again, read switch status.
 - [a] If the switch reads OFF, the condition no longer exists. Contact the OEM to learn which item is wired to this cavity. Refer to section 30.2.3.1.
 - [b] If the switch reads ON, the OEM supplied device is grounding this wire. Contact the OEM for repair procedure. Refer to section 30.2.3.1.

30.2.3.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition ON.
2. Clear codes with diagnostic tool.
3. Note status of CEL/AWL/SEL/RSL.
4. If the CEL/AWL/SEL/RSL are not on, start and run the engine for one minute.
5. Read active and inactive codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If codes 25 or 61/11 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 30.2.1.
 - [c] If codes 25 or 61/11 are not logged, but other codes are logged, refer to section 17.3.

31 FLASH CODE 27 - INTAKE AIR TEMP SENSOR HIGH

Section	Page
31.1 DESCRIPTION OF FLASH CODE 27	31-3
31.2 TROUBLESHOOTING FLASH CODE 27, PID 172/FMI 3	31-3

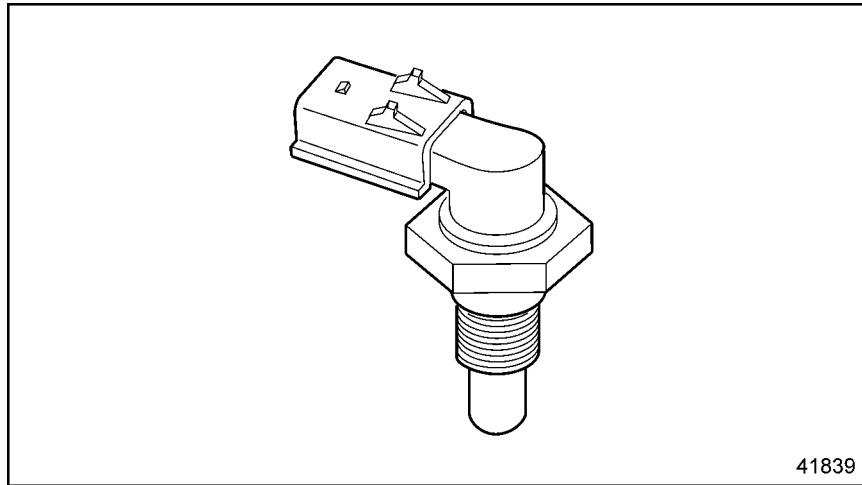


Figure 31-1 Intake Air Temperature Sensor

31.1 DESCRIPTION OF FLASH CODE 27

The SAE J1587 equivalent code for Flash Code 27 is p 172/3, air temperature circuit high.

Flash Code 27 indicates that the engine Air Temperature Sensor (ATS)/Intake Air Temperature Sensor (IAT Sensor), see Figure 31-1, input to the ECM/ECU has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

31.2 TROUBLESHOOTING FLASH CODE 27, PID 172/FMI 3

This diagnostic condition is typically open sensor signal or return circuit.

NOTE:

This code will only be logged during warm engine operation.

The following procedure will troubleshoot Flash Code 27.

31.2.1 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect ATS/IAT Sensor connector.
3. Install a jumper wire between sockets 1 and 2 of the ATS/IAT Sensor harness connector. See Figure 31-2.

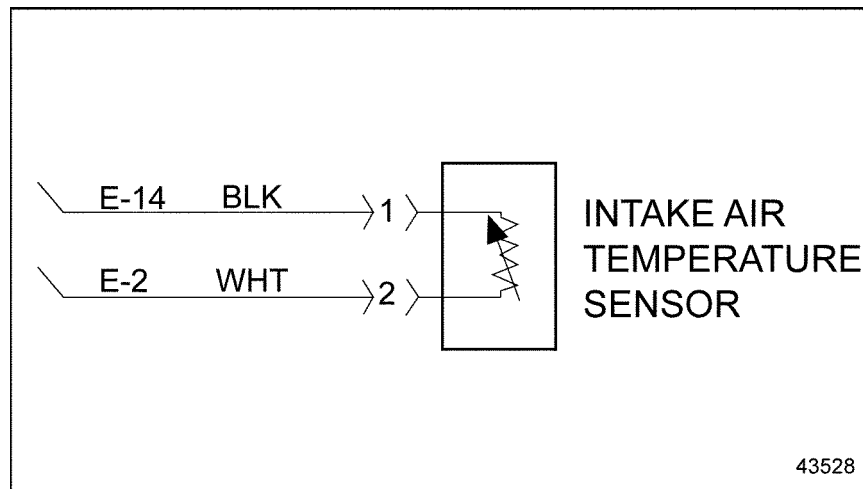


Figure 31-2 Intake Air Temperature Sensor

4. Turn ignition ON.
5. Start and run engine for one minute; (ensure oil temp is greater than 140°F).
6. Read active codes.

- [a] If code p 172/4 or any other codes except p 172/3 are logged, refer to section 31.2.2.
- [b] If any codes except code p 172/4 are logged, refer to section 31.2.3.

31.2.2 Check for Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn ignition/engine OFF.
 2. Remove jumper wire.
 3. Disconnect the engine harness connector at the ECM/ECU.
 4. Measure resistance between sockets E-2 and E-14 on the engine harness connector.
See Figure 31-3.
- [a] If the resistance measurement is less than or equal to 10 Ω , the signal line E-2 is shorted to the engine +5 volt line (E-14). Repair the short and refer to section 31.2.4.1.
 - [b] If the resistance measurement between sockets E-2 and E-14 is greater than 10 Ω or open, go to step 5.

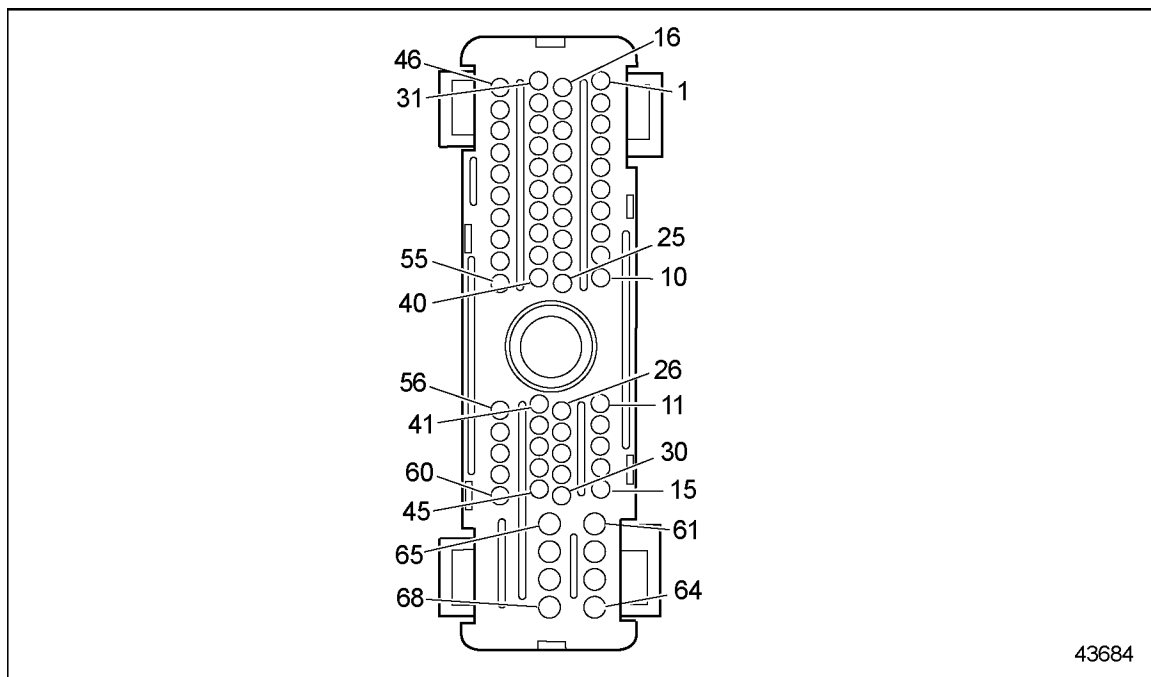


Figure 31-3 ECM/ECU Engine Harness Connector

5. Check terminals at the ATS/IAT Sensor connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure 31-4.

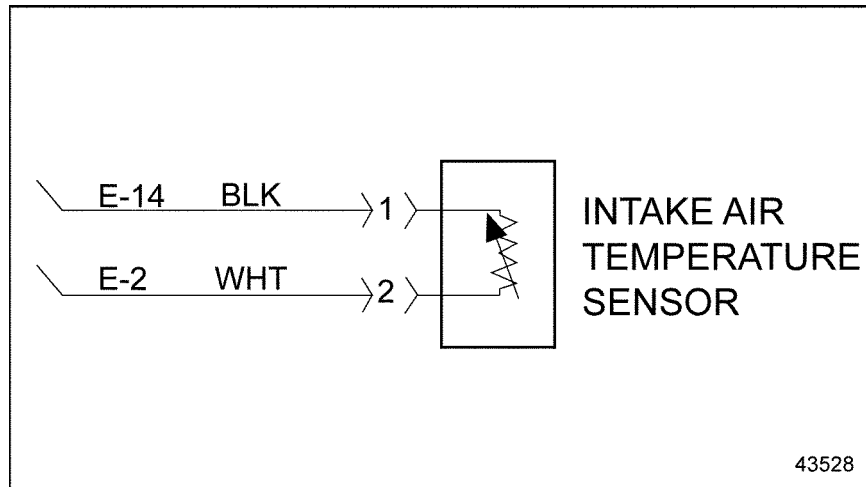


Figure 31-4 Intake Air Temperature Sensor

- [a] If terminals or connectors are damaged, repair them. Refer to section 31.2.4.1.
- [b] If terminals and connectors are not damaged, replace the ATS/IAT Sensor. Refer to section 31.2.4.1.

31.2.3 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
 2. Disconnect the engine harness connector at the ECM/ECU. (Jumper still in place.)
 3. Measure resistance between sockets E-2 and E-14 on the engine harness connector. See Figure 31-5.
- [a] If the resistance measurement is less than or equal to 5 Ω , 4.

- [b] If the resistance measurement between sockets E-2 and E-14 is greater than 5 Ω or open, the signal line E-2 or return line E-14 is open. Repair the open. Refer to section 31.2.4.1.

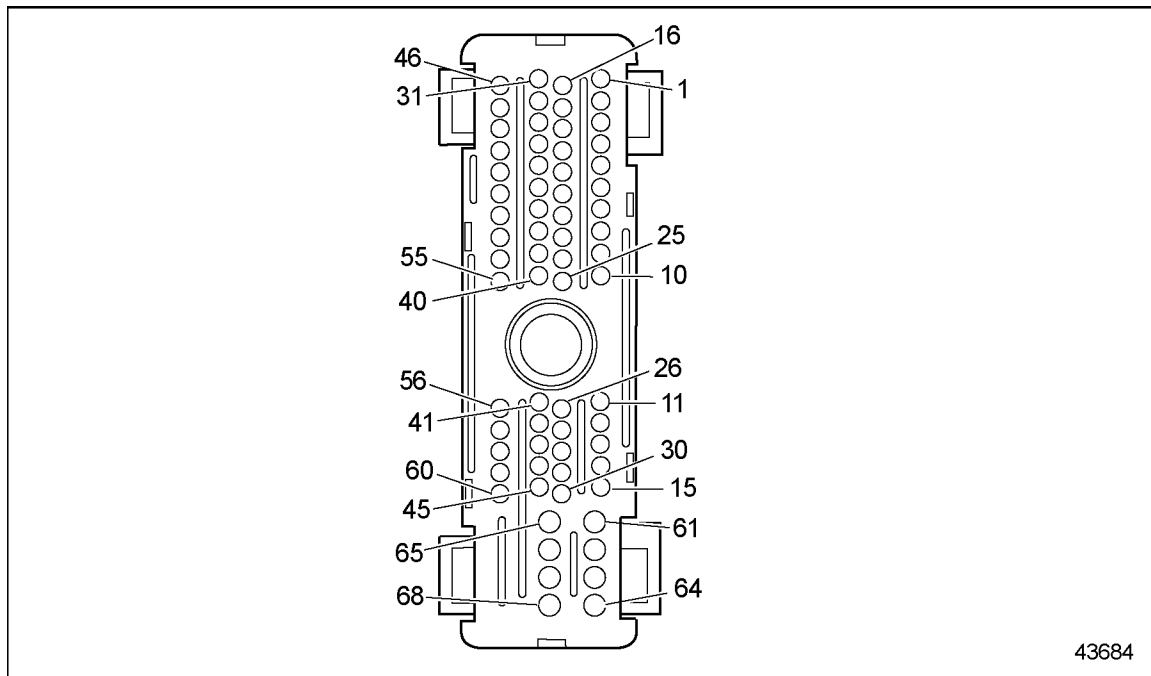


Figure 31-5 ECM/ECU Engine Harness Connector

4. Check terminals at the ECM/ECU engine harness connector (both ECM/ECU and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 31-5.
 - [a] If terminals or connectors are damaged, repair them. Refer to section 31.2.4.1.
 - [b] If terminals and connectors are not damaged, contact Detroit Diesel Customer Support Center (313-592-5800). Refer to section 31.2.4.1.

31.2.4 Check ECM/ECU Connectors

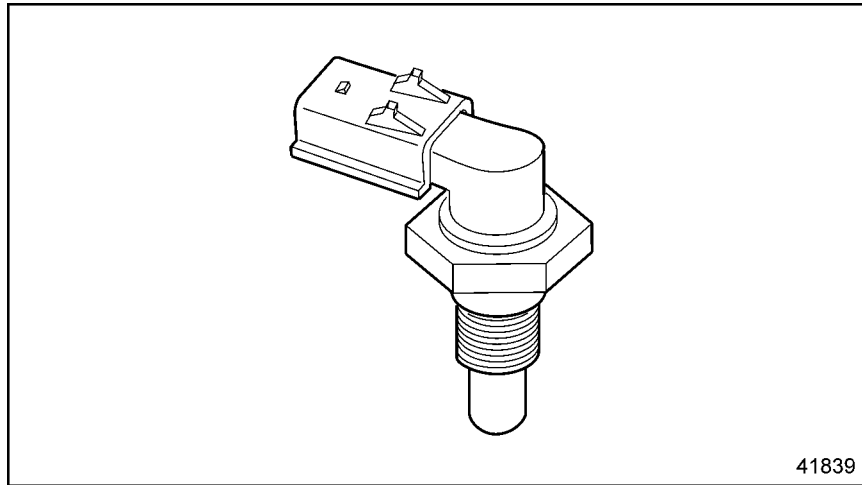
31.2.4.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF and reconnect all connectors.
2. Turn vehicle ignition ON and clear codes. Start and run the engine for eight minutes.
3. Stop the engine and check the diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code p 172/3 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 31.2.1.
 - [c] If any codes except code p 172/3 are logged, refer to section 17.3.

32 FLASH CODE 28 - INTAKE AIR TEMP SENSOR LOW

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32.1 DESCRIPTION OF FLASH CODE 28	32-3
32.2 TROUBLESHOOTING FLASH CODE 28, PID 172/FMI 4	32-3



41839

Figure 32-1 Intake Air Temperature Sensor

32.1 DESCRIPTION OF FLASH CODE 28

The SAE J1587 equivalent code for Flash Code 28 is p 172 4, air temperature circuit low.

Flash Code 28 indicates that the engine Air Temperature Sensor (ATS)/Intake Air Temperature Sensor (IAT Sensor), see Figure 32-1, input to the ECM/ECU has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

32.2 TROUBLESHOOTING FLASH CODE 28, PID 172/FMI 4

This diagnostic condition is typically sensor signal circuit is shorted to sensor return or shorted to ground.

32.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic tool. Read active codes.
 - [a] If code p 172/4 was logged and there are no other codes logged, refer to section 32.2.2.
 - [b] If code p 172/4 and any of the following codes p 110/3, p 175/3, p 174/3, p 72/3 or p 102/3 were logged, refer to section 76.
 - [c] If code p 172/4 and any code except the following were logged p 110/3, p 175/3, p 174/3, p 72/3 or p 102/3, refer to section 32.2.2.

32.2.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect the ATS connector. See Figure 32-2.
3. Start engine and run until the Check Engine Light/Amber Warning Lamp comes on or for eight minutes.
4. With engine still running, read active codes.
 - [a] If code p 172/4 and any other codes were logged, refer to section 32.2.3.

- [b] If p 172/3 and any other codes except p 172/4 were logged, go to step 5.

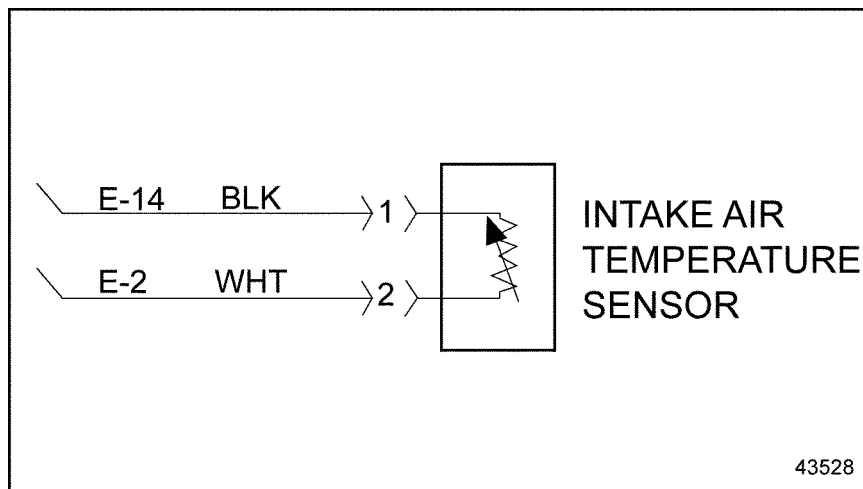


Figure 32-2 Engine Harness to Air Temperature Sensor Connector

5. Check terminals at the ATS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets.
 - [a] If terminals and connectors are not damaged, replace ATS. Refer to section 32.2.3.1.
 - [b] If terminals and connectors are damaged, repair/replace wires and refer to section 32.2.3.1.

32.2.3 Check for Short

Perform the following steps to check for a short.

1. Turn the ignition OFF.
2. Disconnect the engine harness connector at the ECM/ECU.
3. Measure resistance between sockets E-2 and E-14 on the engine harness connector. See Figure 32-3.
4. Measure resistance between socket E-2 and a good ground.
 - [a] If the resistance measurement between sockets E-2 and E-14 and between socket E-2 and a good ground is greater than 10 Ω or open, go to step 5.
 - [b] If the resistance measurement between sockets E-2 and E-14 , or E-2 and battery negative, is less than or equal to 10 Ω , the signal line E-2 is shorted to the return line E-14 or battery ground. Repair short. Refer to section 32.2.3.1.

5. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for damage; bent, corroded and unseated pins or sockets, especially E-2 and E-14 of the ECM/ECU connector.

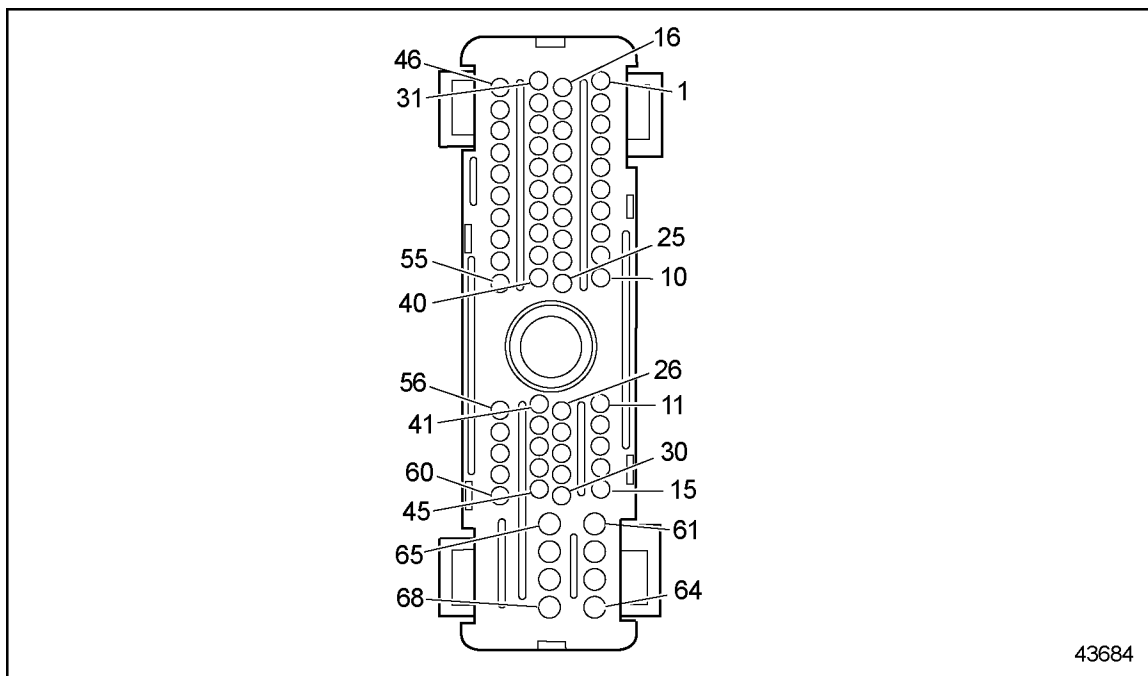


Figure 32-3 ECM/ECU Engine Harness Connector

- [a] If terminals or connectors are not damaged, contact Detroit Diesel Customer Support Center (313-592-5800) and refer to section 32.2.3.1.
- [b] If terminals and connectors are damaged, repair them. Refer to section 32.2.3.1

32.2.3.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn the ignition ON. Clear codes.
4. Start and run the engine for eight minutes. Stop the engine.
5. Read inactive codes.
 - [a] If no codes are displayed, troubleshooting is complete.
 - [b] If code p 172/4 is logged with any other codes, all system diagnostics are complete. Review this section from the first step to find the error.
 - [c] If code p 172/4 is not logged, but other codes are logged, refer to section 17.3.

33 FLASH CODE 29 – TCI / TCO TEMPERATURE LOW

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33.1 DESCRIPTION OF FLASH CODE 29	33-3
33.2 TROUBLESHOOTING FLASH CODE 29, PID 351/FMI 4	33-3
33.3 TROUBLESHOOTING FLASH CODE 29, PID 404/FMI 4	33-5

33.1 DESCRIPTION OF FLASH CODE 29

The SAE J1587 equivalent codes for Flash Code 29 are p 351/4, turbo compressor inlet (TCI) has low voltage and p 404/4 indicates that the turbo compressor outlet (TCO) has low voltage

33.2 TROUBLESHOOTING FLASH CODE 29, PID 351/FMI 4

Flash Code 29 p 351/4 indicates the signal voltage for the Turbo Compressor In Temperature Sensor went below calibration limits.

33.2.1 Check the Turbo Compressor In Temperature Sensor Connector

Perform the following steps to check the Turbo Compressor In Temperature Sensor connector.

1. Unplug the connector at the Turbo Compressor In Temperature Sensor.
2. Measure resistance between cavity 1 and cavity 2. See Figure 33-1.

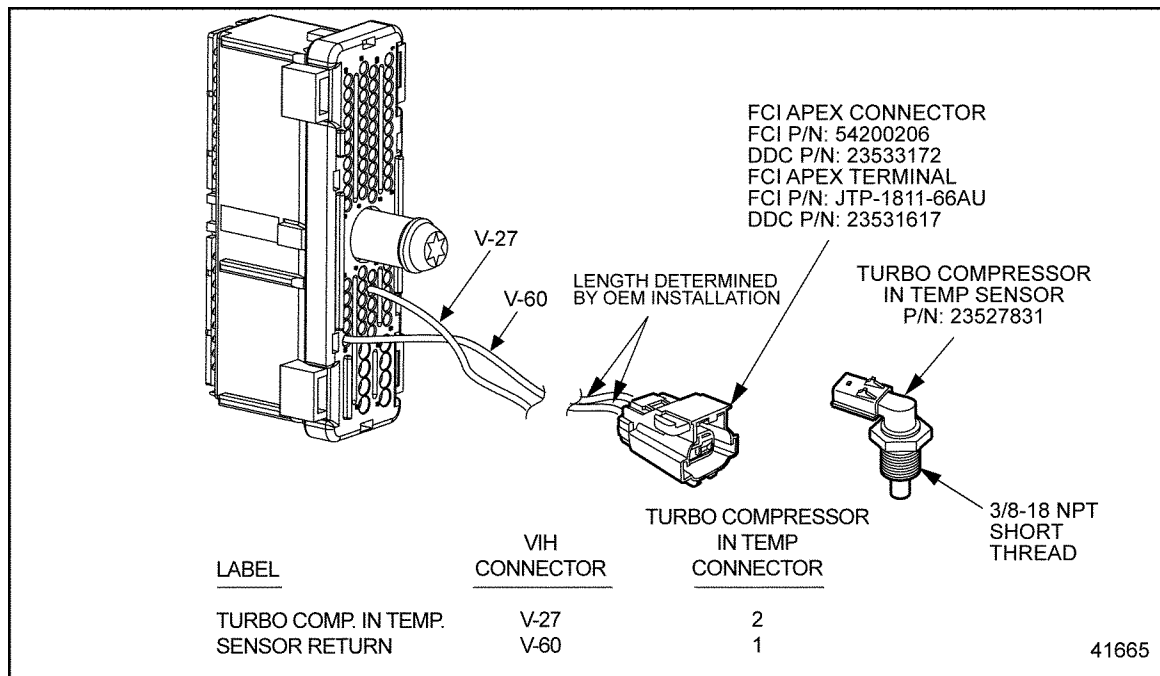


Figure 33-1 TCI Connector and Turbo Compressor In Temperature Sensor

- [a] If measured resistance is greater than 5 Ω , refer to section 33.2.2.
- [b] If measured resistance is less than 5 Ω , V-27 is shorted to V-59 on the ECU 68-pin connector. See Figure 33-2. Repair the short and refer to section 33.2.2.1.

33.2.2 Check for Open

Perform the following steps to check for short:

1. Unplug the vehicle harness.
2. Measure resistance between cavity V-27 and V-11. See Figure 33-2.

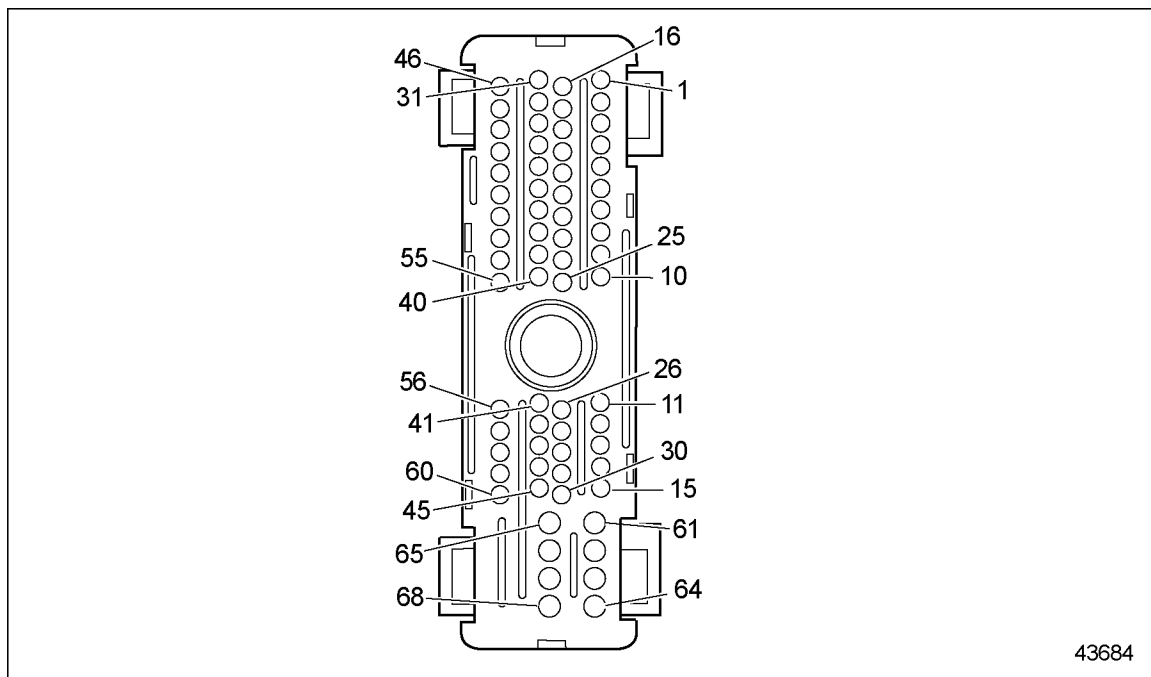


Figure 33-2 ECM/ECU VIH Connector

- [a] If resistance is less than 1.0 K Ω , wire V-27 is shorted to V-11. Repair and test.
- [b] If resistance is greater than 1.1 K Ω , go to step 3.
3. Check for corrosion at the 2-pin and 68-pin connector.
 - [a] If corroded, clean corrosion from the terminals or replace the terminals. Refer to section 33.2.2.1.
 - [b] If terminals are clean, without corrosion, replace the Turbo Compressor Temperature Out Sensor. Refer to section 33.2.2.1.

33.2.2.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF. Reconnect all connectors.
2. Turn ignition ON. Clear codes.
3. Start and run the engine for eight minutes. Stop engine.
4. Read inactive codes.

- [a] If no codes are displayed, troubleshooting is complete.
- [b] If code p 351/4 is logged with any other codes, review this section from the first step to find the error.
- [c] If code p p 351/4 is not logged, but other codes are logged, refer to section 17.3.

33.3 TROUBLESHOOTING FLASH CODE 29, PID 404/FMI 4

The SAE J1587 equivalent code for Flash Code 29 is p 404/4, turbo compressor outlet (TCO) low voltage. Flash Code 29 p 404/4 indicates the signal voltage for the Turbo Compressor Outlet Temperature Sensor went below calibration limits.

See Figure 33-3 for the TCO Connector and sensor.

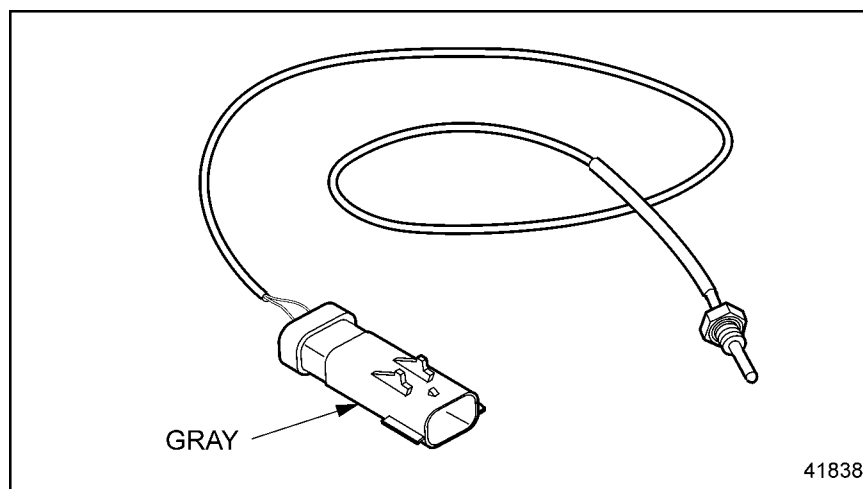


Figure 33-3 TCO Connector and Turbo Compressor Temperature Out Sensor

33.3.1 Check for Short

Perform the following steps to check the Turbo Compressor Temperature Out Sensor connector.

1. Unplug Turbo Compressor Temperature Out Sensor connector.
2. Measure resistance between cavity 1 and cavity 2 of connector.
 - [a] If measured resistance is greater than 5 Ω , refer to section 33.3.2.
 - [b] If measured resistance is less than 5 Ω , E-22 is shorted to E-14. Repair the short. Refer to section 33.3.2.1.

33.3.2 Check for Failed Resistor

Perform the following steps to check for failed resistor:

1. Unplug the Engine Harness. Measure resistance between cavity E-22 and E-14. See Figure 33-4.

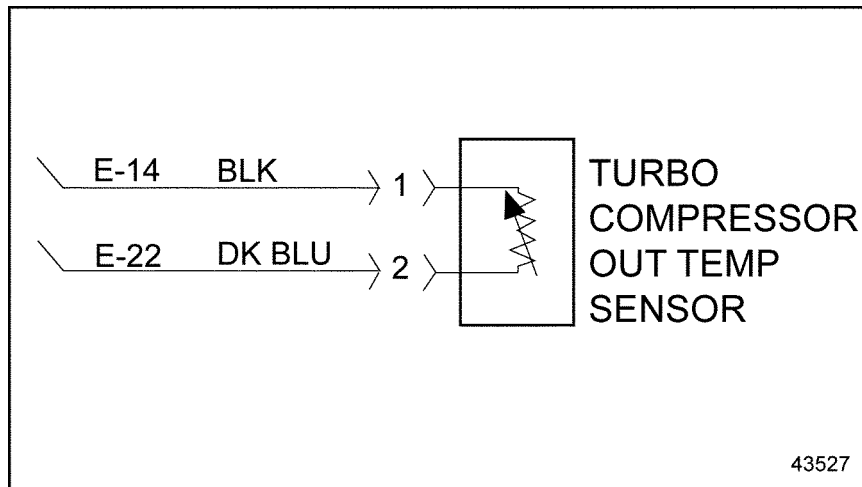


Figure 33-4 Turbo Compressor Outlet Temperature Sensor Circuit

- [a] If resistance is less than 1.0 K Ω , wire E-14 is shorted to E-22. Repair and refer to section 33.3.2.1.
- [b] If resistance is greater than 1.1 K Ω , go to step 2.
2. Check for corrosion at the 2-pin and 68-pin connector.
 - [a] If corroded, clean corrosion from the terminals or replace the terminals. Refer to section 33.3.2.1.
 - [b] If terminals are clean, without corrosion, replace the Turbo Compressor Temperature Out Sensor. Refer to section 33.3.2.1.

33.3.2.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF. Reconnect all connectors. Turn ignition ON.
2. Clear codes, start and run the engine for eight minutes. Stop the engine.
3. Read the inactive codes.
 - [a] If no codes are displayed, troubleshooting is complete.
 - [b] If code p 404/4 is logged with any other codes, review this section from the first step to find the error.
 - [c] If code p 404/4 is not logged, but other codes are logged, refer to section 17.3.

34 FLASH CODE 31 - ENGINE BRAKE FAULT OR AUXILIARY OUTPUT #12–17

Section	Page
34.1 DESCRIPTION OF FLASH CODE 31	34-3
34.2 TROUBLESHOOTING FLASH CODE 31, SID 51, 52/FMI 3, 4	34-3
34.3 TROUBLESHOOTING FLASH CODE 31, SID 260, 261, 262, 263, 264, 265/FMI 3, 4	34-7

34.1 DESCRIPTION OF FLASH CODE 31

The SAE J1587 equivalent code for Flash Code 31 is s 51/3, s 51/4, s 52/3, or s 52/4 is:

- ☐ Engine Brake Low
- ☐ Medium Circuit Has An Open Wire
- ☐ Wire Shorted To Battery Ground

The SAE J1587 equivalent code for Flash Code 31 is also s 260/3, s 260/4, s 262/3, s 262/4, s 263/3, s 263/4, 265/3 or s 265/4 for an open or short to battery in one of the auxiliary outputs #12–17.

34.2 TROUBLESHOOTING FLASH CODE 31, SID 51, 52/FMI 3, 4

This diagnostic condition is typically:

- ☐ Output circuit open (FMI 3)
- ☐ Output wire is shorted to ground (FMI 4)

The following procedure will troubleshoot Flash Code 31.

34.2.1 Check Configuration

Perform the following steps to check configuration.

1. If the unit has engine brakes, refer to section 34.2.2.
2. If the unit does not have engine brakes, the ECM/ECU is configured for engine brakes and shouldn't be. Contact the Detroit Diesel Customer Support Center (313–592–5800) with the engine serial number to have the data changed. Reprogram the ECM/ECU after the change and verify. Refer to section 34.2.6.1.

34.2.2 Determine Failure Mode

Perform the following steps to determine failure mode.

1. Turn vehicle ignition ON.
2. Plug the diagnostic tool.
3. Read SAE code (s 051 or s 052).
 - [a] If the reading is FMI 3, there is an open. Refer to section 34.2.3.
 - [b] If the reading is FMI 4, there is a short to ground. Refer to section 34.2.6.

34.2.3 Check for Open

Perform the following steps to check for open.

1. Turn vehicle ignition OFF.
2. Disconnect the 10-pin connector pigtail from engine brake injector harness.

3. Disconnect the 68-pin Engine Harness connector.
4. Install a jumper wire between pins 9 and 10, ECM/ECU side of pigtail.
5. Measure resistance between E-48 and E-49 of the Engine Harness connector.
 - [a] If measured resistance is less than 50 Ω , refer to section 34.2.4.
 - [b] If measured resistance is greater than 50 Ω , one or both wires are open. Repair open. Refer to section 34.2.6.1.

34.2.4 Check for Open (Inside Valve Cover)

Perform the following steps to check for open wire in the inside valve cover.

1. Reconnect the Engine Harness connector. See Figure 34-1.
2. Measure resistance between pin 9 and the engine block and between pin 10 and engine block and the brake harness connector (brake side).
 - [a] If measured resistance is greater than 50 Ω or open, an open exists in one of the wires where the check was made. Repair open or replace the injector harness. Refer to section 34.2.6.1.
 - [b] If measured resistance is less than 50 Ω , refer to section 34.2.5.

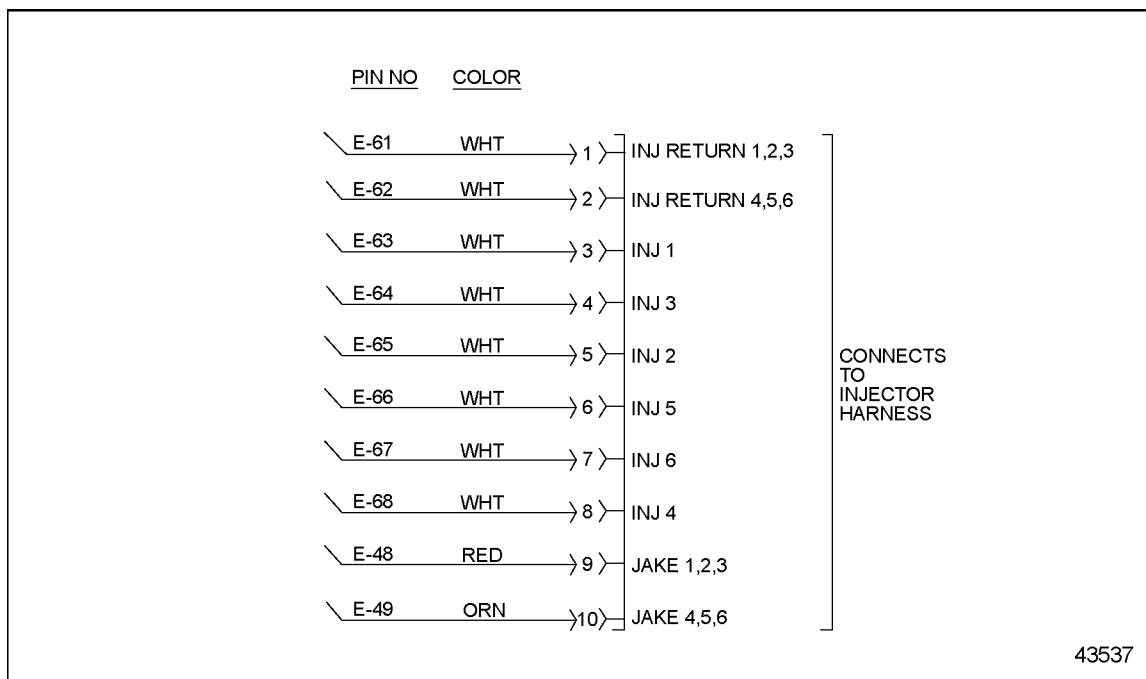


Figure 34-1 Engine Brake Harness Schematic

34.2.5 Check for Cylinder Block Ground

Perform the following steps to check for cylinder block ground.

1. If the cylinder block is connected to the battery ground, 3.
2. If the cylinder block is not connected to the battery ground, install a ground strap from the cylinder block to the battery negative (-). Refer to section 34.2.6.1.
3. Check brake solenoids. Refer to OEM guidelines.
 - [a] If the solenoids are in good condition, contact Detroit Diesel Customer Support Center (313-592-5800).
 - [b] If the solenoids are damaged, repair or replace them. Refer to section 34.2.6.1.

34.2.6 Check for Short

Perform the following steps to check for a short.

1. Turn vehicle ignition OFF.
2. Unplug the Engine Harness connector.
3. Measure resistance between E-48 and a battery ground, and E-48 and the engine block. Repeat this check between E-49 and battery ground, and E-49 and the engine block. See Figure 34-2.

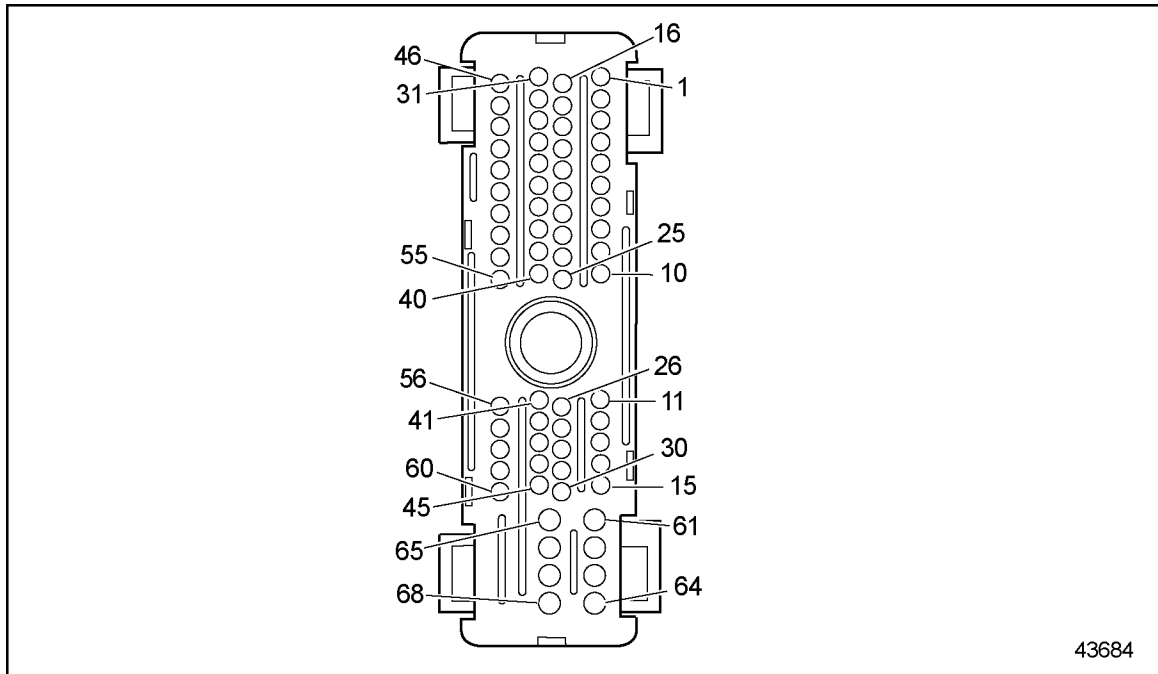


Figure 34-2 ECM/ECU Engine Harness Connector

- [a] If resistance for all measurements is greater than 5 Ω or open, go to step 4.

- [b] If any measured resistance is less than 5 Ω , the wire where the measurement was read is shorted to ground or to the engine. Repair short or replace the wire. Refer to section 34.2.6.1.
- 4. Measure resistance between E-48 and E-49.
 - [a] If measured resistance is less than 10 Ω , the E-48 and E-49 wires are shorted to each other. Repair short. Refer to section 34.2.6.1.
 - [b] If measured resistance is greater than 10 Ω , go to step 5.
- 5. Check brake solenoids. Refer to OEM guidelines.
 - [a] If the solenoids are in good condition, contact Detroit Diesel Customer Support Center (313-592-5800).
 - [b] If the solenoids are damaged, repair or replace them. Refer to section 34.2.6.1.

34.2.6.1 Verify Repairs

Perform the following steps to verify repairs.

1. Connect any connectors removed for troubleshooting.
2. Start, run the engine, and operate the engine brake.
 - [a] If no lights come on, and no codes are logged, the repairs are complete. No further troubleshooting is required.
 - [b] If Amber Warning Lamp displays with codes s 51/3, s 51/4, s 52/3, or s 51/4, review this section to find the error. Refer to section 34.2.1.

34.3 TROUBLESHOOTING FLASH CODE 31, SID 260, 261, 262, 263, 264, 265/FMI 3, 4

The SAE J1587 equivalent codes for Flash Code 31 are listed in Table 34-1.

SAE J1587 Code	Output Number	Fault
s 260 3	Auxiliary output 12	Short to battery
s 260 4	Auxiliary output 12	Open circuit
s 261 3	Auxiliary output 13	Short to battery
s 261 4	Auxiliary output 13	Open circuit
s 262 3	Auxiliary output 14	Short to battery
s 262 4	Auxiliary output 14	Open circuit
s 263 3	Auxiliary output 15	Short to battery
s 263 4	Auxiliary output 15	Open circuit
s 264 3	Auxiliary output 16	Short to battery
s 264 4	Auxiliary output 16	Open circuit
s 265 3	Auxiliary output 17	Short to battery
s 265 4	Auxiliary output 17	Open circuit

Table 34-1 Auxiliary Output Open or Short to Battery

The DDEC ECM/ECU supplies a switched ground to the Auxiliary Output circuit to turn ON the function assigned. Flash Code 31 indicates that the function assigned to the Auxiliary Output #12 through #17 circuit has either an open circuit or a short to battery (+). A short to battery (+) is detected when the DDEC ECM/ECU is unsuccessful in turning ON the configured function.

Flash Code 31 may also indicate that the function assigned to the Auxiliary Output #12 through #17 circuit is open, shorted to ground. This diagnostic condition is detected when the Auxiliary Output function is OFF and the DDEC ECM/ECU measures a low voltage on the circuit output.

34.3.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in the diagnostic tool.
3. Record codes logged.
4. Clear codes.
5. Start and run the engine for one minute.
 - [a] If the code becomes active, refer to section 34.3.2.
 - [b] If the code does not become active, go to step 6.
6. Perform a road test.

- [a] If the code returns, refer to section 34.3.2.
- [b] If the code does not display again, return the vehicle to service or refer to section 19.1.1.

34.3.2 Auxiliary Output Cavity Determination and Electrical Check

Perform the following steps to determine which auxiliary output cavity is associated with the logged codes.

1. Determine which auxiliary output cavity is associated with the code or codes being logged. The SAE code descriptions of the flash codes and the DDC wire numbers are listed in Table 34-2. Continue troubleshooting. Next check connectors, dash light or vehicle power-down relay, or item being driven.

SAE Code Description - Flash Code	Cavity
Auxiliary Output #12 (260 3 or 260 4) 31	E-46
Auxiliary Output #13 (261 3 or 261 4) 31	E-47
Auxiliary Output #14 (262 3 or 262 4) 31	E-50
Auxiliary Output #15 (263 3 or 263 4) 31	E-51
Auxiliary Output #16 (264 3 or 264 4) 31	E-52
Auxiliary Output #17 (265 3 or 265 4) 31	E-53

Table 34-2 Auxiliary Output Cavities

2. Check the connectors of the output wire associated with the code logged at the Vehicle Interface Harness connector or Engine Harness connector.
3. Check the connectors of the output wire associated with the code logged at the item being driven.
 - [a] If the connectors are not good, repair or replace the terminals. Refer to section 34.3.3.1.
 - [b] If the connectors are good and the items being driven (e.g. relay, light) are not in good condition, repair or replace the device. (Contact OEM for test procedure.) Refer to section 34.3.3.1
 - [c] If the connectors are good and the items being driven (e.g. relay, light, are in good condition, refer to section 34.3.3.

34.3.3 Measure Resistance

Perform the following steps to measure the resistance.

1. Turn ignition OFF.
2. Connect the Engine Sensor Harness or Vehicle Interface Harness (connector with output fault).
3. Disconnect the output wire associated with the code logged at the component.
4. Measure the resistance between the removed connector and the ECM/ECU case.
 - [a] If the reading is less than 100K Ω , contact Detroit Diesel Customer Support Center (313-592-5800).
 - [b] If the reading is greater than 100K Ω , this wire is shorted to the battery or open. Repair or replace this wire. Refer to section 34.3.3.1.

34.3.3.1 Verify Repairs

Perform the following steps to verify repairs.

1. Reconnect all connectors.
2. Plug in the diagnostic tool.
3. Clear all codes.
4. Start and run the engine.
 - [a] If the output code returns, refer to section 34.3.1.
 - [b] If the output code does not return, troubleshooting is complete.

35 FLASH CODE 32 - CEL/AWL / SEL/RSL FAULT

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35.1 DESCRIPTION OF FLASH CODE 32	35-3
35.2 TROUBLESHOOTING FLASH CODE 32, SID 238, 239/FMI 3, 4	35-3

35.1 DESCRIPTION OF FLASH CODE 32

The SAE J1587 equivalent code for Flash Code 32 is:

- ☐ s 238/3 SEL/RSL short to battery
- ☐ s 238/4 SEL/RSL open circuit
- ☐ s 239/3 CEL/AWL short to battery
- ☐ s 239/4 CEL/AWL open circuit

35.2 TROUBLESHOOTING FLASH CODE 32, SID 238, 239/FMI 3, 4

Flash Code 32 indicates that the wire for the SEL/RSL or CEL/AWL is open or shorted to Battery +.

This diagnostic condition is typically:

- ☐ Open/broken output wire
- ☐ Shorted output wire

The following procedure will troubleshoot Flash Code 32.

35.2.1 Determine Failure Mode Identifier (3 or 4)

Perform the following steps to determine FMI.

1. Turn ignition ON.
2. Plug in your diagnostic tool.
3. Read codes.
 - [a] If code 238/4 or 239/4 is logged, reprogram the ECM/ECU. Refer to section 35.2.2.1.
 - [b] If code 238/3 or 239/3 is logged, refer to section 35.2.2.

35.2.2 Check for Short to Battery

Perform the following steps to determine failure.

1. Turn vehicle ignition OFF.
2. Disconnect vehicle harness connector.
3. Turn ignition ON.
4. Remove CEL/AWL bulb and SEL/RSL bulb.

5. Measure voltage between V-02 and a good ground. See Figure 35-1.

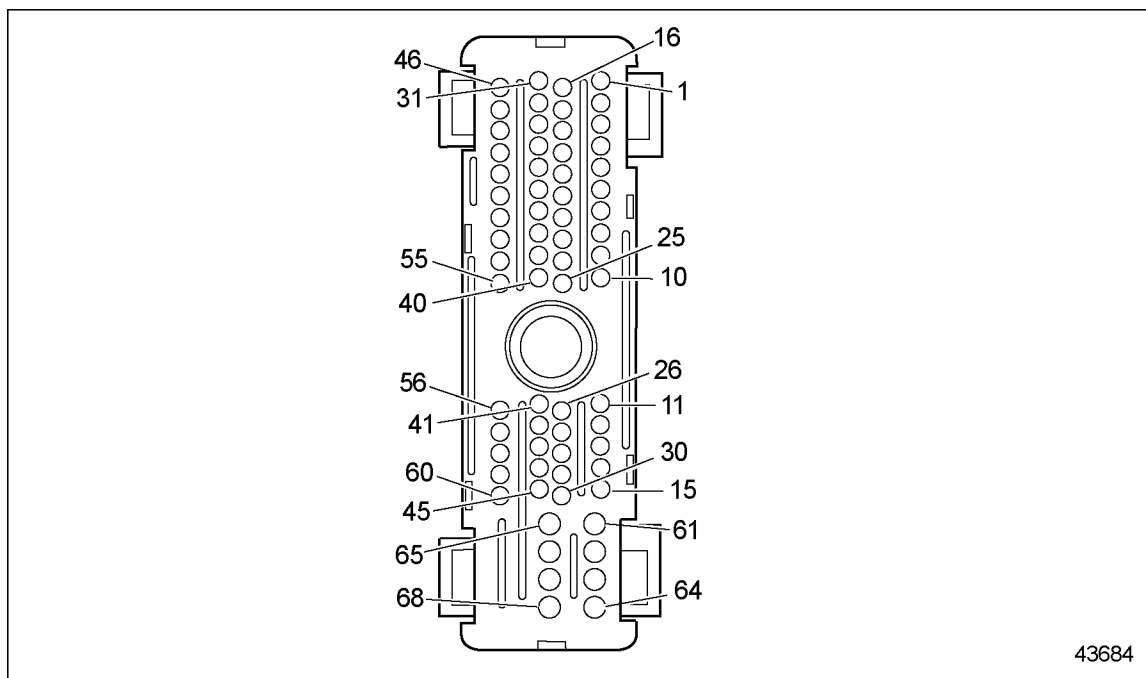


Figure 35-1 ECM/ECU Vehicle Interface Harness Connector

6. Measure voltage between V-07 and a good ground.
 - [a] If either measurement was greater than 0.5 volts, the wire that had the reading is shorted to some voltage source. Replace the wire(s). Refer to section 35.2.2.1.
 - [b] If no measurement was greater than 0.5 volts, contact Detroit Diesel Customer Support Center (313-592-5800).

35.2.2.1 Verify Repairs

Perform the following steps to verify repairs.

1. Connect all connectors.
2. Start and run the engine.
3. Plug the diagnostic tool. Read the codes.
 - [a] If active code 32 is logged, review this section to find the error. Refer to section 35.2.
 - [b] If code 32 is not logged, troubleshooting is complete.

36 FLASH CODE 33 - TBS/IMP SENSOR HIGH

Section	Page
36.1 DESCRIPTION OF FLASH CODE 33	36-3
36.2 TROUBLESHOOTING FLASH CODE 33, PID 102/FMI 3	36-3

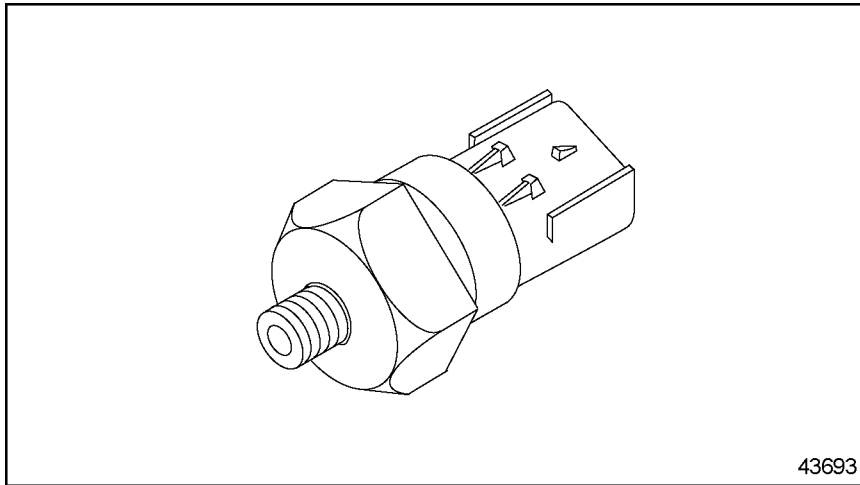


Figure 36-1 Intake Manifold Pressure Sensor

36.1 DESCRIPTION OF FLASH CODE 33

The SAE J1587 equivalent code for Flash Code 33 is p 102/3.

Flash Code 33 p 102/3 indicates that the engine Turbo Boost Sensor/Intake Manifold Pressure Sensor (TBS/IMP Sensor) input to the ECM/ECU has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

36.2 TROUBLESHOOTING FLASH CODE 33, PID 102/FMI 3

This diagnostic condition is typically:

- Open sensor return circuit
- Sensor signal circuit is shorted to the sensor +5 volt supply

36.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Plug the diagnostic tool.
2. Turn vehicle ignition switch ON and read the active codes.
 - [a] If code p 102/3 and no other codes were logged, refer to section 36.2.2.
 - [b] If any of the following codes are also present: p 73/3 or 4, p 94/3 or 4, p 100/3 or 4, p 101/3 or 4, p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, refer to section 76.

36.2.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF and disconnect the TBS/IMP Sensor connector. See Figure 36-2.

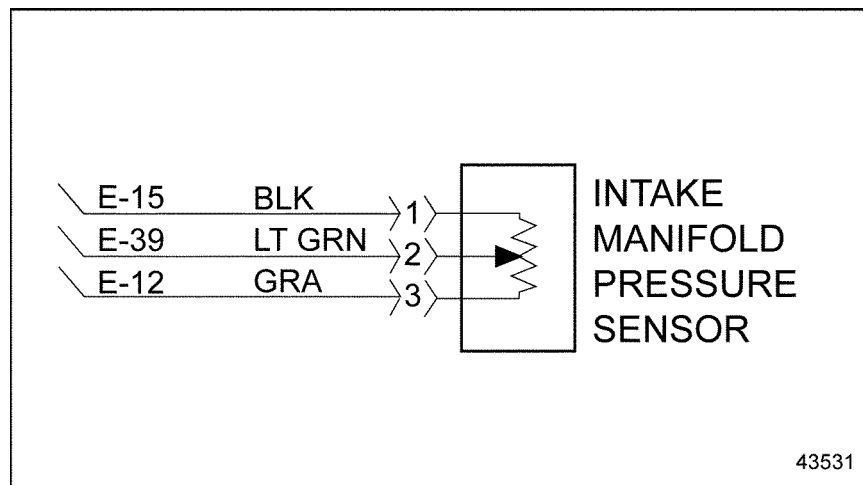


Figure 36-2 Turbo Boost/Intake Manifold Pressure Sensor

2. Start and run the engine at idle. Read active codes logged.
 - [a] If active code 102/3 and any other codes are logged, refer to section 36.2.4.
 - [b] If active code 102/4 and any other codes except 102/3 are logged, refer to section 36.2.3.

36.2.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn ignition switch OFF.
2. Install a jumper wire between pin 1 and pin 2 of the TBS/IMP Sensor harness connector. See Figure 36-2.
3. Disconnect the Engine Harness connector at the ECM/ECU. See Figure 36-3.
4. Measure resistance between sockets E-15 and E-39 on the Engine Harness connector.
 - [a] If resistance measurement is less than or equal to 5 Ω , 5.
 - [b] If resistance measurement is greater than 5 Ω , the return line E-15 is open. Repair the open. Refer to section 36.2.5.1.

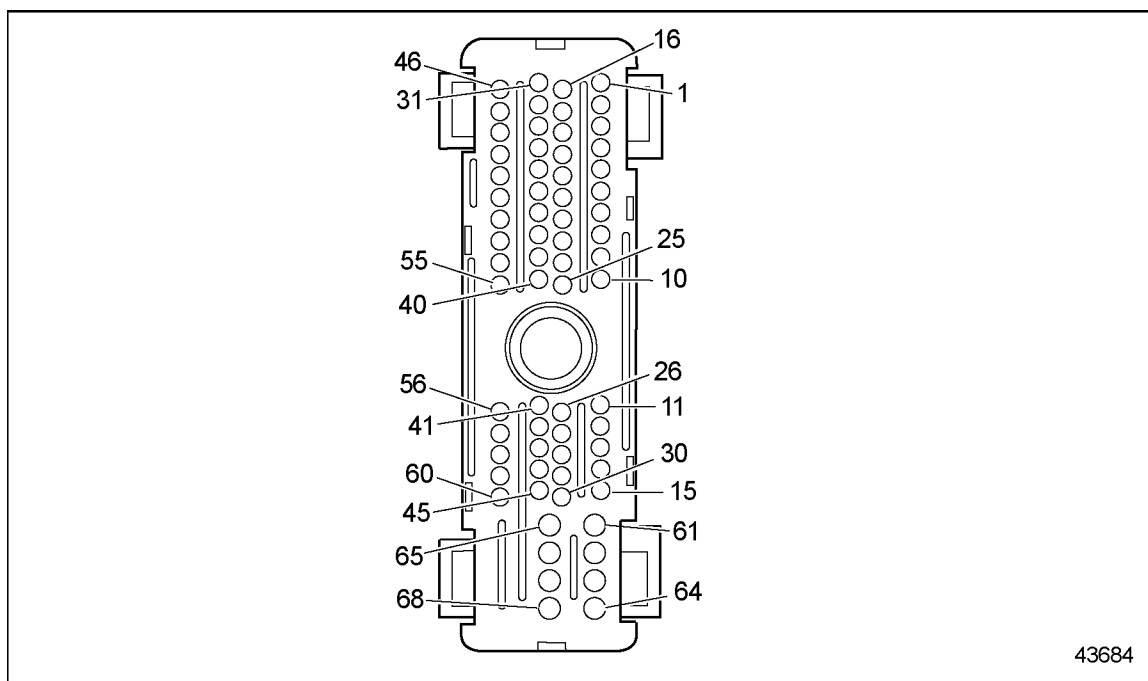


Figure 36-3 ECM/ECU Engine Harness and Vehicle Interface Harness Connector

5. Check terminals at the TBS/IMP Sensor connector (both sensor and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 36-4.
 - [a] If the terminals and connectors are damaged, repair them. Refer to section 36.2.5.1.

- [b] If the terminals and connectors are not damaged, replace the TBS/IMP Sensor.
Refer to section 36.2.5.1.

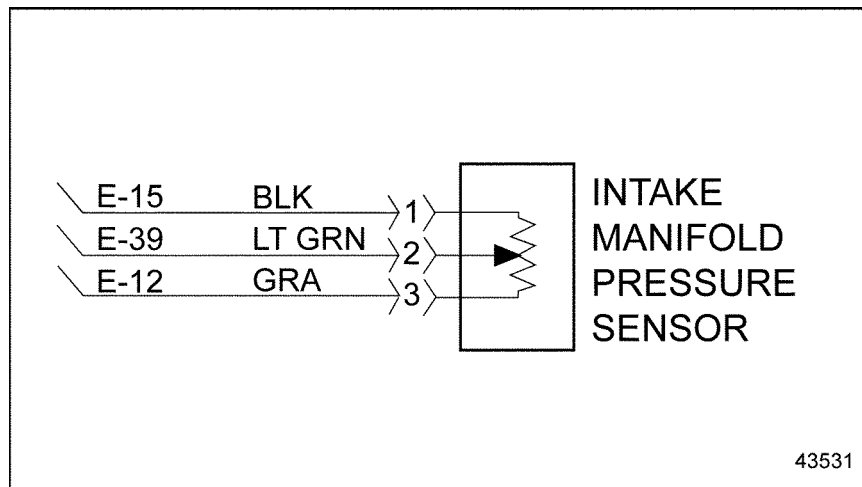


Figure 36-4 Turbo Boost/ Intake Manifold Pressure Sensor

36.2.4 Check for Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line:

1. Turn vehicle ignition OFF.
 2. Disconnect Engine Harness connector from the ECM/ECU.
 3. Measure resistance between sockets E-39 and E-12 on the Engine Harness connector.
See Figure 36-3.
- [a] If measured resistance is less than or equal to 10,000 Ω , the signal line E-39 is shorted to the engine +5 volt line E-12. Repair short. Refer to section 36.2.5.1.
- [b] If measured resistance is greater than 10,000 Ω , or open, refer to section 36.2.5.

36.2.5 Check for Short to Battery

Perform the following steps to check for a short to the battery (+):

1. Remove both fuses to the ECM/ECU.
 2. Disconnect the Vehicle Interface Harness and the Engine Harness at the ECM/ECU.
 3. Measure resistance between sockets E-39 of the Engine Harness connector and V-15 on the Vehicle Interface Harness connector. See Figure 36-3
 4. Measure resistance between socket E-39 on the Engine Harness connector Vehicle Interface Harness connector sockets V-61 and V-65.
- [a] If the resistance measurement is less than or equal to 100 Ω , a short exists between sockets where the measurement was taken. Repair short and reinsert fuses, or reset breakers. Refer to section 36.2.5.1.

- [b] If the resistance measurement is greater than 100 Ω , or open, go to step 5.
- 5. Check terminals at the ECM/ECU Engine Harness connector (both the ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If terminals and connectors are damaged, repair both. Refer to section 36.2.5.1.
 - [b] If terminals and connectors are not damaged, reprogram the ECM/ECU. Refer to section 36.2.5.1.

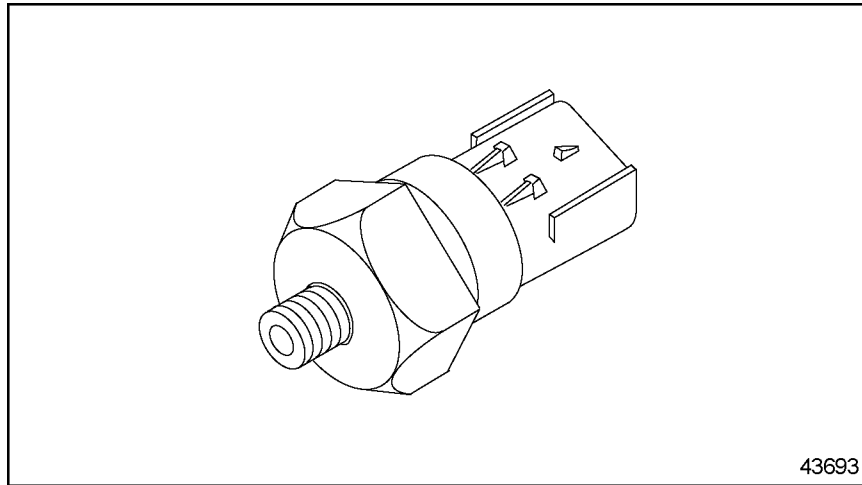
36.2.5.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF. Reconnect all connectors.
2. Turn ignition ON. Clear codes.
3. Start and run the engine for one minute. Stop the engine.
4. Check diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code 102/3 is not logged, and other codes are logged, refer to section 9.1.
 - [c] If code 102/3 is logged, and other codes are logged, refer to section 36.2.1.

37 FLASH CODE 34 - TBS/IMP SENSOR LOW

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37.1 DESCRIPTION OF FLASH CODE 34	37-3
37.2 TROUBLESHOOTING FLASH CODE 34, PID 102/FMI 4	37-3



43693

Figure 37-1 Intake Manifold Pressure Sensor

37.1 DESCRIPTION OF FLASH CODE 34

The SAE J1587 equivalent code for Flash Code 34 is p 102/4.

Flash Code 34 p 102/4 indicates that the engine Turbo Boost Sensor/Intake Manifold Pressure Sensor (TBS/IMP Sensor) input to the ECM/ECU has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

37.2 TROUBLESHOOTING FLASH CODE 34, PID 102/FMI 4

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to the sensor return circuit or ground
- ☐ Plugged or restricted air filter.

37.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Plug the diagnostic tool.
2. Turn vehicle ignition switch ON.
3. Read active codes.
 - [a] If code p 102/4 was logged and there are no other logged codes, refer to section 37.2.2.
 - [b] If code p 102/4 and any of the following codes p 73/3 or 4, p 94/3 or 4, p 100/3 or 4, p 101/3 or 4, p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, were logged, refer to section 76.
 - [c] If code p 102/4 was logged and none of the following codes p 73/3 or 4, p 94/3 or 4, p 100/3 or 4, p 101/3 or 4, p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, were logged, refer to section 37.2.2.

37.2.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect TBS/IMP Sensor connector.
3. Install a jumper wire between sockets 2 and 3 of the TBS/IMP Sensor harness connector. See Figure 37-2.
4. Turn ignition ON.
5. Start engine and run until either the Amber Warning Lamp is on, or until the engine has been running at least one minute at greater than 1000 rpm.
6. Read logged codes.

- [a] If active code p 102/4 and any other codes are logged, refer to section 37.2.3.
- [b] If active code p 102/3 and any other codes except p 102/4 are logged, go to step 7.

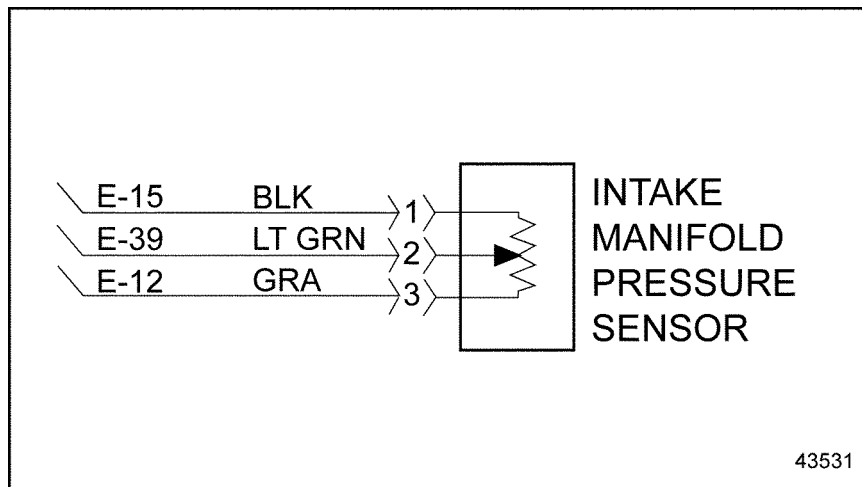


Figure 37-2 Turbo Boost/Intake Manifold Pressure Sensor

7. Check terminals at the TBS/IMP Sensor connectors (both the TBS/IMP Sensor and harness side) for damage: bent, corroded and unseated pins or sockets.
 - [a] If the terminals and connectors are damaged, repair them. Refer to section 37.2.8.1.
 - [b] If the terminals and connectors are not damaged, replace the TBS/IMP Sensor. Refer to section 37.2.8.1.

37.2.3 Check for +5 Volt

Perform the following steps to check for +5 volt.

1. Remove jumper.
2. Turn ignition ON.
3. Measure voltage on TBS/IMP Sensor harness connector, pin 1 (red lead) to pin 3 (black lead).
 - [a] If the voltage measurement is greater than 6 volts, refer to section 37.2.8.
 - [b] If the voltage measurement is between 4 and 6 volts, refer to section 37.2.4.
 - [c] If the voltage measurement is less than 4 volts, refer to section 37.2.6.

37.2.4 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn vehicle ignition OFF.
2. Disconnect the Engine Harness connector at the ECM/ECU.
3. Install a jumper wire between pins 1 and 2 of the TBS/IMP Sensor harness connector. See Figure 37-3.
4. Measure resistance between sockets E-39 and E-15 on the Engine Harness connector.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 37.2.5.
 - [b] If the resistance measurement is greater than 5 Ω , or open, and the signal line (E-39) is open, repair the open. Refer to section 37.2.8.1.

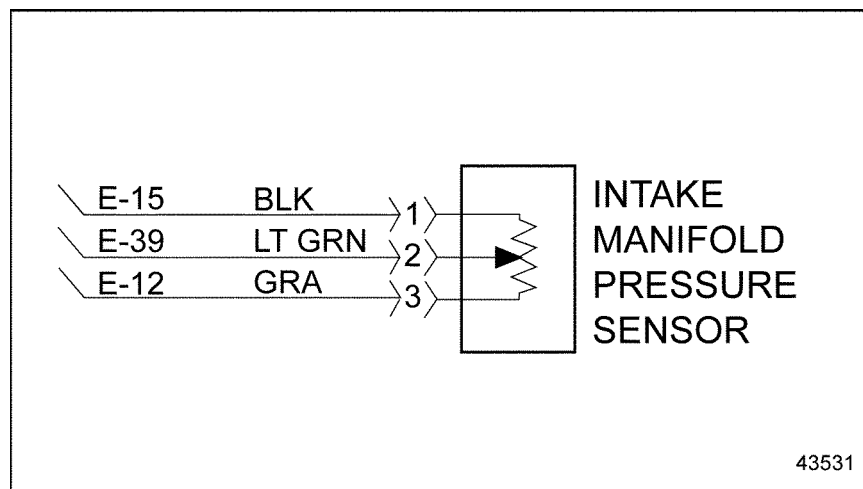


Figure 37-3 Turbo Boost/Intake Manifold Pressure Sensor

37.2.5 Check for Short

Perform the following steps to check for short.

1. Remove jumper.
2. Measure resistance between pins 1 and 2 on the TBS/IMP Sensor harness connector.
 - [a] If measured resistance between pins 1 and 2 is greater than 100 Ω , or open, go to step 3.
 - [b] If measured resistance between pins 1 and 2 is less than 100 Ω , the signal line (E-39) is shorted to the return line (E-15). Repair the short. Refer to section 37.2.8.1.
3. Also measure resistance between socket 2 and a good ground.
 - [a] If measured resistance between socket 2 and a good ground is greater than 100 Ω , or open, go to step 4.

- [b] If measured resistance between socket 2 and a good ground is less than 100 Ω , the signal line (E-39) is shorted to the battery ground. Repair the short and refer to section 37.2.8.1.
- 4. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 37-4.
 - [a] If terminals and connectors are damaged, repair them and refer to section 37.2.8.1.
 - [b] If terminals and connectors are not damaged, install a test ECM/ECU. Refer to section 37.2.8.1.

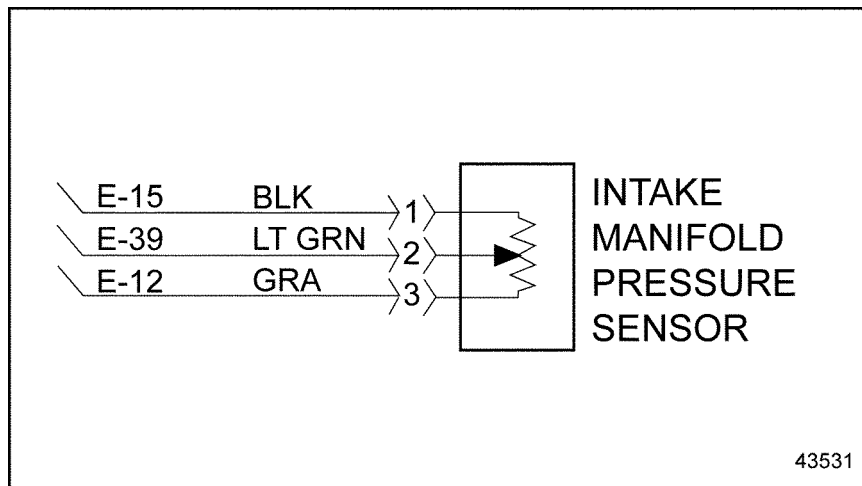


Figure 37-4 Turbo Boost/Intake Manifold Pressure Sensor

37.2.6 Check for Open +5 Volt Line

Perform the following steps to check for open +5 volt line.

1. Turn vehicle ignition OFF.
2. Disconnect the Engine Harness connectors at the ECM/ECU.
3. Install a jumper wire between pins 1 and 3 of the TBS/IMP Sensor harness connector. See Figure 37-5.
4. Read resistance between sockets E-15 and E-12 on the Engine Harness connector.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 37.2.7.

- [b] If the resistance measurement is greater than 5 Ω , or open, the ECM/ECU +5 volt line (E-12) is open. Repair open. Refer to section 37.2.8.1.

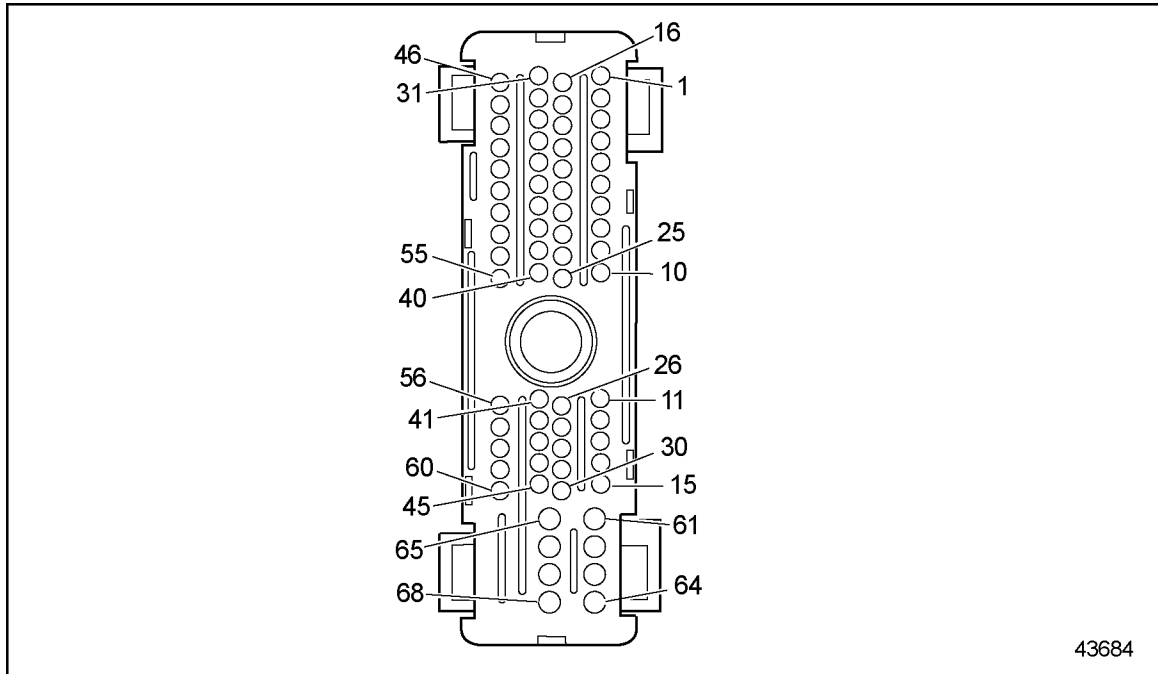


Figure 37-5 ECM/ECU Engine and Vehicle Connector

37.2.7 Check for Short

Perform the following steps to check for short.

1. Remove jumper.
2. Measure resistance between pins 1 and 3 on the TBS/IMP Sensor harness connector. See Figure 37-4.
 - [a] If measured resistance between pins 1 and 3 is greater than 100 Ω , or open, go to step 3.
 - [b] If measured resistance between pins 1 and 3 is less than 100 Ω , the 5 volt supply (E-12) is shorted to the return line (E-15). Repair the short. Refer to section 37.2.8.1.
3. Also measure resistance between socket 3 and a good ground.
 - [a] If measured resistance between socket 3 and a good ground is greater than 100 Ω , or open, go to step 4.
 - [b] If measured resistance between socket 3 and a good ground is less than 100 Ω , the 5 volt supply (E-12) is shorted to the battery ground. Repair the short and refer to section 37.2.8.1.
4. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 37-4.

- [a] If terminals and connectors are damaged, repair them and refer to section 37.2.8.1.
- [b] If terminals and connectors are not damaged, install a test ECM/ECU. Refer to section 37.2.8.1.

37.2.8 Check for Short to Battery +

Perform the following steps to check for short to battery +.

1. Turn vehicle ignition OFF.
2. Remove both fuses to the ECM/ECU.
3. Disconnect the Engine Harness and Vehicle Interface Harness at the ECM/ECU.
4. Measure resistance between socket E-12 on the Engine Harness connector and socket V-15 of the Vehicle Interface Harness connector, and between E-12 and V-61 and V-65. See Figure 37-5.
 - [a] If measured resistance is less than or equal to 100 Ω , a short exists between sockets where less than 100 Ω was measured. Repair short and reinsert fuses. Refer to section 37.2.8.1.
 - [b] If the resistance measurement is greater than 100 Ω , or open, go to step 5.
5. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 37-4.
 - [a] If terminals and connectors are damaged, repair them and refer to section 37.2.8.1.
 - [b] If terminals and connectors are not damaged, install a test ECM/ECU. Refer to section 37.2.8.1.

37.2.8.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check diagnostic tool for codes.
 - [a] If no codes are logged, no further troubleshooting is required.
 - [b] If code p 102/4 and any other codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 37.2.1.
 - [c] If code p 102/4 is not logged and any other codes are logged, refer to section 9.1.

38 FLASH CODE 35 - OPS/EOP SENSOR HIGH

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38.1 DESCRIPTION OF FLASH CODE 35	38-3
38.2 TROUBLESHOOTING FLASH CODE 35, PID 100/FMI 3	38-3

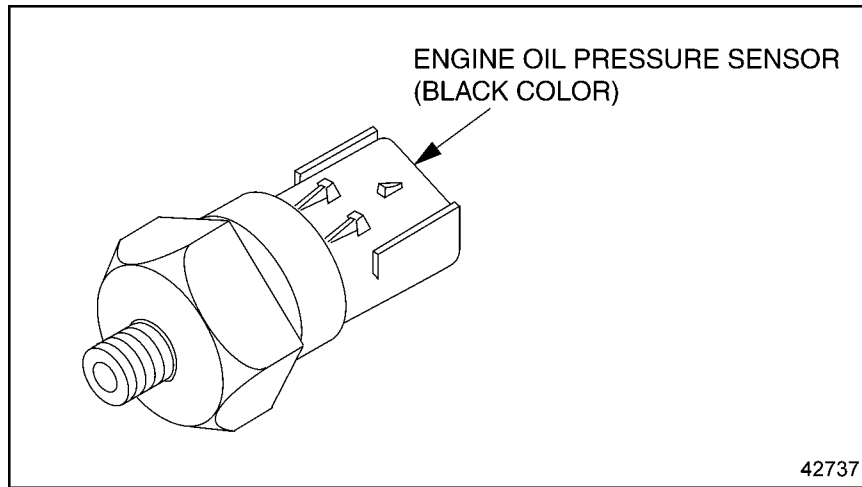


Figure 38-1 Engine Oil Pressure Sensor

38.1 DESCRIPTION OF FLASH CODE 35

The SAE J1587 equivalent code for Flash Code 35 is p 100/3, oil pressure circuit high.

NOTE:

Code 35 p 100/3 is logged if oil pressure is high, engine is warm, and engine is at idle.

Flash Code 35 p 100/3 indicates that the engine Oil Pressure Sensor/Engine Oil Pressure Sensor (OPS/EOP Sensor), see Figure 38-1, input to the ECM/ECU has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

38.2 TROUBLESHOOTING FLASH CODE 35, PID 100/FMI 3

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply
- ☐ Failed/damaged sensor

38.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug the diagnostic tool.
3. Read active codes.
 - [a] If code p 100/3 and no other codes were logged, refer to section 38.2.2.
 - [b] If code p 100/3 and any of the following codes were logged: p 73/3 or 4, p 94/3 or 4, p 100/4, p 101/3 or 4, p 102/3 or 4, p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, refer to section 76.

38.2.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect OPS/EOP Sensor connector.
3. Turn ignition ON.
4. Start and run the engine.
5. Select engine temperature (COOLANT TEMP or OIL TEMP) on the diagnostic tool.
6. Warm up engine until engine temperature reading is greater than 60°C (140°F).
7. After warm-up, let engine run at idle.
8. Read active codes.

- [a] If active code p 100/3 and any other codes were logged, refer to section 38.2.4.
- [b] If code p 100/4 and any other codes except p 100/3 were logged, refer to section 38.2.3.

38.2.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM/ECU.
3. Install a jumper wire between pin 1 and pin 2 of the OPS/EOP Sensor harness connector. See Figure 38-2.
4. Measure resistance between sockets E-15 and E-31 on the engine harness connector.
 - [a] If resistance measurement is less than or equal to 5 Ω , go to step 5.
 - [b] If resistance measurement is greater than 5 Ω , the return line (E-15) is open. Repair the open and refer to section 38.2.5.1.

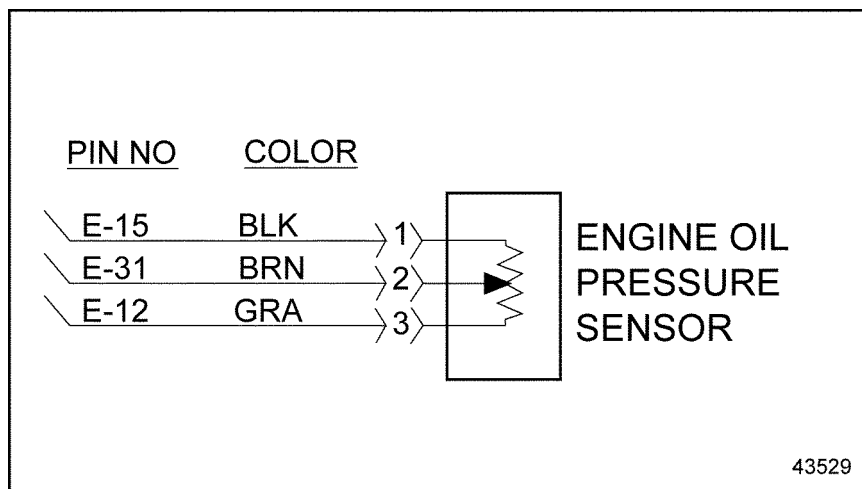


Figure 38-2 Engine Harness Connector to Engine Oil Pressure Sensor

5. Check terminals at the OPS/EOP Sensor connectors (both the sensor and harness side) for damage: bent, corroded and unseated pins or sockets.
 - [a] If the terminals and connectors are damaged, repair them and refer to section 38.2.5.1.
 - [b] If the terminals and connectors are not damaged, replace the OPS/EOP Sensor. Refer to section 38.2.5.1.

38.2.4 Check for Signal Short to 5 Volt

Perform the following steps to check for signal open.

1. Turn vehicle ignition OFF.
 2. Disconnect the engine harness connector at the ECM/ECU.
 3. Measure resistance between sockets E-31 and E-12 on the engine harness connector.
See Figure 38-3.
- [a] If the resistance measurement is less than or equal to 100 Ω , the signal line (E-31) is shorted to the engine +5 volt line (E-12). Repair the short and refer to section 38.2.5.1.
- [b] If the resistance measurement is greater than 100 Ω , or open, refer to section 38.2.5.

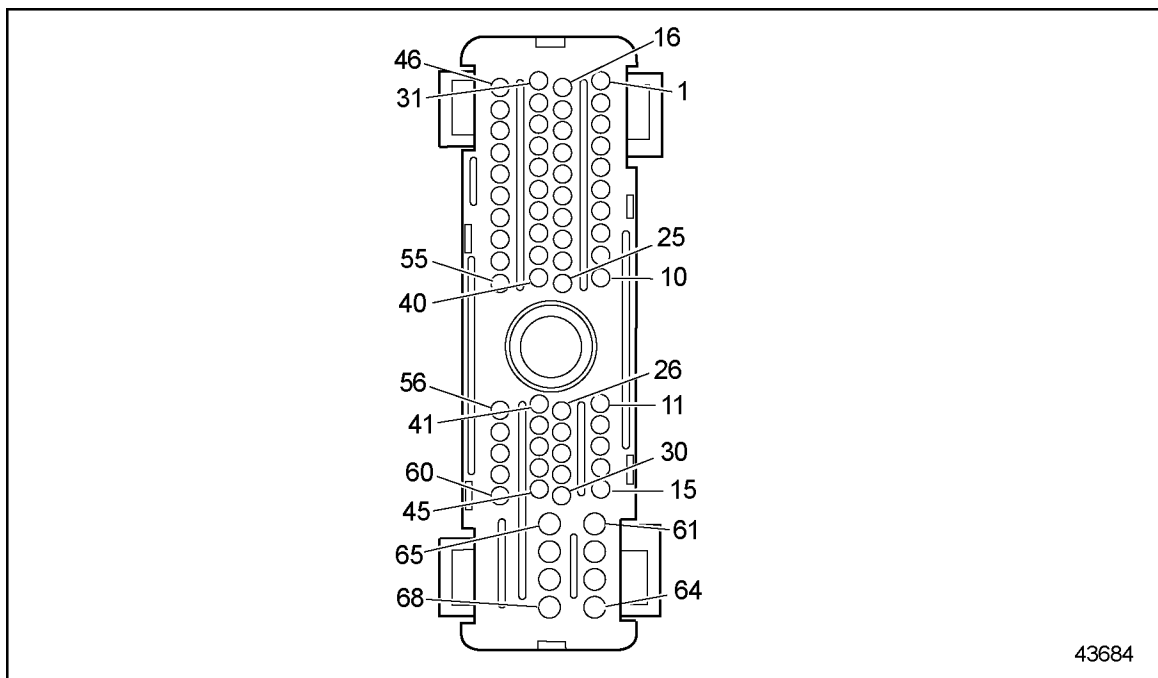


Figure 38-3 ECM/ECU Engine Harness and VIH Connector

38.2.5 Check for Short to Battery (+)

Perform the following steps to check for a short to battery (+).

1. Remove both fuses to the ECM/ECU.
 2. Disconnect the vehicle harness connector at the ECM/ECU. See Figure 38-3.
 3. Measure resistance between socket E-31 on the engine harness connector and socket V-15 of the vehicle harness connector, and between E-31 and V-61 and V-65.
- [a] If resistance measurement is greater than 100 Ω , or open, go to step 4.

- [b] If resistance measurement is less than or equal to 100 Ω , a short exists between sockets where less than 100 Ω resistance was read. Repair short and reinsert fuses. Refer to section 38.2.5.1.
- 4. Inspect the terminals at the ECM/ECU connector (ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If the terminals and connector are damaged, repair both and refer to section 38.2.5.1.
 - [b] If the terminals and connector are not damaged, go to step 5.
- 5. Check terminals at the OPS/EOP Sensor connectors (both the sensor and harness side) for damage: bent, corroded and unseated pins or sockets.
 - [a] If the terminals and connectors are damaged, repair them and refer to section 38.2.5.1.
 - [b] If the terminals and connectors are not damaged, replace the OPS/EOP Sensor. Refer to section 38.2.5.1.

38.2.5.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check codes with diagnostic tool.
 - [a] If no codes are logged, no further troubleshooting is required.
 - [b] If code p 100/3 is not logged, but other codes are logged, refer to section 17.3.
 - [c] If code p 100/3 is logged and all system diagnostics are complete, contact Detroit Diesel Customer Support Center (313-592-5800).

39 FLASH CODE 36 - OPS/EOP SENSOR LOW

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39.1 DESCRIPTION OF FLASH CODE 36	39-3
39.2 TROUBLESHOOTING FLASH CODE 36, PID 100/FMI 4	39-3

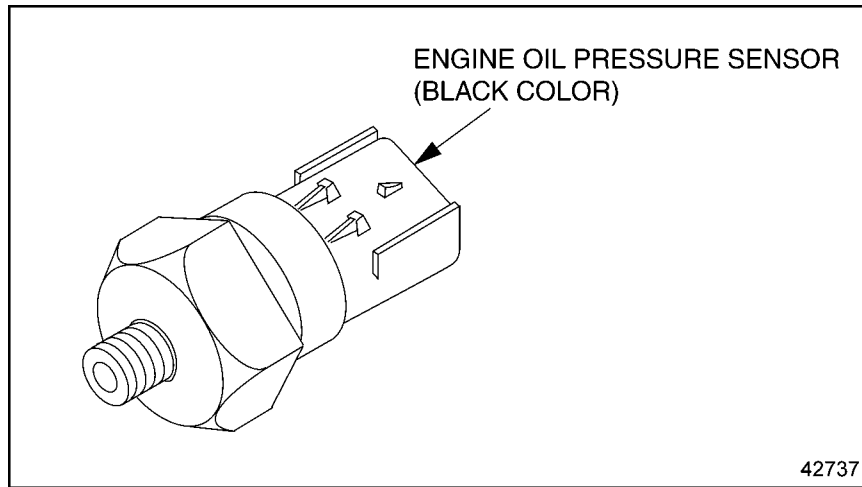


Figure 39-1 Engine Oil Pressure Sensor

39.1 DESCRIPTION OF FLASH CODE 36

The SAE J1587 equivalent code for Flash Code 36 is p 100/4, oil pressure circuit low.

Flash Code 36 indicates that the Engine Oil Pressure Sensor/Engine Oil Pressure Sensor (OPS/EOP Sensor), see Figure 39-1, input to the ECM/ECU has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

39.2 TROUBLESHOOTING FLASH CODE 36, PID 100/FMI 4

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to the sensor return circuit

39.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Plug the diagnostic tool.
2. Turn vehicle ignition switch ON.
3. Read active codes.
 - [a] If code p 100/4 and no other codes were logged, refer to section 39.2.2.
 - [b] If code p 100/4 was logged and none of the following codes were logged: p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, p 101/3 or 4, p 102/3 or 4, p 73/3 or 4, p 94/3 or 4, p 100/3, refer to section 39.2.2.
 - [c] If code p 100/4 and any of the following codes were logged: p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, p 101/3 or 4, p 102/3 or 4, p 73/3 or 4, p 94/3 or 4, p 100/3, refer to section 76.

39.2.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect OPS connector and install a jumper wire between sockets 2 and 3 of the OPS/EOP Sensor connector. See Figure 39-2.
3. Turn ignition ON. Read active codes.
4. If active codes p 100/3 or 4 were logged, proceed with the following:
 - [a] If active code p 100/4 and any other codes were logged, refer to section 39.2.3.
 - [b] If code p 100/3 and any other codes except 100/4 were logged, go to step 6.

5. If active codes p 100/3 or 4 were not logged, warm up engine until either codes are logged or the engine temperature (COOLANT TEMP or OIL TEMP on the DDR) has been greater than 60°C (140°F) for one minute.
 - [a] If active code p 100/4 and any other codes were logged, refer to section 39.2.3.
 - [b] If code p 100/3 and any other codes except 100/4 were logged, go to step 6.

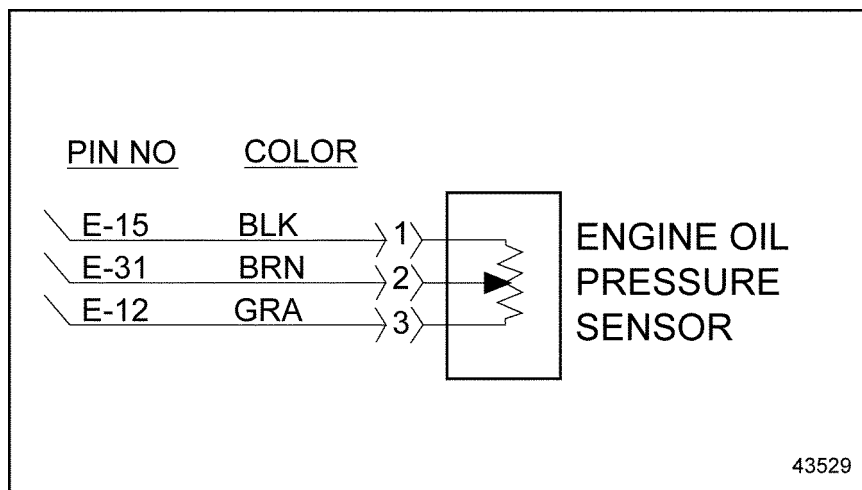


Figure 39-2 Engine Harness Connector to Engine Oil Pressure Sensor

6. Turn ignition OFF.
7. Check terminals at the OPS/EOP Sensor connectors (both the sensor and harness side) for damage: bent, corroded and unseated pins or sockets.
 - [a] If the terminals and connectors are damaged, repair them and refer to section 39.2.7.1.
 - [b] If the terminals and connectors are not damaged, replace the OPS/EOP Sensor. Refer to section 39.2.7.1.

39.2.3 Check for +5 Volts

Perform the following steps to check for +5 volts.

1. Turn vehicle ignition OFF. Remove jumper wire.
2. Turn ignition ON.
3. Measure voltage on OPS/EOP Sensor harness connector, socket 3 (gray lead) to socket 1 (black lead).
 - [a] If the voltage measurement is less than 4 volts, refer to section 39.2.5.
 - [b] If the voltage measurement is greater than 6 volts, refer to section 39.2.7.
 - [c] If the voltage measurement is between 4 and 6 volts, refer to section 39.2.4.

39.2.4 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn the ignition OFF.
2. Disconnect the Engine Harness connector at the ECM/ECU. See Figure 39-3.
3. Install a jumper wire between sockets 1 and 2 of the OPS/EOP Sensor harness connector.
4. Measure resistance between sockets E-15 and E-31 on the Engine Harness connectors.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 39.2.7 and go to step 4.
 - [b] If the resistance measurement is greater than 5 Ω or open, the signal line (E-31) is open. Repair the open and refer to section 39.2.7.1.

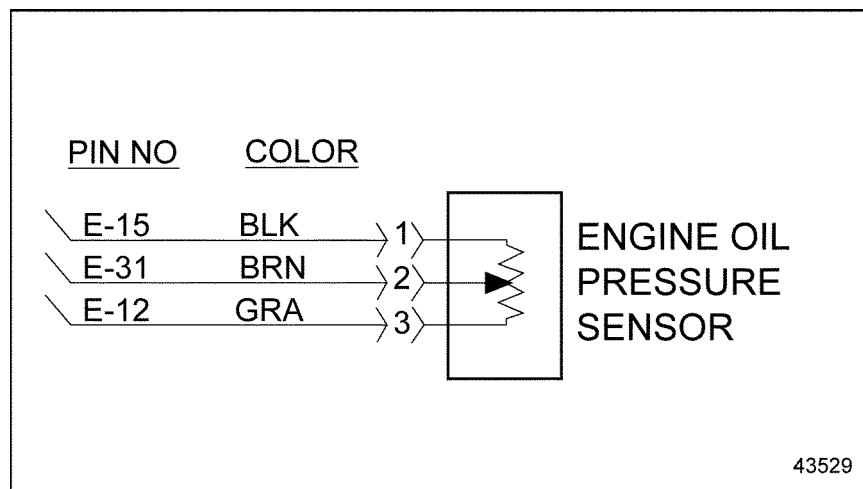


Figure 39-3 Engine Harness Connector to Oil Pressure Sensor

39.2.5 Check for Open +5 Volt Line

Perform the following steps to check for open +5 volt line.

1. Turn the ignition OFF. Disconnect the Engine Harness connectors at the ECM/ECU.
2. Install a jumper wire between pins 1 and 3 of the OPS/EOP Sensor connector.
3. Measure resistance between sockets E-15 and E-12 on the Engine Harness connector. See Figure 39-4.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 39.2.6.

- [b] If the resistance measurement is greater than 5 Ω or open, the engine +5 volt line (E-12) is open. Repair the open and refer to section 39.2.7.1.

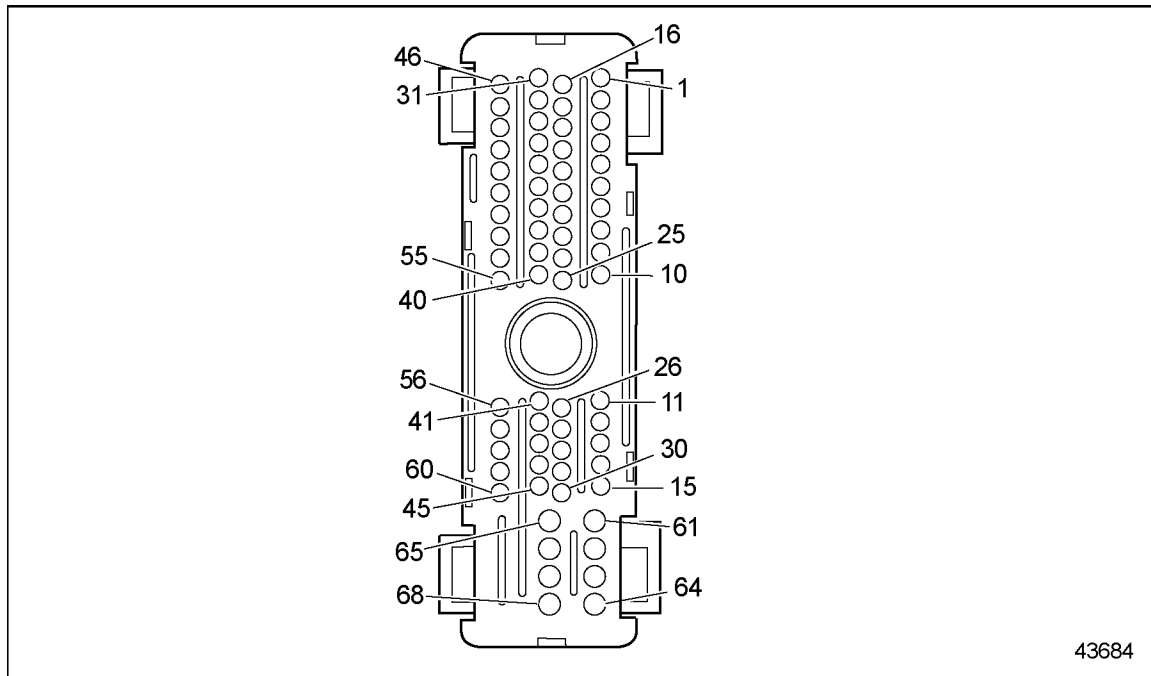


Figure 39-4 ECM/ECU Engine Harness/Vehicle Harness Connector

39.2.6 Check for Short

Perform the following steps to check for a short.

1. Remove jumper wire.
2. Measure resistance between sockets 1 and 3 on the OPS/EOP Sensor harness connector. Also measure resistance between socket 3 and a good ground.
 - [a] If either resistance measurement is less than or equal to 100 Ω , the engine +5 volt line (E-12) is shorted to the return line (E-15) or battery ground. See Figure 39-4. Repair the short and refer to section 39.2.7.1.
 - [b] If the resistance measurement is greater than 100 Ω or open, replace OPS/EOP Sensor and go to step 3.
3. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for damage: bent, corroded and unseated pins or sockets. Check E-12, E-15, and E-31 terminals and pins at ECM/ECU.
 - [a] If the terminals and connectors are damaged, repair them and refer to section 39.2.7.1.
 - [b] If the terminals and connectors are not damaged, reprogram the ECM/ECU. Refer to section 39.2.7.1.

39.2.7 Check for Short to Battery + and Ground

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM/ECU.
2. Disconnect the Vehicle Interface Harness connector at the ECM/ECU.
3. Measure resistance between socket E-31 on the Engine Harness connector and socket V-15 of the Vehicle Interface Harness connector, and between E-31 and V-61 and V-65. See Figure 39-4.
 - [a] If resistance measurement is greater than 100 Ω , or open, replace OPS/EOP Sensor. Refer to section 39.2.7.1.
 - [b] If resistance measurement is less than or equal to 100 Ω , a short exists between sockets where less than 100 Ω resistance was read. Repair short and reinsert fuses and go to step 4.
4. Turn vehicle ignition OFF and remove jumper wire. Measure resistance between sockets E-31 and E-15 on the Engine Harness connector. See Figure 39-4.
 - [a] If resistance measurement is greater than 100 Ω , or open, go to step 5.
 - [b] If resistance measurement is less than or equal to 100 Ω , the signal line (E-31) and return line (E-15) are shorted together. Repair the short. Refer to section 39.2.7.1.
5. Measure resistance between socket E-31 and a good ground. Also measure resistance between E-31 and E-15. See Figure 39-4.
 - [a] If both resistance measurements are greater than 100 Ω or open, replace OPS/EOP Sensor. Refer to section 39.2.7.1.
 - [b] If either resistance measurement is less than 100 Ω , the signal line (E-31) is shorted to the return line (E-15) or battery ground. Repair short and refer to section 39.2.7.1.

39.2.7.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF. Reconnect all connectors.
2. Turn ignition ON. Clear codes.
3. Start and run the engine for one minute. Stop engine.
4. Check diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code p 100/4 is not logged, and other codes are logged, refer to section 17.3.
 - [c] If code p 100/4 is logged and other codes are logged, review this section from the first step to find the error. Refer to section 39.2.1.

40 FLASH CODE 37 - FRS/FUEL RESTRICTION SENSOR VOLTAGE HIGH

Section	Page
40.1 DESCRIPTION OF FLASH CODE 37	40-3
40.2 TROUBLESHOOTING FLASH CODE 37, PID 95/FMI 3	40-3

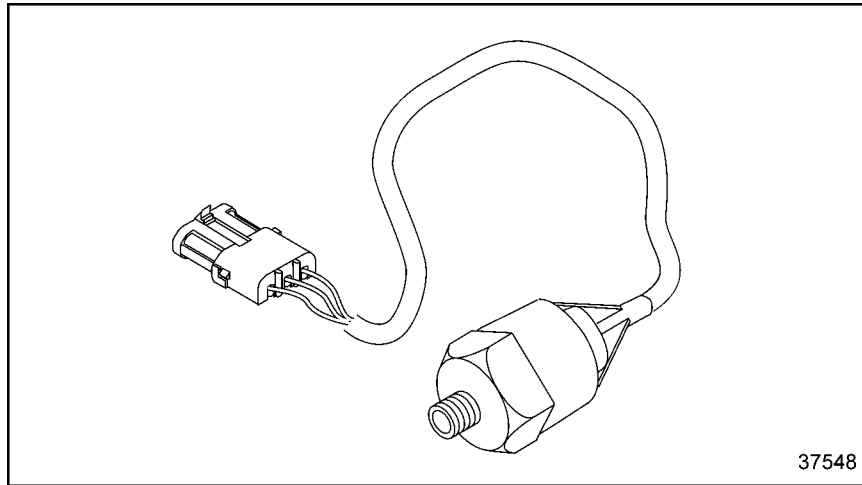


Figure 40-1 FRS/Fuel Restriction Sensor

40.1 DESCRIPTION OF FLASH CODE 37

The SAE J1587 equivalent code for Flash Code 37 is p 95/3 fuel restriction input voltage high.

Flash Code 37 p 95/3 indicates that the FRS/Fuel Restriction Sensor, see Figure 40-1, input to the ECM/ECU has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

40.2 TROUBLESHOOTING FLASH CODE 37, PID 95/FMI 3

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply

40.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug the diagnostic tool.
3. Read active codes.
 - [a] If active code p 95/3 was logged, and no other codes were logged, refer to section 40.2.2.
 - [b] If active codes p 94/3 and any or all of the following codes were logged, p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, p 101/3 or 4, p 102/3 or 4, p 100/3 or 4, p 95/4, p 73/3 or 4, refer to section 76.

40.2.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect FRS/Fuel Restriction Sensor connector.
3. Turn ignition ON.
4. Start and run engine.
5. Select Engine Temperature (COOLANT TEMP & OIL on the DDR).
6. Warm up engine until engine temperature reading is greater than 60°C (140°F).
7. Leave engine running at idle after warm-up. Run for five minutes.
8. Read active codes.
 - [a] If active codes p 95/3 and any other codes were logged, refer to section 40.2.4.
 - [b] If active code 95/4 and any other codes except 95/3 was logged, refer to section 40.2.3.

40.2.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn vehicle ignition OFF.
2. Disconnect the Engine Harness connector at the ECM/ECU.
3. Install a jumper wire between pins A and B of the FRS/Fuel Restriction Sensor harness connector. See Figure 40-2.

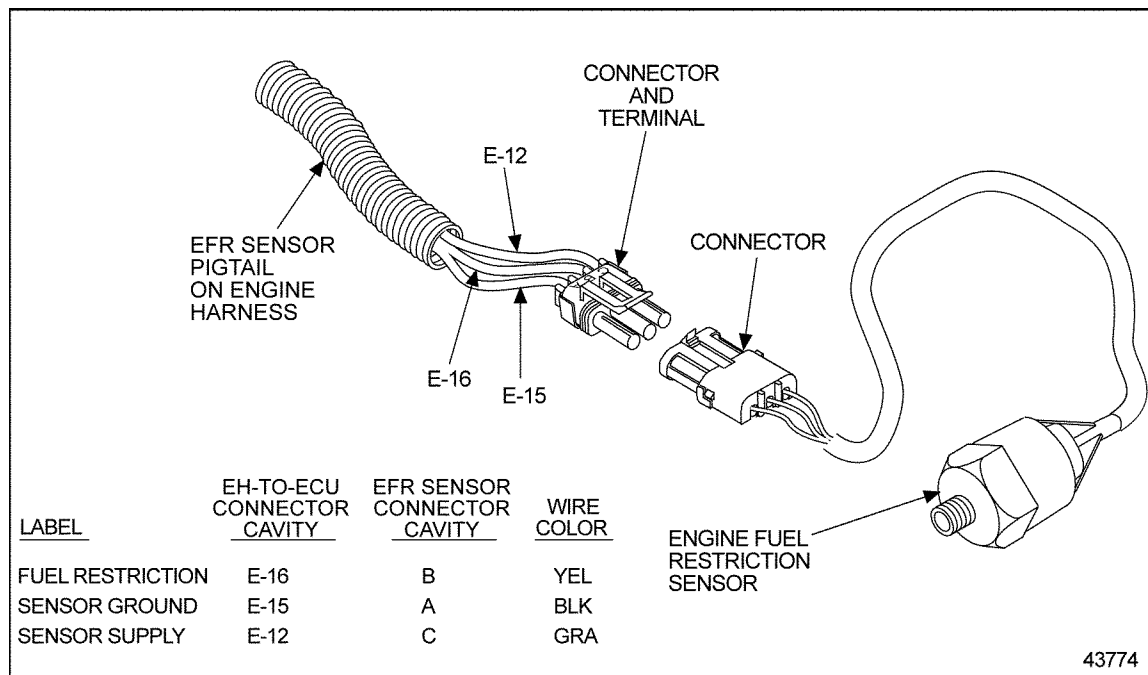


Figure 40-2 FRS/Fuel Restriction Sensor

4. Measure resistance between sockets E-16 and E-15 on the Engine Harness connectors.
 - [a] If resistance measurement is less than or equal to 5 Ω , go to step 5.
 - [b] If resistance measurement is greater than 5 Ω , or open, the return line (E-15) is open. Repair the open and refer to section 40.2.5.1.
5. Inspect terminals at the FRS/Fuel Restriction Sensor connectors (both the sensor and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If the terminals and connectors are damaged, repair them and refer to section 40.2.5.1.
 - [b] If the terminals and connectors are not damaged, replace the FRS/Fuel Restriction Sensor and refer to section 40.2.5.1.

40.2.4 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the Engine Harness connectors at the ECM/ECU.
3. Measure resistance between sockets E-12 and E-16 on the Engine Harness connector.
 - [a] If the resistance measurement is greater than 100 Ω or open, refer to section 40.2.5.
 - [b] If the resistance measurement is less than or equal to 100 Ω , the signal line (E-16) is shorted to the engine +5 volt line (E-12). Repair the short and refer to section 40.2.5.1.

40.2.5 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM/ECU.
2. Disconnect the Vehicle Interface Harness connector. See Figure 40-3.
3. Measure resistance between socket E-16 on the Engine Harness connector and socket V-15 of the Vehicle Interface Harness connector, and between E-16 and sockets V-61 and V-65.
 - [a] If the resistance measurement is greater than 1,000 Ω or open, go to step 4.
 - [b] If the resistance measurement is less than or equal to 1,000 Ω , a short exists between sockets where less than 1,000 Ω was measured. Repair short and reinsert fuses. Refer to section 40.2.5.1.

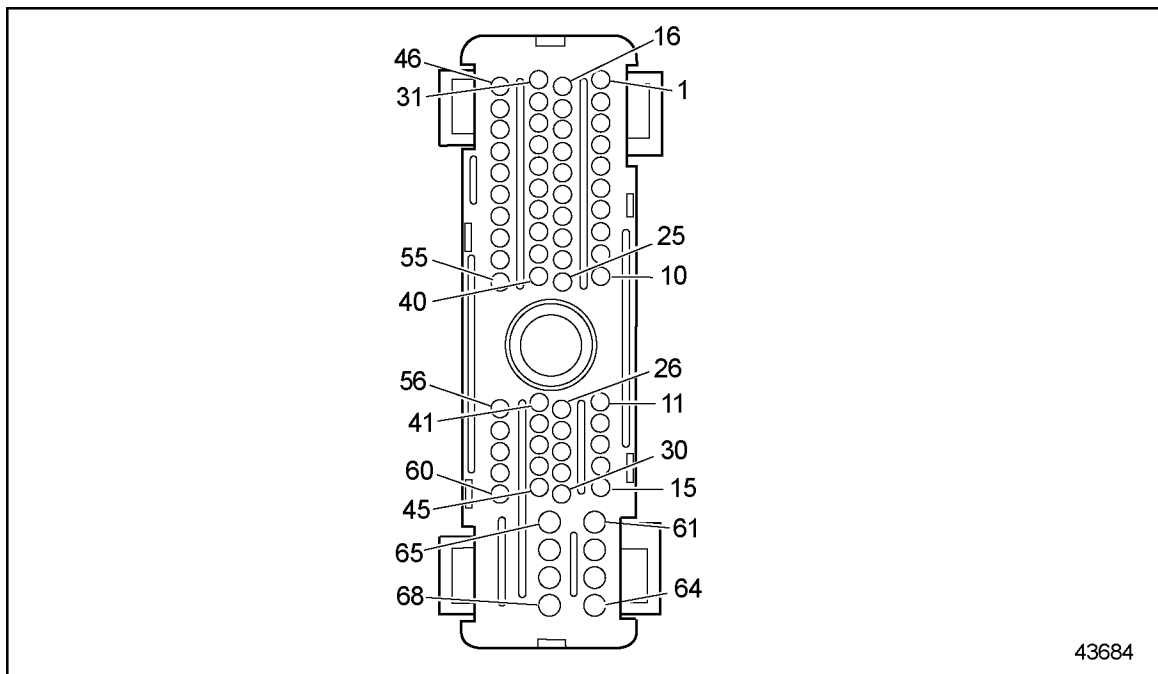


Figure 40-3 ECM/ECU Engine/Vehicle Interface Harness Connector

4. Inspect terminals at the ECM/ECU connector (both the ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 40.2.5.1.
 - [b] If terminals and connectors are not damaged, replace the FRS/Fuel Restriction Sensor (see Figure 40-4) and check the active codes. If code p 95/3 is logged, reprogram the ECM/ECU. Refer to section 40.2.5.1.

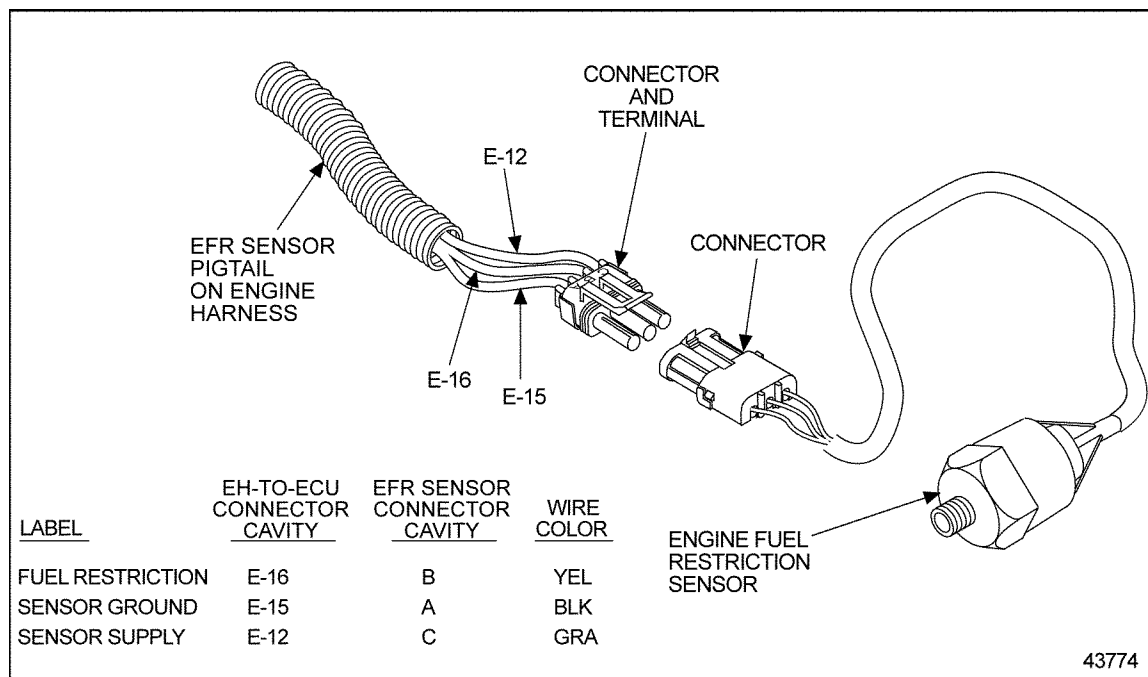


Figure 40-4 FRS/Fuel Restriction Sensor

40.2.5.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF and reconnect all connectors.
2. Turn ignition ON and clear codes.
3. Start and run the engine for one minute.
4. Stop the engine and check diagnostic tool for codes.
 - [a] If no codes are logged, no further troubleshooting is required.
 - [b] If codes p 95/3 was not logged, and other codes are logged, refer to section 17.3.
 - [c] If code p 95/3 and other codes are logged, review this section from the first step to find the error. Refer to section 40.2.1.

41 FLASH CODE 38 - FRS/FUEL RESTRICTION SENSOR VOLTAGE LOW

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41.1 DESCRIPTION OF FLASH CODE 38	41-3
41.2 TROUBLESHOOTING FLASH CODE 38, PID 95/FMI 4	41-3

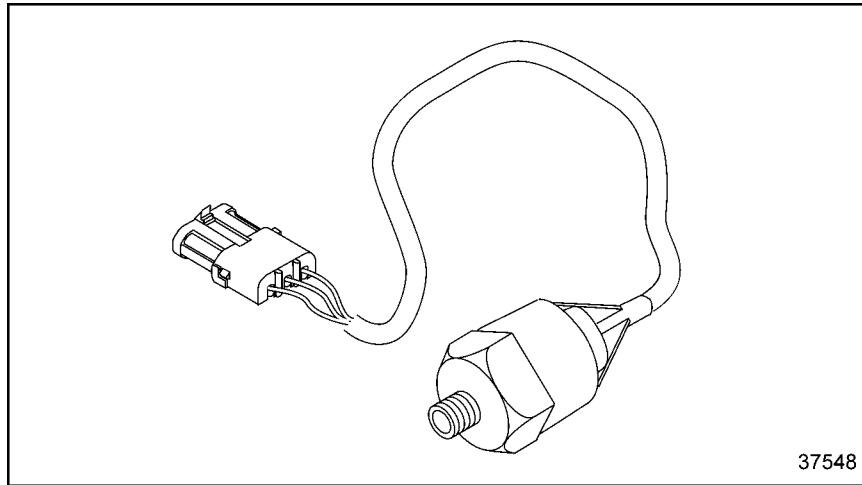


Figure 41-1 FRS/Fuel Restriction Sensor

41.1 DESCRIPTION OF FLASH CODE 38

The SAE J1587 equivalent code for Flash Code 38 is p 95/4, FRS, fuel pressure restriction input voltage low.

Flash Code 38 indicates that FRS/Fuel Restriction Sensor, see Figure 41-1, input to the ECM/ECU has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

41.2 TROUBLESHOOTING FLASH CODE 38, PID 95/FMI 4

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to the sensor return circuit

41.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug the diagnostic tool.
3. Read active codes.
 - [a] If active code p 95/4 and no other codes were logged, refer to section 41.2.2.
 - [b] If active code p 95/4 and any or all of the following codes were logged, p 95/3, p 100/3 or 4, p 101/3 or 4, p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, refer to section 76.
 - [c] If active code 95/4 and codes other than the following codes were logged, p 95/3, p 100/3 or 4, p 101/3 or 4, p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, refer to section 41.2.2.

41.2.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect FRS/Fuel Restriction Sensor connector and install a jumper wire between sockets B and C of the FRS/Fuel Restriction Sensor harness connector. See Figure 41-2.
3. Turn ignition ON.
4. Read logged codes.
5. If active codes p 95/3 or 4 are not logged, start and run the engine until either these active codes display or engine temperature (COOLANT TEMP & OIL on DDR) has been greater than 60°C (140°F) for more than one minute.
 - [a] If active code p 95/4 and any other codes are logged, refer to section 41.2.3.

- [b] If active code p 95/3 and any other codes except code 95/4 are logged, check to ensure ECM/ECU and FPS/FRS connectors are wired properly. Go to step 6.
6. Inspect terminals at the FRS/Fuel Restriction Sensor connectors (both the sensor and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 41-2.

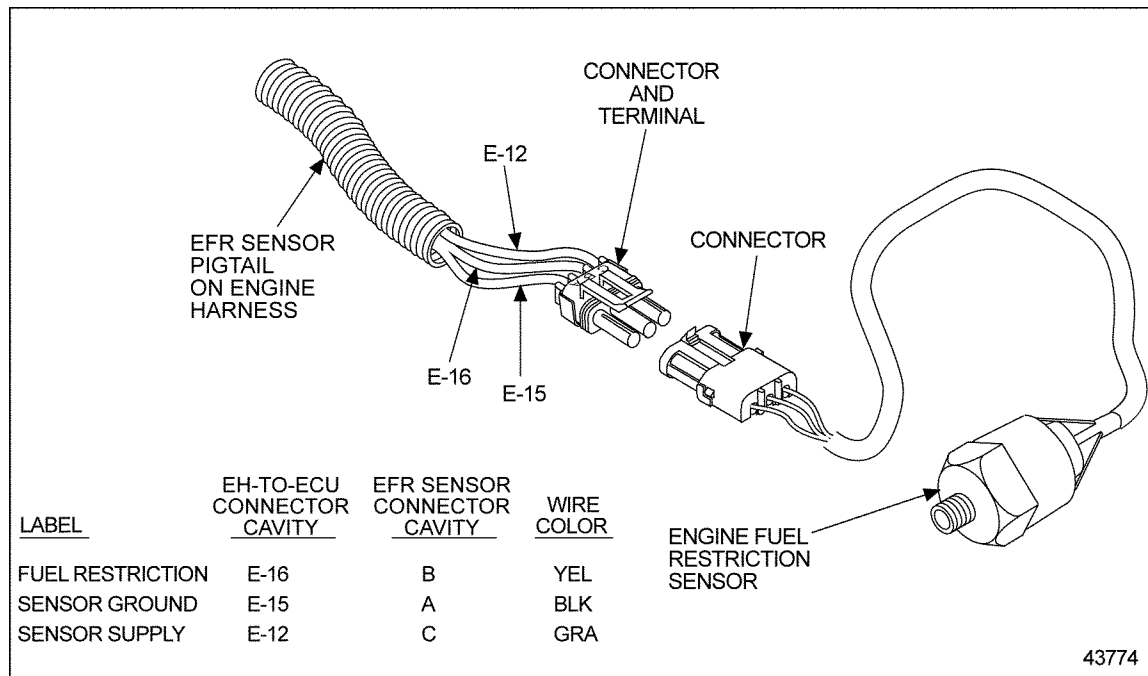


Figure 41-2 FRS/Fuel Restriction Sensor

- [a] If the terminals and connectors are damaged, repair them and refer to section 41.2.8.1.
- [b] If the terminals and connectors are not damaged, replace the FRS/Fuel Restriction Sensor and refer to section 41.2.8.1.

41.2.3 Check for +5 Volts

Perform the following steps to check for +5 volts.

1. Turn vehicle ignition OFF and remove jumper wire. Turn ignition ON.
2. Measure voltage on FRS/Fuel Restriction Sensor harness connector, socket C to socket A.
 - [a] If the voltage measurement is greater than 6 volts, refer to section 41.2.6.
 - [b] If the voltage measurement is less than 4 volts, refer to section 41.2.5.
 - [c] If the voltage measurement is between 4 and 6 volts, refer to section 41.2.4.

41.2.4 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn vehicle ignition OFF and disconnect Engine Harness connector at the ECM/ECU.
2. Install a jumper wire between pins A and B of the FRS/Fuel Restriction Sensor harness connector. See Figure 41-3.

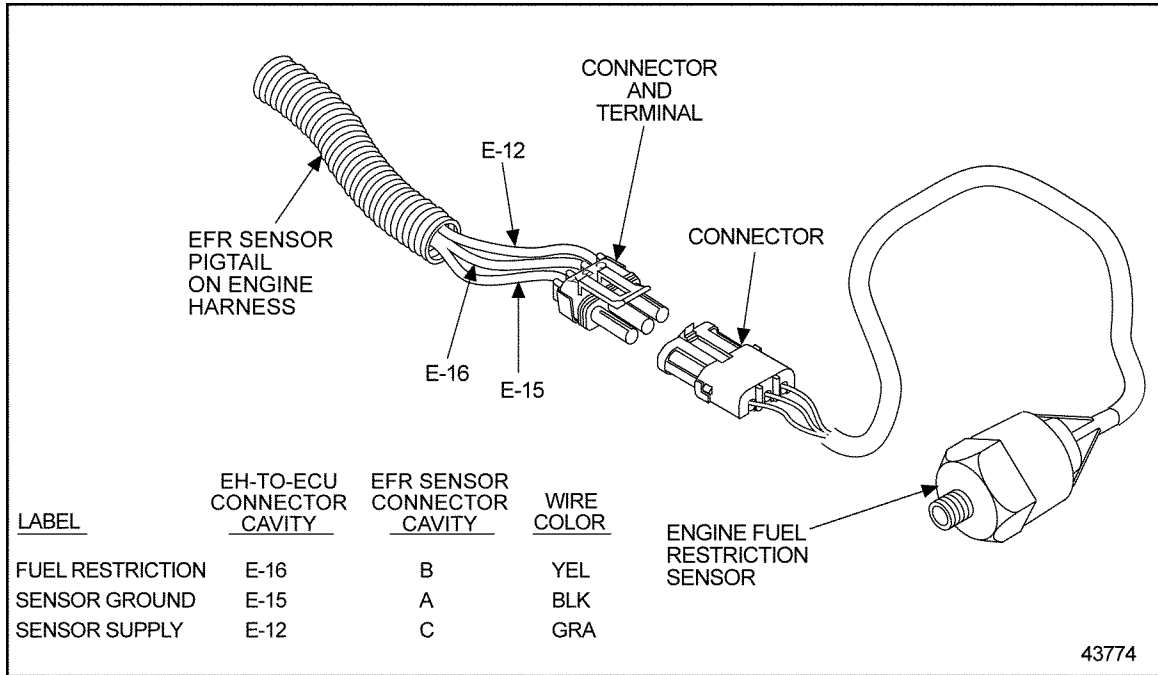


Figure 41-3 FRS/Fuel Restriction Sensor

3. Measure resistance between sockets E-16 and E-15 on the Engine Harness connector.
 - [a] If resistance measurement is less than or equal to 5 Ω refer to section 41.2.7.
 - [b] If the resistance measurement is greater than 5 Ω or open, the signal line (E-16) or return line (E-15) is open. Repair the open and refer to section 41.2.8.1.

41.2.5 Check for Open +5 Volt Line and Short

Perform the following steps to check for open +5 volt line.

1. Turn vehicle ignition OFF.
2. Disconnect the Engine Harness connectors at the ECM/ECU.
3. Install a jumper wire between sockets A and C of the FRS harness connector.
4. Measure resistance between sockets E-12 and E-15 on the Engine Harness connector.
 - [a] If resistance measurement is less than or equal to 5 Ω , go to step 5.

- [b] If the resistance measurement is greater than 5 Ω or open, the engine +5 volt line (E-16) is open. Repair the open and refer to section 41.2.8.1.
- 5. Remove jumper wire.
- 6. Measure resistance between sockets A and C of the FRS sensor connector.
 - [a] If the resistance measurement is greater than 100 Ω or open, refer to section 41.2.8.
 - [b] If the resistance measurement is less than or equal to 100 Ω , the return line (E-15) is shorted to the engine +5 volt line (E-12). Repair the short and refer to section 41.2.8.1.

41.2.6 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM/ECU.
2. Disconnect the Vehicle Interface Harness connector at the ECM/ECU. See Figure 41-4.
3. Measure resistance between socket E-12 on the Engine Harness connector and socket V-15 of the Vehicle Interface Harness connector, and between E-12 and the 5-way power harness sockets V-61 and V-65.
 - [a] If the resistance measurement is greater than 1,000 Ω or open, refer to section 41.2.8.
 - [b] If the resistance measurement is less than or equal to 1,000 Ω , a short exists between sockets where less than 1,000 Ω was measured. Repair short and reinsert fuses. Refer to section 41.2.8.1.

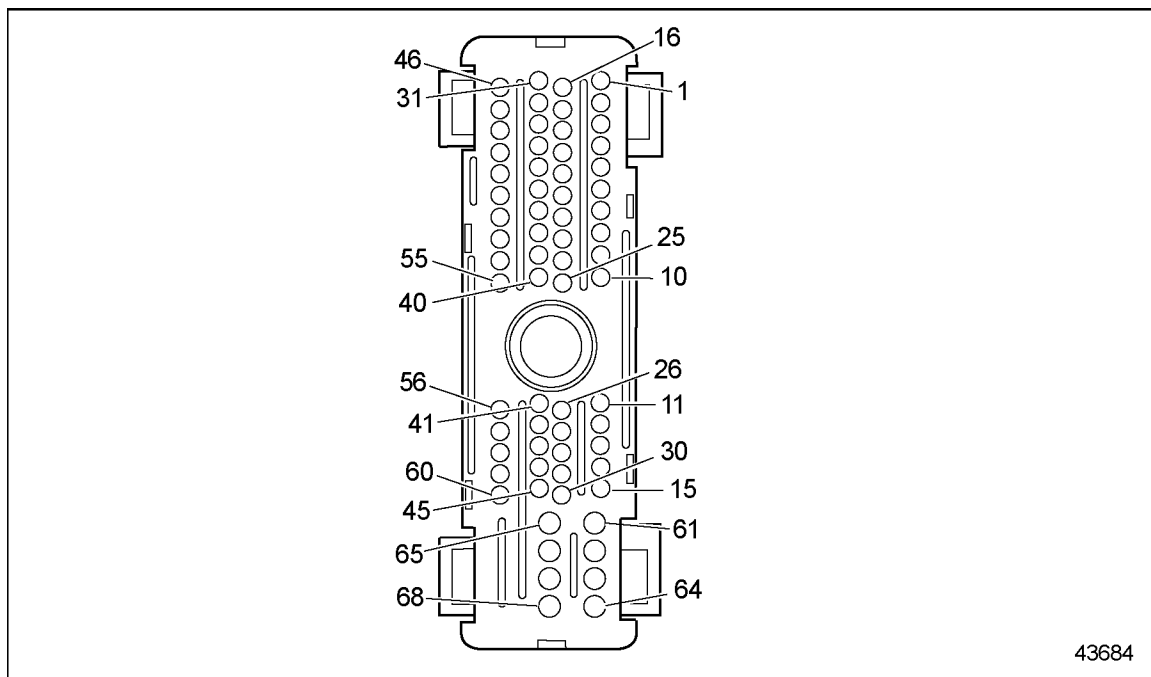


Figure 41-4 ECM/ECU Vehicle Harness Connector

41.2.7 Check for Short to Ground

Perform the following steps to check for a short to ground.

1. Turn ignition switch OFF.
2. Remove jumper wires.
3. Measure resistance between sockets E-16 and E-15 on the Engine Harness connector. Also measure resistance between socket E-16 and a good ground.
 - [a] If both resistance measurements are greater than 100 Ω or open, refer to section 41.2.8.
 - [b] If either resistance measurement is less than or equal to 100 Ω , the signal line (E-16) and return line (E-15) are shorted together, or the signal line (E-16) is shorted to battery ground. Repair the short. Refer to section 41.2.8.1.

41.2.8 Replace FRS/Fuel Restriction Sensor

Perform the following steps to replace the FRS/Fuel Restriction Sensor.

1. Turn ignition switch OFF.
2. Replace FRS/Fuel Restriction Sensor. Reconnect all connectors.
3. Turn ignition ON. Clear codes.
4. Start and run the engine for one minute.
 - [a] If Amber Warning Lamp comes on, go to step 5.
 - [b] If Amber Warning Lamp does not come on, refer to section 41.2.8.1.
5. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets. Check E-12, E-16 and E-15 terminals at ECM/ECU.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 41.2.8.1.
 - [b] If terminals and connectors are not damaged, install a test ECM/ECU. Refer to section 41.2.8.1.

41.2.8.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON. Clear codes.
4. Start and run the engine for one minute. Stop engine.
5. Check diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.

- [b] If code p 95/4 is not logged, and other codes are logged, refer to section 17.3.
- [c] If code p 95/4 is logged, and other codes are logged, review this section from the first step to find the error. Refer to section 41.2.1.

42 FLASH CODE 39 – EGR VALVE / VNT VANE FAULT

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42.1 DESCRIPTION OF FLASH CODE 39	42-3
42.2 TROUBLESHOOTING FLASH CODE 39, SID 147/FMI 12	42-3
42.3 TROUBLESHOOTING FLASH CODE 39, SID 146, 147/FMI 2, 12, 7, 14, 11	42-4

42.1 DESCRIPTION OF FLASH CODE 39

Flash Code 39 is used for several Exhaust Gas Recirculation (EGR) system or Variable Nozzle Turbine (VNT) operational faults. These codes are typically logged in the ECM/ECU when one of the components are faulty.

The SAE J1587 equivalent codes for Flash Code 39, EGR valve fault:

- ☐ s 146/2, EGR leak — Boost Power
- ☐ s 146/12, EGR leak — Boost Jake
- ☐ s 146/7, EGR Valve not responding

The SAE J1587 equivalent codes for Flash Code 39, VNT vane fault:

- ☐ s 147/2, VNT Vanes not responding — Boost Power
- ☐ s 147/12, VNT Vanes not responding — Boost Jake or faulty Barometric Pressure Sensor
- ☐ s 147/14, EGR flow too low
- ☐ s 147/11, VNT Vanes at Max — Jake
- ☐ s 147/7, VNT Vanes not responding — EGR

There are no wires to check for Flash Code 39. The sensor values and the ECM/ECU calibration are used to decide a mechanical fault is present.

42.2 TROUBLESHOOTING FLASH CODE 39, SID 147/FMI 12

Engines built from February 2004 (S/N: 06R0761470) through the end of July 2004 (S/N: 06R0788688) may have a defective Barometric Pressure Sensor.

A faulty Barometric Pressure Sensor can cause this fault (SID 147/FMI 12). Refer to section 42.2.1 first to check the sensor.

42.2.1 Check Barometric Pressure Sensor

Check for a faulty Barometric Pressure Sensor as follows:

1. Turn the ignition ON but leave the engine OFF.
2. Using Detroit Diesel Diagnostic Link (DDDL) or a Diagnostic Data Reader (DDR) compare Barometric Pressure to Air Inlet Pressure.
 - [a] If the pressure differential is 4.1 kPa (0.6 psi) the sensor is not faulty and has not caused the code. Refer to section 42.3.1.
 - [b] If the differential is greater than 4.1 kPa (0.6 psi), replace the Barometric Pressure Sensor and check for codes. If there are no codes your troubleshooting is complete. If there are still codes, refer to section 42.3.1.
 - [c] If the pressure differential is less than 4.1 kPa (0.6 psi), contact the Detroit Diesel Customer Support Center (313-592-5800).

42.3 TROUBLESHOOTING FLASH CODE 39, SID 146, 147/FMI 2, 12, 7, 14, 11

The following procedure will troubleshoot Flash Code 39.

42.3.1 EGR Related Codes

For all EGR related codes, first refer to section 19.18, “Exhaust Gas Recirculation System Basic Checks,” and perform the steps listed. Performing the basic checks will troubleshoot the components that could be responsible for logging these codes.

If the basic checks all pass, and no fault can be found with the VNT/turbocharger or EGR valve, then it is recommended that the information you have collected be available to discuss with the Detroit Diesel Customer Support Center (313–592–5800).

- Code s 146/7 — occurs if actual EGR rate during EGR mode operation is less than it should be. This fault will lock boost mode operation and illuminate the CEL/AWL for the remainder of the ignition cycle.
- Code s 146/2 — occurs if actual EGR rate during Power Boost mode operation is greater than a calibrated value. This fault will illuminate the CEL/AWL for the duration of the fault being active.
- Code s 146/12 — occurs if actual EGR rate during Boost Jake mode operation is greater than a calibrated value. This fault will illuminate the CEL/AWL for the duration of the fault being active.
- Code s 147/7 — occurs if error in actual EGR rate vs desired EGR rate (Actual – Desired) during EGR mode operation. This FMI signifies excessive EGR flow. This fault will lock boost mode operation and illuminate the CEL/AWL for the remainder of the ignition cycle if the actual is greater than the desired.
- Code s 147/2 — occurs if error in actual boost vs desired boost during Power Boost mode operation is greater than it should be. This fault will illuminate the CEL/AWL for the duration of the fault being active.
- Code s 147/12 — occurs if error in actual boost vs desired boost during Jake Boost mode operation is greater than it should be. This fault will illuminate the CEL/AWL for the duration of the fault being active.
- Code s 147/14 — occurs if error in actual EGR rate vs desired EGR rate (Desired – Actual) during EGR mode operation. This FMI signifies low EGR flow. This fault will illuminate the CEL/AWL for the duration of the fault being active.

42.3.2 Verify Repairs

Perform the following steps to verify repairs:

1. Reassemble the engine.
2. Start and run the engine.
3. Perform a road test.
4. Check for logged codes.

- [a] For Series 60 engines, refer to section 10.18 or call Detroit Diesel Customer Service Center (313-592-5800).
- [b] If no codes are logged, repairs are complete.

43 FLASH CODE 41 - MISSING TRS/CKP PULSES OR EXTRA SRS/CMP PULSES

Section	Page
43.1 DESCRIPTION OF FLASH CODE 41	43-3
43.2 TROUBLESHOOTING FLASH CODE 41, SID 21/FMI 0	43-3

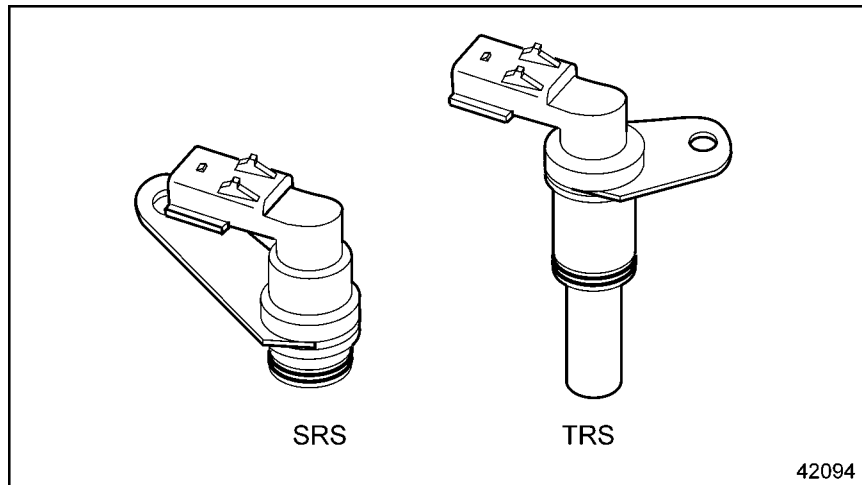


Figure 43-1 SRS/CMP and TRS/CKP Sensors — Series 60

43.1 DESCRIPTION OF FLASH CODE 41

The SAE J1587 equivalent code for Flash Code 41 is s 21/0.

Flash Code 41 indicates that the ECM/ECU has detected missing Timing Reference Sensor/Crankshaft Position Sensor pulses, or the ECM/ECU has detected extra Synchronous Reference Sensor/Camshaft Position Sensor pulse, see Figure 43-1.

43.2 TROUBLESHOOTING FLASH CODE 41, SID 21/FMI 0

The following procedure will troubleshoot Flash Code 41.

43.2.1 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn ignition OFF.
2. Disconnect Engine Harness connector at the ECM/ECU. See Figure 43-2.
3. Read resistance between sockets E-17 and E-18 on the Engine Harness connector.
 - [a] If the resistance reading is less than or equal to 135 Ω , refer to section 43.2.2.
 - [b] If the resistance reading is greater than 136 Ω or open, refer to section 43.2.3.

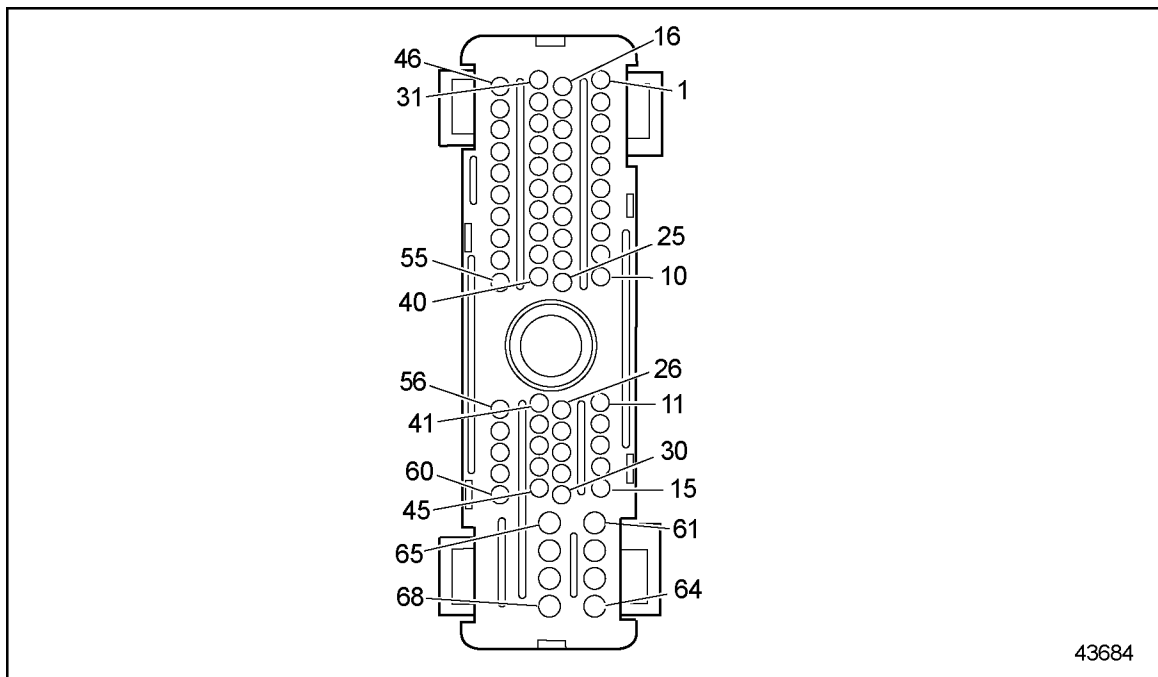


Figure 43-2 Engine Harness Connector

43.2.2 Check for Short

Perform the following steps to check for a short.

1. Disconnect the TRS/CKP connector.
2. Measure resistance between sockets E-17 and E-18 on the Engine Harness connector.
See Figure 43-3.
3. Measure resistance between socket E-17 and ground, and between socket E-18 and ground.
 - [a] If the resistance measurement is greater than 10,000 Ω or open, refer to section 43.2.4.
 - [b] If the resistance measurement is less than or equal to 10,000 Ω , a short exists between E-17 and E-18 or where less than 10,000 Ω resistance was read. Repair the short.
Refer to section 43.2.8.1.

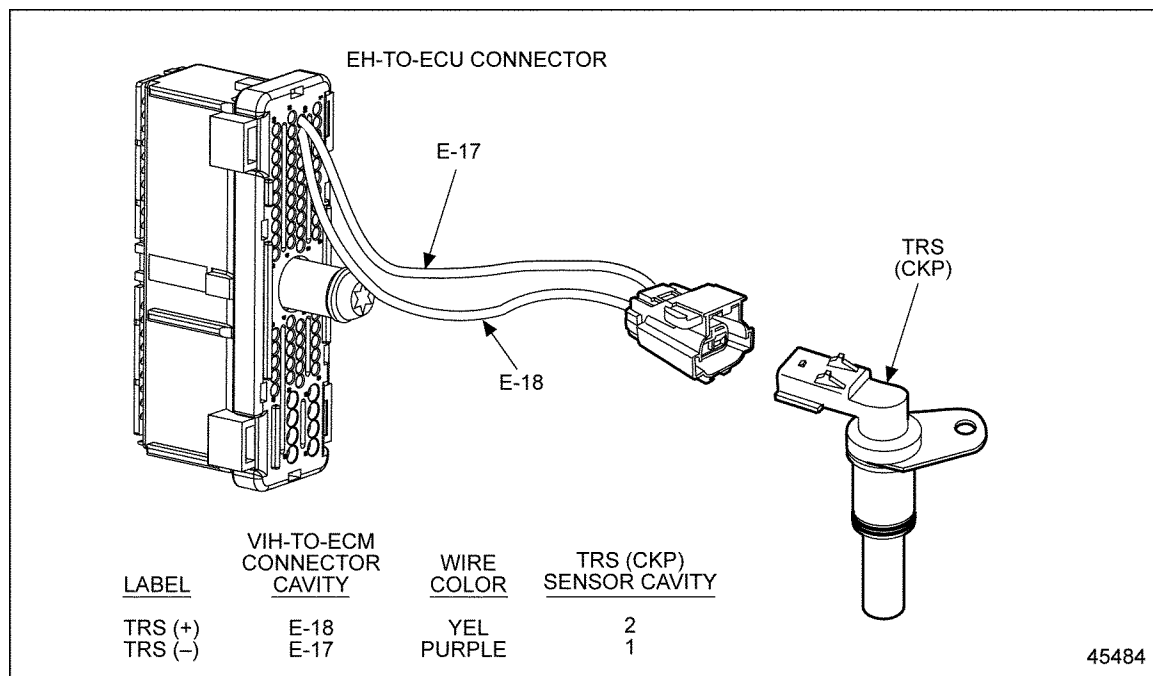


Figure 43-3 Engine Harness Connector to Crankshaft Position Sensor

43.2.3 Open Crankshaft Position Sensor Line Check

Perform the following steps to check the open TRS/CKP line.

1. Disconnect the TRS/CKP connector.
2. Install a jumper wire between sockets 1 and 2 of the TRS/CKP harness connector.
3. Measure resistance between sockets E-17 and E-18 on the Engine Harness connector.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 43.2.4.
 - [b] If the resistance measurement is greater than 5 Ω , or open, the signal line E-18 or return line E-17 is open. Repair the open. Refer to section 43.2.8.1.

43.2.4 Check Crankshaft Position Sensor Resistance and Gap

Perform the following steps to check TRS/CKP resistance and TRS/CKP/CMP gap:

1. Measure resistance of TRS/CKP across sensor connector pins 1 and 2. See Figure 43-4.
 - [a] If the resistance measurement is greater than 136 Ω , go to step 4.
 - [b] If the resistance measurement is between 100 and 135 Ω , go to go to step 2.

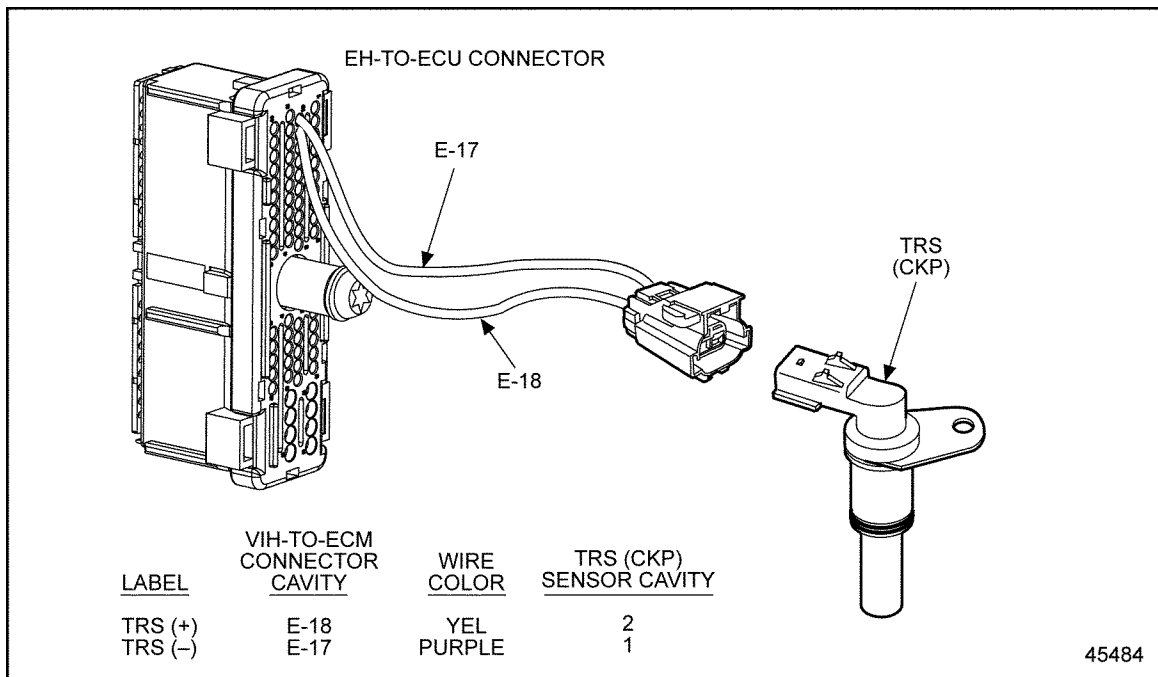


Figure 43-4 Engine Harness Connector to Crankshaft Position Sensor

2. Bar the engine until the TRS/CKP is over a TRS/CKP tooth of the pulse wheel.
3. Check the gap between TRS/CKP and the tooth of the pulse wheel (0.020 to 0.040 in.). A depth micrometer can be used.
 - [a] If the gap setting is correct, refer to section 43.2.5.
 - [b] If the gap setting is not correct, adjust the TRS/CKP until the gap setting is correct. If the problem returns, the pulse wheel may be loose or bad or damaged. Refer to section 43.2.8.1.
4. Check terminals at the TRS/CKP (both the TRS/CKP and harness side) for damaged, bent, corroded, and unseated pins or sockets. See Figure 43-4
 - [a] If the terminals and connectors are damaged, repair them. Refer to section 43.2.8.1.
 - [b] If the terminals and connectors are not damaged, replace the TRS/CKP. Refer to section 43.2.8.1.

43.2.5 Camshaft Position Sensor Check

Perform the following steps to check the SRS/CMP:

1. Check for SRS/CMP code.
 - [a] If code 21/1 is not logged, go to step 3.
 - [b] If code 21/1 is logged, go to step 2.
2. Measure resistance between sockets E-20 and E-19 on the Engine Harness connector. See Figure 43-5.
 - [a] If measured resistance is greater than $136\ \Omega$, or open, refer to section 43.2.7.
 - [b] If measured resistance is less than $135\ \Omega$, or open, refer to section 43.2.6.

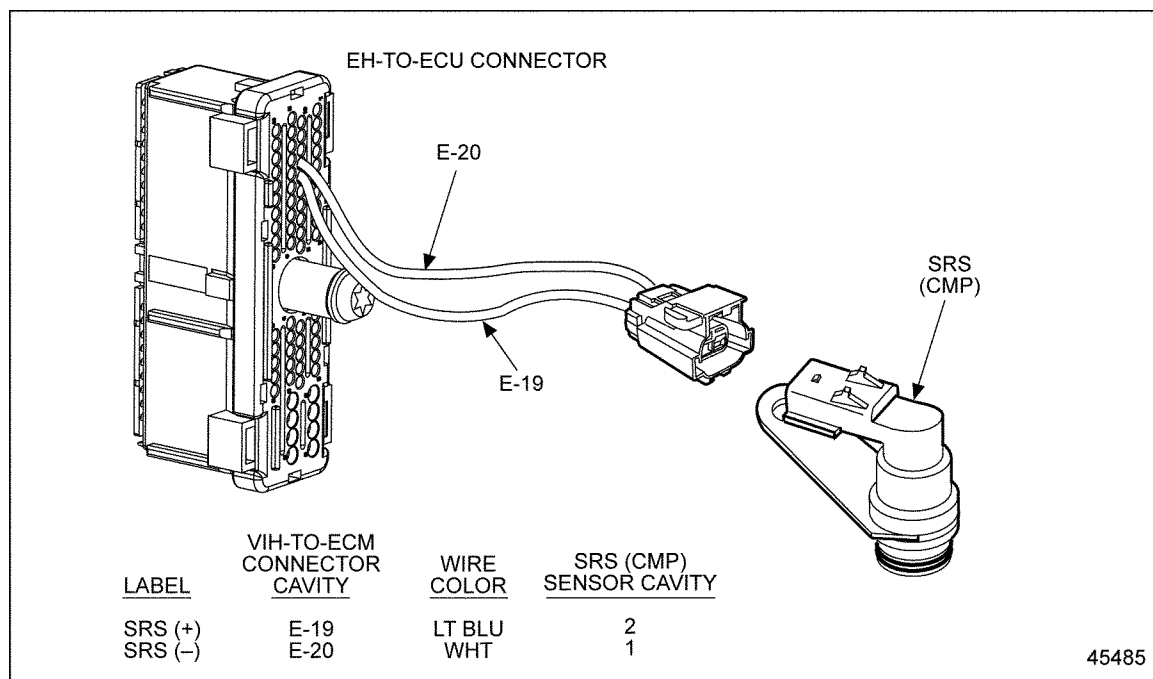


Figure 43-5 Engine Harness Connector to Camshaft Position Sensor

3. Check terminals at the ECM/ECU Engine Harness connectors (both the ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 43.2.8.1.
 - [b] If terminals and connectors are not damaged, install a test ECM/ECU. Refer to section 43.2.8.1.

43.2.6 Check for Short

Perform the following steps to check for a short.

1. Disconnect the SRS/CMP connector.
2. Measure resistance between sockets E-19 and E-20 on the Engine Harness connector.
 - [a] If measured resistance is greater than 10,000 Ω , or open, go to step 3.
 - [b] If measured resistance is less than or equal to 10,000 Ω , the signal line E-20 is shorted to the return line E-19. Repair the short. Refer to section 43.2.8.1.
3. Measure resistance of SRS/CMP across the sensor connector pins 1 and 2.
 - [a] If the measured resistance is greater than 136 Ω , go to step 4.
 - [b] If the measured resistance is between 100 and 136 Ω , go to step 5.
4. Check terminals at the SRS/CMP (both the SRS/CMP and harness side) for damage: bent, corroded, and unseated pins or sockets, or bad contacts.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 43.2.8.1.
 - [b] If terminals and connectors are not damaged, replace the SRS/CMP. Refer to section 43.2.8.1.
5. Check terminals at the ECM/ECU Engine Harness connectors (both the ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 43.2.8.1.
 - [b] If terminals and connectors are not damaged, install a test ECM/ECU. Refer to section 43.2.8.1.

43.2.7 Open Camshaft Position Sensor Line Check

Perform the following steps to check for an open SRS/CMP line.

1. Disconnect the SRS/CMP connector.
2. Install a jumper wire between sockets 1 and 2 of the SRS harness connectors.
3. Measure resistance between sockets E-19 and E-20 on the Engine Harness connector.
 - [a] If measured resistance is less than or equal to 5 Ω , go to step 4.
 - [b] If measured resistance is greater than 5 Ω , or open, the signal line E-20 or return line E-19 is open. Repair the open and refer to section 43.2.8.1.
4. Measure resistance of SRS/CMP across the sensor connector pins 1 and 2.
 - [a] If the measured resistance is greater than 136 Ω , go to step 5.
 - [b] If the measured resistance is between 100 and 136 Ω , go to step 6.
5. Check terminals at the SRS/CMP (both the SRS/CMP and harness side) for damage: bent, corroded, and unseated pins or sockets, or bad contacts.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 43.2.8.1.

- [b] If terminals and connectors are not damaged, replace the SRS/CMP. Refer to section 43.2.8.1.
- 6. Check terminals at the ECM/ECU Engine Harness connectors (both the ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If terminals and connectors are damaged, repair them. Check for code 21/0. If there are no codes, refer to section 43.2.8.1. If code s 21/0 appears, refer to section 43.2.8 and check the injector harness.
 - [b] If terminals and connectors are not damaged, install a test ECM/ECU. Check for code s 21/0. If there are no codes, refer to section 43.2.8.1. If code s 21/0 appears, refer to section 43.2.8 and check the injector harness.

43.2.8 Check Injector Drive Harness for Short

Check the injector drive harness for a short as follows:

1. Disconnect the injector harness 10 pin connector and locate the terminals for each injector position. See Figure 43-6.

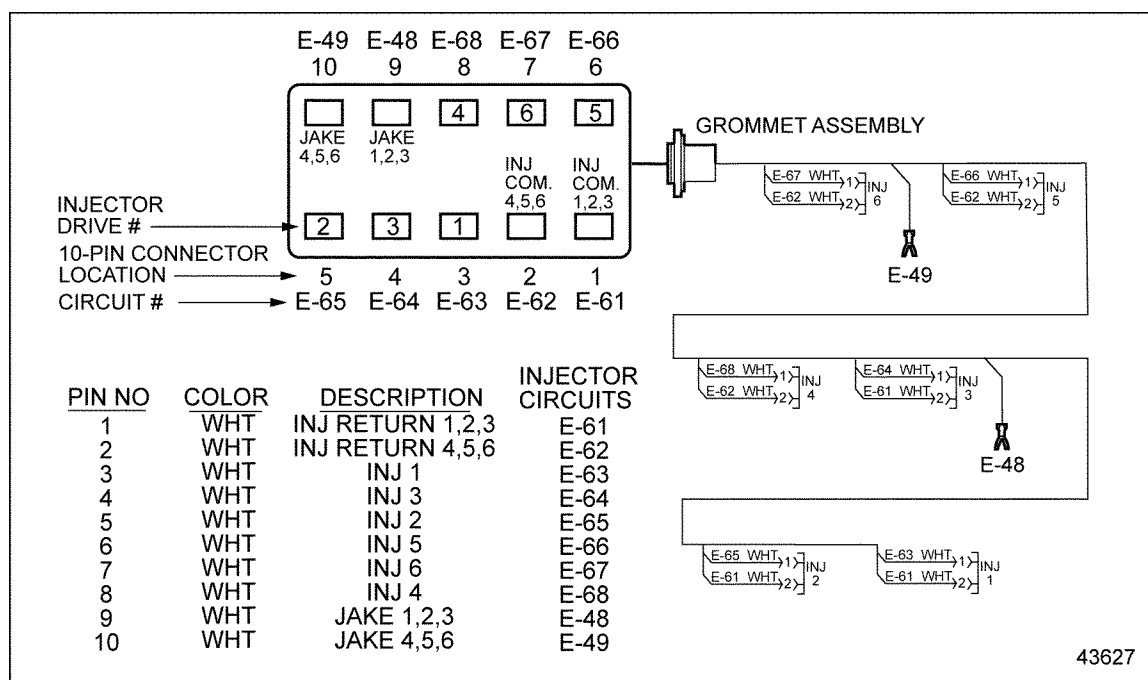


Figure 43-6 Injector Harness with Jake Brake

2. Measure resistance between that terminal and the cylinder block.
 - [a] If the measured resistance is less than 5Ω , the wire is shorted to the block. Replace the harness between the 10 pin connector and the ECM/ECU. Refer to section 43.2.8.1.
 - [b] If the measured resistance is greater than 5Ω , call the Detroit Diesel Customer Support Center (313-592-5800).

43.2.8.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Start and run the engine for one minute. Stop engine.
5. Check diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code s 21/0 is logged, check the injector harness for a short to ground (can cause extra pulses). Refer to Chapter 57, section 57.2.3, "Check for Short."
 - [c] If code s 21/0 and any other codes are logged, and the TRS/CKP or SRS/CMP was not replaced, refer to section 43.2.5.
 - [d] If code s 21/0 and any other codes are logged and the TRS/CKP or SRS/CMP was replaced, review this section to find the error or contact Detroit Diesel Customer Support Center (313-592-5800).
 - [e] If any codes except code s 21/0 are logged, refer to section 17.3.

44 FLASH CODE 42 - MISSING SRS/CMP PULSES OR EXTRA TRS/CKP PULSES

Section	Page
44.1 DESCRIPTION OF FLASH CODE 42	44-3
44.2 TROUBLESHOOTING FLASH CODE 42, SID 21/FMI 1	44-3

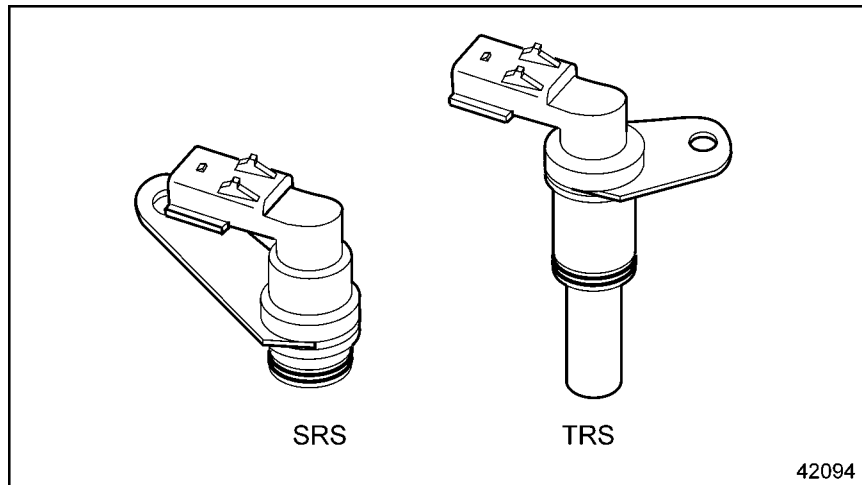


Figure 44-1 SRS/CMP and TRS/CKP Sensors — Series 60

44.1 DESCRIPTION OF FLASH CODE 42

The SAE J1587 equivalent code for Flash Code 42 is s 21/1.

Flash Code 42 indicates that the ECM/ECU has detected missing Synchronous Reference Sensor/Camshaft Position Sensor (SRS/CMP) pulses, or the ECM/ECU has detected extra Timing Reference Sensor/Crankshaft Position Sensor (TRS/CKP) pulses, see Figure 44-1.

44.2 TROUBLESHOOTING FLASH CODE 42, SID 21/FMI 1

The following procedure will troubleshoot Flash Code 42.

44.2.1 Resistance Check

Perform the following steps to check resistance.

1. Turn vehicle ignition OFF.
 2. Disconnect Engine Harness connector at ECM/ECU.
 3. Measure resistance between sockets E-19 and E-20 on the Engine Harness connector. See Figure 44-2.
- [a] If the resistance measurement is less than or equal to 135Ω , refer to section 44.2.2.
- [b] If the resistance measurement is greater than 136Ω or open, refer to section 44.2.3.

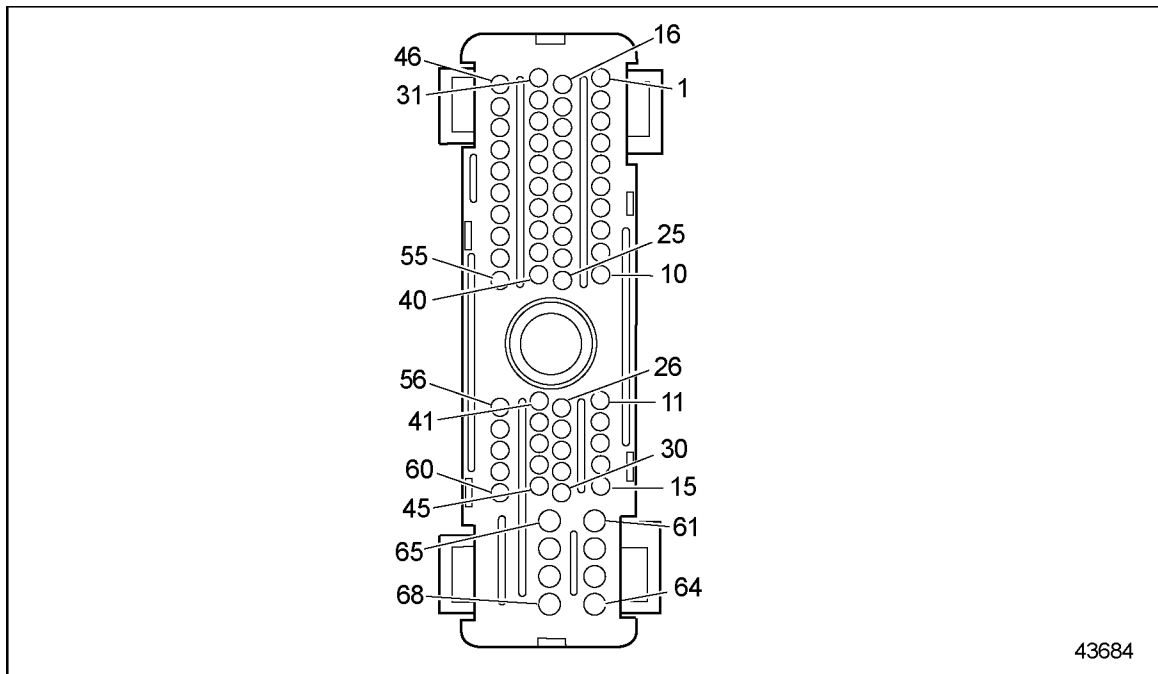


Figure 44-2 ECM/ECU Engine Harness Connector

44.2.2 Check for Short

Perform the following steps to check for a short.

1. Disconnect the SRS/CMP Connector.
2. Measure resistance between sockets E-19 and E-20 on the Engine Harness connector.
See Figure 44-2.
3. Measure resistance between socket E-19 and ground, and between socket E-20 and ground.
 - [a] If the resistance measurement is less than or equal to 10,000 Ω , a short exists. Repair the short. Refer to section 44.2.13.1.
 - [b] If the resistance measurement is greater than 10,000 Ω , or open, refer to section 44.2.4.

44.2.3 Open Camshaft Position Sensor Line Check

Perform the following steps to check for an open SRS/CMP line.

1. Disconnect the SRS/CMP connector.
2. Install a jumper wire between sockets 1 and 2 of the SRS/CMP harness connector.
See Figure 44-3.
3. Measure resistance between sockets E-19 and E-20 on the Engine Harness connector.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 44.2.4.

- [b] If the resistance measurement is greater than 5 Ω or open, the signal line (E-20) or return line (E-19) is open. Repair the open. Refer to section 44.2.13.1.

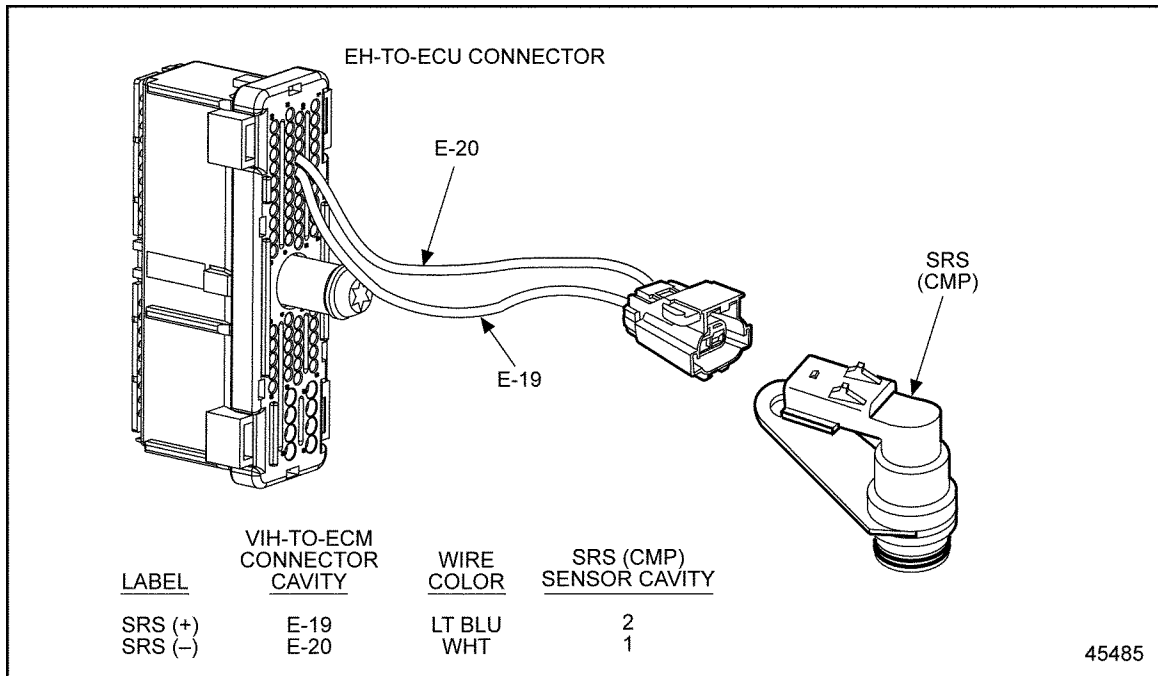


Figure 44-3 Engine Harness Connector to Camshaft Position Sensor

44.2.4 Camshaft Position Sensor and Sensor Connectors Test

Perform the following steps to test the SRS/CMP.

1. Measure resistance of SRS/CMP across the sensor connector pins 1 and 2.
 - [a] If the resistance measurement is less than or equal to 100 Ω or greater than 136 Ω , go to step 2.
 - [b] If the resistance measurement is between 100 and 135 Ω , refer to section 44.2.5.
2. Check terminals at the SRS/CMP (both the SRS/CMP and harness side) for damage: bent, corroded, and unseated pins or sockets, or a bad contact. See Figure 44-3
 - [a] If terminals and connectors are damaged, repair them. Refer to section 44.2.13.1.
 - [b] If terminals and connectors are not damaged, replace the SRS/CMP. Refer to section 44.2.12.

44.2.5 Check Camshaft Position Sensor Gap

Perform the following steps to check the SRS/CMP gap.

1. Bar engine until SRS/CMP is over the SRS/CMP pin.
2. Check the gap between SRS/CMP and the pin.

- [a] If the gap setting is correct 0.508-1.016 mm (0.020 - 0.040 in.), refer to section 44.2.6. A depth micrometer can be used.
- [b] If the gap setting is not correct, inspect for a loose or missing pin in the the bull gear and repair as necessary. Following repairs, refer to section 44.2.13.1.

44.2.6 Check for Crankshaft Position Sensor Code

Perform the following steps to check for TRS/CKP code.

1. If code 21/0 is not logged, go to step 2. If code 21/0 is logged, refer to section 44.2.7.
2. Check terminals at the ECM/ECU Engine Harness connectors (both the ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 44.2.13.1.
 - [b] If terminals and connectors are not damaged, refer to section 44.2.13.

44.2.7 Crankshaft Position Sensor Resistance Check

Perform the following steps to check TRS/CKP resistance.

1. Remove the Engine Harness connector.
2. Measure resistance between sockets E-17 and E-18 on the Engine Harness connector. See Figure 44-4.
 - [a] If the resistance measurement is greater than 136 Ω , refer to section 44.2.9.

- [b] If the resistance measurement is less than or equal to 135 Ω , refer to section 44.2.8.

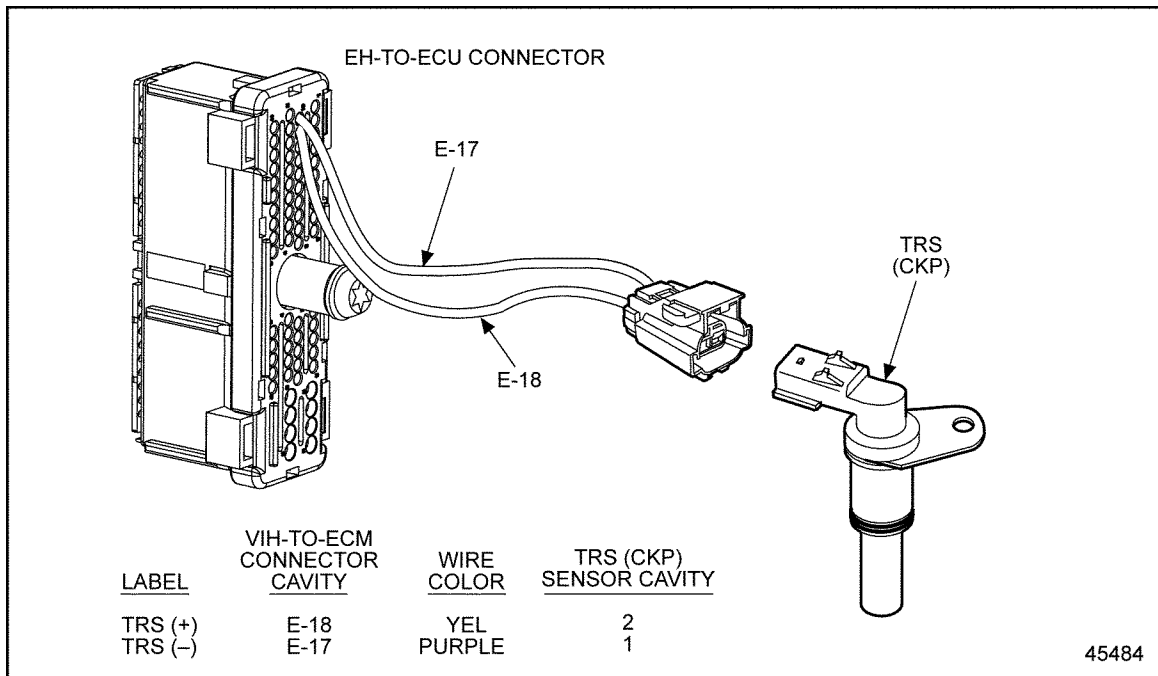


Figure 44-4 Engine Harness Connector to Crankshaft Position Sensor

44.2.8 Check for Short

Perform the following steps to check for a short.

1. Disconnect the TRS/CKP connector.
2. Measure resistance between sockets E-17 and E-18 on the Engine Harness connector.
 - [a] If measured resistance is greater than 10,000 Ω , or open, refer to section 44.2.10.
 - [b] If measured resistance is less than or equal to 10,000 Ω , the signal line (E-18) is shorted to the return line (E-17). Repair the short. Refer to section 44.2.13.1.

44.2.9 Open Crankshaft Position Sensor Line Check

Perform the following steps to check for an open TRS/CKP line.

1. Disconnect the TRS/CKP connector.
2. Install a jumper wire between sockets 1 and 2 of the TRS/CKP harness connector. See Figure 44-4.
3. Measure resistance between sockets E-17 and E-18 on the Engine Harness connector.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 44.2.10.
 - [b] If the resistance measurement is greater than 5 Ω , or open, the signal line (E-18) or return line (E-17) is open. Repair the open. Refer to section 44.2.13.1.

44.2.10 Crankshaft Position Sensor and Sensor Connectors Test

Perform the following steps to test the TRS/CKP.

1. Measure resistance of TRS/CKP across the sensor connector pins 1 and 2.
 - [a] If the resistance measurement is greater than 136 Ω or less than 100 Ω , go to step 2.
 - [b] If the resistance measurement is between 100 and 135 Ω , refer to section 44.2.6 and go to step 2.
2. Check terminals at the TRS/CKP (both the TRS/CKP and harness end) for damage: bent, corroded, and unseated pins or sockets or bad contacts. See Figure 44-5.

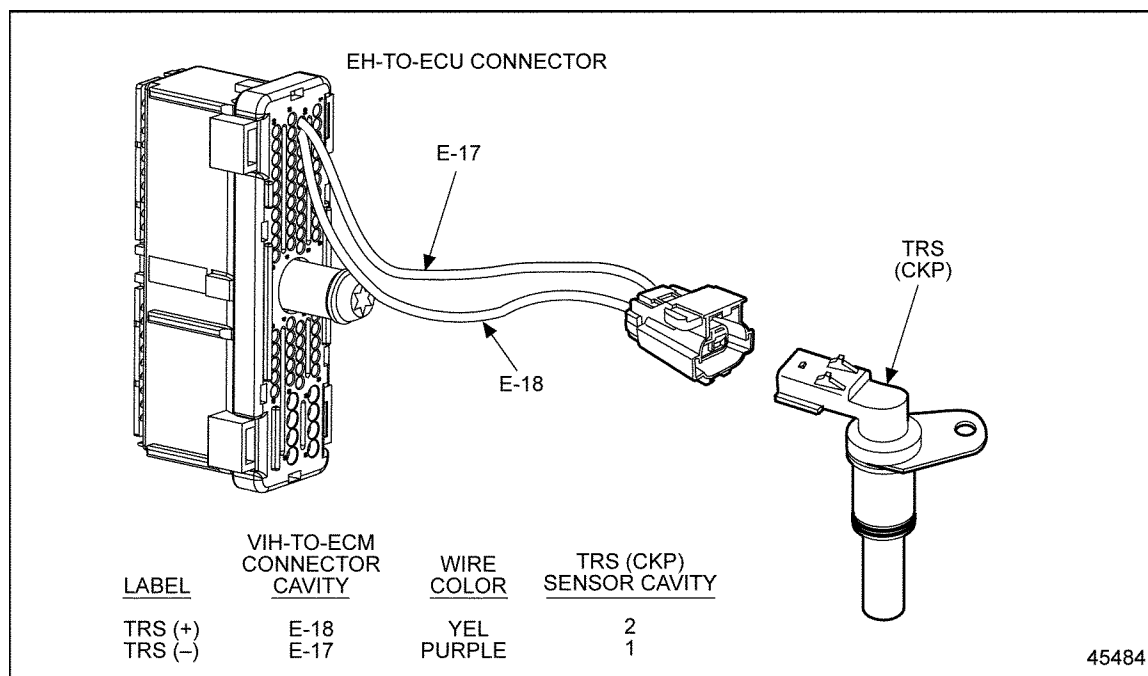


Figure 44-5 Engine Harness Connector to Crankshaft Position Sensor

- [a] If terminals and connectors are damaged, repair them. Check for code s 21/1. If there are no codes, refer to section 44.2.13.1. If code s 21/1 appears, refer to section 44.2.11.
- [b] If terminals and connectors are not damaged, replace the TRS/CKP. Check for code s 21/1. If there are no codes, refer to section 44.2.12. If code s 21/1 appears, refer to section 44.2.11.

44.2.11 Check the Injector Drive Harness for Short

Check the injector drive harness for a short as follows:

1. Disconnect the injector harness 10 pin connector and locate the terminals for each injector position. See Figure 43-6.

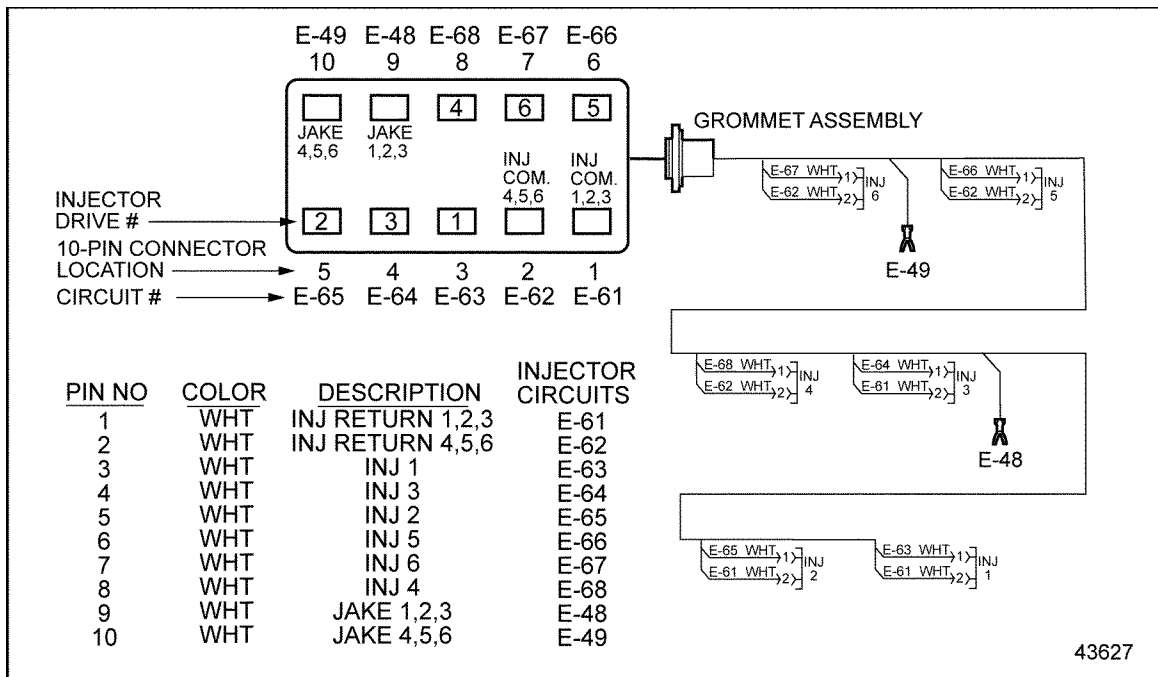


Figure 44-6 Injector Harness with Jake Brake

2. Measure resistance between that terminal and the cylinder block.
 - [a] If the measured resistance is less than 5Ω, the wire is shorted to the block. Replace the harness between the 10 pin connector and the ECM/ECU. Refer to section 44.2.12.
 - [b] If the measured resistance is greater than 5Ω, call the Detroit Diesel Customer Support Center (313-592-5800).

44.2.12 Verify Crankshaft Position Sensor / Camshaft Position Sensor

Perform the following steps to verify operation of the CKP/CMP.

1. Turn the vehicle ignition OFF, reconnect all connectors and clear codes.
2. Start and run the engine for one minute. Stop the engine.
3. Check diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If any codes except code s 21/1 are logged, refer to section 17.3.

- [c] If code s 21/1 and any other codes are logged, and the CMP was not replaced, refer to section 44.2.6.
- [d] If code 21/1 and any other codes are logged, and the CMP was replaced, refer to section 44.2.13.

44.2.13 Verify Cranking Voltage

Perform the following steps to verify cranking voltage.

1. Turn vehicle ignition OFF, connect all connectors.
2. Connect 12 volt from a fully charged battery power connector.
3. Connect to ECM/ECU.
4. Start the engine.
 - [a] If the engine starts, check the battery. If a voltage equalizer is installed, check the operation of the equalizer. If the equalizer is not working, refer to section 44.2.13.1.
 - [b] If the engine does not start, replace the ECM/ECU. Refer to section 44.2.13.1.

44.2.13.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF, reconnect all connectors.
2. Turn vehicle ignition ON and clear codes.
3. Start and run the engine for one minute. Stop the engine.
4. Check the diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code s 21/1 is logged, check the injector harness for a short to ground (can cause extra pulses). Refer to Chapter 57, section 57.2.3, "Check for Short."
 - [c] If code s 21/1 and any other codes are logged, review this section to find the error or call the Customer Support Center (313-592-5800).
 - [d] If any codes except code s 21/1 are logged, refer to section 17.3.

45 FLASH CODE 43 - COOLANT LEVEL LOW

Section	Page
45.1 DESCRIPTION OF FLASH CODE 43, PID 111/FMI1	45-3
45.2 TROUBLESHOOTING FLASH CODE 43, PID 111/FMI1	45-3

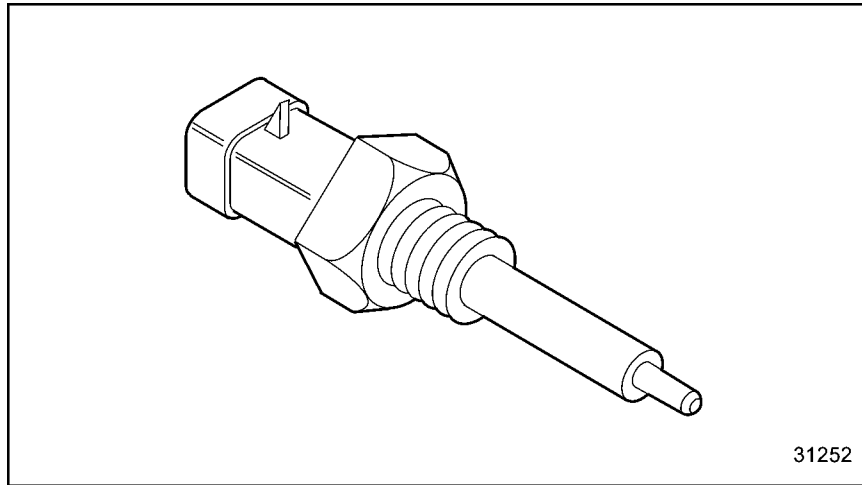


Figure 45-1 Engine Coolant Level Sensor

45.1 DESCRIPTION OF FLASH CODE 43, PID 111/FMI1

The SAE J1587 equivalent code for Flash Code 43 is p 111/1.

Flash Code 43 indicates that the ECM/ECU has detected that the engine coolant level has dropped below the recommended safe operating range.

45.2 TROUBLESHOOTING FLASH CODE 43, PID 111/FMI1

This code indicates that the coolant level is below the CLS/ECL Sensor probe (see Figure 45-2) or the ACLS/AECL Sensor probe if there are two coolant level sensors (see Figure 45-3). Add coolant and return to service. If the code persists with the level of coolant full, contact Detroit Diesel Customer Service Center (313-592-5800).

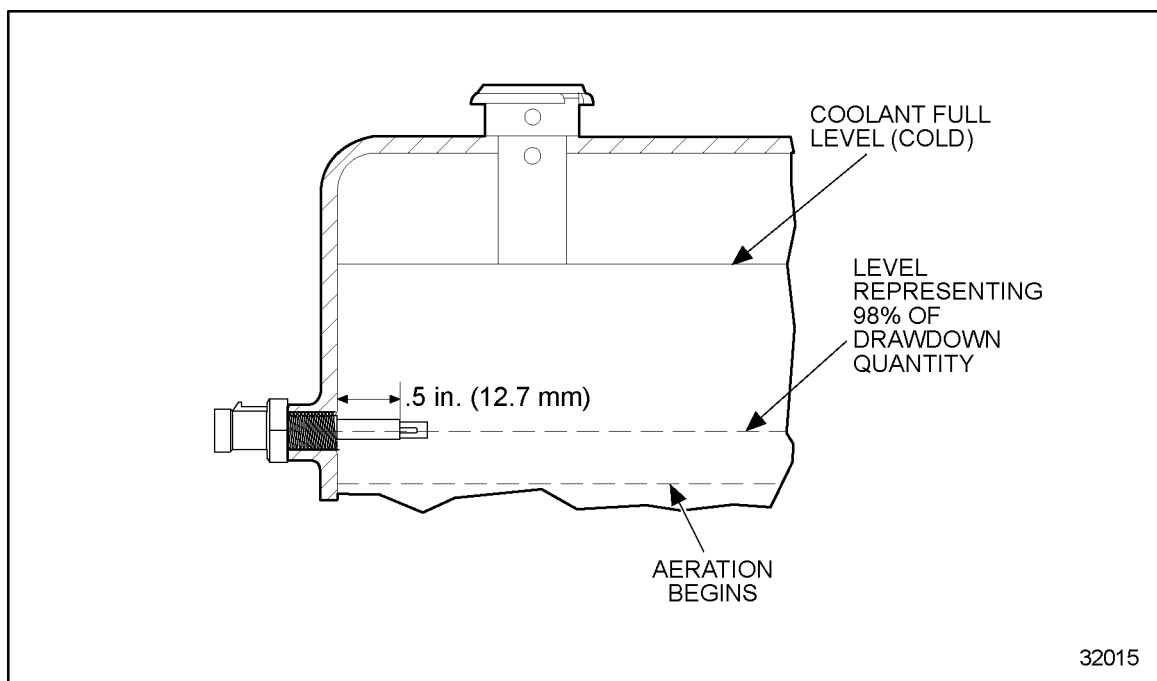


Figure 45-2 Coolant Level Sensor Location

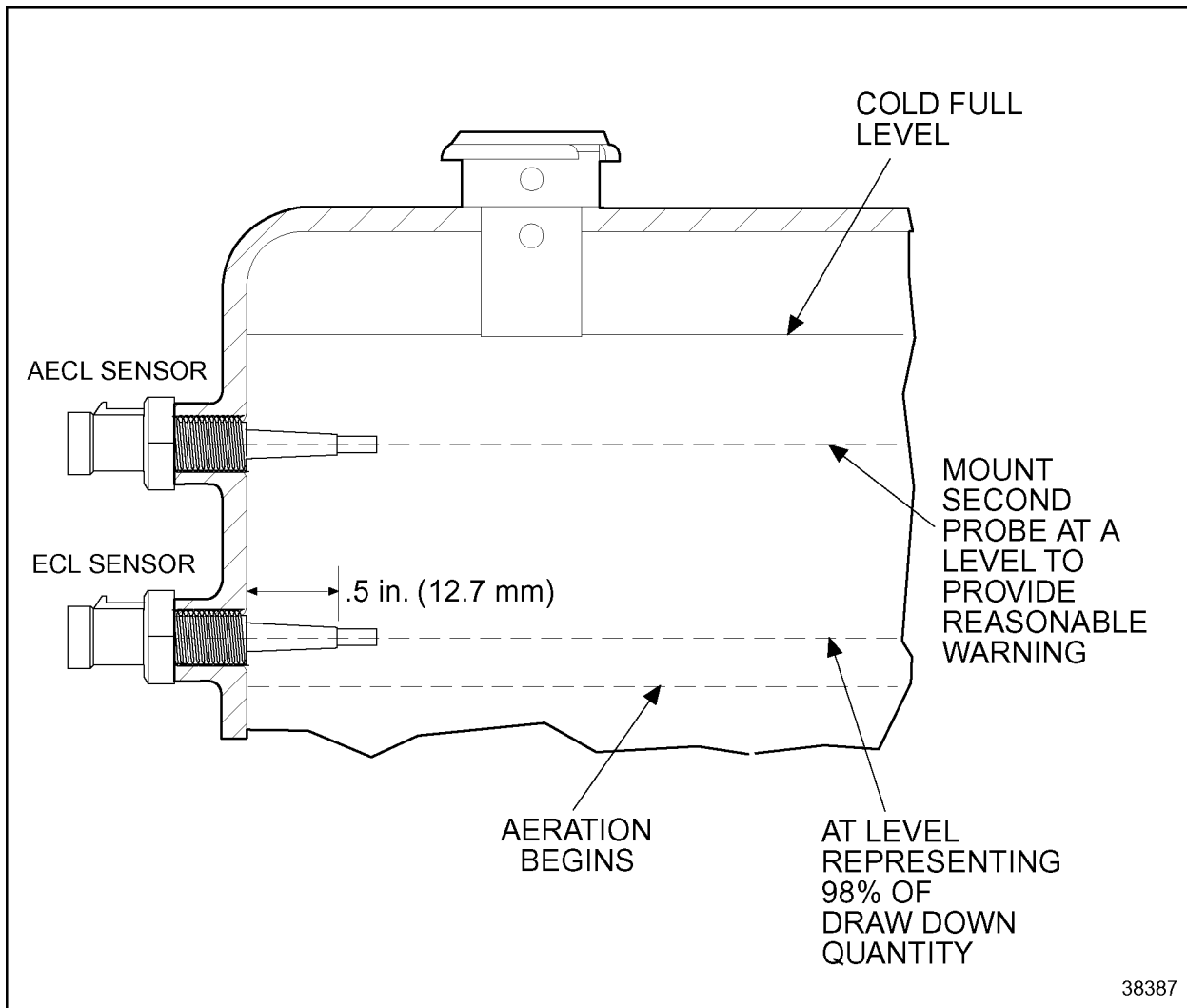


Figure 45-3 Add Engine Coolant Level Sensor Location - Radiator Surge Tank

The following procedure will troubleshoot Flash Code 43:

45.2.1 Coolant Level Low

Perform the following steps to diagnose the coolant level low.

1. Turn ignition ON; plug in diagnostic tool.
2. Read active codes.
 - [a] If code 111/1 is logged, there is an indication of a low coolant level condition. Add coolant to ensure coolant level probe is immersed in coolant.
 - [b] If code 111/1 remains active, refer to section 45.2.2.

45.2.2 Replace Coolant Level Sensor

Using the sensor tester may be of assistance. Use Tool J 37164.

NOTE:

When replacing the coolant level sensor, the CLS/ECL Sensor could be an OEM supplied part.

1. Turn ignition OFF; replace CLS/ECL Sensor.
2. Turn ignition ON.
3. Read active codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If codes are logged, refer to section 45.2.3.

45.2.3 Clean and Check Alternator Grounds

Perform the following steps to check the alternator ground.

1. If the grounds are clean and good, troubleshooting is complete.
2. If the grounds are damaged, repair the ground circuit and verify repairs. Refer to section 45.2.3.1.

45.2.3.1 Verify Repairs

Perform the following steps to verify repairs

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear diagnostic tool codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check diagnostic tool for codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code 111/1, and any other codes are logged, refer to section 45.2.1, and repeat the procedure, or contact the Detroit Diesel Customer Support Center (313-592-5800).
 - [c] If any code other than 111/1 is logged, refer to section 17.3.

46 FLASH CODE 44 - COOLANT OR OIL TEMP HIGH

Section	Page
46.1 DESCRIPTION OF FLASH CODE 44	46-3
46.2 TROUBLESHOOTING FLASH CODE 44, PID 105, 110, 172, 175/FMI 0, 14	46-3

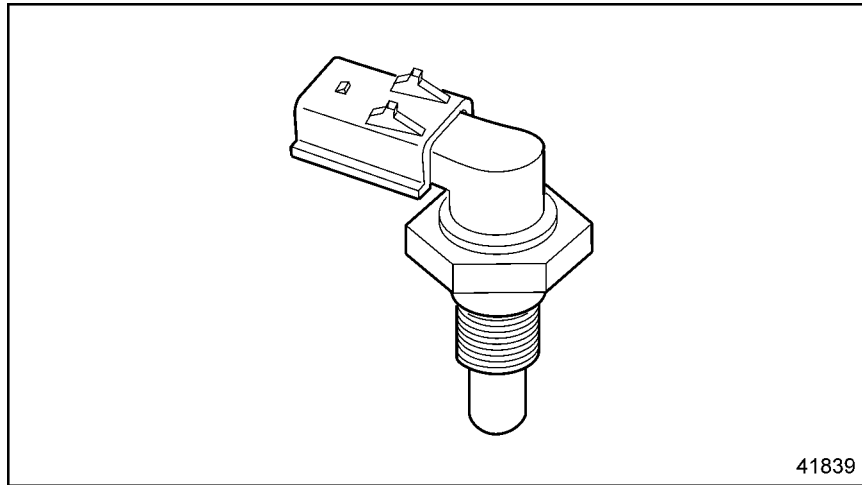


Figure 46-1 Coolant or Oil Temperature Sensor

46.1 DESCRIPTION OF FLASH CODE 44

The SAE J1587 equivalent code for Flash Code 44 is p 105/0, intake manifold temperature high.

The SAE J1587 equivalent code for Flash Code 44 is p 105/14, engine power derate due to intake manifold temperature.

The SAE J1587 equivalent code for Flash Code 44 is p 110/0, coolant temperature high.

The SAE J1587 equivalent code for Flash Code 44 is p 172/0, air inlet temperature high.

The SAE J1587 equivalent code for Flash Code 44 is p 175/0, oil temperature high.

The SAE J1587 equivalent code for Flash Code 44 is p 175/14, oil temperature derate.

The SAE J1587 equivalent code for Flash Code 44 is p 110/14 coolant temperature derate.

Flash Code 44 indicates that the ECM/ECU has detected that the engine coolant temperature has exceeded the recommended safe operating range. See Figure 46-1, for the sensor.

It also indicates that the ECM/ECU has detected that the engine oil temperature has exceeded the recommended safe operating range. This normally occurs due to a mechanical fault.

The FMI of 14 is an advice for the engine derate for high oil temperature or coolant temperature or intake manifold temperature. This code is stored for information only. This code will not turn on the CEL/AWL. No troubleshooting is suggested or recommended for this code. Clear the inactive code and return to service.

46.2 TROUBLESHOOTING FLASH CODE 44, PID 105, 110, 172, 175/FMI 0, 14

Perform the following steps to troubleshoot Flash Code 44.

46.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic tool.
3. Read active codes.
 - [a] If active codes other than 110/0, 172/0 or 175/0 are logged, service them first.
 - [b] If active codes 110/0, 105/0, 172/0, or 175/0 are logged, and no other codes are logged, air inlet, intake manifold, oil or coolant temperature was higher than it should have been. Inspect for damage. Plug in the reader and determine if code is air inlet, intake manifold, coolant or oil temperature high.
 - [c] If active code 110/0 is logged, and the duration of this code is less than 20 seconds, or if it has multiple occurrences which average less than 20 seconds each, contact Detroit Diesel Customer Service Center (313-592-5800).

- [d] There is no action required for active code 110/14 or 175/14. This code is for information only.

NOTE:

For information concerning high temperature levels, refer to section 4.1 in the service manual.

47 FLASH CODE 45 - ENGINE OIL PRESSURE LOW

Section	Page
47.1 DESCRIPTION OF FLASH CODE 45	47-3
47.2 TROUBLESHOOTING FLASH CODE 45. PID 100/FMI 1	47-3

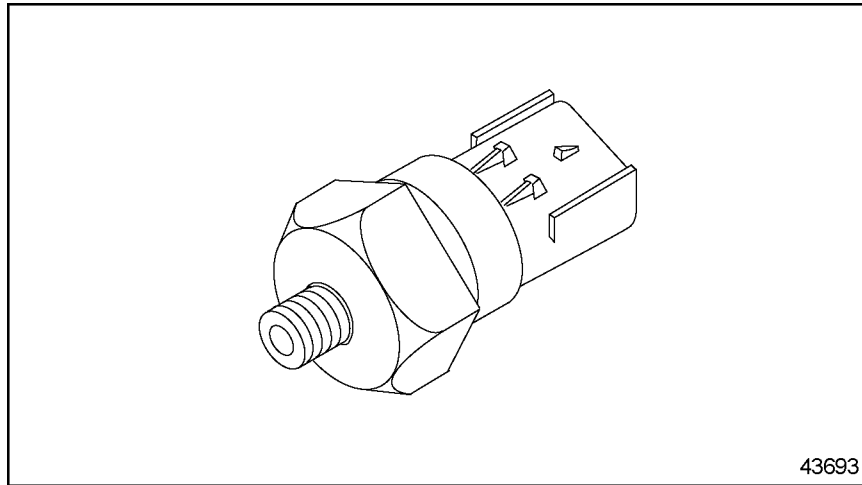


Figure 47-1 Engine Oil Pressure Sensor

47.1 DESCRIPTION OF FLASH CODE 45

The SAE J1587 equivalent code for Flash Code 45 is p 100/1, oil pressure low.

Flash Code 45 indicates that the ECM/ECU has detected that the engine oil pressure has dropped below the recommended safe operating range. See Figure 47-1 for the Oil Pressure Sensor/Engine Oil Pressure Sensor.

47.2 TROUBLESHOOTING FLASH CODE 45. PID 100/FMI 1

Perform the following steps to troubleshoot Flash Code 45.

Conditions: ECM/ECU looks for a minimum pressure vs. speed. This can vary for each engine type.

47.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic tool.
3. Read active codes.
 - [a] If codes other than p 100/1 are logged, service them first.
 - [b] If code p 100/1 is logged, and no other codes are logged, there was an engine running condition which caused the oil pressure to drop below the recommended safe operating range

NOTE:

For information concerning low oil pressure level, refer to section 3.1 in the engine service manual.

48 FLASH CODE 46 - BATTERY VOLTAGE LOW

Section	Page
48.1 DESCRIPTION OF FLASH CODE 46	48-3
48.2 TROUBLESHOOTING FLASH CODE 46, PID 168/FMI 1	48-3

48.1 DESCRIPTION OF FLASH CODE 46

The SAE J1587 equivalent codes for Flash Code 46 are as follows.

- p 168/1 battery voltage low.
- s 211/1 — Vehicle sensor supply voltage low (Pins V-11/V-12). Troubleshoot by referring to section 77.
- s 232/1 — Engine sensor supply voltage low (Pins E-12/E-26). Troubleshoot by referring to section 76.

48.2 TROUBLESHOOTING FLASH CODE 46, PID 168/FMI 1

The power wiring supplies 12 or 24 volts to the ECM/ECU. The system must be sourced directly from the battery.

NOTE:

Connection to reverse polarity will damage the system if not properly fused.

Flash Code 46 p 168/1 indicates that the main battery supply voltage to the ECM/ECU has dropped below the recommended operating range.

The DDEC V system will operate on 12 or 24 volts.

- Normal operating voltage of the DDEC system is 11 to 32 volts DC, measured at the ECM/ECU.
- Operating the ECM/ECU between 6 and 11 volts may result in degraded engine operation. (Transient operation in this range during engine starting is considered normal for 12-volt systems.)
- Operating the ECM/ECU over 32 volts will cause damage.
- Reversing polarity will cause damage to the ECM/ECU if the power harness is not properly fused.

48.2.1 Battery Check

Perform the following steps to check the battery.

1. Start and run the engine for one minute.
2. Measure voltage on battery + terminal (red lead) to battery - terminal (black lead). See Figure 48-1.
 - [a] If the engine does not start, inspect the battery and charging/starting system, and proceed if okay. Refer to section 17.3.
 - [b] If the engine does start and the voltage measurement is less than or equal to 10.0 volts, service the discharged battery and charging/starting system.

- [c] If the engine does start and the voltage measurement is greater than 10.0 volts, refer to section 48.2.2.

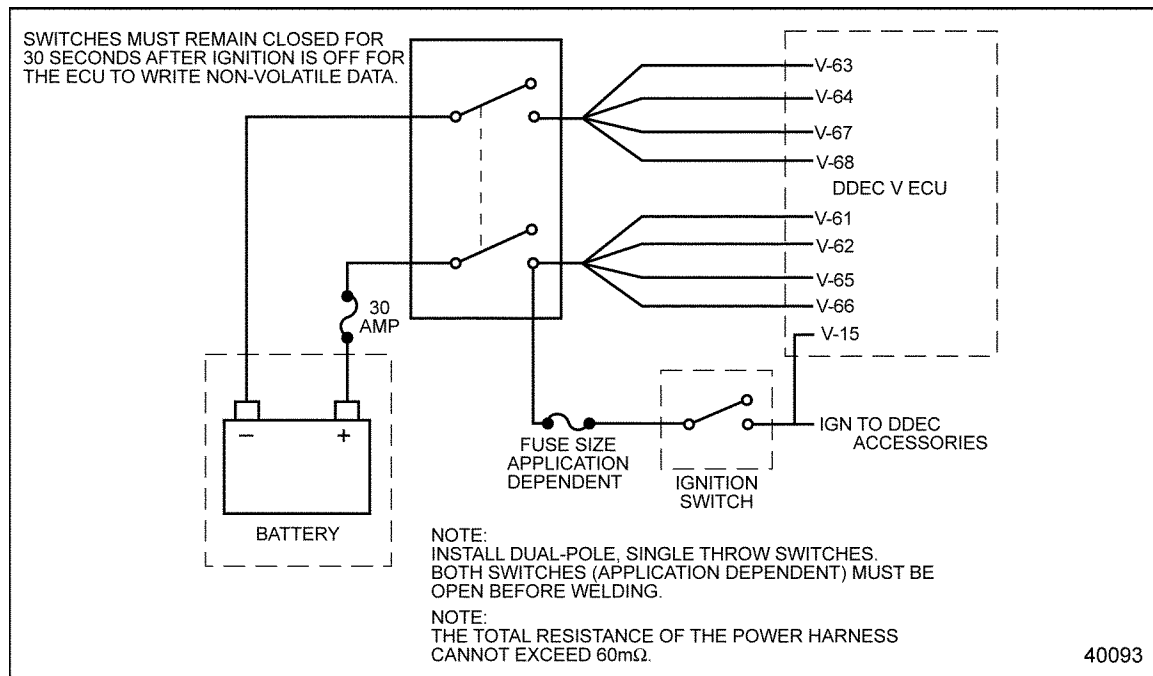


Figure 48-1 Power Wiring

48.2.2 Voltage Check at ECM/ECU

Perform the following steps to check voltage at the ECM/ECU.

1. Keep engine running.
2. Select ECM/ECU INPUT VOLT on the diagnostic tool.
3. Observe ECM/ECU voltage reading on diagnostic tool.
 - [a] If the voltage measurement is less than or equal to 10.0 volts, refer to section 48.2.3.
 - [b] If the voltage measurement is greater than 10.0 volts, refer to section 48.2.5.

48.2.3 Voltage Check at ECM/ECU Via Volt-Ohm Meter

Perform the following steps to check voltage at the ECM/ECU.

1. Turn the vehicle ignition OFF.
2. Disconnect the Vehicle Interface Harness (VIH) connector at the ECM/ECU.
3. Measure voltage from socket V-61, V-62, V-65, and V-66 (red lead) of the VIH connector and a good battery ground (black lead). Do not use lines (V-63, V-64, or V-68) as a ground reference. See Figure 48-2 for the VIH connector. See Figure 48-1 for the power wiring.
 - [a] If the voltage measurement is less than or equal to 11.5 volts, refer to section 48.2.4.

- [b] If the voltage measurement is greater than 11.5 volts, refer to section 48.2.5.

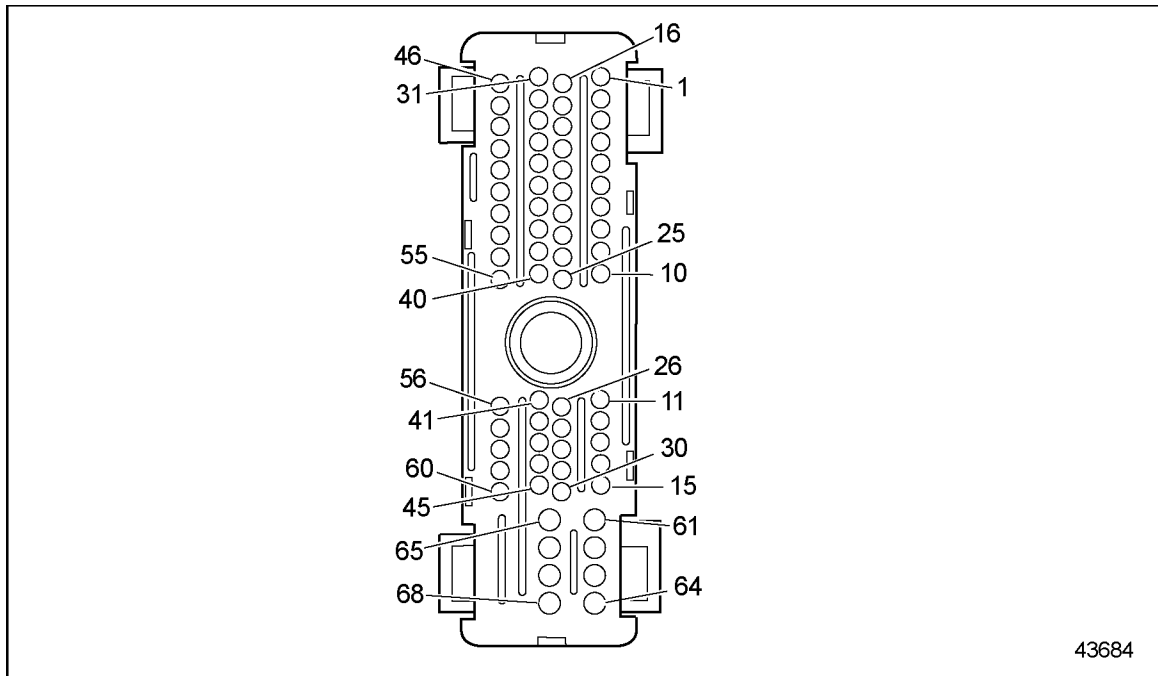


Figure 48-2 Vehicle Interface Harness Connector

48.2.4 Check for Bad Battery + Line

Perform the following steps to check for a bad battery + line.

1. Remove fuse(s) to the ECM/ECU.
2. Measure voltage at socket A of one fuseholder (red lead) to a good ground (black lead). For the VIH connector, see Figure 48-2.
3. Repeat voltage measurement at other fuseholder.
 - [a] If the voltage measurement is greater than 11.5 volts on both readings, the battery + line between the fuseholder and ECM/ECU has an open, or the ECM/ECU power connector has a corroded connection. Repair the problem. Refer to section 48.2.6.1.
 - [b] If the voltage measurement is less than or equal to 11.5 volts on either reading, the battery + line near the battery is open, or a corroded connection exists at battery + terminal. Repair the problem. Refer to section 48.2.6.1.

48.2.5 Ground Check at ECM/ECU

Perform the following steps to check the ground at the ECM/ECU.

1. Disconnect the vehicle harness connectors at the ECM/ECU. See Figure 48-2.
2. Measure voltage on socket V-61 and V-62 to socket V-63 and V-64 and socket V-65 and V-66 connector to socket V-67 and V-68.

- [a] If voltage measurement is greater than 11.5 volts on either reading, go to step 3.
 - [b] If the voltage measurement is less than or equal to 11.5 volts on either reading, the ground wire is open or has a corroded connection. Repair ground wire, and refer to section 48.2.6.1.
3. Check terminals at the VIH connector (both ECM/ECU and harness side) for damage; bent, corroded, and unseated pins or sockets.
- [a] If terminals and connector are damaged, repair them. Refer to section 48.2.6.1.
 - [b] If terminals and connector are not damaged, verify the power and ground are wired directly to the battery. Refer to section 48.2.6.

48.2.6 Code Check

Perform the following steps to check for codes.

1. Install the Vehicle Interface Module (J-41005–5).
2. Turn ignition ON; plug in the diagnostic tool.
3. Check for codes.
 - [a] If code reoccurs, install test ECM/ECU, then refer to section 48.2.6.1.
 - [b] If code does not reoccur, check power harness wires for breaks, abrasions, etc. Then refer to section 48.2.6.1.

48.2.6.1 Verify Repair

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with diagnostic tool.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check diagnostic tool for codes.
 - [a] If no codes are displayed, troubleshooting is complete.
 - [b] If code p 168/1 is not logged, and other codes are logged, refer to section 17.3.
 - [c] If code p 168/1 and other codes are logged, refer to section 48.2.1 to troubleshoot the error.

49 FLASH CODE 47 - AIR / FUEL PRESSURE HIGH

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49.1 DESCRIPTION OF FLASH CODE 47	49-3
49.2 TROUBLESHOOTING FLASH CODE 47, PID 106, 102/FMI 0	49-3

49.1 DESCRIPTION OF FLASH CODE 47

The SAE J1587 equivalent code for Flash Code 47 is p 106/0, air inlet pressure high.

The SAE J1587 equivalent code for Flash Code 47 is p 102/0, turbo boost pressure high (Diesel-fueled engines).

Flash Code 47 indicates that the ECM/ECU has detected that the air inlet pressure or turbo boost pressure has exceeded a programmed operating range. This normally occurs due to a mechanical fault in the air system or fuel system of the engine.

49.2 TROUBLESHOOTING FLASH CODE 47, PID 106, 102/FMI 0

For diesel engines, code 47 indicates that the turbo boost pressure has exceeded a calibration limit programmed in the ECM/ECU.

This (diesel-fueled engine) code indicates a mechanical fault. Check for reasons for high turbo boost pressure, e.g. VNT stuck. Refer to the mechanical troubleshooting in this manual.

50 FLASH CODE 48 - AIR / FUEL / EGR PRESSURE LOW OR EGR / TCI / TCO TEMPERATURE LOW

Section	Page
50.1 DESCRIPTION OF FLASH CODE 48	50-3
50.2 TROUBLESHOOTING FLASH CODE 48, PID 94, 412, 411, 351, 404/FMI 1	50-3

50.1 DESCRIPTION OF FLASH CODE 48

The SAE J1587 equivalent code for Flash Code 48 is p 094/1, fuel pressure low.

The SAE J1587 equivalent code for Flash Code 48 is p 412/1, EGR temperature low.

The SAE J1587 equivalent code for Flash Code 48 is p 411/1, EGR Delta-Pressure low.

The SAE J1587 equivalent code for Flash Code 48 is p 351/1, TCI temperature below range.

The SAE J1587 equivalent code for Flash Code 48 is p 404/1, TCO temperature below range.

Flash Code 48 indicates that the ECM/ECU has detected that the Fuel Pressure has dropped below a programmed limit.

50.2 TROUBLESHOOTING FLASH CODE 48, PID 94, 412, 411, 351, 404/FMI 1

This condition is normally associated with a restriction in the fuel supply system (currently not used):

- ☐ Plugged fuel filter
- ☐ Low fuel supply

NOTE:

Not all engines use a fuel pressure sensor.

For gas engines, code 48 indicates that the air inlet pressure has dropped below a calibration limit.

Flash Code 48 is also used to identify the EGR Delta-Pressure, or EGR temperature is below programmed limits. This condition is typically due to:

- ☐ EGR valve not opening completely
- ☐ EGR valve not opening at all – leaking CAC.
- ☐ Leaking EGR piping/hoses.

Flash Code 48 also indicates the exhaust gas temperature fell below calibrated limits, or EGR Delta-Pressure fell below calibrated limits. Possible causes include:

- ☐ EGR valve not opening
- ☐ EGR valve not opening fully
- ☐ Leaking CAC

Flash Code 48 also indicates the TCI (Turbo Compressor Inlet) or TCO (Turbo Compressor Outlet) temperature fell below the calibrated limits. Possible causes include:

- ☐ Leaking CAC
- ☐ Leaking inlet piping
- ☐ EGR valve not opening properly

Fuel Pressure code is logged as a result of a mechanical fault. Check for reasons for low fuel pressure. Refer to appropriate service manual, section 5.

For all EGR related codes, always perform *Exhaust Gas Recirculation System Basic Checks*. Refer to section 19.18.

Then, perform the following steps to troubleshoot code 48:

50.2.1 Check for Other Codes

Perform the following steps to check for other codes:

1. Turn ignition ON.
2. Plug in diagnostic tool.
3. Read active codes.
 - [a] If code 39 and others display, service the other codes first.
 - [b] If code 39 did not display, refer to section 50.2.2.

50.2.2 Vehicle Air Test

The vehicle air test should have been performed during *Exhaust Gas Recirculation System Basic Checks*. Refer to section 19.18. If the test was not performed, refer to proper section and perform all steps.

1. If the vehicle air system failed the test, resolve low vehicle air pressure.
2. If the vehicle air system passed the test, replace the EGR valve and refer to section 50.2.2.1 for verification of repairs.
3. No additional DDEC troubleshooting is recommended for these codes. Do all the Basic Checks and then contact Detroit Diesel Customer Service Center (313–592–5800) for instructions, providing a snapshot and code logging details.

50.2.2.1 Verify Repairs

Perform these steps to verify repairs to the vehicle air system:

1. Connect all connectors.
2. Start engine.
3. Perform road test.
4. Has the fault returned?
 - [a] If the code is logged, review this section to find the error. If the fault returns after review, try a test ECM/ECU or contact the Detroit Diesel Customer Service Center (313–592–5800).
 - [b] If no codes are logged, troubleshooting is complete.

49 FLASH CODE 49 – TCO OR TCI TEMPERATURE HIGH

Section	Page
49.1 DESCRIPTION OF FLASH CODE 49	49-3
49.2 TROUBLESHOOTING FLASH CODE 49, PID 351, 404/FMI 0, 14	49-3

49.1 DESCRIPTION OF FLASH CODE 49

The SAE J1587 equivalent codes for Flash Code 49 are p 351/0, Turbo Compressor Inlet (TCI) temperature above range; p 404/0, Turbo Compressor Outlet (TCO) temperature above range; and p 404/14, TCO derate.

49.2 TROUBLESHOOTING FLASH CODE 49, PID 351, 404/FMI 0, 14

There is no recommended DDEC troubleshooting for this code. Perform basic checks. Contact the Detroit Diesel Customer Support Center (313-592-58-) with a snapshot and code logging details for instructions.

Code p 404/14 is logged without turning on a AWL or broadcasting the fault. This FMI (14) is an information code only – 404/14 is logged when the ECM/ECU derates the engine due to high TCO temperature.

50 FLASH CODE 51 – TCO OR TCI TEMPERATURE CIRCUIT FAILED HIGH

Section	Page
50.1 DESCRIPTION OF FLASH CODE 51	50-3
50.2 TROUBLESHOOTING FLASH CODE 51, PID 351/FMI 3	50-3
50.3 TROUBLESHOOTING FLASH CODE 51, PID 404/FMI 3	50-5

50.1 DESCRIPTION OF FLASH CODE 51

The SAE J1587 equivalent codes for Flash Code 51 are p 351/3, TCI temperature failed high and p 404/3, TCO temperature failed high.

Flash Code 51 indicates the Turbo Compressor Inlet (TCI) or Turbo Compressor Outlet (TCO) temperature circuit voltage has exceeded established limits.

50.2 TROUBLESHOOTING FLASH CODE 51, PID 351/FMI 3

Possible causes are an open wire or a failed sensor.

50.2.1 Check for Codes

Follow these steps to check for codes:

1. Unplug coding sensor.
2. Insert jumper wire between #1–#2 of the sensor connector.
3. Start and run engine for six minutes.
 - [a] If code 351/3 displays, refer to section 50.2.2.
 - [b] If code 351/4 displays, go to step 4.
4. Check the connectors for damaged, bent or broken pins. See Figure 50-1.

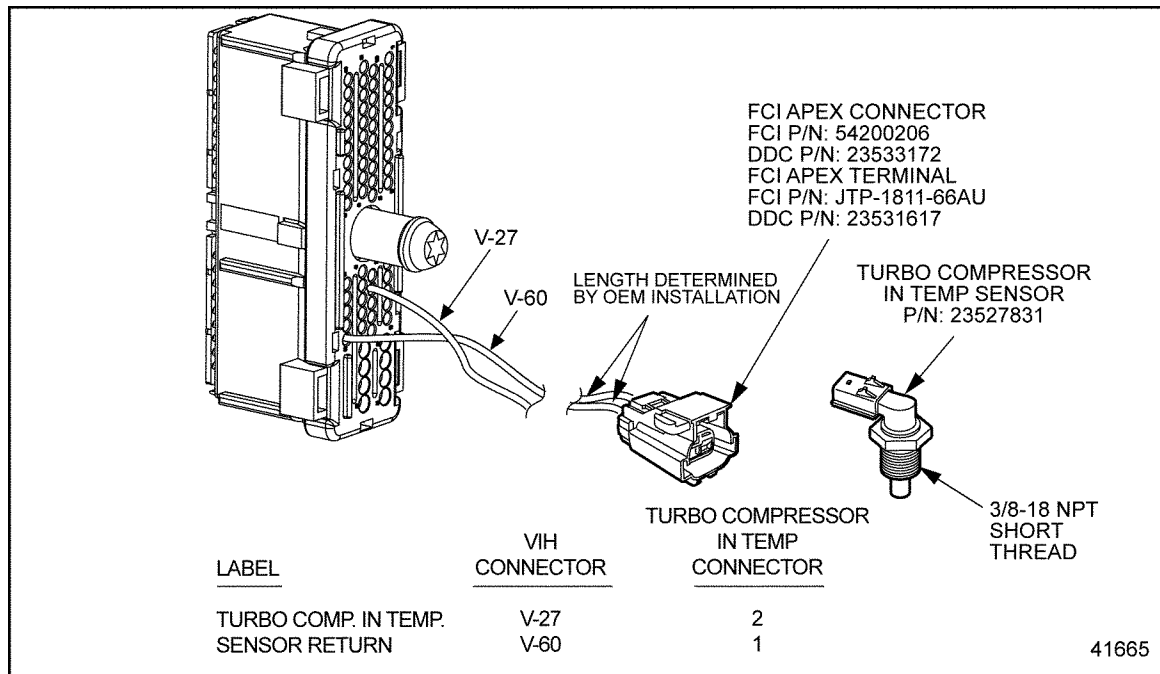


Figure 50-1 TCI Sensor and Connector

- [a] If damaged pins are found, repair the connector and test. Refer to section 50.2.2.1.

- [b] If no damaged pins are found, replace the sensor (see Figure 50-2). Then, refer to section 50.2.2.1.

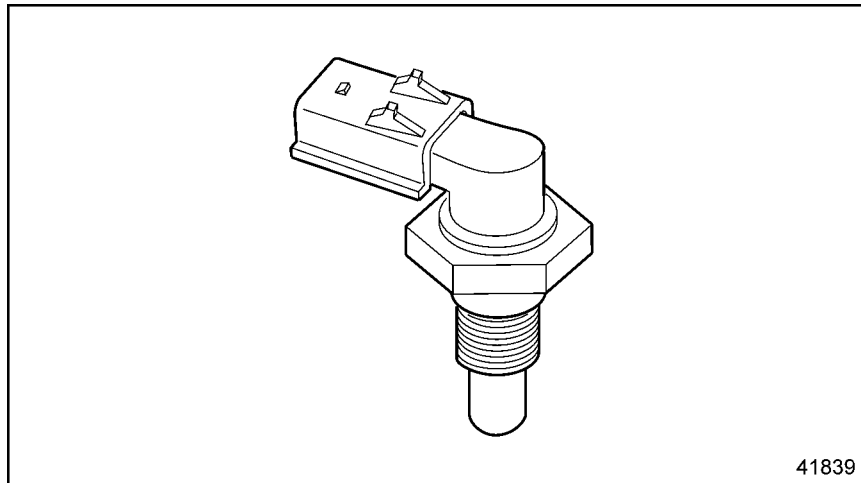


Figure 50-2 Turbo Compressor In Temperature Sensor

50.2.2 Check for Open

The steps that brought you to this procedure indicate either the signal wire or return is open. Follow these steps to check for open:

1. If code 351 displays, check cavity V-27 at the VIH connector.
2. Is the wire open?
 - [a] If the wire was open, repair it and refer to section 50.2.2.1.
 - [b] If the wire was not open, replace the TCIT Sensor (see Figure 50-1). Then refer to section 50.2.2.1.

50.2.2.1 Verify Procedure

Follow these steps to verify the procedure.

1. Reconnect all connectors.
2. Start and run the engine.
3. Check for codes.
 - [a] If code 351 displays, try a test ECM/ECU programmed for EGR.
 - [b] If no codes display, the procedure is finished.
 - [c] If codes other than 351 display, troubleshoot those codes.

50.3 TROUBLESHOOTING FLASH CODE 51, PID 404/FMI 3

Possible causes are an open wire or a failed sensor.

50.3.1 Check for Codes

Follow these steps to check for codes:

1. Unplug the TCO Sensor.
2. Insert jumper wire between #1—#2 of the sensor connector.
3. Start and run engine for six minutes.
 - [a] If code 404/3 displays, refer to section 50.3.2.
 - [b] If code 404/4 displays, go to step 4.
4. Check the connectors for damaged, bent or broken pins. See Figure 50-3.

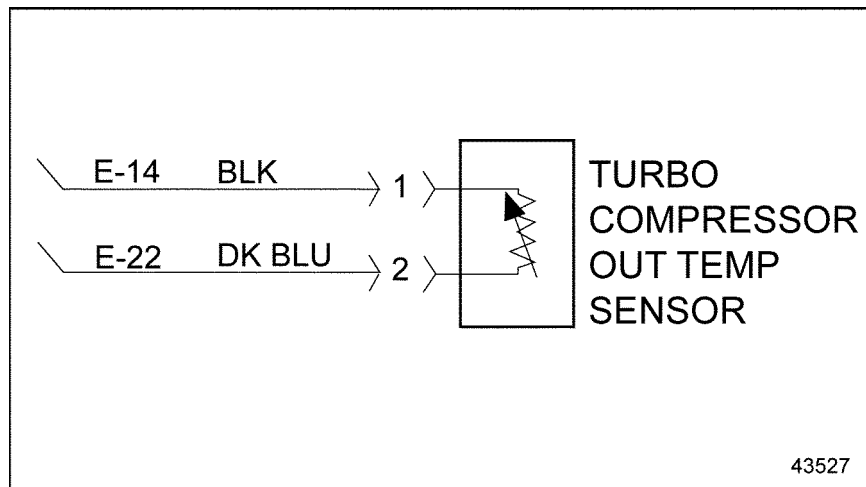


Figure 50-3 Turbocharger Compressor Out Temperature Circuit

- [a] If damaged pins are found, repair the connector and test. Refer to section 50.3.2.1.

- [b] If no damaged pins are found, replace the sensor (see Figure 50-4) Then, refer to section 50.3.2.1.

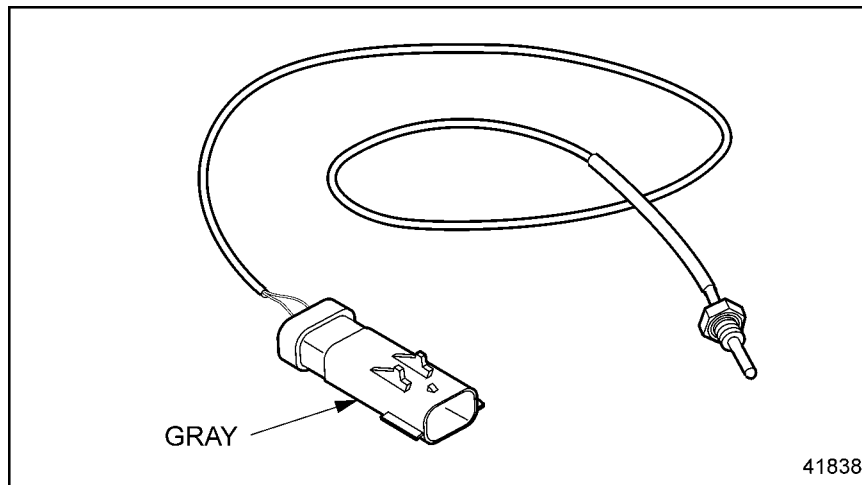


Figure 50-4 Turbo Compressor Temperature Out Sensor

50.3.2 Check for Open

The steps that brought you to this procedure indicate either the signal wire or return is open. Follow these steps to check for open:

1. Check cavity E-22 at the EH connector. See Figure 50-5.

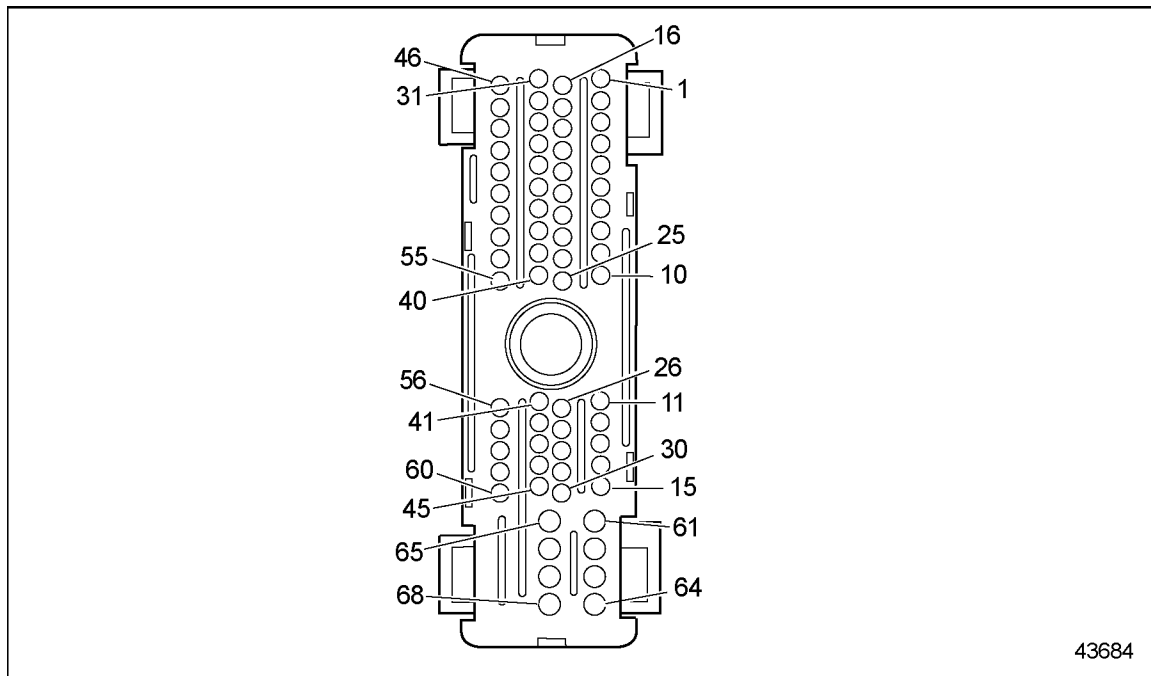


Figure 50-5 Engine Harness Connector

2. Is the wire open?
 - [a] If the wire was open, repair it and refer to section 50.3.2.1.
 - [b] If the wire was not open replace the TCTO Sensor (see Figure 50-4). Then refer to section 50.3.2.1.

50.3.2.1 Verify Procedure

Follow these steps to verify the procedure.

1. Reconnect all connectors.
2. Start and run the engine.
3. Check for codes.
 - [a] If codes 351 or 404 display, try a test ECM/ECU programmed for EGR.
 - [b] If no codes display, the procedure is finished.
 - [c] If codes other than 351 or 404 display, troubleshoot those codes.

51 FLASH CODE 52 - ECM/ECU FAULT

Section	Page
51.1 DESCRIPTION OF FLASH CODE 52	51-3
51.2 TROUBLESHOOTING FLASH CODE 52, SID 254/FMI 12	51-3

51.1 DESCRIPTION OF FLASH CODE 52

The SAE J1587 equivalent code for Flash Code 52 is s 254/12.

Flash Code 52 indicates that the DDEC system ECM/ECU internal Analog to Digital (A/D) Convertor device has malfunctioned. Intermittent diagnostic conditions of this type can be caused by faulty external electrical system.

51.2 TROUBLESHOOTING FLASH CODE 52, SID 254/FMI 12

The following procedures will troubleshoot Flash Code 52, SID 254/FMI 12.

51.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic tool.
3. Read active codes.
 - [a] If active codes other than s 254/12 are logged, service them first.
 - [b] If active code s 254/12 is logged, and no other codes are logged, hook up test ECM/ECU. If code clears, replace the ECM/ECU. If code is not cleared, contact Detroit Diesel Customer Support Center (313-592-5800).

NOTE:

For information concerning ECM/ECU replacement, refer to section 2.9 in the service manual.

52 FLASH CODE 53 - ECM/ECU MEMORY FAULT

Section	Page
52.1 DESCRIPTION OF FLASH CODE 53	52-3
52.2 TROUBLESHOOTING FLASH CODE 53, PID 253/FMI 12/2	52-3

52.1 DESCRIPTION OF FLASH CODE 53

The SAE J1587 equivalent code for Flash Code 53 is s 253/12, EEPROM write fail.

The SAE J1587 equivalent code for Flash Code 53 is s 253/2, nonvolatile checksum incorrect.

Flash Code 53 indicates that the ECM/ECU was unable to read or update a valid copy of an engine data record (calibration, faults, or accumulators) stored in nonvolatile memory.

52.2 TROUBLESHOOTING FLASH CODE 53, PID 253/FMI 12/2

The following procedure will troubleshoot Flash Code 53.

52.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic tool.
3. Read active codes.
 - [a] If codes other than 253/12 or 253/2 are logged, service them first.
 - [b] If codes 253/12 or 253/2 are the only codes logged, reprogram the ECM/ECU. Refer to section 52.2.2.

52.2.2 Test for Codes

Perform the following steps to test for codes.

1. Start and run the engine.
2. Read active codes with diagnostic tool.
 - [a] If active code 253/2 is logged, and no other codes are logged, install a test ECM/ECU. Refer to section 52.2.2.1.

NOTE:

It is recommended that a "Test" ECM/ECU be tried first to determine the need to replace the ECM/ECU. For information concerning ECM/ECU replacement, refer to section 2.9 in the service manual.

- [b] If no codes are logged, troubleshooting is complete.

52.2.2.1 Verify Repairs

Perform the following steps to verify repairs.

1. Start and run the engine.
 - [a] If no codes are logged, troubleshooting is complete.

- [b] If codes are logged, contact the Detroit Diesel Customer Support Center (313-592-5800).

53 FLASH CODE 54 - VSS FAULT

Section	Page
53.1 DESCRIPTION OF FLASH CODE 54	53-3
53.2 TROUBLESHOOTING FLASH CODE 54, PID 84/FMI 12	53-3

53.1 DESCRIPTION OF FLASH CODE 54

The SAE J1587 equivalent code for Flash Code 54 is p 84/12.

Flash Code 54 indicates that during engine operation the vehicle speed that is measured by the Vehicle Speed Sensor (VSS) is less than the expected value for the current engine speed/conditions.

53.2 TROUBLESHOOTING FLASH CODE 54, PID 84/FMI 12

This diagnostic condition is typically an open sensor signal circuit. In a system without VSS Anti-tampering, the code is logged when the mph >1500 and PW >15° and vehicle speed < 3 mph. With or without VSS Anti-tampering, mph will be limited if the code is logged.

NOTE:

Code will not be logged for the first five hours of ECM/ECU life (total engine hours).

The following procedure will troubleshoot Flash Code 54.

53.2.1 Check Vehicle Speed Sensor Circuit

Begin troubleshooting by taking the vehicle for a test drive with an assistant.

1. View the diagnostic tool; select Vehicle Speed.
 - [a] If mph reads 0 (zero), or stays steady with the vehicle in motion, go to step 2.
 - [b] If speed appears correct, refer to section 53.2.6.
2. Identify the speed sensor type - type one or type two.
 - The type one sensor is a magnetic pickup and may be located in one of the following locations: transmission tail shaft, wheel rim, mechanical speedometer cable. If you have a type one sensor, verify with diagnostic tool signal type - magnetic. Go to step 3.
 - The type two sensor communicates with square wave input and output signals and requires the ECM/ECU to be configured correctly. If you have a type two sensor, verify with diagnostic tool signal type - switched. Refer to section 53.2.7.
3. With ignition off, disconnect the Vehicle Interface Harness (VIH) connector.
4. Measure resistance of VSS circuit across VIH connector pins, V-17 and V-18. See Figure 53-1.
 - [a] If the resistance measurement is less than 50 Ω , refer to section 53.2.2.
 - [b] If the resistance measurement is greater than 3,000 Ω or open, refer to section 53.2.3.
 - [c] If the resistance measurement is between 50 and 3,000 Ω , refer to section 53.2.4.

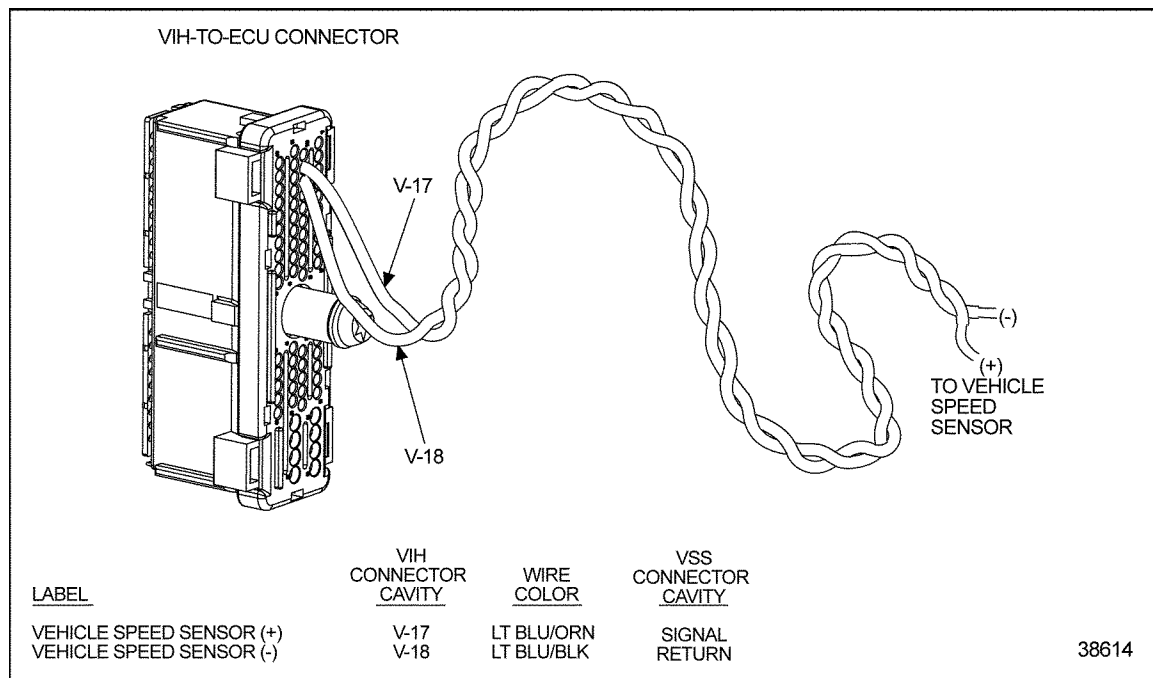


Figure 53-1 VIH-to-ECM/ECU Connector

53.2.2 Check for Short and VSS Connectors

Perform the following steps to check for short.

1. Disconnect VSS connector.
2. Measure resistance between VIH connector terminals V-17 and V-18. See Figure 53-1.
 - [a] If the resistance measurement is less than or equal to 1,000 Ω , the signal wire V-17 or return wire V-18, are shorted together. Repair the short; refer to section 53.2.7.1.
 - [b] If the resistance measurement is greater than 1,000 Ω or open, go to step 3.
3. Measure resistance of VSS across Vehicle Speed Sensor connector pins. See Figure 53-1.
 - [a] If the resistance measurement is less than 50 Ω , go to step 4.
 - [b] If the resistance measurement is greater than 3,000 Ω or open, go to step 4.
 - [c] If the resistance measurement is between 50 and 3,000 Ω , check the terminals at the ECM/ECU VIH connector for bent, corroded, and unseated pins or sockets, on both the ECM/ECU and harness sides. If there is no damage, refer to section 53.2.6. If there is damage, repair and refer to section 53.2.7.1.
4. Check terminals at the VSS connectors (both sensor side and harness side) for bent, corroded, and unseated pins or sockets.
 - [a] If the terminals and connectors are not damaged, replace the VSS. Refer to section 53.2.7.1.

- [b] If the terminals and connectors are damaged, repair them. Refer to section 53.2.7.1.

53.2.3 Check for Open

Perform the following steps to check for open.

1. Disconnect the ECM/ECU VIH connector and VSS connector.
2. Install a jumper wire between sockets 1 and 2 of the VSS harness connector.
3. Measure resistance between sockets V-17 and V-18 on the ECM/ECU VIH connector. See Figure 53-1.
 - [a] If the resistance measurement is less than or equal to 5 Ω , go to step 4.
 - [b] If the resistance measurement is greater than 5 Ω or open, the VSS signal line V-17 or return line V-18 is open. Repair open and refer to section 53.2.7.1.
4. Measure resistance of VSS across Vehicle Speed Sensor connector pins. See Figure 53-1.
 - [a] If the resistance measurement is less than 50 Ω , go to step 4.
 - [b] If the resistance measurement is greater than 3,000 Ω or open, go to step 5.
 - [c] If the resistance measurement is between 50 and 3,000 Ω , check the terminals at the ECM/ECU VIH connector for bent, corroded, and unseated pins or sockets, on both the ECM/ECU and harness sides. If there is no damage, refer to section 53.2.6. If there is damage, repair and refer to section 53.2.7.1.
5. Check terminals at the VSS connectors (both sensor side and harness side) for bent, corroded, and unseated pins or sockets.
 - [a] If the terminals and connectors are not damaged, replace the VSS. Refer to section 53.2.7.1.
 - [b] If the terminals and connectors are damaged, repair them. Refer to section 53.2.7.1.

53.2.4 Check for Short to Ground

Perform the following steps to check for short to ground.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Measure resistance between sockets V-17 and V-18 and a good ground. See Figure 53-1.
 - [a] If the resistance measurement is greater than 1,000 Ω or open, refer to section 53.2.5.
 - [b] If the resistance measurement is less than or equal to 1,000 Ω , the signal wire V-17 or return wire V-18, is shorted to ground, or wired to an unauthorized device. Repair the short; refer to section 53.2.7.1.

53.2.5 Check for Short to Power

Perform the following steps to check for short to power.

1. Turn ignition ON.
2. Measure voltage at the ECM/ECU VIH connector between socket V-17 and a good ground. Also measure voltage between socket V-18 and a good ground. See Figure 53-2.

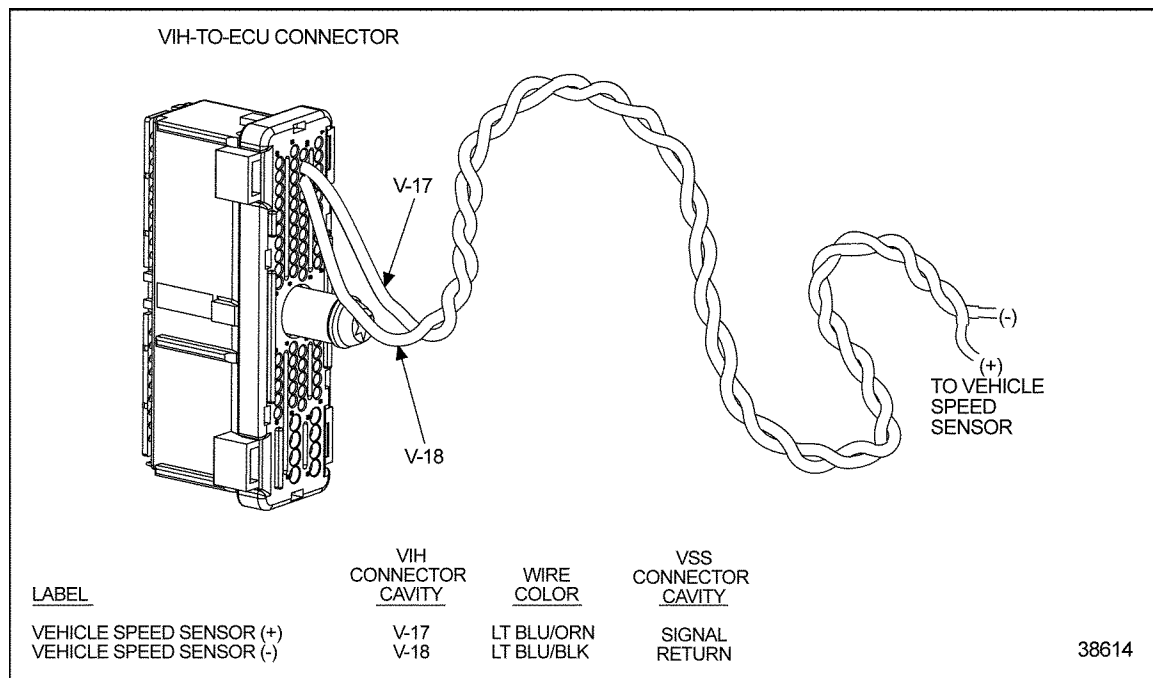


Figure 53-2 VIH-to-ECM/ECU Connector

- [a] If both voltage measurements are less than 0.2 volts, go to step 3.
- [b] If either voltage measurement is greater than or equal to 0.2 volts, the VSS signal V-17 or VSS return line V-18 is shorted to the battery or some other source of voltage. Repair the short; refer to section 53.2.7.1.
3. Check the terminals at the ECM/ECU VIH connector for bent, corroded, and unseated pins or sockets, on both the ECM/ECU and harness sides. See Figure 53-2.
 - [a] If the terminals and connectors are not damaged, refer to section 53.2.6.
 - [b] If the terminals and connectors are damaged, repair them. Refer to section 53.2.7.1.

53.2.6 Vehicle Speed Mechanical Checks

Perform the following vehicle speed mechanical checks.

1. Check for plugged fuel filters.
2. Check if any metal or debris is lodged between the VSS and the pulse wheel.

3. Check if the sensor is loose.
4. Ensure the VSS pulse wheel is in fixed position relative to magnetic pickup.
5. Check for proper air gap between magnetic pickup and pulse wheel.
 - [a] If all mechanical checks are okay, contact the Detroit Diesel Customer Support Center (313-592-58900) for review if anti-tamper = yes.
 - [b] If all mechanical checks are not okay, repair the mechanical failure. Refer to section 53.2.7.1.

53.2.7 Check for Short to Ground

Perform the following steps to check for short to ground.

1. Turn ignition OFF and disconnect the ECM/ECU VIH connector.
2. Measure resistance between sockets V-17 and a good ground. See Figure 53-2.
 - [a] If the resistance measurement is greater than 10,000 Ω or open, contact the component supplier for instructions. The wiring is okay, but the device may be defective. Refer to section 53.2.7.1.
 - [b] If the resistance measurement is less than or equal to 100 Ω , the VSS signal line V-17 is shorted to ground, Repair the short; refer to section 53.2.7.1.

53.2.7.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn the ignition OFF.
2. Reconnect all the connectors.
3. Turn the ignition ON.
4. Clear diagnostic tool codes.
5. Perform a road test with an assistant. Ensure the vehicle is loaded.
6. Stop the engine.
7. Check diagnostic tool for codes.
 - [a] If no codes are logged, no further troubleshooting is required.
 - [b] If code 84/12 is not logged, and other codes are logged, refer to section 17.3.
 - [c] If code 84/12 is logged, and any other codes are logged, troubleshoot the error (refer to section 53.2.1 and go to step 2) and perform tasks.

54 FLASH CODE 55 - J1939 DATA LINK FAULT

Section	Page
54.1 DESCRIPTION OF FLASH CODE 55	54-3
54.2 TROUBLESHOOTING FLASH CODE 55, SID 231/216/FMI 12/14	54-3

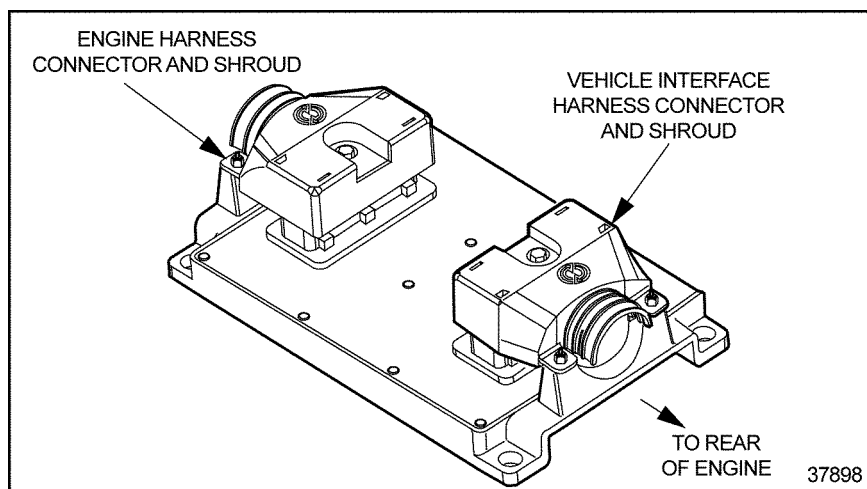


Figure 54-1 **ECM/ECU**

54.1 DESCRIPTION OF FLASH CODE 55

The SAE J1587 equivalent code for Flash Code 55 is s 231/12, ECM/ECU fault and s 216/14, missing other ECM/ECU. It also indicates DDEC ECM/ECU has lost its connection with other ECM/ECU devices or indicates a loss or shorted J1939 data link. If code s 216/14 is logged with p 86/14 then Smart Cruise has a fault. If code s 216/14 is logged with p 84/12 there is an incorrectly programmed or shorted J1939 data link.

54.2 TROUBLESHOOTING FLASH CODE 55, SID 231/216/FMI 12/14

Flash Code 55 indicates the ECM/ECU, see Figure 54-1, has detected a fault in the J1939 Data Link that could be incorrect programming or a wiring fault with the J1939 data link wires. See Figure 54-2.

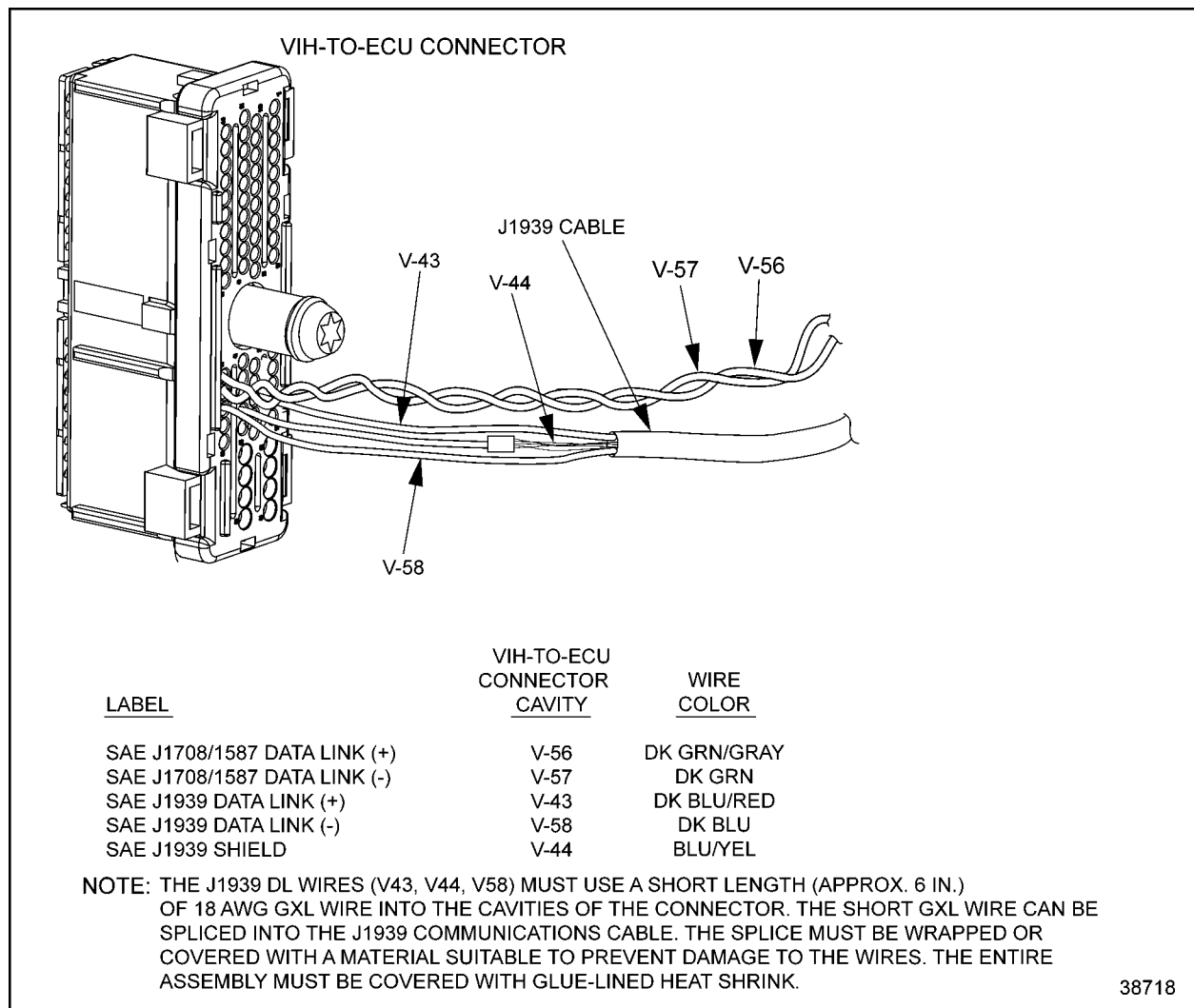


Figure 54-2 VIH-TO-ECM/ECU CONNECTOR

The following procedure will troubleshoot Flash Code 55.

54.2.1 Check J1939 Data Link and ECM/ECU Code

Perform the following steps to check for J1939 data link fault.

1. Is this a J1939 transmission/engine application?
 - [a] If yes, go to step 2 or contact the Detroit Diesel Customer Support Center (313-592-5800).
 - [b] If no, use programming station and go to "update customer calibration" and select transmission to manual, or correct transmission. Save changes. Refer to section 54.2.1.1.
2. Check the diagnostic tool to see if code s 216/14 is displayed. This indicates DDEC ECM/ECU has lost its connection with other ECM/ECU devices and has a lost or shorted J1939 data link.
 - [a] If code 86/14 displays also, there is a fault with Smart Cruise. Contact the OEM for instructions.
 - [b] If code 84/12 displays also, the fault is with the ECM/ECU programming or a J1939 data link short. Contact the OEM for VSS (Vehicle Speed Sensor) troubleshooting.

54.2.1.1 Verify Repairs

Perform the following steps to verify repairs.

1. Start engine.
2. Plug in diagnostic tool.
3. Read codes.
 - [a] If active codes s 216/14 or s 231/12 are not logged, troubleshooting is complete.
 - [b] If active codes s 216/14 or s 231/12 are logged, contact the Detroit Diesel Customer Support Center (313-592-5800).

55 FLASH CODE 56 - J1587 DATA LINK FAULT

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55.1 DESCRIPTION OF FLASH CODE 56	55-3
55.2 TROUBLESHOOTING FLASH CODE 56, SID 250/FMI12	55-3

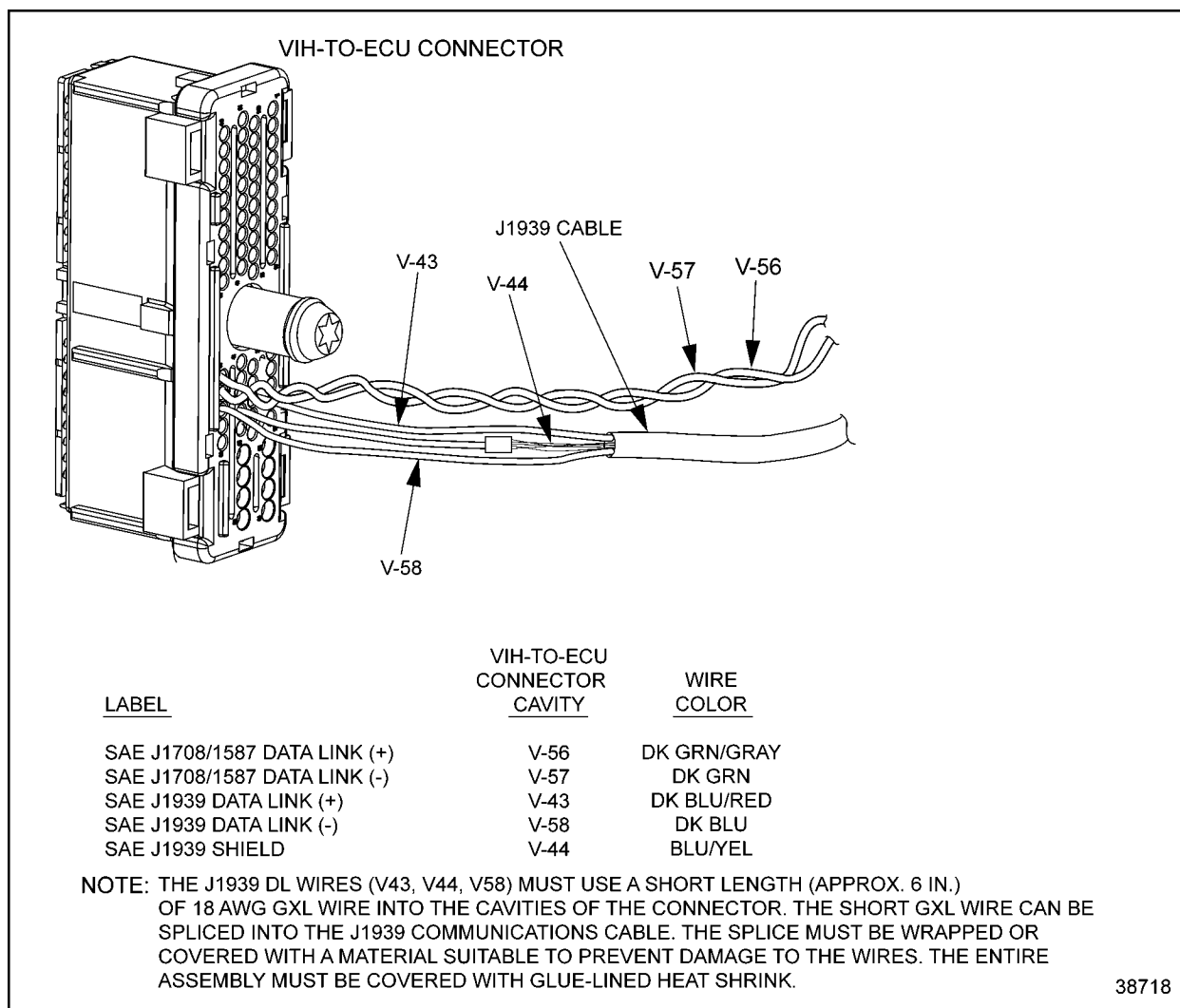


Figure 55-1 VIH-to-ECM/ECU Connector

55.1 DESCRIPTION OF FLASH CODE 56

The SAE J1587 equivalent code for Flash Code 56 is s 250/12.

Flash Code 56 indicates that the J1587 (diagnostic) data link is no longer allowing the ECM/ECU to transmit data. See Figure 55-1.

55.2 TROUBLESHOOTING FLASH CODE 56, SID 250/FMI12

This diagnostic condition is typically:

- ☐ Either or both of the data link circuits are open at some point in the network.
- ☐ Either or both of the data link circuits are shorted to ground at some point in the network.
- ☐ Either or both of the data link circuits are shorted to battery (+) at some point in the network.
- ☐ The pair of data link circuits are shorted together.

The following procedure will troubleshoot Flash Code 56.

55.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic tool.
3. Read active codes.
 - [a] If codes other than 250/12 are logged, service them first.
 - [b] If code 250/12 is logged, and no other codes are logged, Refer to section 55.2.2.
 - [c] If no data is logged, refer to section 17.3.

55.2.2 Clear Codes

Perform the following steps to clear codes.

1. Clear codes.
2. Start and run the engine.
3. Observe CEL/AWL/code.
 - [a] If CEL/AWL is on with code 250/12 logged, refer to section 55.2.3.
 - [b] If no CEL/AWL code is logged, refer to section 55.2.4.1.

55.2.3 Check for Devices of Original Equipment Manufacturer

Perform the following steps to check for OEM devices.

1. Turn vehicle ignition OFF.
2. Determine if any OEM equipment utilizes the J1587 data link. (ABS, ProDriver®, satellite systems, etc.).
 - [a] If any OEM devices are installed, refer to section 55.2.4, step 1.
 - [b] If no OEM devices are installed, refer to section 55.2.4, step 2.

55.2.4 Disconnect Nodes (Data Link Devices)

Perform the following steps to disconnect the nodes.

1. Disconnect OEM installed devices, one at a time e.g. ABS, satellite systems, etc. Verify ABS switch is not in "Test" mode.
 - [a] If the disconnect does not solve the problem, continue the procedure.
 - [b] If the disconnect solved the problem, go to 4[b].
2. Connect vehicle interface module, J 41005.
3. Start and run the engine.
4. Observe CEL/AWL codes.
 - [a] If CEL/AWL or codes displayed, and the CEL/AWL is on with code 250/12 logged, replace the ECM/ECU with a test ECM/ECU. Refer to section 55.2.4.1.
 - [b] If no CEL/AWL or codes are displayed, contact OEM for instructions on how to proceed. Refer to section 55.2.4.1.

55.2.4.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Start and run the engine.
 - [a] If the CEL/AWL or codes are displayed, and if code 250/12 is logged, all system diagnostics are complete. Review this section to find the error.
 - [b] If the CEL/AWL or codes are not displayed, troubleshooting is complete.

56 FLASH CODE 58 — CRUISE CONTROL INPUT FAULT

Section	Page
56.1 DESCRIPTION OF FLASH CODE 58	56-3
56.2 TROUBLESHOOTING FLASH CODE 58	56-3

56.1 DESCRIPTION OF FLASH CODE 58

The SAE J1587 equivalent codes for Flash Code 58 are listed in Table 56-1.

Flash Code	SID	FMI	Description
58	s 216	7	* ECM/ECU information not responding
58	s 242	9	Cruise control resume/accel switch not responding
58	s 242	12	Cruise control/accel switch failed
58	s 243	9	Cruise control set/coast switch not responding
58	s 243	12	Cruise control set/coast switch failed
58	s 244	9	Cruise control enable switch not responding
58	s 244	12	Cruise control enable switch failed
58	s 245	9	Clutch pedal switch not responding
58	s 245	12	Clutch pedal switch failed
58	s 246	9	Service brake pedal switch not responding
58	s 246	12	Service brake pedal switch failed
58	p 40	9	Engine retarder switch not responding
58	p 40	12	Engine retarder switch failed
58	p 70	9	Park brake/safety loop switch not responding
58	p 70	12	Park brake/safety loop switch failed

* Mux'd dashboard devices

Table 56-1 SAE J1587 Codes for Flash Code 58

56.2 TROUBLESHOOTING FLASH CODE 58

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

If a code is logged with 216/14, troubleshoot by referring to section 54 or otherwise contact the Detroit Diesel Customer Support Center (313-592-5800).

57 FLASH CODE 61 - INJECTOR RESPONSE LONG

Section	Page
57.1 DESCRIPTION OF FLASH CODE 61	57-3
57.2 TROUBLESHOOTING FLASH CODE 61, SID 1/2/3/4/5/6/FMI 0	57-3

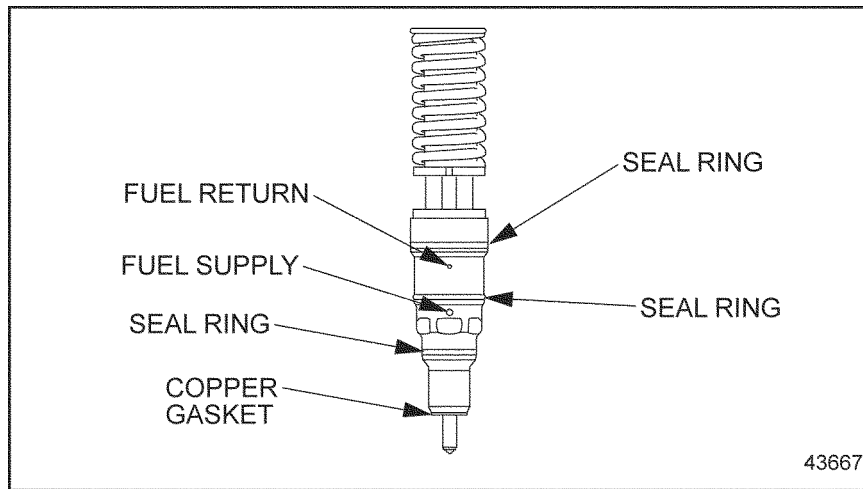


Figure 57-1 **N3 Injector**

57.1 DESCRIPTION OF FLASH CODE 61

The SAE J1587 equivalent code for Flash Code 61 is s 1/0, or s 2/0, or s 3/0, or s 4/0, or s 5/0 or s 6 /0 (six cylinder engine, FMI 6 = Grounded Circuit).

Flash Code 61 indicates that the time interval that starts when the DDEC V ECM/ECU requests an injector (see Figure 57-1) be turned on to when the injector solenoid valve actually closes is longer than the high limit of the expected range. Engine oil temperature must be greater than 87°F (30°C).

57.2 TROUBLESHOOTING FLASH CODE 61, SID 1/2/3/4/5/6/FMI 0

This diagnostic condition is typically:

- ☐ Bad injector harness and or connection (high resistance)
- ☐ Poor vehicle grounds
- ☐ Sticky solenoid valve

NOTE:

The injector diagnostic SID indicates which cylinder number has an injector with a long response time. The injector number describes the cylinder and or bank which has the injector with a long response time. The diagnostic tool will display the injector text description.

Injector response times generally increase with low battery supply voltage and decrease with high battery supply voltage. Although injector response times vary from injector to injector at a given rpm, each individual injector response time should remain relatively consistent from one firing to the next. Wide variations in response time (typically ± 0.2 msec) for one injector at a steady engine rpm may indicate an electrical problem (faulty alternator or voltage regulator, poor or broken ground cables, etc.).

The following procedure will troubleshoot Flash Code 61.

57.2.1 Test Alternator Ground

Perform the following steps to test alternator ground.

1. Disable the alternator by removing the alternator belt.
2. Start and run the engine; warm to greater than 87°F (30°C).
3. Does the code return?
 - [a] If Flash Code 61 does not return, repair or replace the alternator grounds and refer to section 57.2.4.1.
 - [b] If the code(s) return, refer to section 57.2.2.

57.2.2 Determine Cylinders With Fault

The location of the injector logging the codes is listed in Table 57-1.

	SID 1	SID 2	SID 3	SID 4	SID 5	SID 6
Firing Order	# 1	# 2	# 3	# 4	# 5	# 6
S60 Cylinder # (block location)	1	5	3	6	2	4

Table 57-1 Determine Cylinders With Fault

To measure the resistance, perform the following:

1. Disconnect the engine Harness connector at the ECM/ECU for those injectors logging the codes.
2. Establish a good ECM/ECU case ground by measuring the resistance across two points on the ECM/ECU. The resistance should measure less than or equal to 1 Ω .
3. Once a good case ground is established, keep one of the measurement probes in place and move the other probe to one of the five exposed male injector terminals on the ECM/ECU.
4. Measure the resistance. Repeat this procedure at each of the five terminals.
 - [a] If any terminals have a resistance of less than 1,000 Ω , replace the ECM/ECU. Refer to section 57.2.4.1.
 - [b] If all terminals have a resistance of greater than 1,000 Ω , refer to section 57.2.3.

57.2.3 Check for Short

Perform the following steps to check for a short.

1. Disconnect the injector harness 10 pin connector and locate the terminals associated with the codes. See Figure 57-2.
2. Measure resistance between that cavity and the cylinder block on both sides of the 10 pin connector.
 - [a] If measured resistance is less than 10 Ω , the wire is shorted to the engine. Repair or replace the harness and refer to section 57.2.4.1.
 - [b] If measured resistance is greater than 10 Ω , go to step 3.
3. Measure resistance between the 10 pin connector side and between the cavity logging the code and the return wire.
 - [a] If the measured resistance is less than 5 Ω , the wire is shorted to the return. Replace the harness between the 10 pin connector and the ECM/ECU. Refer to section 57.2.4.1.
 - [b] If the measured resistance is greater than 5 Ω , go to step 4.
4. Remove the valve cover to gain access to the cylinder associated with the code.

5. Remove the connector terminals at the injector solenoid(s).
6. Measure resistance between that cavity and the appropriate return cavity (E-61 or E-62).
 - [a] If measured resistance is less than 5 Ω , the wire is shorted to the return wire. Repair or replace the harness and refer to section 57.2.4.1.
 - [b] If measured resistance is greater than 5 Ω , refer to section 57.2.4.

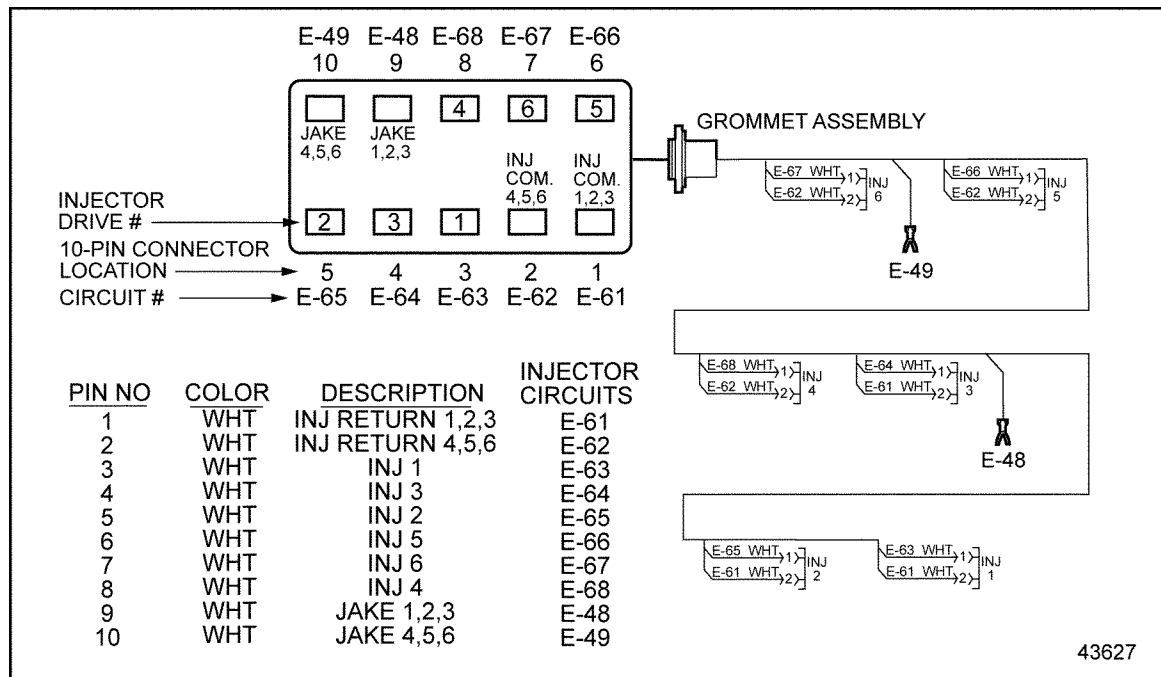


Figure 57-2 Injector Harness with Jake Brake

57.2.4 Check for Open

Perform the following steps to check for an open.

1. Insert a jumper wire between the cavity associated with the code and the return for that connector (E-61 or E-62).
2. Measure resistance across the injector connectors (disconnected from injector solenoid).
 - [a] If the measured resistance is greater than 5 Ω , the injector wire is open. Repair or replace the harness and refer to section 57.2.4.1.
 - [b] If the measured resistance is less than 5 Ω , try a test ECM/ECU. Refer to section 57.2.4.1.
 - [c] If the measured resistance is less than 5 Ω , and the ECM/ECU was replaced, replace the injector.

57.2.4.1 Verify Repairs

Perform the following steps to verify repairs:

1. Start and run the engine. Warm to 87°F (30°C).
2. Check diagnostic tool for codes.
 - [a] If injector codes are logged, please review this section from the first step to find the problem. Refer to section 57.2.2.
 - [b] If no codes are logged, no further troubleshooting is required.

58 FLASH CODE 62 - AUXILARY OUTPUT #1, #2, #5–11 FAULT

Section	Page
58.1 DESCRIPTION OF FLASH CODE 62	58-3
58.2 TROUBLESHOOTING FLASH CODE 62, SID 26, 40, 53, 54, 55, 56, 257, 258, 259/FMI 3, 4	58-3

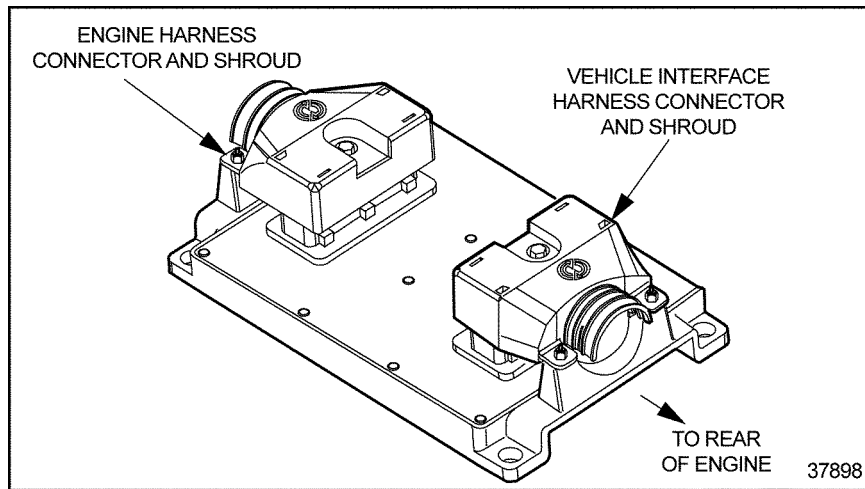


Figure 58-1 **ECM/ECU**

58.1 DESCRIPTION OF FLASH CODE 62

The SAE J1587 equivalent codes for Flash Code 62 are listed in Table 58-1.

SAE J1587 Code	Output Number	Fault
s 026 3	Auxiliary output #1	Short to battery
s 026 4	Auxiliary output #1	Open circuit
s 040 3	Auxiliary output #2	Short to battery
s 040 4	Auxiliary output #2	Open circuit
s 053 3	Auxiliary output #5	Short to battery
s 053 4	Auxiliary output #5	Open circuit
s 054 3	Auxiliary output #6	Short to battery
s 054 4	Auxiliary output #6	Open circuit
s 055 3	Auxiliary output #7	Short to battery
s 055 4	Auxiliary output #7	Open circuit
s 056 3	Auxiliary output #8	Short to battery
s 056 4	Auxiliary output #8	Open circuit
s 257 3	Auxiliary output #9	Short to battery
s 257 4	Auxiliary output #9	Open circuit
s 258 3	Auxiliary output #10	Short to battery
s 258 4	Auxiliary output #10	Open circuit
s 259 3	Auxiliary output #11	Short to battery
s 259 4	Auxiliary output #11	Open circuit

Table 58-1 Auxiliary Output Open or Short to Battery

The DDEC ECM/ECU supplies a switched ground to the Auxiliary Output circuit to turn ON the function assigned. Flash Code 62 indicates that the function assigned to the Auxiliary Output #1 through #11 circuit has either an open circuit or a short to battery (+). A short to battery (+) is detected when the DDEC ECM/ECU, see Figure 58-1, is unsuccessful in turning ON the configured function.

Flash Code 62 may also indicate that the function assigned to the Auxiliary Output #1, #2, #5 through #11 circuit is open, shorted to ground. This diagnostic condition is detected when the Auxiliary Output function is OFF and the DDEC ECM/ECU measures a low voltage on the circuit output.

58.2 TROUBLESHOOTING FLASH CODE 62, SID 26, 40, 53, 54, 55, 56, 257, 258, 259/FMI 3, 4

This diagnosis is typically an open circuit or a short to battery (+) or an open circuit shorted to ground. The following procedure will troubleshoot Flash Code 62.

58.2.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in the diagnostic tool. Record codes logged then clear the codes.
3. Start and run the engine for one minute.
 - [a] If the code becomes active, refer to section 58.2.2.
 - [b] If the code does not become active, go to step 4.
4. Perform a road test.
 - [a] If the code returns, refer to section 58.2.2.
 - [b] If the code does not display again, return the vehicle to service, or refer to section 19.1.1.

58.2.2 Auxiliary Output Cavity Determination

Determine which auxiliary output cavity is associated with the code or codes being logged. The SAE code descriptions of Flash Code 62 and the DDC wire numbers are listed in Table 58-2. Continue troubleshooting. Refer to section 58.2.3.

Output	SAE Code Description	VIH and EH Cavity
Auxiliary Output #1	SID 26/FMI 3 or 4	V-04
Auxiliary Output #2	SID 40/FMI 3 or 4	V-05
Auxiliary Output #5	SID 53/FMI 3 or 4	V-06
Auxiliary Output #6	SID 54/FMI 3 or 4	V-07
Auxiliary Output #7	SID 55/FMI 3 or 4	V-40
Auxiliary Output #8	SID 56/FMI 3 or 4	V-53
Auxiliary Output #9	SID 257/FMI 3 or 4	V-54
Auxiliary Output #10	SID 258/FMI 3 or 4	V-55
Auxiliary Output #11	SID 259/FMI 3 or 4	E-13

Table 58-2 Auxiliary Output Cavities

58.2.3 Electrical Check

Perform the following steps to check connectors, dash light or vehicle power-down relay, or item being driven.

1. Check the connectors of the output wire associated with the code logged at the vehicle harness connector or engine sensor harness connector.
2. Check the connectors of the output wire associated with the code logged at the item being driven.

- [a] If the connectors are not good, repair or replace the terminals. Refer to section 58.2.4.1.
- [b] If the connectors are good and the items being driven (e.g. relay, light) are not in good condition, repair or replace the device. (Contact OEM for test procedure.) Refer to section 58.2.4.1.
- [c] If the connectors are good and the items being driven (e.g. relay, light, are in good condition, refer to section 58.2.4.

58.2.4 Measure Resistance

Perform the following steps to measure the resistance.

1. Turn ignition OFF.
2. Connect the Engine Sensor Harness or Vehicle Interface Harness (connector with output fault).
3. Disconnect the output wire associated with the code logged at the component.
4. Measure the resistance between the removed connector and the ECM/ECU case.
 - [a] If the reading is less than 100K Ω , contact Detroit Diesel Customer Support Center (313-592-5800).
 - [b] If the reading is greater than 100K Ω , this wire is shorted to the battery or open. Repair or replace this wire. Refer to section 58.2.4.1.

58.2.4.1 Verify Repairs

Perform the following steps to verify repairs.

1. Reconnect all connectors.
2. Plug diagnostic tool into the connector.
3. Clear all codes.
4. Start and run the engine.
 - [a] If the output code returns, refer to section 58.2.1.
 - [b] If the output code does not return, troubleshooting is complete.

59 FLASH CODE 63 - PWM FAULT

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59.1 DESCRIPTION OF FLASH CODE 63	59-3
59.2 TROUBLESHOOTING FLASH CODE 63, SID 57–60/FMI 0/1/3/4/7	59-4

59.1 DESCRIPTION OF FLASH CODE 63

Flash Code 63 indicates that the pulse width modulation (PWM) output(s) used is either shorted to battery positive or open-circuited.

The SAE J1587 equivalent codes for Flash Code 63 are listed in Table 59-1.

Flash Code	SID	FMI	Description
63	s 57	0	PWM #1 (V-52) above normal range
63	s 57	1	PWM #1 (V-52) below normal range
63	s 57	3	PWM #1 (V-52) short to battery
63	s 57	4	PWM #1 (V-52) open circuit
63	s 57	7	PWM #1 (V-52) mechanical system failure
63	s 58	0	PWM #2 (V-46) above normal range
63	s 58	0	PWM #2 (V-46) below normal range
63	s 58	3	PWM #2 (V-46) short to battery
63	s 58	4	PWM #2 (V-46) open circuit
63	s 58	7	PWM #2 (V-46) mechanical system failure
63	s 59	0	PWM #3 (E-1) above normal range
63	s 59	1	PWM #3 (E-1) below normal range
63	s 59	3	PWM #3 (E-1) short to battery
63	s 59	4	PWM #3 (E-1) open circuit
63	s 59	7	PWM #3 (E-1) mechanical system failure
63	s 60	0	PWM #4 (E-4) above normal range
63	s 60	1	PWM #4 (E-4) below normal range
63	s 60	3	PWM #4 (E-4) short to battery
63	s 60	4	PWM #4 (E-4) open circuit
63	s 60	7	PWM #4 (E-4) mechanical system failure
63	s 267	0	PWM #5 (E-8) above normal range
63	s 267	1	PWM #5 (E-8) below normal range
63	s 267	3	PWM #5 (E-8) short to battery
63	s 267	4	PWM #5 (E-8) open circuit
63	s 267	7	PWM #5 (E-8) mechanical system failure
63	s 268	0	PWM #6 (E-11) above normal range
63	s 268	1	PWM #6 (E-11) below normal range
63	s 268	3	PWM #6 (E-11) short to battery
63	s 268	4	PWM #6 (E-11) open circuit
63	s 268	7	PWM #6 (E-11) mechanical system failure

Table 59-1 SAE J 1587 Equivalent Code for Flash Code 63

For all EGR related codes, always perform the EGR basic checks for Series 60 engines, refer to section 19.18.

59.2 TROUBLESHOOTING FLASH CODE 63, SID 57–60/FMI 0/1/3/4/7

The following procedures will troubleshoot Flash Code 63.

59.2.1 Determine Assignment

Perform the following steps to determine assignment.

1. Turn ignition ON and plug in the diagnostic tool.
2. Select INs/OUTs. To what is PWM assigned? Write down assignment vs cavity and code, listed in Table 59-2.

Code	PWM	Wire Location
s 057	PWM #1	V-52
s 058	PWM #2	V-46
s 059	PWM #3	E-1
s 060	PWM #4	E-4
s 267	PWM #5	E-8
s 268	PWM #6	E-11

Table 59-2 PWM Assignments

3. Select code display.
4. Determine Failure Mode Identifier (FMI).
 - [a] If FMI 3 displays, there is a short to the battery. Refer to section 59.2.2.
 - [b] If FMI 4 displays, refer to step 5.
 - [c] If the FMI is 0, 1, or 7, call the Detroit Diesel Customer Support Center (313–592–5800).
5. Determine if there is a component wired to this position to verify function.
 - [a] If there is a component wired to this position, refer to section 59.2.3.
 - [b] If there is no component wired to this position, reprogram to eliminate the assigned function. (A change may be required to the DDC mainframe.) Refer to section 59.2.4.1.

59.2.2 Verify Short to Battery

Perform the following steps to verify a short to battery:

1. Turn ignition OFF.
2. Disconnect the vehicle connector: if PWM 1 or 2; engine connector if PWM 3, 4, 5 or 6.
3. Measure voltage between the cavity with the code and the good ground.
 - [a] If the voltage measurement is greater than 3 volts, the connector is shorted to the battery. Repair. Refer to section 59.2.4.1.
 - [b] If the voltage measurement is less than 3 volts, contact the Detroit Diesel Customer Support Center (313-592-5800).

59.2.3 Check Component Connections

Perform the following steps to check component connections:

1. Turn the vehicle ignition switch to the OFF position.
2. Inspect the connections of the PWM wire associated with the flash code logged at both harness connector and the item being driven.
 - [a] If the connectors are damaged or broken, repair or replace the damaged terminals. Verify repairs. Refer to section 59.2.4.1.
 - [b] If the connectors are not damaged or broken, ensure the item is connected to the pulse width modulation wire. If the item is not connected, repair or replace the connector. Verify repairs. Refer to section 59.2.4.1.
 - [c] If the item is connected, measure the resistance. Refer to section 59.2.4.

59.2.4 Measure Resistance Between Connector and the ECM/ECU Case

Perform the following steps to measure resistance between the connector and the ECM/ECU case:

1. Turn the vehicle ignition to the OFF position.
2. Ensure connector is installed on the engine harness side or vehicle harness side.
3. Disconnect the PWM wire associated with the code logged at the component.
4. Measure the resistance between the removed connector and the ECM/ECU case.
 - [a] If the resistance measurement is less than 100K Ω , verify the pin assignment with wiring - view with diagnostic tool. Refer to section 59.2.4.1.
 - [b] If the resistance measurement is greater than 100,000 Ω , the wire is open or shorted to battery. Repair or replace the wire. Verify repairs. Refer to section 59.2.4.1.

59.2.4.1 Verify Repairs

Perform the following steps to verify repairs for Flash Code 63.

1. Reconnect all connectors and clear all codes from the diagnostic tool.
2. Plug in the diagnostic tool.
3. Turn vehicle ignition switch to the ON position.
 - [a] If Flash Code 63 was not logged, no further troubleshooting is required.
 - [b] If Flash Code 63 was logged, please review this section from the first step to find the error. Refer to section 59.2.1.

60 FLASH CODE 64, TURBO SPEED

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60.1 DESCRIPTION OF FLASH CODE 64	60-3
60.2 TROUBLESHOOTING FLASH CODE 64, PID 103/FMI 8/0	60-3

60.1 DESCRIPTION OF FLASH CODE 64

The SAE J1587 equivalent code for Flash Code 64 is p 103/8, Turbo Speed Sensor input failure and p 103/0, turbo overspeed. The turbo speed (an EGR code) has exceeded a programmed limit; performance concerns may result during active code.

60.2 TROUBLESHOOTING FLASH CODE 64, PID 103/FMI 8/0

For all EGR related codes, always refer to section 19.18, "Exhaust Gas Recirculation System Basic Checks," and perform all the checks.

The following procedure will troubleshoot Flash Code 64 p103/8 or 0.

60.2.1 Turbocharger Overspeed Check

Perform the following steps to check for turbocharger overspeed:

1. Disconnect turbo speed sensor connector. See Figure 60-1.

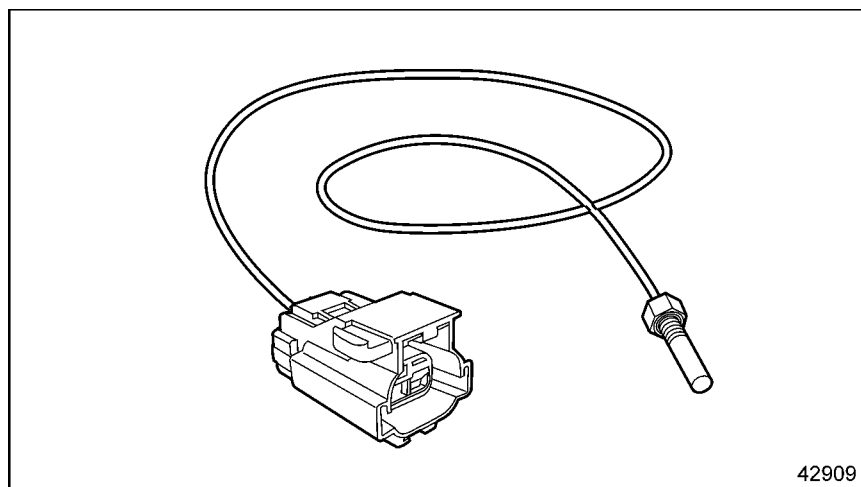


Figure 60-1 Turbo Speed Sensor

2. Measure resistance between cavity 2 and battery ground. See Figure 60-2.

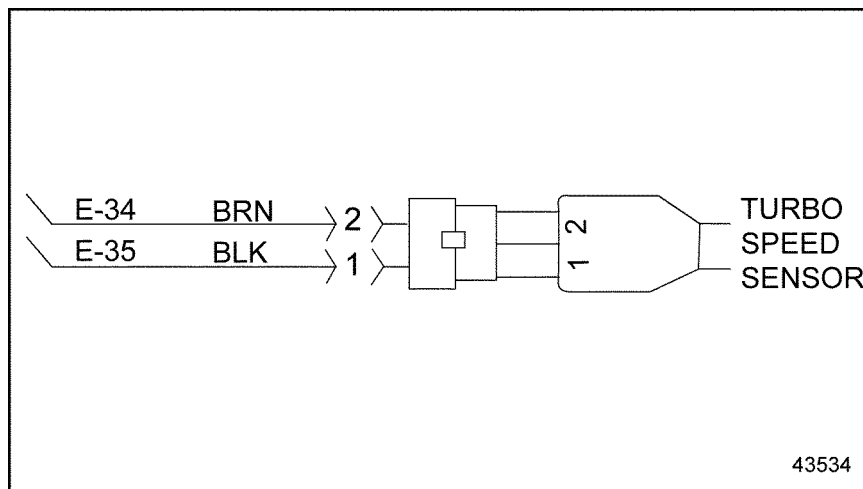


Figure 60-2 Turbo Speed Sensor Wiring

- [a] If the resistance measurement is greater than or equal to 5 Ω , replace the sensor. Verify repair. Refer to section 60.2.1.1.
- [b] If the resistance measurement is less than 5 Ω , replace the wire. Verify repair. Refer to section 60.2.1.1.

60.2.1.1 Verify Repairs

Perform the following steps to verify repairs for the EGR valve:

1. Connect all connectors.
2. Start and run the engine.
3. Road test the engine.
 - [a] If code 64 was not logged, no further troubleshooting is required.
 - [b] If code 64 was logged, refer to section 19.18, "Exhaust Gas Recirculation System Basic Checks," and perform all the checks. Then call the Detroit Diesel Customer Supprt Center (313-592-5800) or try a test ECM/ECU.
 - [c] If checks passed for the VPOD test (refer to section 19.18), no further troubleshooting is required.
 - [d] If checks were not performed (refer to section 19.18), perform those checks first.

61 FLASH CODE 65 - AIR FILTER RESTRICTION INPUT VOLTAGE HIGH OR LOW

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61.1 DESCRIPTION OF FLASH CODE 65	61-3
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61.3 TROUBLESHOOTING FLASH CODE 65, PID 107/FMI 4	61-7

61.1 DESCRIPTION OF FLASH CODE 65

For diesel engines, one of the the SAE J1587 equivalent codes for Flash Code 65 is p 107/3, air filter sensor voltage high. the SAE J1587 equivalent codes for Flash Code 65 is p 107/4, air filter sensor voltage low.

For diesel-fueled engines, Flash Code 65 p 107/3 indicates that the air filter sensor input voltage has exceeded or the expected range. Flash Code 65 p 107/4 indicates that the Air Filter Restriction Sensor (AFRS) input voltage has dropped below the expected range.

61.2 TROUBLESHOOTING FLASH CODE 65, PID 107/FMI 3

Follow these procedures to troubleshoot code 65, p 107/3, Air Filter Restriction Sensor (AFRS) failed high.

61.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug the diagnostic tool.
3. Read active codes.
 - [a] If code p 107/3 and no other codes were logged, refer to section 61.2.2.
 - [b] If code p 107/4 or any other codes were logged, refer to section 61.3.1.

61.2.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect AFRS connector. See Figure 61-1.
3. Turn ignition ON.
4. Start and run the engine.
5. Select engine temperature (COOLANT TEMP or OIL TEMP on the DDR).
6. Warm up engine until engine temperature reading is greater than 60°C (140°F).
7. After warm-up, let engine run at idle.
8. Read active codes.
 - [a] If active code p 107/3 and any other codes were logged, refer to section 61.2.4.

- [b] If code p 107/4 and any other codes except p 107/3 were logged, refer to section 61.2.3.

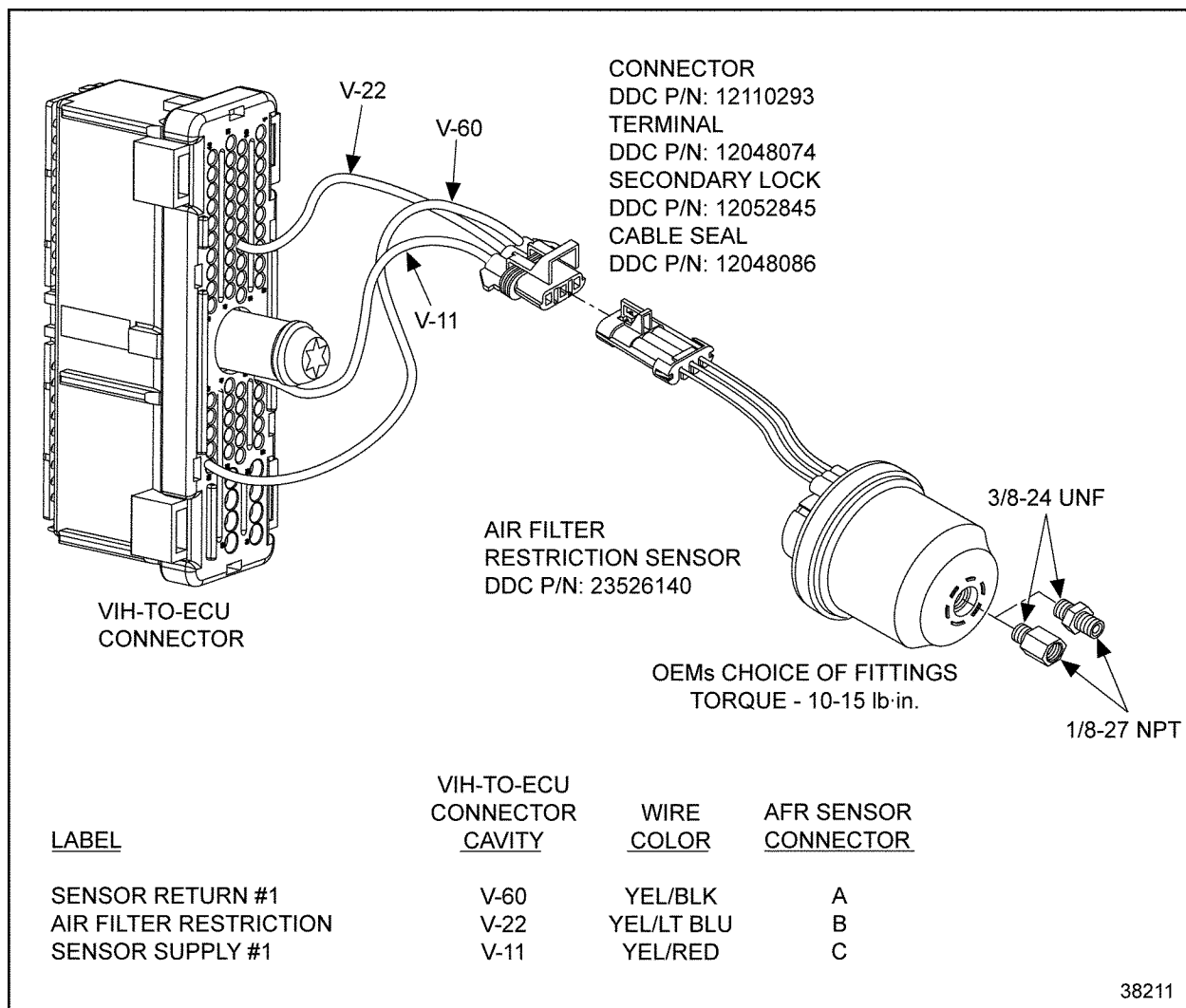


Figure 61-1 Air Filter Restriction Sensor Wiring Diagram

61.2.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM/ECU.
3. Install a jumper wire between pin A and pin B of the AFRS harness connector. See Figure 61-1.
4. Measure resistance between sockets V-22 and V-60 on the engine harness connector.

- [a] If resistance measurement is less than or equal to 5 Ω , go to step 5.

- [b] If resistance measurement is greater than 5 Ω , the return line (V-60) is open. Repair the open and refer to section 61.2.5.1.
- 5. Check terminals at the AFRS connectors (both the sensor and harness side) for damage: bent, corroded and unseated pins or sockets.
 - [a] If the terminals and connectors are damaged, repair them and refer to section 61.2.5.1.
 - [b] If the terminals and connectors are not damaged, replace the AFRS. Refer to section 61.2.5.1.

61.2.4 Check for Signal Short to 5 Volt

Perform the following steps to check for signal open.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM/ECU.
3. Measure resistance between sockets V-22 and V-11 on the engine harness connector. See Figure 61-2.
 - [a] If the resistance measurement is less than or equal to 100 Ω , the signal line (V-22) is shorted to the engine +5 volt line (V-11). Repair the short and refer to section 61.2.5.1.
 - [b] If the resistance measurement is greater than 100 Ω , or open, refer to section 61.2.5.

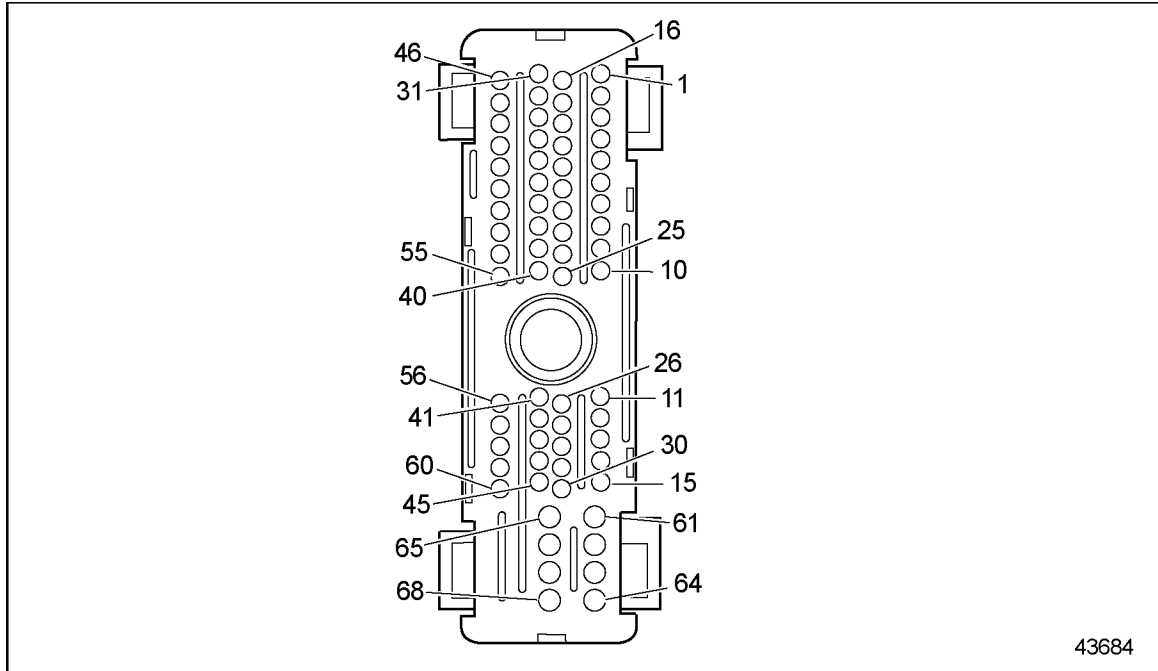


Figure 61-2 ECM/ECU VIH Connector

61.2.5 Check for Short to Battery (+)

Perform the following steps to check for a short to battery (+).

1. Remove both fuses to the ECM/ECU.
2. Disconnect the vehicle harness at the ECM/ECU. See Figure 61-2.
3. Measure resistance between socket V-20 on the engine harness connector and sockets V-61 and V-65 of the vehicle harness connector.
 - [a] If resistance measurement is greater than 100 Ω , or open, go to step 4.
 - [b] If resistance measurement is less than or equal to 100 Ω , a short exists between sockets where less than 100 Ω resistance was read. Repair short and reinsert fuses. Refer to section 61.2.5.1.
4. Inspect the terminals at the ECM/ECU connector (ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If the terminals and connector are damaged, repair both and refer to section 61.2.5.1.
 - [b] If the terminals and connector are not damaged, go to step 5.
5. Check terminals at the AFRS connectors (both the sensor and harness side) for damage: bent, corroded and unseated pins or sockets.
 - [a] If the terminals and connectors are damaged, repair them and refer to section 61.2.5.1.
 - [b] If the terminals and connectors are not damaged, replace the AFRS. Refer to section 61.2.5.1.

61.2.5.1 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition switch OFF and reconnect all connectors.
2. Turn ignition ON and clear codes.
3. Start and run the engine for one minute.
4. Stop engine.
5. Check codes with diagnostic tool.
 - [a] If no codes are logged, no further troubleshooting is required.
 - [b] If code p 107/3 is not logged, but other codes are logged, refer to section 17.3.
 - [c] If code p 107/3 is logged, Contact Detroit Diesel Customer Support Center (313-592-5800).

61.3 TROUBLESHOOTING FLASH CODE 65, PID 107/FMI 4

Follow these procedures to troubleshoot code 65 p 107/4 AFRS failed low.

61.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Plug the diagnostic tool.
2. Turn vehicle ignition switch ON.
3. Read active codes.
 - [a] If code p 107/4 and no other codes were logged, refer to section 61.3.2.
 - [b] If code p 107/4 was logged and none of the following codes were logged: p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, p 101/3 or 4, p 102/3 or 4, p 73/3 or 4, p 94/3 or 4, p 100/3, refer to section 61.3.2.
 - [c] If code 107/4 and any of the following codes were logged: p 110/3 or 4, p 174/3 or 4, p 175/3 or 4, p 101/3 or 4, p 102/3 or 4, p 73/3 or 4, p 94/3 or 4, p 100/3, refer to section 76.

61.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect AFRS connector and install a jumper wire between sockets B and C of the AFRS harness connector. See Figure 61-3.
3. Turn ignition ON.
4. Read active codes.
5. If active codes p 107/3 or 4 were not logged, go to step 6. If active codes p 107/3 or 4 were logged, proceed with the following:
 - [a] If active code p 107/4 and any other codes were logged, refer to section 61.3.4.
 - [b] If code p 107/3 and any other codes except 107/4 were logged, refer to section 61.3.3.
6. Warm up engine until either codes are logged or the engine temperature (COOLANT TEMP or OIL TEMP on DDR) has been greater than 60°C (140°F) for one minute.
 - [a] If active code p 107/4 and any other codes were logged, refer to section 61.3.4.

[b] If code p 107/3 and any other codes except 107/4 were logged, refer to section 61.3.3.

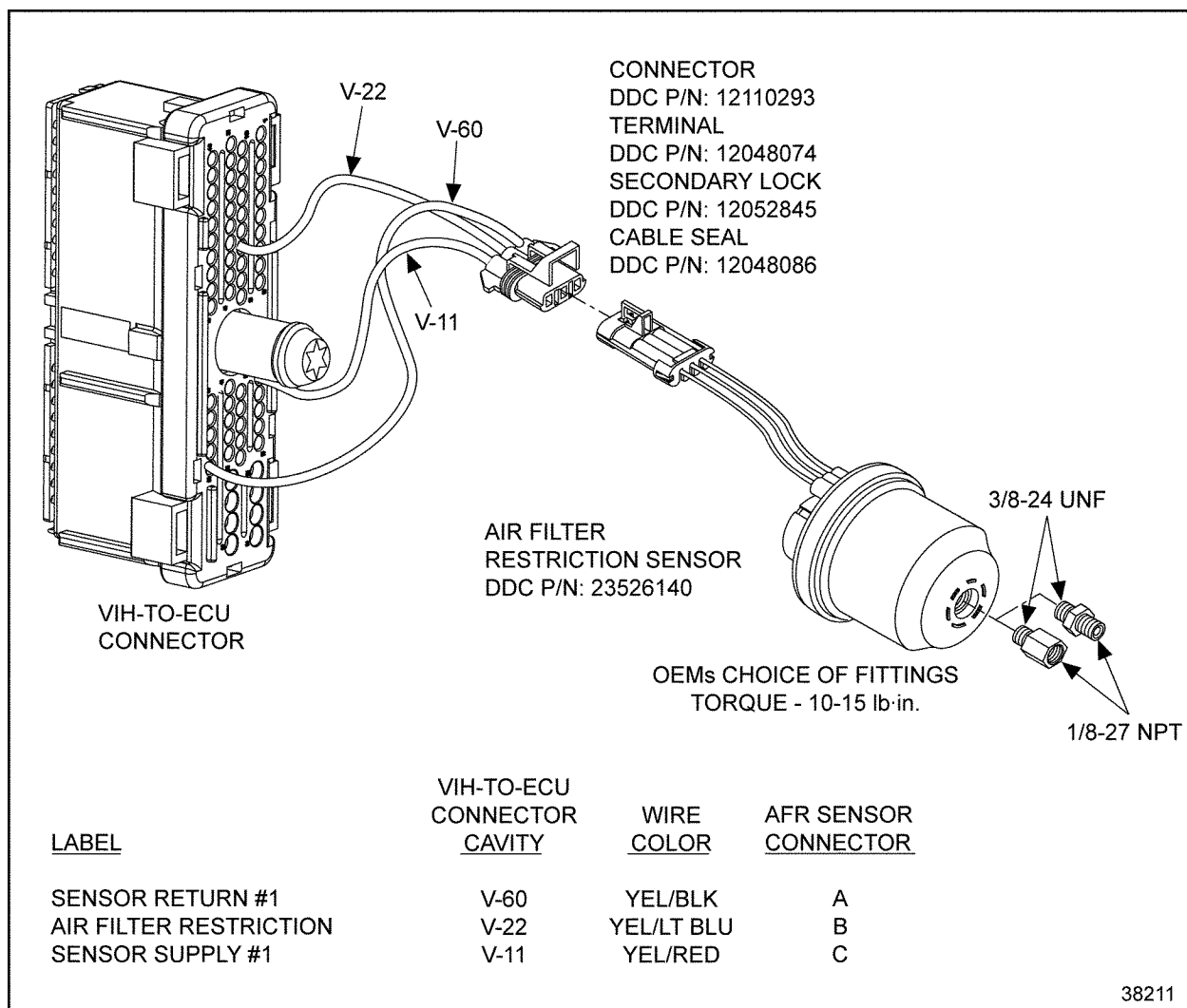


Figure 61-3 VIH Connector to Air Filter Restriction Sensor

61.3.3 Check Air Filter Restriction Sensor and ECM/ECU Connectors

Perform the following steps to check the AFRS and ECM/ECU connectors.

1. Turn ignition OFF.
2. Check terminals at the AFRS connectors (both the sensor and harness side) for damage: bent, corroded and unseated pins or sockets. Check terminals at the ECM/ECU harness connector (both ECM/ECU and harness side) for damage: bent, corroded and unseated pins or sockets. Check V-11, V-22 and V-60 terminals and pins at ECM/ECU.

[a] If the terminals and connectors are damaged, repair them and refer to section 61.3.9.1.

- [b] If the terminals and connectors are not damaged, replace the AFRS and check for codes. If you are still logging p 107/4 reprogram the ECM/ECU. Refer to section 61.3.9.1.

61.3.4 Check for +5 Volts

Perform the following steps to check for +5 volts.

1. Turn vehicle ignition OFF.
2. Remove jumper wire.
3. Turn ignition ON.
4. Measure voltage on AFRS harness connector, socket C (red test lead) to socket A (black test lead).
 - [a] If the voltage measurement is less than 4 volts, refer to section 61.3.6.
 - [b] If the voltage measurement is greater than 6 volts, refer to section 61.3.8.
 - [c] If the voltage measurement is between 4 and 6 volts, refer to section 61.3.5.

61.3.5 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn the ignition OFF.
2. Disconnect the VIH connector at the ECM/ECU. See Figure 61-3.
3. Install a jumper wire between sockets A and B of the AFRS harness connector.
4. Measure resistance between sockets V-22 and V-60 on the engine harness connectors.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 61.3.9.
 - [b] If the resistance measurement is greater than 5 Ω or open, the signal line (V-22) is open. Repair the open and refer to section 61.3.9.1.

61.3.6 Check for Open +5 Volt Line

Perform the following steps to check for open +5 volt line.

1. Turn ignition OFF and disconnect the engine harness connectors at the ECM/ECU.
2. Install a jumper wire between pins A and C of the AFRS connector.
3. Measure resistance between sockets V-11 and V-60 on the engine harness connector.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 61.3.7.
 - [b] If the resistance measurement is greater than 5 Ω or open, the engine +5 volt line (V-11) is open. Repair the open and refer to section 61.3.9.1.

61.3.7 Check for Short

Perform the following steps to check for a short.

1. Remove jumper wire.
2. Measure resistance between sockets A and C on the AFRS harness connector. Also measure resistance between socket C and a good ground.
 - [a] If either resistance measurement is less than or equal to 100 Ω , the engine +5 volt line (V-11) is shorted to the return line (V-60) or battery ground. Repair the short and refer to section 61.3.9.1.
 - [b] If the resistance measurement is greater than 100 Ω or open, replace AFRS and refer to section 61.3.9.1.

61.3.8 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM/ECU.
2. Disconnect the vehicle harness at the ECM/ECU. See Figure 61-4.
3. Measure resistance between socket V-11 on the vehicle harness connector and socket V-61 and V-65 of the vehicle harness connector and between V-11 and V-15.
 - [a] If resistance measurement is greater than 100 Ω , or open, replace AFRS. Refer to section 61.3.9.1.
 - [b] If resistance measurement is less than or equal to 100 Ω , a short exists between sockets where less than 100 Ω resistance was read. Repair short and reinsert fuses. Refer to section 61.3.9.1.

61.3.9 Check for Short to Ground

Perform the following steps to check for a short to ground.

1. Turn vehicle ignition OFF and remove the jumper wire.

2. Measure resistance between sockets V-22 and V-60 on the VIH connector. See Figure 61-4.

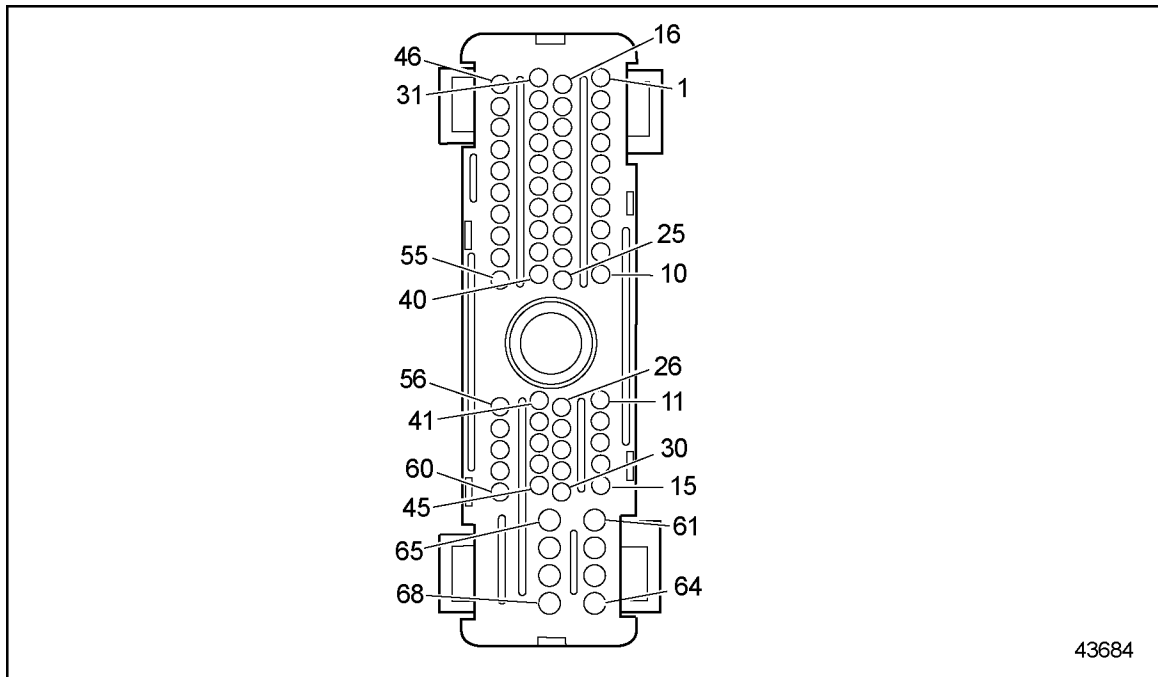


Figure 61-4 ECM/ECU VIH Connector

- [a] If resistance measurement is greater than 100 Ω , or open, go to step 3.
- [b] If resistance measurement is less than or equal to 100 Ω , the signal line (V-22) and return line (V-60) are shorted together. Repair the short. Refer to section 61.3.9.1.
3. Measure resistance between socket V-22 and a good ground. Also measure resistance between V-22 and V-60.
 - [a] If both resistance measurements are greater than 100 Ω or open, replace AFRS. Refer to section 61.3.9.1.
 - [b] If either resistance measurement is less than 100 Ω , the signal line (V-22) is shorted to the return line (V-60) or battery ground. Repair short and refer to section 61.3.9.1.

61.3.9.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF and reconnect all connectors.
2. Turn ignition ON and clear codes.
3. Start and run the engine for one minute.
4. Stop engine.
5. Check diagnostic tool for codes.

- [a] If no codes are logged, troubleshooting is complete.
- [b] If code p 107/4 is not logged, and other codes are logged, refer to section 17.3.
- [c] If code p 107/4 is logged with or without other codes, review this section from the first step to find the error. Refer to section 61.3.1. If no error is located, refer to section 61.3.3.

62 FLASH CODE 66

Section	Page
62.1 DESCRIPTION OF FLASH CODE 66, PID 99/FMI 3/4	62-3

62.1 DESCRIPTION OF FLASH CODE 66, PID 99/FMI 3/4

Flash Code 66 indicates the oil filter restriction circuit input to the ECM/ECU has exceeded or dropped below the allowed range.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

63 FLASH CODE 68 - IDLE VALIDATION FAULT

Section	Page
63.1 DESCRIPTION OF FLASH CODE 68	63-3
63.2 TROUBLESHOOTING FLASH CODE 68, SID 230/FMI 5/6	63-3

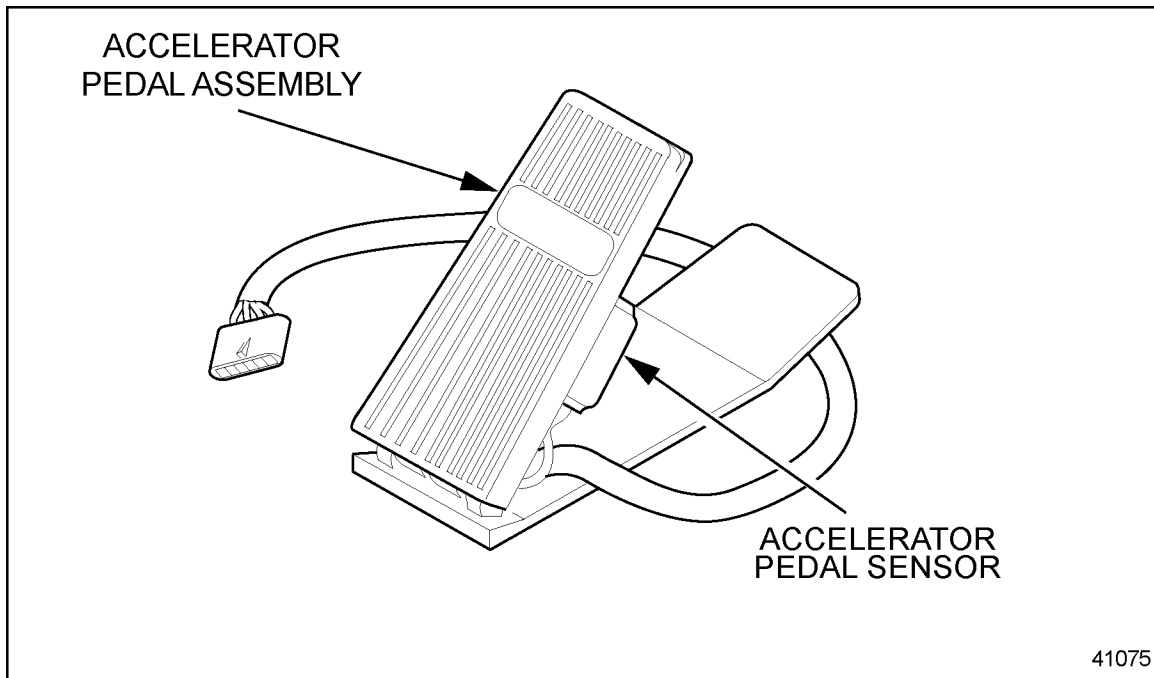


Figure 63-1 Accelerator Pedal Assembly

63.1 DESCRIPTION OF FLASH CODE 68

The SAE J1587 equivalent code for Flash Code 68 is s 230/5 (open circuit) or s 230/6 (short to ground).

NOTE:

Code 230/5 (open) is set when the Throttle Position Sensor/Accelerator Pedal Sensor (TPS/AP Sensor) counts are less than 120 and IVS input is opened.

NOTE:

Code 230/6 (short to ground) is set when TPS/AP Sensor counts are greater than 282 and IVS input is grounded to battery (-).

63.2 TROUBLESHOOTING FLASH CODE 68, SID 230/FMI 5/6

Flash Code 68 indicates that the ECM/ECU, see Figure 63-1, has detected a fault in the Idle Validation Switch (IVS) logic.

The following procedure will troubleshoot Flash Code 68.

63.2.1 Check for Idle Validation Switch Code

Perform the following steps to check for IVS active code:

1. Turn ignition ON.
2. Plug in diagnostic tool.
3. Cycle foot pedal; then read codes.
 - [a] If the IVS code is open (FMI 5), validate the throttle pedal application. Go to step 4.
 - [b] If the IVS code is grounded (FMI 6), check the IVS switch. Refer to section 63.2.2.
4. Visually check to determine which throttle pedal has been installed that utilizes the IVS function.
 - [a] If the throttle pedal has an idle validation switch installed, verify TPS count. Refer to section 63.2.4.
 - [b] If the throttle pedal has no idle validation switch installed, update customer calibration using a programming station. Change the settings from idle validation to "No Function" and save changes. Verify repairs. Refer to section 63.2.5.1.

63.2.2 Check the Idle Validation Switch

Perform the following step to check the idle validation switch:

1. Turn the vehicle ignition switch to the ON position.

 WARNING:
PERSONAL INJURY
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

2. Start and run the engine.

NOTE:

Vehicle need not be moving to perform this check.

3. Plug in diagnostic tool.
4. Compare idle validation switch input status (switch light status) with the throttle position sensor counts.
 - [a] If the IVS status is ON with the TPS/AP Sensor count being greater than 282, measure for resistance. Refer to section 63.2.3.
 - [b] If the IVS status is OFF with the TPS/AP Sensor count being greater than 282, clear inactive codes. No further troubleshooting is required. Refer to section 63.2.5.1.

63.2.3 Check Resistance Between Idle Validation Switch Contacts

Perform the following steps to measure resistance:

1. Turn vehicle ignition to the ON position. Refer to OEM guidelines.
2. Move TPS/AP Sensor so counts are greater than 285.
3. Measure resistance between the ECM/ECU input V-16 at the TPS/AP Sensor and V-59 using a volt-ohm meter.
 - [a] If the resistance was less than 100 Ω , the idle validation input/switch is grounded or defective. Contact OEM for repair procedure. Refer to section 63.2.5.1.
 - [b] If the resistance was greater than 100 Ω , the fault condition no longer exists. No further troubleshooting is required. Refer to section 63.2.5.1.

63.2.4 Determine Throttle Position Sensor Counts / Idle Validation Switch Status

Perform the following steps to determine TPS/AP Sensor counts:

1. Turn vehicle ignition to the ON position. Refer to OEM guidelines.

 WARNING: PERSONAL INJURY
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

2. Plug in diagnostic tool.

NOTE:

Vehicle need not be moving to determine TPS counts.

3. Compare idle validation switch status (switch light status) with the throttle position sensor counts.
 - [a] If the IVS input is ON with the TPS/AP Sensor count being less than 120, the problem no longer exists. Refer to section 63.2.5.1.
 - [b] If the IVS input is OFF with the TPS/AP Sensor count being less than 120, refer to section 63.2.5.

63.2.5 Check Resistance Between Idle Validation Switch Contacts

Perform the following steps to determine resistance:

1. Turn vehicle ignition switch to the ON position.
2. Measure resistance between the ECM/ECU input at the TPS/IVS end of the harness and battery ground.
 - [a] If the resistance is less than 100 Ω , the IVS is defective. Replace the switch. (Contact the OEM for procedure.) Verify repairs. Refer to section 63.2.5.1.
 - [b] If the resistance is greater than 100 Ω , either the IVS input or V-59 wire is open; repair the open. Verify repairs. Refer to section 63.2.5.1.

63.2.5.1 Verify Repairs

Perform the following steps to verify repairs:

1. Clear inactive codes.



WARNING:

PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

2. Start and run the engine.
3. Depress foot pedal to at least half throttle (> 290 counts).
4. Release foot pedal and allow the engine to idle.
5. Visually observe the check engine light (CEL/AWL) and diagnostic tool.
 - [a] If the CEL/AWL comes on, no further troubleshooting is required.
 - [b] If code 68 is logged, refer to section 63.2.1 to troubleshoot Flash Code 68 again.

64 FLASH CODE 71 - INJECTOR RESPONSE SHORT

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64.1 DESCRIPTION OF FLASH CODE 71	64-3
64.2 TROUBLESHOOTING FLASH CODE 71, SID 1/2/3/4/5/6/FMI 0	64-3

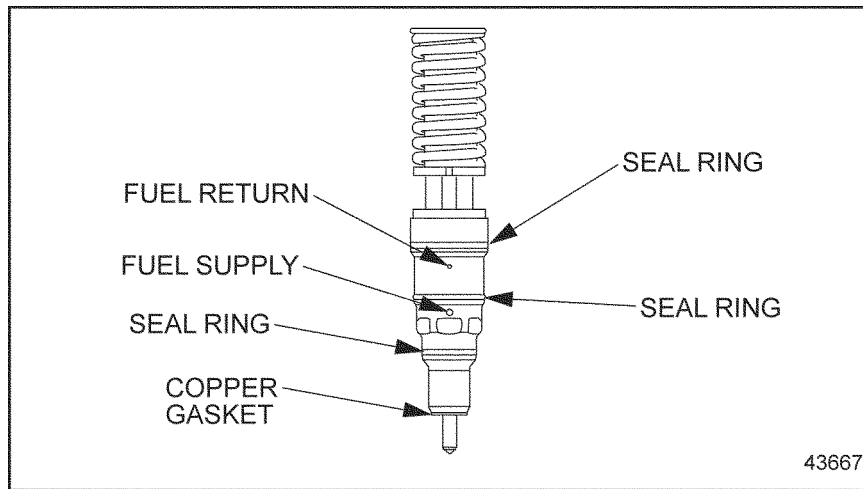


Figure 64-1 **N3 Injector**

64.1 DESCRIPTION OF FLASH CODE 71

The SAE J1587 equivalent code for Flash Code 71 is s 001/1, or s 002/1, or s 003/1, or s 004/1, or s 005/1, or s 006/1.

Flash Code 71 indicates that the time interval that starts when the DDEC ECM/ECU requests an injector be turned on, to when the injector solenoid valve actually closes, is shorter than the lower limit of the expected range.

64.2 TROUBLESHOOTING FLASH CODE 71, SID 1/2/3/4/5/6/FMI 0

This diagnostic condition is typically:

- ☐ Aerated fuel system
- ☐ High system battery (+) supply voltage
- ☐ Mechanical injector failure
- ☐ Failed solenoid

NOTE:

The injector diagnostic SID indicates which cylinder number has an injector with a short response time. The injector number describes the cylinder and bank that has the injector with a short response time. The diagnostic tool will display the injector text description.

Injector response times generally increase with low battery supply voltage and decrease with high battery supply voltage. Although injector response times vary from injector to injector at a given rpm, each individual injector response time should remain relatively consistent from one firing to the next. Wide variations in response time (typically ± 0.2 ms) for one injector at a steady engine rpm may indicate an electrical problem (faulty alternator or regulator, poor or broken ground cables, etc.). See Figure 64-1 for injector diagram.

64.2.1 Determine Cylinders With Fault

The injector location that is logging the codes is listed in Table 64-1.

	SID 1	SID 2	SID 3	SID 4	SID 5	SID 6
Firing Order	# 1	# 2	# 3	# 4	# 5	# 6
S60 Cylinder # (block location)	1	5	3	6	2	4

Table 64-1 Determine Cylinders With Fault

1. Disconnect the 10-pin injector harness connector.
2. Establish a good ECM/ECU case ground by measuring the resistance across two points on the ECM/ECU. The resistance should measure less than or equal to 1 Ω .
3. Once a good case ground is established, keep one of the measurement probes in place and move the other probe to one of the exposed male injector terminals on the ECM/ECU.

4. Measure the resistance. Repeat this procedure at each of the terminals.
 - [a] If any terminals have a resistance of less than 1000 Ω , replace the ECM/ECU. Refer to section 64.2.4.1.
 - [b] If all terminals have a resistance of greater than 1000 Ω , refer to section 64.2.2.

64.2.2 Check for Short

Perform the following steps to check for a short. See Figure 64-2.

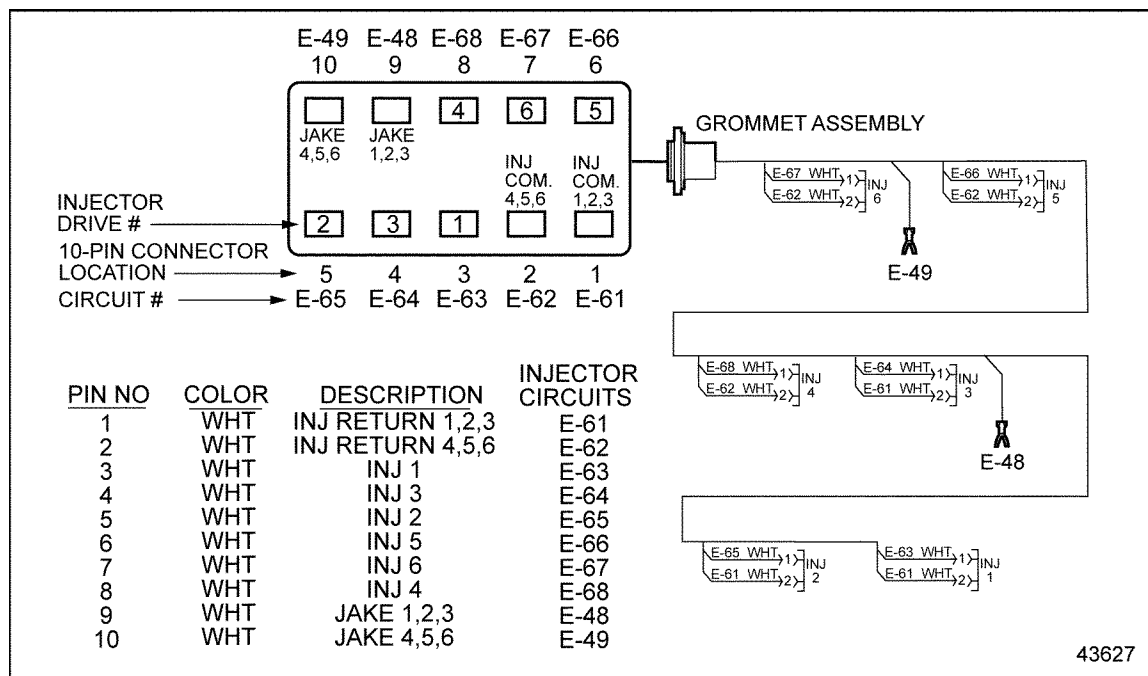


Figure 64-2 Injector Harness

1. Locate the injector harness connector terminals associated with the codes.
2. Measure resistance between those cavities and the cylinder block.
3. Also, measure resistance between that cavity and the appropriate return cavity (G or E).
 - [a] If measured resistance is less than 5 Ω , the wire is shorted. Repair or replace the harness and refer to section 64.2.4.1.
 - [b] If measured resistance is greater than 5 Ω , refer to section 64.2.3.

64.2.3 Check for Open

Perform the following steps to check for an open.

1. Insert a jumper wire between the cavity associated with the code and the return for that connector (E-61 and E-62).
2. Remove the valve cover to gain access to the cylinder associated with the code.
3. Remove the connector terminals at the injector solenoid.
4. Measure resistance between the terminal plugs.
 - [a] If the measured resistance is greater than 5 Ω , the injector wire is open. Repair or replace the harness and refer to section 64.2.4.1.
 - [b] If the measured resistance is less than 5 Ω , and the ECM/ECU software is less than 3.00, reprogram the ECM/ECU. Refer to section 64.2.4.1.
 - [c] If the measured resistance is less than 5 Ω , and the ECM/ECU software is 3.00 or higher, remove the alternator belt to disable the alternator and refer to section 64.2.4.

64.2.4 Assemble

Perform the following steps to assemble the components.

1. Connect the connectors.
2. Install the valve cover.
3. Start and run the engine.
4. Stop engine.
5. Does the code return?
 - [a] If the code does not return, repair or replace the alternator grounds and refer to section 64.2.4.1.
 - [b] If the codes return, replace the injector and solenoid. Refer to section 64.2.4.1.

64.2.4.1 Verify Repairs

Perform the following steps to verify repairs:

1. Start and run the engine.
2. Stop engine.
3. Check diagnostic tool for codes.
 - [a] If no codes are logged, no further troubleshooting is required.
 - [b] If injector codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 64.2.1.

65 FLASH CODE 72 - VEHICLE OVERSPEED

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65.1 DESCRIPTION OF FLASH CODE 72	65-3
65.2 TROUBLESHOOTING FLASH CODE 72, PID 84/FMI 0/11	65-3

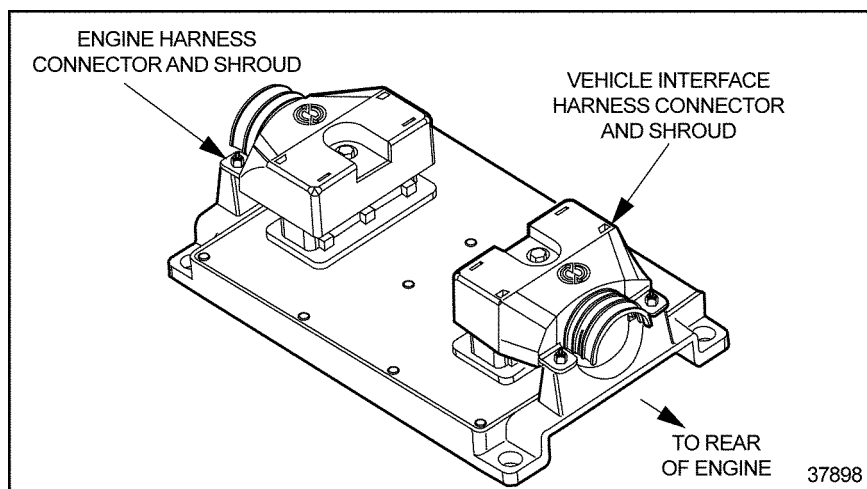


Figure 65-1 ECM/ECU

65.1 DESCRIPTION OF FLASH CODE 72

The SAE J1587 equivalent code for Flash Code 72 is p 84/0 or p 84/11.

Flash Code 72 indicates that the vehicle speed signal to the ECM/ECU (with fueling to the engine) has exceeded the vehicle speed limit that is defined in the ECM/ECU calibration. See Figure 65-1.

Flash Code 72 also may indicate that the vehicle speed signal to the ECM/ECU (without fueling to the engine) has exceeded a secondary vehicle speed limit that is defined in the ECM/ECU calibration.

65.2 TROUBLESHOOTING FLASH CODE 72, PID 84/FMI 0/11

Use the following procedures to troubleshoot Flash Code 72, p 84/0 or 11.

65.2.1 Overspeed

Perform the following steps to troubleshoot overspeed.

1. These codes indicate the vehicle speed has exceeded the limits programmed into the ECM/ECU. Verify Cruise Control and VSS information.
 - [a] Code p 84/0 - Overspeed with fuel limit has been exceeded.
 - [b] Code p 84/11 - Overspeed without fuel limit has been exceeded.
2. Determine if limits are a reasonable distance above the road speed limit.
 - [a] If the limits are a reasonable distance, go to step 3.
 - [b] If the limits are not a reasonable distance above the road speed limit, change the limits and perform the test. Refer to section 65.2.1.1.
3. Determine if the Fuel Economy Incentive feature configured recently.
 - [a] If configured recently, review the limits. W/FEI limits may need to be increased.
 - [b] If not configured recently, the conditions are normal. The vehicle has exceeded speed limits set.

65.2.1.1 Verification Test

Perform the following steps to troubleshoot overspeed.

1. Start and run the engine.
2. Perform a road test.
 - [a] If the overspeed condition has disappeared, troubleshooting is complete.
 - [b] If the overspeed condition still exists, review this section from the beginning to find the error. Refer to section 65.2.1.

66 FLASH CODE 73 — AIR FILTER RESTRICTION HIGH

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66.1 DESCRIPTION OF FLASH CODE 73	66-3
66.2 TROUBLESHOOTING FLASH CODE 73, PID 107/FMI 0	66-3

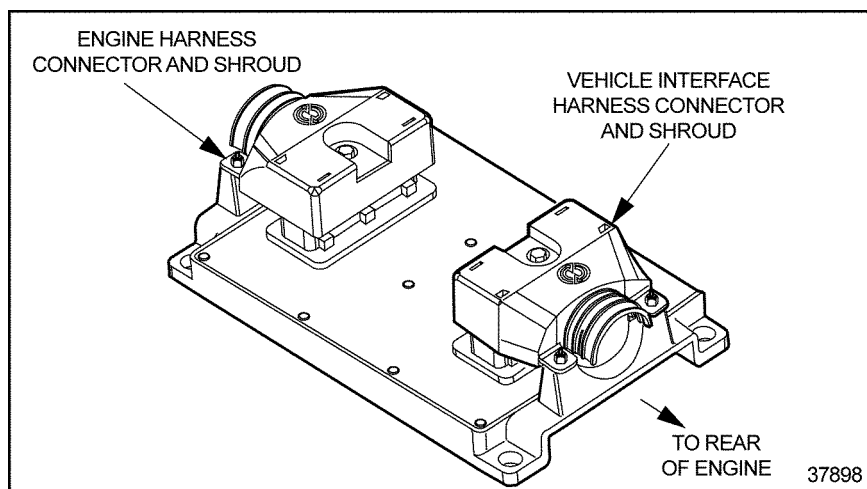


Figure 66-1 ECM/ECU

66.1 DESCRIPTION OF FLASH CODE 73

The SAE code for flash code 73 is p107/0. Code p107/0 indicates that the air filter restriction is high.

66.2 TROUBLESHOOTING FLASH CODE 73, PID 107/FMI 0

The air inlet system requires service, typically changing the air filter.

67 FLASH CODE 74 — OI SAFETY LOOP

Section	Page
67.1 DESCRIPTION OF FLASH CODE 74	67-3
67.2 TROUBLESHOOTING FLASH CODE 74, PID 70/FMI 4	67-3

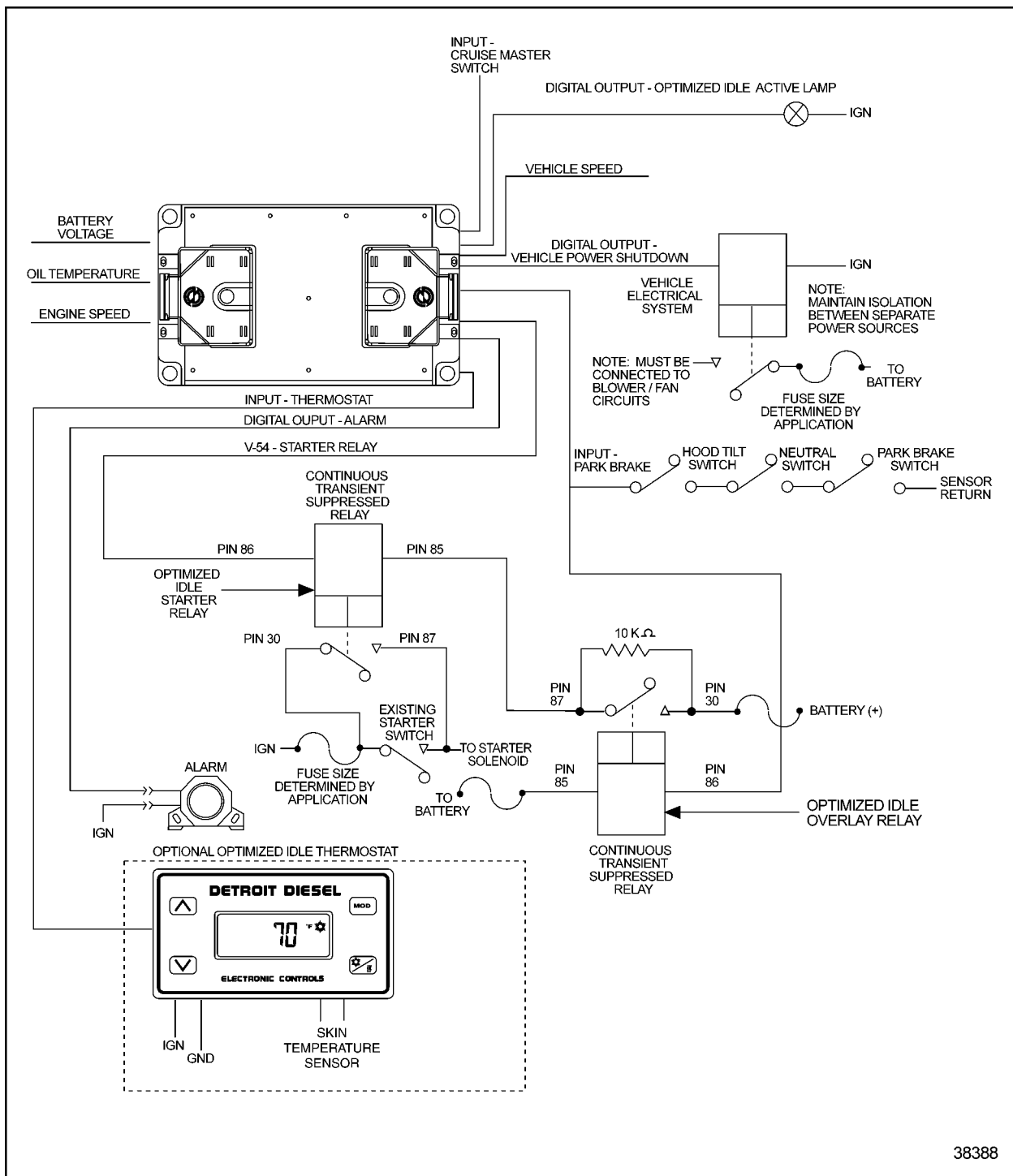


Figure 67-1 Optimized Idle Schematic

67.1 DESCRIPTION OF FLASH CODE 74

The SAE J1587 equivalent code for Flash Code 74 is p 70/4.

Flash Code 74 indicates that the Park Brake digital input is shorted to ground between the VIH connector and one of the switches (Park Brake Switch, Neutral Switch, Hood Switch or optional OEM interlock).

- If this code is inactive, it may indicate that the vehicle moved during Optimized Idle® operation or that two consecutive engine start attempts were not successful.
- Flash Code 74 may also indicate that the relay coil is open or is shorted (causing the unsuccessful engine start).

67.2 TROUBLESHOOTING FLASH CODE 74, PID 70/FMI 4

The following procedure will troubleshoot Flash Code 74. For system overview, see Figure 67-1.

67.2.1 Check Diagnostic Data Reader for Codes

Perform the following steps to check the diagnostic tool for codes:

1. Turn the vehicle ignition switch ON.
2. Plug in the diagnostic tool. Check for active and inactive Optimized Idle codes.

NOTE:

Service any other logged codes first.

3. Visually examine the diagnostic tool for code 74.
 - [a] If code 74 was logged, check for short to ground. Refer to section 67.2.2.
 - [b] If code 74 was not logged, verify fault has been resolved. Refer to section 67.2.3.1.

67.2.2 Check for Short to Ground

Perform the following steps to check for short to ground:

1. Open the vehicle hood. Refer to OEM guidelines.
2. Turn the vehicle ignition switch to the ON position and plug in the diagnostic tool.

NOTE:

The diagnostic tool may already be installed.

3. Looking at the diagnostic tool, select switch/light status (Park Brake/ISD) and verify that it is On.
 - [a] If the Park Brake status is not ON, go to step 4.

- [b] If the Park Brake status is ON, the input wire is shorted to ground between the hood switch and the ECM/ECU. Repair or replace the wire. Verify fault has been resolved. Refer to section 67.2.3.1.
- 4. Close the vehicle hood. Refer to OEM guidelines.
- 5. Put the transmission in gear. Refer to OEM guidelines.
- 6. Looking at the diagnostic tool, verify that the switch/light status (Park Brake) is ON.
 - [a] If the park brake status is not ON, continue checking for a short to ground. Go to step 7.
 - [b] If the Park Brake status is ON, the input wire is shorted to ground between the hood switch and the neutral switch. Repair or replace the wire. Verify fault has been resolved. Refer to section 67.2.3.1.
- 7. Put the transmission in neutral. Refer to OEM guidelines.
- 8. Ensure the parking brake is not set. Refer to OEM guidelines.
- 9. Looking at the diagnostic tool, verify that the switch/light status (Park Brake/ISD) is ON.
 - [a] If the Park Brake/ISD status is not ON, check for vehicle speed. Refer to section 67.2.3.
 - [b] If the Park Brake/ISD status is ON, the input wire is shorted to ground between the park brake switch and the neutral switch. Repair or replace the wire. Refer to section 53.2. Verify fault has been resolved. Refer to section 67.2.3.1.

67.2.3 Check Vehicle Speed

Perform the following steps to check vehicle speed:

 WARNING: PERSONAL INJURY
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

- 1. Start engine with vehicle in park. Refer to OEM guidelines.
- 2. Plug the diagnostic tool.
- 3. View ECM/ECU data list (vehicle speed in mile/h or km/h).
- 4. Increase engine rpm.
- 5. Verify vehicle speed.
 - [a] If vehicle speed did not vary, verify fault has been resolved. Refer to section 67.2.3.1.

- [b] If vehicle speed did vary or was ever greater than 0 rpm, perform flash code 54 troubleshooting. Refer to section 53.2. Upon completion of repair, verify fault has been resolved. Refer to section 67.2.3.1.

67.2.3.1 Verify Repairs

Perform the following steps to verify repairs for flash code 74.

1. Turn vehicle ignition to the OFF position.
2. Reconnect all connectors.
3. Close vehicle hood. Refer to OEM guidelines.
4. Set the park brake. Refer to OEM guidelines.
5. Put the transmission in neutral position. Refer to OEM guidelines.



WARNING:

PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

6. Start the engine.
7. Turn the cruise master switch to the ON position.

NOTE:

If the switch was set to the ON position before the vehicle was started, turn the switch to the OFF position and then to the ON position.

8. Wait for the engine to shut down.

NOTE:

After the idle timer expires, the engine will either shut down or continue to run to charge the battery or keep the oil temperature between 16°C (61°F) and 40°C (104°F).

9. Turn the thermostat on (if installed).
10. Adjust the set point and heating and cooling mode until the thermostat requires the engine to start.

NOTE:

If the thermostat is not installed, wait for the lube oil temperature to fall below 16°C (61°F).

NOTE:

The alarm will sound and the engine will start. Vehicle power (blower fans) will turn on approximately 30 seconds after the engine starts, due to the thermostat.

11. Verify that Optimized Idle operates properly.
 - [a] If Optimized Idle is not operating properly, refer to section 67.2.1 to troubleshoot code 74.
 - [b] If Optimized Idle is operating correctly, troubleshooting is complete.

68 FLASH CODE 75 - BATTERY VOLT HIGH

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68.1 DESCRIPTION OF FLASH CODE 75	68-3
68.2 TROUBLESHOOTING FLASH CODE 75, ...	68-3

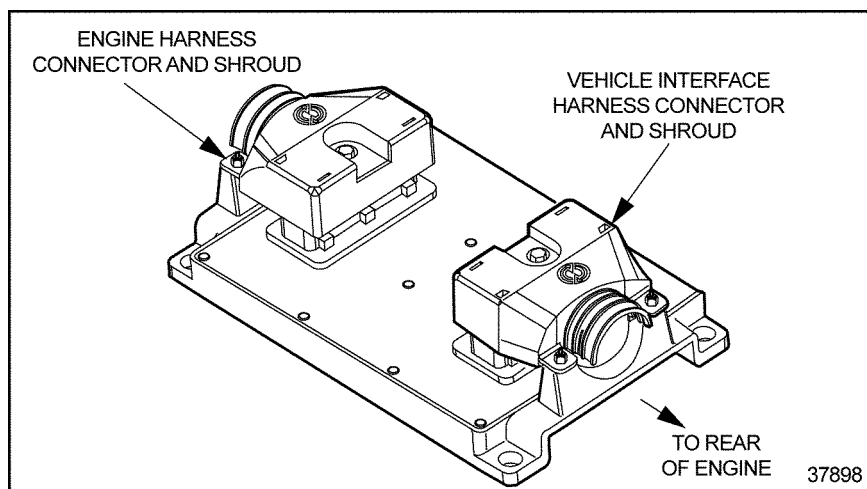


Figure 68-1 ECM/ECU

68.1 DESCRIPTION OF FLASH CODE 75

The SAE J1587 equivalent code for Flash Code 75 is p 168/0 ECM/ECU battery voltage high, or s 211/0 sensor supply voltage high (V-11, V-12), or s 232/0 sensor supply voltage high (E-26).

Flash Code 75 indicates that the DDEC ECM/ECU, see Figure 68-1, has detected that the main battery supply voltage to the ECM/ECU has exceeded the recommended operating range.

68.2 TROUBLESHOOTING FLASH CODE 75,

The following procedure will troubleshoot Flash Code 75, PID 168/FMI 0 or SID 211/FMI 0.

68.2.1 High Voltage

Perform the following steps to troubleshoot high voltage.

1. Turn ignition ON.
2. Plug in the diagnostic tool.
3. Read logged codes.
 - [a] If any codes other than 168/0 are received, service the other codes first.
 - [b] If code 168/0 and no other codes are logged, the voltage to the ECM/ECU is too high. Check batteries and/or vehicle charging system.
 - [c] If code 211/0 is logged, refer to section 77, Vehicle Interface Harness.
 - [d] If code 232/0 is logged, refer to section 76, Engine Harness.

NOTE:

Also indicates the sensor supply voltage is too high.

69 FLASH CODE 77 - EXHAUST BACK PRESSURE FAULT AND SEVERAL INFORMATION CODES

Section	Page
69.1 DESCRIPTION OF FLASH CODE 77	69-3
69.2 TROUBLESHOOTING FLASH CODE 77, PID 81, FMI 3	69-5
69.3 TROUBLESHOOTING FLASH CODE 77, PID 81, FMI 4	69-6

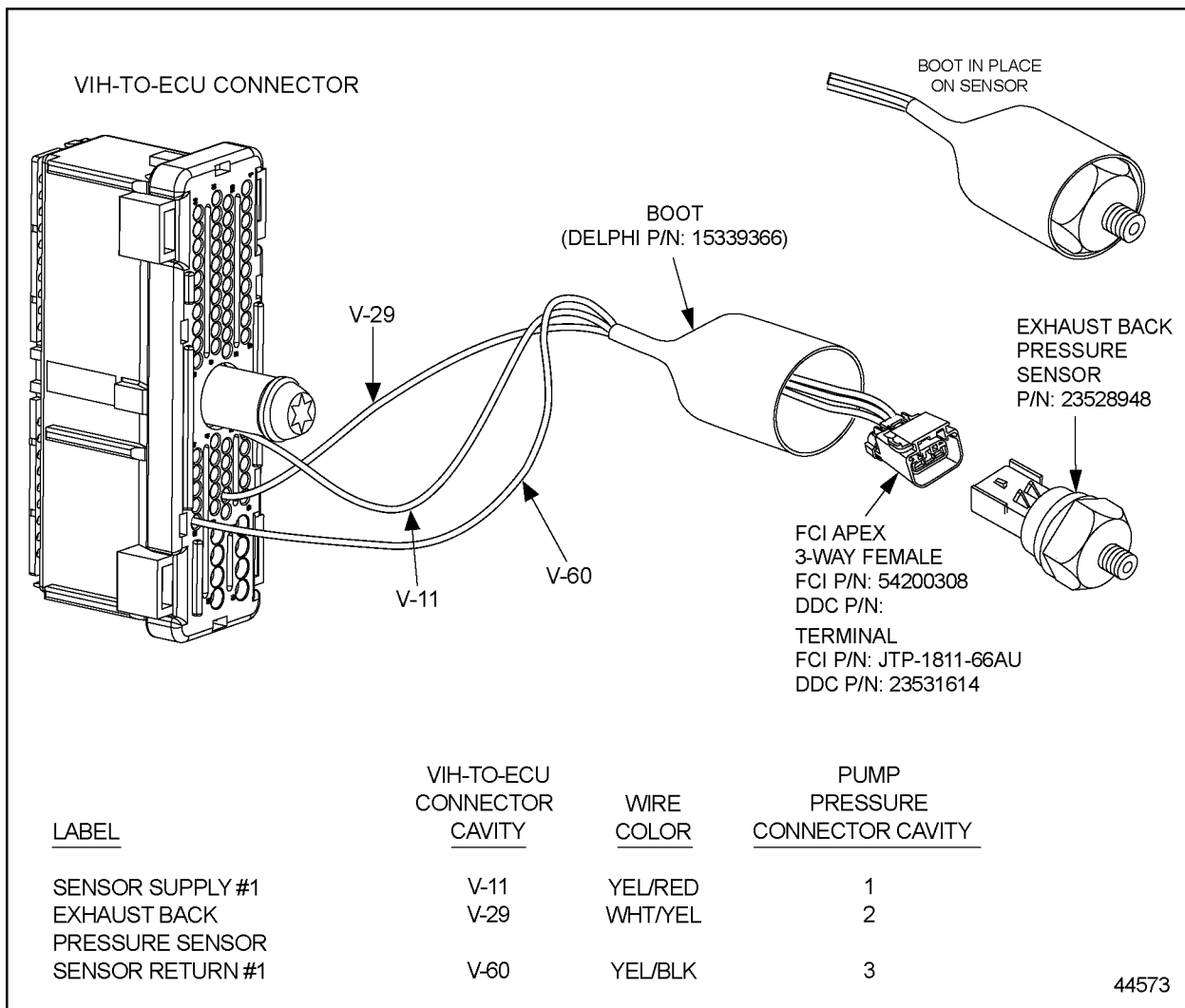


Figure 69-1 Exhaust Back Pressure Sensor

69.1 DESCRIPTION OF FLASH CODE 77

Flash Code 77 is used for several DDEC information codes.

The SAE J1587 equivalent codes for Flash Code 77 are listed in Table 69-1 and Table 69-2:

PID / FMI	Description	Troubleshooting
p 73 1	Fire pump pressure below range Indicates the water pump pressure fell below a calibrated value.	No troubleshooting available for this code. Possible faults could be restricted water supply of failing pump.
p 81 0	Exhaust back pressure above range	Indicates the exhaust back pressure measured was above (FMI 0) or below (FMI 1) a calibrated value. Back pressure too high is usually a sign of a restricted exhaust or failing muffler/converter.
p 81 1	Exhaust back pressure below range	
p 81 12	Exhaust back pressure at rampdown threshold	Indicates the engine derated due to high exhaust back pressure. This could have been presented as a sudden power loss. This code is not a DDEC fault and should be treated as a information code only.
p 81 3	Exhaust back pressure failed high	Indicates the signal voltage to the ECM/ECU went above or below a programmed limit. Typically, less than 25 V for FMI 4 and greater than 4.75 V for FMI3. Refer to section 69.2 for troubleshooting.
p 81 4	Exhaust back pressure failed low	
p 95 1	Fuel filter differential pressure below range	Fuel filter or oil filter differential pressure sensor fell below calibrated limit. Not likely to show up on any on-highway engines. These sensors are used as part of the Maintenance Alert System.
p 99 1	Oil filter differential pressure below range	
p 100 0	Engine oil pressure above range	Indicates that DDEC detected oil pressure too high following shutdown. Typically, this is caused by a stuck sensor. The code is generated on the next ignition cycle and stays active for the duration of the ignition cycle.

Table 69-1 Flash Code 77 (1 of 2)

PID / FMI	Description	Troubleshooting
p 102 1	Turbo boost pressure below range	Indicates one of these parameters fell below a calibrated limit. Details of these codes should be recorded and technical service contacted, since it is unlikely these codes will be used on highway engines.
p 105 1	Inlet manifold temperature below range	
p 107 1	Air filter differential pressure below range	
p 108 0	Barometric pressure above range	Currently these codes should not log with on-highway engines.
p 108 1	Barometric pressure below range	
p 109 0	Coolant pressure above range	Not used for Series 50 or Series 60.
p 110 1	Coolant temperature below range	Neither of these codes should be seen for on-highway engines.
p 111 0	Coolant level above range	
p 171 0	Ambient air temperature above range	Neither of these codes should be seen for on-highway engines.
p 171 1	Ambient air temperature below range	
p 172 1	Air inlet temperature below range	
p 174 0	TCO temperature above range (temporary code)	Refer to code/section 49 – 404/0.
p 174 0	Fuel temperature above range	Indicates fuel temperature exceeded DDC limits for that particular engine. No DDEC troubleshooting is suggested. High fuel temperature should be reviewed with the OEM to determine if any additional fuel coolers need to be considered.
p 174 1	TCO temperature below range (temporary code)	Refer to code/section 48 – 404 1.
p 174 1	Fuel temperature below range	Indicates the fuel temperature fell below a calibrated range. No troubleshooting is suggest.
p 175 1	Engine oil temperature below range	Indicates the engine oil temperature fell below a calibrated range. No troubleshooting is suggest.
p 222 14	Anti theft fault present	Contact DDC Customer Support Center (313-592-5800).
p 251 10	Clock module abnormal rate of change	Codes indicate internal faults with the clock components. Contact DDC Customer Support Center (313-592-5800).
p 251 13	Clock module failure	
p 252 10	Clock module abnormal rate of change	
p 252 13	Clock module failure	
p 354 0	Relative humidity above range	Currently, these codes should not log with on-highway engines.
p 354 1	Relative humidity below range	

Table 69-2 Flash Code 77 (2of 2)

At this time, this code is logged without illuminating a CEL/AWL.

There is an established procedure to troubleshoot only Flash Code 77, p 81/3 (refer to section 69.2.) and p 81/4 (refer to section 69.3.1). There is no established procedure to troubleshoot other variations of this code.

69.2 TROUBLESHOOTING FLASH CODE 77, PID 81, FMI 3

Flash Code 77, p 81/3 is exhaust back pressure failed high.

- The code is used to determine if high fuel temperature may be a cause of reduced power levels.
- High fuel temperature will reduce available horsepower.
- Refer to the recommendations of the vehicle manufacturer regarding the possible need for additional fuel cooling.

69.2.1 Exhaust Back Pressure Failed High

Follow these steps to troubleshoot exhaust back pressure failed high:

1. Disconnect Exhaust Back Pressure Sensor.
2. Start and run the engine.
3. Check codes displayed.
 - [a] If code p 81/3 displays, refer to section 69.2.2.
 - [b] If code p 81/4 displays, refer to section 69.2.4.

69.2.2 Check for Short to +5 Line

Follow these steps to check for a short to the +5 volt line:

1. Unplug the ECM/ECU vehicle connector.
2. Measure resistance between cavities B and C.
 - [a] If the resistance measures greater than 5 Ω , refer to section 69.2.3.
 - [b] If the resistance measures less than 5 Ω , wire #916 is shorted to #510. Repair the short and refer to section 69.2.4.1.

69.2.3 Check for Open

Perform the following steps to check for open:

1. Install jumper between cavities V-60 and V-11.
2. Measure resistance between cavities A and B of the EBP Sensor connector.
 - [a] If measured resistance is less than 50 Ω , refer to section 69.2.4.
 - [b] If measured resistance is greater than 50 Ω , wire V-60 is open. Repair the open and refer to section 69.2.4.1.

69.2.4 Check Connectors

Perform the following steps to check the connectors:

1. If connectors are not damaged, replace the Exhaust Back Pressure Sensor. Refer to section 69.2.4.1.
2. If the connectors are corroded, bent, or damaged, repair or replace them. Refer to section 69.2.4.1.

69.2.4.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF and reconnect all connectors.
2. Turn ignition ON and clear codes.
3. Start and run the engine for one minute.
4. Stop the engine and check diagnostic tool for codes.
 - [a] If no codes are logged, no further troubleshooting is required.
 - [b] If codes p 81/3 was not logged, and other codes are logged, refer to section 17.3.
 - [c] If code p 81/3 and other codes are logged, review this section from the first step to find the error. .

69.3 TROUBLESHOOTING FLASH CODE 77, PID 81, FMI 4

Flash Code 77, p 81/4 is exhaust back pressure failed low

69.3.1 Exhaust Back Pressure Sensor Failed Low

Perform the following steps to troubleshoot this condition:

1. Unplug EBP Sensor.
2. Install a jumper cable between cavities A and B.
3. Start engine.
 - [a] If code p 81/3 displays, refer to section 69.3.2.
 - [b] If code p 81/4 displays, wire #510 is open. Repair the open and refer to section 69.3.3.1.

69.3.2 Check for Short

1. Remove jumper cable.
2. Measure continuity between cavities A and C.
 - [a] If measured continuity is greater than 50 Ω , refer to section 69.3.3.

- [b] If measured continuity is less than 50 Ω , wire V-29 is shorted to wire V-60. Repair the short and refer to section 69.3.3.1.

69.3.3 Check Connectors

Perform the following steps to check the connectors:

1. If connectors are not damaged, replace the EBP Sensor and refer to section 69.3.3.1.
2. If the connectors are corroded, bent, or damaged, repair or replace them and refer to section 69.3.3.1.

69.3.3.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF and reconnect all connectors.
2. Turn ignition ON and clear codes.
3. Start and run the engine for one minute.
4. Stop the engine and check diagnostic tool for codes.
 - [a] If no codes are logged, no further troubleshooting is required.
 - [b] If codes p 81/4 was not logged, and other codes are logged, refer to section 17.3.
 - [c] If code p 81/4 and other codes are logged, review this section from the first step to find the error.

70 FLASH CODE 81 – OIL LEVEL OR EXHAUST TEMP CIRCUIT FAILED HIGH

Section	Page
70.1 DESCRIPTION OF FLASH CODE 81	70-3
70.2 TROUBLESHOOTING FLASH CODE 81, PID 411/FMI 3	70-3
70.3 TROUBLESHOOTING FLASH CODE 81, PID 412/FMI 3	70-4
70.4 TROUBLESHOOTING FLASH CODE 81, PID 98/FMI 3	70-6
70.5 TROUBLESHOOTING FLASH CODE 81, PID 173/FMI 3	70-7

70.1 DESCRIPTION OF FLASH CODE 81

The SAE J1587 equivalent code for Flash Code 81 is p 411/3, p 412/3, p 98/3 or p 173/3. .

Flash Code 81 is used to identify oil level or exhaust temperature voltage high. The four PIDs identified by Flash Code 81 are:

- PID 411/FMI 3 – EGR Delta Pressure check high (refer to section 70.2)
- PID 412/FMI 3 – EGR temperature high (refer to section 70.3)
- PID 98/FMI 3 – Engine Oil Level Sensor (EOL Sensor) input voltage high (refer to section 70.4)
- PID 173/FMI 3 – exhaust gas temperature circuit failed high (refer to section 70.5)

70.2 TROUBLESHOOTING FLASH CODE 81, PID 411/FMI 3

For all EGR related codes, always perform the “Exhaust Gas Recirculation System Basic Checks.” Refer to section 19.18.

70.2.1 Check for Open

Perform the following steps to check for an open.

1. Unplug the Engine Harness connector and unplug the EGR Delta-Pressure Sensor.
2. Install a jumper wire between cavities E-15 and E-38 at the engine sensor connector. See Figure 70-1.

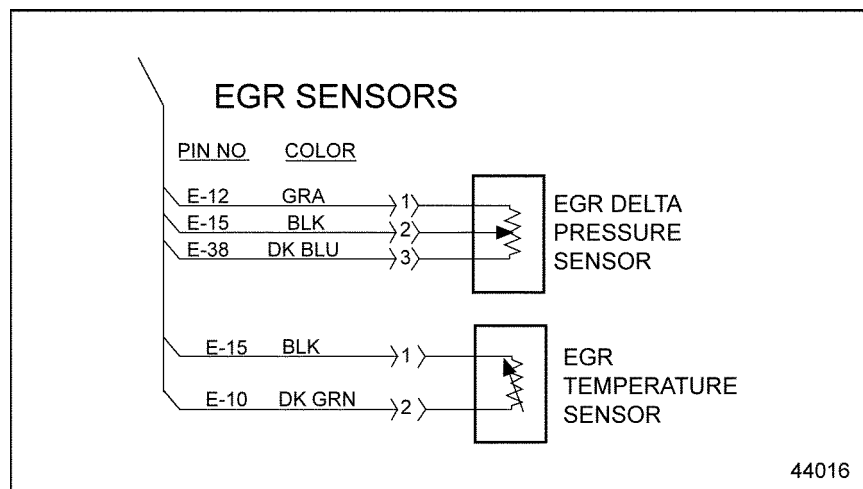


Figure 70-1 EGR Delta-Pressure Sensor Wiring

3. Measure resistance between cavity 2 and 3. See Figure 70-1.
 - [a] If the resistance measurement is less than or equal to 5 Ω , Refer to section 70.2.2.
 - [b] If the resistance measurement is greater than 5 Ω , circuit E-15 is open. Repair and verify. Refer to section 70.2.2.1.

70.2.2 Check for Short

Perform the following steps to check for short:

1. Remove the jumper wire.
2. Measure resistance between E-12 and E-38. See Figure 70-1.
 - [a] If the resistance measurement is less than 1.5 k Ω , circuit E-12 is shorted to E-38. Repair and verify. Refer to section 70.2.2.1.
 - [b] If the resistance measurement is equal to 1.5 k Ω , replace the EGR Delta P sensor and go to 70.2.2.1.

70.2.2.1 Verify Repair

Perform the following steps to verify repairs.

1. Connect all connectors and start and run the engine.
2. Road test the engine.
 - [a] If code 81 was not logged, no further troubleshooting is required.
 - [b] If code 81 was logged, review this section from the first step to find the error. Refer to section 70.2.1. If this is the second time through the procedure, call the Detroit Diesel Customer Support Center (313-592-5800) or try a test ECM/ECU.

70.3 TROUBLESHOOTING FLASH CODE 81, PID 412/FMI 3

For all EGR related codes, always perform the “Exhaust Gas Recirculation System Basic Checks.” Refer to section 19.18.

70.3.1 Check for Open

Perform the following steps to check for an open.

1. Disconnect the EGR Temperature Sensor.
2. Install a jumper wire between cavities 1 and 2. See Figure 70-2.
3. Disconnect the Engine Harness connector.
4. Measure resistance between E-10 and E-15. See Figure 70-2.
 - [a] If the resistance measurement is less than or equal to 5 Ω , Refer to section 70.3.2.

- [b] If the resistance measurement is greater than 5 Ω , circuit E-10 or E-15 is open. Repair and verify. Refer to section 70.3.2.1.

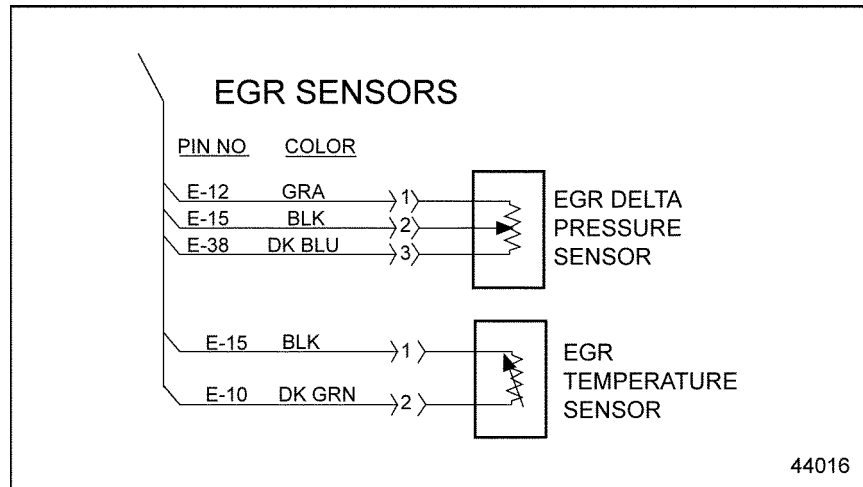


Figure 70-2 EGR Temperature Sensor Wiring

70.3.2 Check for Short

Perform the following steps to check for short:

1. Remove jumper wire.
2. Measure resistance between the engine block and E-10. See Figure 70-2.
 - [a] If the resistance measurement is less than 1.5 k Ω , circuit E-10 is shorted. Repair and verify. Refer to section 70.3.2.1.
 - [b] If the resistance measurement is greater than 1.5 k Ω , replace the EGR temperature sensor.

70.3.2.1 Verify Repairs

Perform the following steps to verify repairs.

1. Connect all connectors.
2. Start and run the engine.
3. Road test the engine.
 - [a] If code 81 was not logged, no further troubleshooting is required.
 - [b] If code 81 was logged, please review this section from the first step to find the error. Refer to section 70.2.1. If this is the second time through the procedure, call the Detroit Diesel Customer Support Center (313-592-5800) or try a test ECM/ECU.

70.4 TROUBLESHOOTING FLASH CODE 81, PID 98/FMI 3

The EOL Sensor is part of the Maintenance Alert System (MAS). Troubleshoot p 98/3 using the following procedures.

70.4.1 Multiple Code Check

Perform the following steps to check for multiple codes:

1. Turn ignition ON and plug in your diagnostic tool.
2. Read active codes. Turn ignition OFF.
 - [a] If code 98/3 displays with code s 232/0, troubleshoot s 232/0 first.
 - [b] If code 98/3 displays, refer to section 70.4.2.

70.4.2 Check Connectors and Sensor

Perform the following steps to check the connectors:

1. Unplug the OLS/EOL Sensor.
2. Turn the ignition ON and read the codes.
 - [a] If code 98/4 displays, check connectors for open, damage or unseated conditions. Go to step 3.
 - [b] If code 98/3 displays, refer to section 70.4.3.
3. Replace the EOL Sensor. Verify the repair. Refer to section 70.4.3.1.

70.4.3 Check for Short and Open

Perform the following steps to check for short and open:

1. Measure resistance between pin B and pin C of the EOL Sensor. See Figure 70-3.
 - [a] If the reading is less than 10 Ω , wire E-12 is shorted to wire E-21. Repair the short or replace the harness and verify the repair. Refer to section 70.4.3.1.
 - [b] If the reading is greater than 10 Ω , go to step 2.
2. Unplug the Engine Harness connector.
3. Insert a jumper harness between the pins A and B of the EOL Sensor connector. Measure resistance between cavity E-15 and E-21. See Figure 70-3.
 - [a] If reading is greater than 10 Ω , cavity E-15 is open. Repair the open or replace the harness; verify the repair. See Figure 70-3. Refer to section 70.4.3.1.

- [b] If the reading is less than 10 Ω , contact the Detroit Diesel Customer Support Center (313-592-5800) or try a test ECM/ECU.

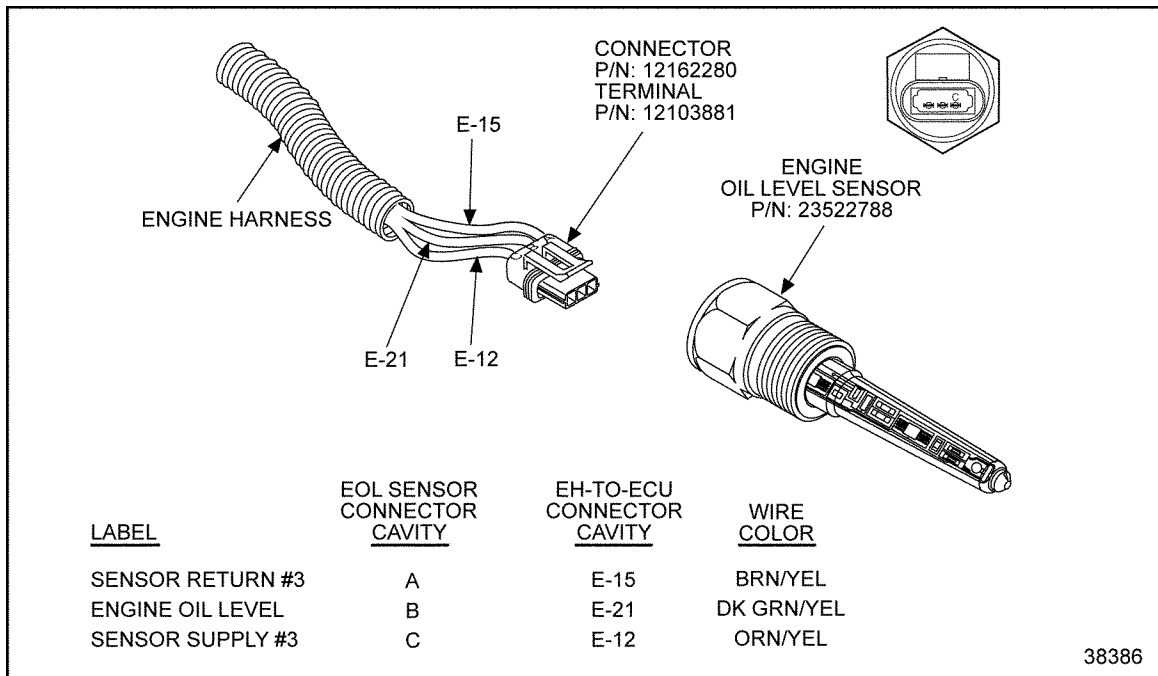


Figure 70-3 Oil Level Sensor

70.4.3.1 Verify Repairs

Perform the following steps to verify repairs:

1. Plug in all connectors. Start and run the engine for two minutes
2. Check for codes. If no codes display, the repair is complete. If code 98/3 displays, review the troubleshooting of the EOL Sensor to find the error. Refer to section 70.4.1.

70.5 TROUBLESHOOTING FLASH CODE 81, PID 173/FMI 3

Typically, the exhaust gas temperature circuit failed high is caused by an open signal or short to battery +. Perform the following procedures to troubleshoot code p 173/3.

70.5.1 Check for Open and Short

Check for open as follows:

1. Disconnect the Exhaust Temperature Sensor connector.
2. Install a jumper wire between the two pins at the ET Sensor. See Figure 70-4.
3. Unplug the vehicle harness connector at the ECM/ECU.

4. Measure resistance between V-60 of the VIH connector and V-23 connector; see Figure 70-4.
 - [a] If resistance measures less than 5 Ω , go to step 5.
 - [b] If resistance is greater than 5 Ω , either the circuit V-60 is opened, or V-23 is open. Repair the open or replace the wire and test. Refer to section 70.5.1.1.
5. Remove the jumper and measure resistance again between V-60 and V-23; see Figure 70-4.

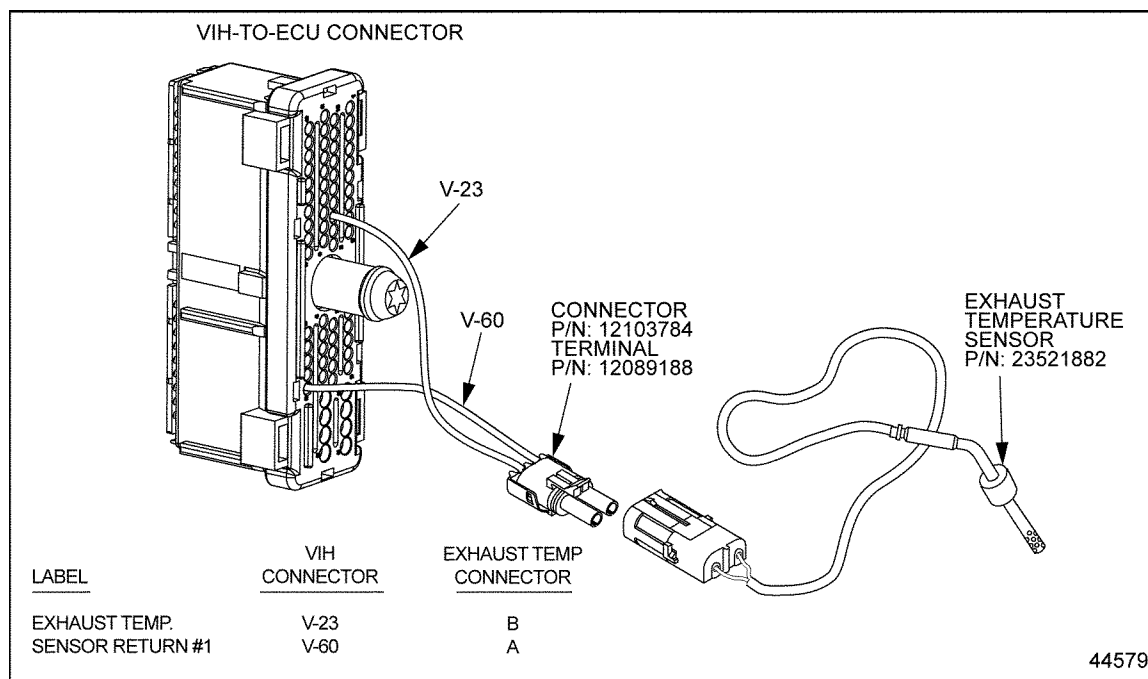


Figure 70-4 Exhaust Temperature Sensor

- [a] If the reading is greater than 400 Ω , the resistor between circuit V-60 and V-23 has failed. Replace the resistor or replace the harness.
- [b] If the reading is less than 400 Ω , replace the ETS, and refer to section 70.5.1.1.

70.5.1.1 Verify Repair

Perform the following steps to test the repair:

1. Connect all removed connectors. Start and run the engine.
2. Perform road test.
3. Plug in diagnostic tool and read active codes.
 - [a] If no codes display, repairs are complete.
 - [b] If code 81 displays, review the procedure for checking exhaust gas temperature circuit failed high; refer to section 70.5.1.1. If this is the second time through the procedure, call the DDC Customer Support Center (313-592-5800) or try a test ECM/ECU.

71 FLASH CODE 82 – OIL LEVEL OR EXHAUST TEMP CIRCUIT FAILED LOW

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71.3 TROUBLESHOOTING FLASH CODE 82, PID 412/FMI 4	71-5
71.4 TROUBLESHOOTING FLASH CODE 82, PID 98/FMI 4	71-6
71.5 TROUBLESHOOTING FLASH CODE 82, PID 173/FMI 4	71-8

71.1 DESCRIPTION OF FLASH CODE 82

Flash Code 82 is used to identify oil level or exhaust temperature voltage low.

The SAE J1587 equivalent code for Flash Code 82 is:

- ❑ PID 411/FMI 4 – EGR delta pressure circuit failed low
- ❑ PID 412/FMI 4 – EGR temperature failed low
- ❑ PID 98/FMI 4 – Oil Level Sensor/Engine Oil Level Sensor (OLS/EOL Sensor) input voltage low (Maintenance Alert System)
- ❑ PID 173/FMI 4 – Exhaust gas temperature circuit failed low

71.2 TROUBLESHOOTING FLASH CODE 82, PID 411/FMI 4

The following procedure will troubleshoot Flash Code 82 p 411/4.

For all EGR related codes, always perform the “Exhaust Gas Recirculation System Basic Checks.” Refer to section 19.18.

71.2.1 Check EGR Delta-Pressure Sensor

Perform the following steps to check the EGR Delta-Pressure Sensor:

1. Unplug the EGR Delta-P Sensor connector.
2. Unplug the Engine Harness connector.
3. Install a jumper wire between cavities 2 and 3 at the EGR Delta-Pressure Sensor:
See Figure 71-1.

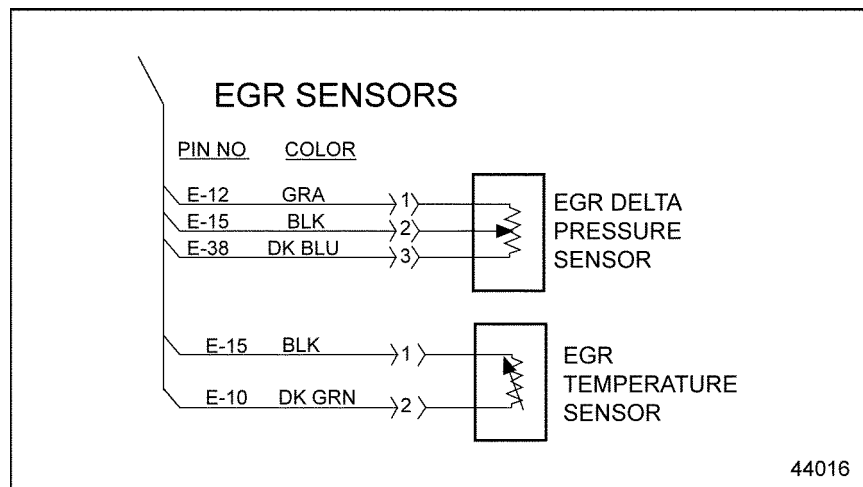


Figure 71-1 EGR Pressure Sensor Wiring

4. Measure resistance between cavities E-38 and E-15. See Figure 71-1.
[a] If the resistance measurement is less than or equal to 5 Ω , Refer to section 71.2.2.

- [b] If the resistance measurement is greater than 5 Ω , circuit E-38 or E-12 is open. Repair the open and refer to section 71.2.2.1.

71.2.2 Check for Open

Perform the following steps to check for an open.

1. Remove jumper cable.
2. Measure resistance between cavities E-38 and E-15. See Figure 71-1.
 - [a] If the resistance measurement is less than 5 Ω , E-38 is shorted to E-15. Repair short and refer to section 71.2.2.1.
 - [b] If the resistance measurement is greater than 5 Ω , replace the sensor and refer to section 71.2.2.1.

71.2.2.1 Verify Repair

Perform the following steps to verify repairs for the EGR temperature or pressure sensor:

1. Connect all connectors.
2. Start and run the engine.
3. Road test the engine.
 - [a] If code 82 was not logged, no further troubleshooting is required.
 - [b] If code 82 was logged, please review this section from the first step to find the error. Refer to section 71.2.1. If this is the second time through the procedure, call the Detroit Diesel Customer Support Center (313-592-5800) or try a test ECM/ECU.

71.3 TROUBLESHOOTING FLASH CODE 82, PID 412/FMI 4

For all EGR related codes, always perform the “Exhaust Gas Recirculation System Basic Checks.” Refer to section 19.18.

71.3.1 Check for Short

Perform the following steps to check for a short:

1. Unplug the EGR temperature sensor.
2. Measure resistance between cavities 1 and 2. See Figure 71-2.

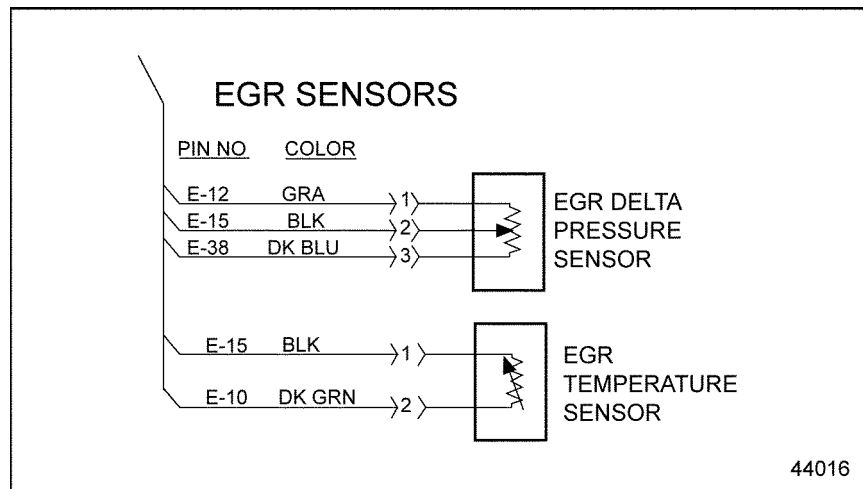


Figure 71-2 EGR Temperature Sensor Wiring

- [a] If the resistance measurement is less than or equal to 5 Ω , circuit E-10 has shorted to circuit E-15. Repair the short. Verify. Refer to section 71.3.1.1.
- [b] If the resistance measurement is greater than 5 Ω , replace the EGR temperature sensor and verify the repair. Refer to section 71.3.1.1.

71.3.1.1 Verify Repair

Perform the following steps to verify repairs for the EGR temperature or pressure sensor:

1. Connect all connectors. Start and run the engine.
2. Road test the engine.
 - [a] If code 82 was not logged, no further troubleshooting is required.
 - [b] If code 82 was logged, please review this section from the first step to find the error. Refer to section 71.3.1. If this is the second time through the procedure, call the Detroit Diesel Customer Support Center (313-592-5800) or try a test ECM/ECU.

71.4 TROUBLESHOOTING FLASH CODE 82, PID 98/FMI 4

The OLS/EOL Sensor is part of the Maintenance Alert System (MAS).

71.4.1 Read Codes

Perform the following steps to read codes:

1. Turn ignition ON, plug in the diagnostic tool and read the active codes.
2. Record or print codes and turn the ignition OFF.
 - [a] If code 98/4 displays with 232/1, troubleshoot 232/1 first.
 - [b] If code 98/4 displays, refer to section 71.4.2.

71.4.2 Check for Open and a Short

Perform the following steps to check for open:

1. Unplug the Oil Level Sensor/Engine Oil Level Sensor.
2. Insert the jumper wire between cavities B and C. See Figure 71-3.

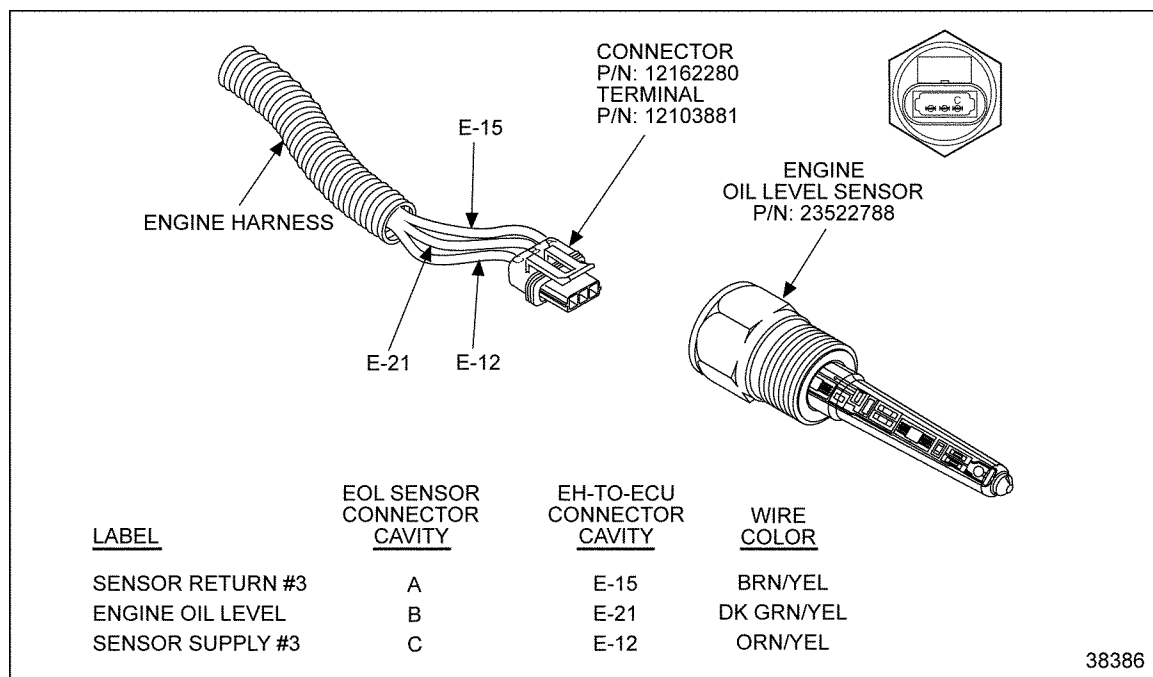


Figure 71-3 Oil Level Sensor

3. Turn ignition ON.
4. Read codes.

- [a] If code 98/3 displays, check the connectors for damaged, open or broken pins. If everything checks out, go to step 5. If damage is noted, repair and verify the repairs. Refer to section 71.4.4.
- [b] If code 98/4 displays, refer to section 71.4.3.
- 5. Measure resistance between cavity A and C , and again between cavity A and B of the sensor connector. See Figure 71-3.
 - [a] If either reading is less than 10 Ω , that wire is shorted to the sensor return E-15. Repair the short or replace the harness. Verify the repair. Refer to section 71.4.4.
 - [b] If both readings are greater than 10 Ω , replace the sensor. Verify the repair. Refer to section 71.4.4.

71.4.3 Check Engine Harness Connector for Open

Perform the following steps to check for open:

1. Unplug the Engine Harness connector at the ECM/ECU.
2. Measure resistance with the jumper still plugged in, between cavity E-21 and E-12. See Figure 71-3.
 - [a] If the reading is greater than 10 Ω , either the E-12 or E-21 wire is open. Repair the open or replace the harness. Verify the repair. Refer to section 71.4.4.
 - [b] If the reading is greater than 10 Ω , replace the sensor. Verify the repair. Refer to section 71.4.4.

71.4.4 Verify Repairs

Follow these steps to verify the repair:

1. Plug in all connectors.
2. Start and run the engine for five minutes.
3. Plug in diagnostic tool and read active codes.
 - [a] If no codes display, troubleshooting is complete. Return the engine to service.
 - [b] If code 98/4 displays, review the MAS troubleshooting to find the error or contact the DDC Customer Support Center (313-592-5800) for assistance. Refer to section 71.4.1.

71.5 TROUBLESHOOTING FLASH CODE 82, PID 173/FMI 4

For all EGR related codes, always perform the “Exhaust Gas Recirculation System Basic Checks.” Refer to section 19.18. Follow these procedures to troubleshoot exhaust gas temperature.

71.5.1 Check for Open

Typically, the exhaust gas temperature circuit failed low is caused by an open signal or short to battery+. Perform the following steps to troubleshoot code p 173/4:

1. Disconnect the ETS connector.
2. Install a jumper wire between the two pins at the ETS. See Figure 71-4.

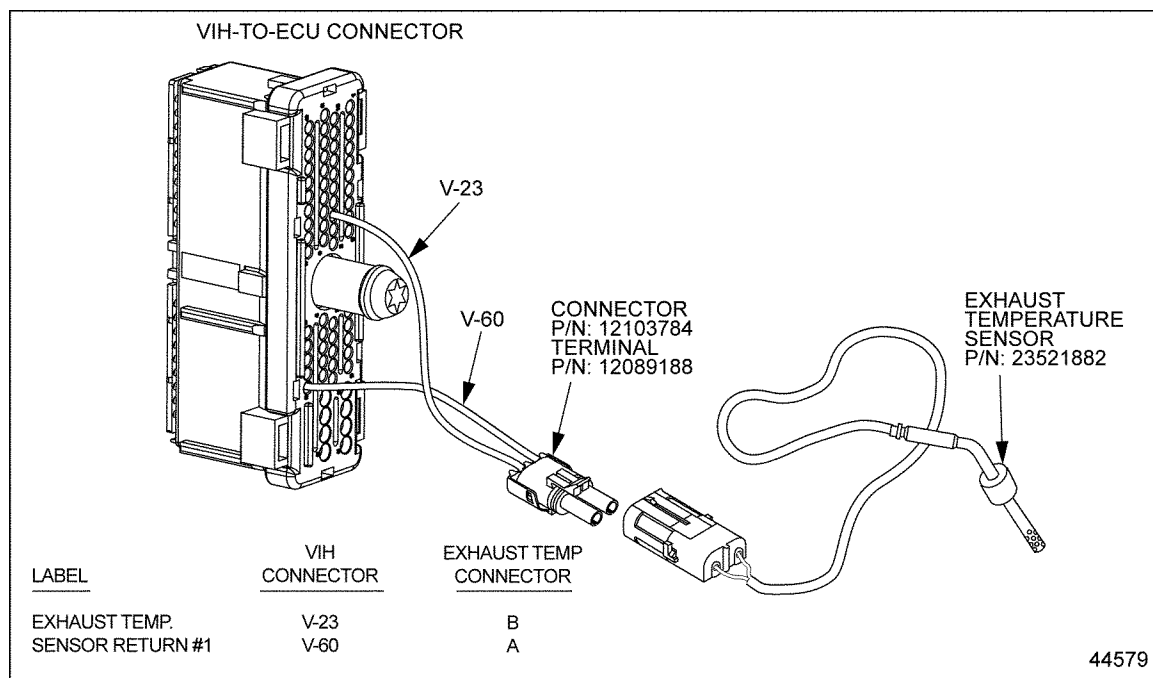


Figure 71-4 Exhaust Temperature Sensor Wiring

3. Unplug vehicle harness connector at the ECM/ECU.
4. Measure resistance between V-23 and V-60. See Figure 71-4.
 - [a] If resistance measures $< 5 \Omega$, refer to section 71.5.2.
 - [b] If resistance is $> 5 \Omega$, either the circuit V-60 is opened, or V-23 is opened. Repair the open or replace the wire and test. Refer to section 71.5.3.1.

71.5.2 Check for Short

Perform the following steps to check for a short:

1. Remove the jumper.
2. Measure resistance again between V-23 and V-60. See Figure 71-4.
 - [a] If the reading is $> 400 \Omega$, the resistor between circuit V-60 and V-23 has failed. Replace the resistor or replace the harness.
 - [b] If the reading is $< 400 \Omega$, replace the ETS, and refer to section 71.5.3.

71.5.3 Check for Short to Ground

Perform the following steps to check for short to ground:

1. Measure the resistance between cavity V-23 and ground (battery and block). See Figure 71-4.
2. Measure the resistance between cavity V-60 and ground (battery and block).
 - [a] If any readings are less than 5Ω , that wire is shorted to ground. Repair or replace the wire and test. Refer to section 71.5.3.1.
 - [b] If both readings are greater than 5Ω , replace ETS and test. Refer to section 71.5.3.1.

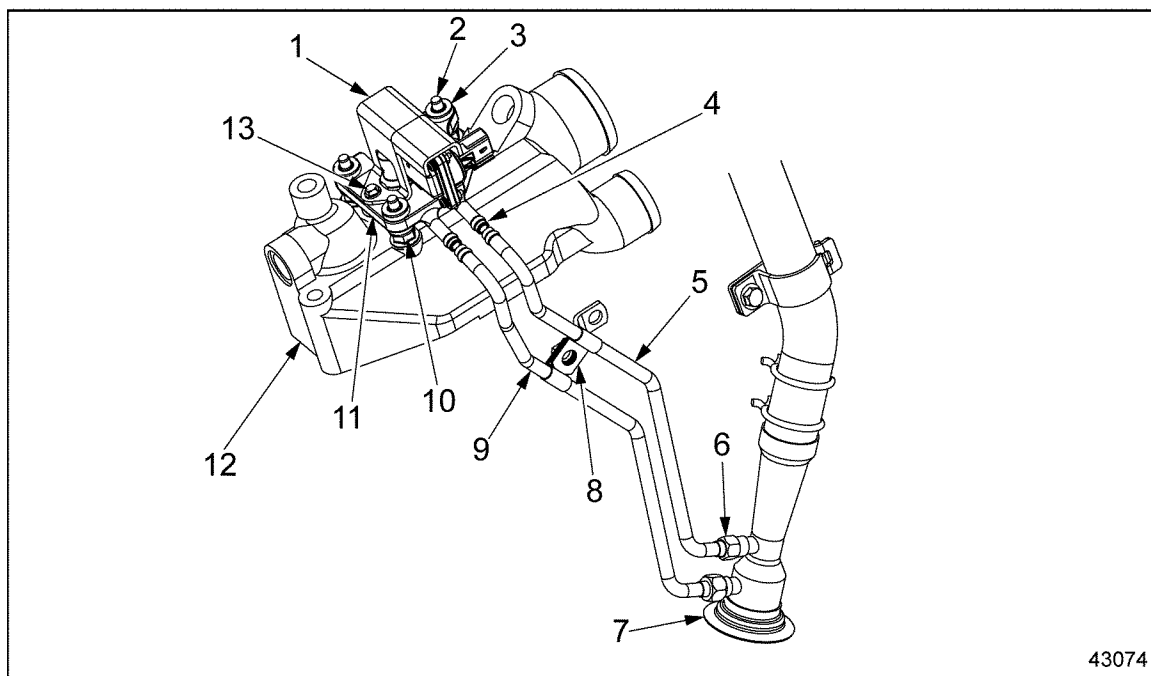
71.5.3.1 Verify Repair

Perform the following steps to test and verify the repair:

1. Connect all removed connectors.
2. Start and run the engine.
3. Perform road test.
4. Plug in diagnostic tool and read active codes.
 - [a] If no codes display, repairs are complete.
 - [b] If code 81 displays, review the procedure for checking exhaust gas temperature circuit failed high; refer to section 71.5.1. If this is the second time through the procedure, call the Customer Support Center (313-592-5800) or try a test ECM/ECU.

72 FLASH CODE 83 – EGR TEMP OR EGR DELTA-PRESSURE

Section	Page
72.1 DESCRIPTION OF FLASH CODE 83	72-3
72.2 TROUBLESHOOTING FLASH CODE 83, PID 411/FMI 0	72-4
72.3 TROUBLESHOOTING FLASH CODE 83, PID 412/FMI 0	72-8



1. Delta-P Sensor	6. Nut	10. Nut
2. Stud	7. Delivery Pipe	11. Bracket
3. Isolator	8. Clip	12. Thermostat Housing
4. Hose Clamp	9. Delta-P Tube	13. Bolt
5. Delta-P Tube		

Figure 72-1 Delta-P Sensor and Related Parts

72.1 DESCRIPTION OF FLASH CODE 83

The SAE J1587 equivalent code for Flash Code 83 is one of the following:

- p 411/0 – EGR Delta-Pressure high
- p 412/0 – EGR temperature high;

See Figure 72-2 for the EGR Delta P Sensor.

See Figure 72-3 for the EGR Temperature Sensor.

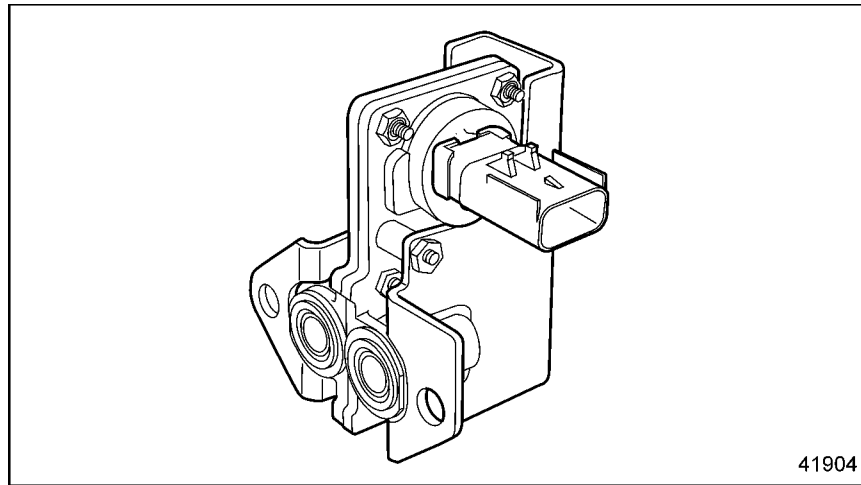


Figure 72-2 EGR Delta P Sensor

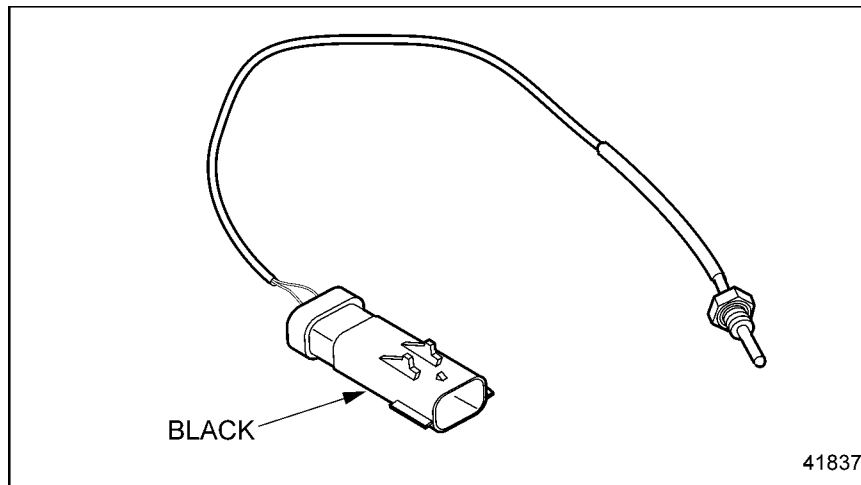


Figure 72-3 EGR Temperature Sensor

72.2 TROUBLESHOOTING FLASH CODE 83, PID 411/FMI 0

Flash code 83, p 411/0 indicates that the EGR Delta pressure is high. These conditions are typically:

- EGR valve stuck open
- EGR valve stuck partly open

For all EGR related codes, always refer to section 19.18 and perform the exhaust gas recirculation system checks.

72.2.1 Check for an EGR Valve Stuck Open or Partly Open

This same procedure may be found in the *Series 60 EGR Technician's Guide* 7SE60 as Test A.

Check for a stuck EGR valve as follows:

1. Remove the turbocharger to charge-air-cooler (CAC) pipe.

 WARNING:
PRESSURIZED CHARGE COOLER SYSTEM
To avoid eye or face injury from flying debris, wear a face shield or goggles.

2. Pressurize the CAC inlet to 207 kPa (30 psi) using special tool TLZ00100 or equivalent.
3. Using DDDL, monitor the boost psi.
 - [a] If the pressure is below 187 kPa (27 psi), visually inspect the CAC, hoses, and the delivery tube for leaks. Repair as necessary.
 - [b] If the pressure is 187 kPa (27 psi) or higher, continue to step 4.
4. Disconnect the EGR actuator oil lines.
5. Connect a regulated air supply line to the EGR actuator regulated to 69 kPa (10 psi).
6. Using DDDL, activate EGR VPOD (PWM #2) to 90%.
7. Monitor the boost kPa (psi) pressure for pressure drops when the EGR valve opens.

NOTE:

The pressure should have dropped significantly to approximately 62 kPa (9 psi) or less.

- [a] If the air pressure dropped to 62 kPa (9 psi), no further testing is required. Refer to section 72.2.5.1.
- [b] If the pressure dropped slightly, perform step 8 .
8. Physically inspect the EGR valve for a mechanical failure. If the EGR valve is not functioning correctly, replace the EGR valve.
 - [a] If no active codes are present, refer to section 72.2.5.1.

- [b] If code p 411/0 is still active, refer to section 72.2.2.

72.2.2 Check the Delta P Sensor

Check the Delta P Sensor as follows:

1. Turn the ignition ON (key On, engine OFF).
2. Connect either Detroit Diesel Diagnostic Link (DDDL) or the Diagnostic Data Reader (DDR).
3. Read the Delta P counts.
 - [a] If the Delta P counts read 86–135, verify that the Venturi Tube hoses-to-Delta P Sensor, are correctly installed and are not damaged. Repair as necessary, verify repairs. Also visually inspect the delivery pipe for damage and proper assembly. If no problem was found, go to step 4.

NOTE:

Reversed and damaged hoses will have an adverse effect on engine performance resulting in black exhaust smoke and engine surging.

- [b] If the Delta P counts are out of the 86–135, replace the sensor. Refer to section 72.2.5.1.
- 4. Visually inspect the charge air mixer tube and the delivery pipe for exhaust leaks and breaks. If no damage is present, check the VPOD output pressure. Refer to section 72.2.3.

72.2.3 VPOD Output Pressure Test

Perform the follow steps to check the VPOD output pressure:

1. Disconnect the air hoses from the EGR actuator and VNT actuator.
2. Install gages at the outlet of the EGR and VNT air lines.

NOTE:

Both gages should be accurate to within 1.4 kPa (0.2 psi).

3. Using either DDDL or DDR, activate PWM #2 (EGR) and PWM #4 (VNT) duty cycles and monitor the output pressure from the VPOD.
4. Test: activating 11 % duty cycle: Pressure = 106-134 kPa (15.4-19.4 psi). go to step 5.
5. Test: activating 90 % duty cycle: Pressure = 485-515 kPa (70-75 psi).
 - [a] If the VPOD readings are 485-515 kPa (70-75 psi), refer to section 72.2.5.1.
 - [b] If the VPOD readings were not 485-515 kPa (70-75 psi), measure the VPOD input pressure. go to step 6.

NOTE:

Both activations must have full linkage travel.

6. Measure the VPOD input pressure to Port 1.
 - [a] If the supply pressure is not between 703-1296 kPa (90-120 psi), troubleshoot the vehicle air system until that result is obtained. Repair as necessary.
 - [b] If the supply pressure is between 703-1296 kPa (90-120 psi), perform a Supply Voltage Test. Refer to section 72.2.4.

72.2.4 Supply Voltage Test

Perform the follow steps to verify the VPOD supply voltage.

1. Check VPOD label to determine if it is + 12 V or + 24 V system.

NOTE:

A 1,000 Ω resistor is required to perform step 2.

2. Unplug the VPOD wire connectors and insert the 1,000 Ω resistor between cavities Number 1 and Number 3.
 - [a] Turn ignition switch ON.
 - [b] Measure voltage from pin 3 to pin 1.
 - [c] Plug in DDDL or DDR to measure the ECU voltage.
3. Is the VPOD voltage and the ECU voltage correct?
 - [a] If the VPOD voltage and the ECU voltage are correct, perform a VPOD Wiring Test, refer to section 72.2.5.
 - [b] If the VPOD voltage and the ECU voltage were not correct, match the VPOD component to the ECU voltage and perform a VPOD Wiring Test, refer to section 72.2.5.

72.2.5 VPOD WiringTest

Perform the following steps to test the VPOD wiring:

NOTE:

VPOD power should have been verified during the VPOD Supply Voltage Test. If not, perform a VPOD Supply Voltage Test.

1. Turn ignition switch ON.
2. Disconnect the VPOD sensor connectors.
3. Insert a 1,000 Ω resistor between cavities Number 2 and Number 1 for a 12 V version, or cavities Number 2 and Number 3 for a 24 V version.
4. Connect a VOM to the VPOD connector between pin Number 2 and pin Number 3 for a 12 V VPOD or pin Number 2 and pin Number 1 for a 24 V VPOD.
5. Using either a DDDL or DDR, activate the PWM #4 (VNT) and ensure:

- [a] Activating 50 % duty cycle: $VDC = 50\%$ of the VPOD supply voltage ± 1 volt. (e.g. voltage to VPOD = $13.8 \text{ V} * 0.5 = 6.8 \text{ V}$, therefore 5.8 V to 7.8 V at VPOD is okay).
- 6. Listen for air leaks from the VPOD when PWM are activated to 50%.
 - [a] If the PWM voltage measurement is correct, replace the VPOD.
 - [b] If the PWM voltage measurement is incorrect and the wiring checks were correct, try a test ECU programmed for EGR or contact the Detroit Diesel Customer Support Center (313-592-5800).
- 7. Verify repairs. Refer to section 72.2.5.1.

72.2.5.1 Verify Repairs

Perform the following steps to verify repairs for the EGR valve:

- 1. Connect all connectors.
- 2. Start and run the engine.
- 3. Road test the engine.
 - [a] If code 83 was not logged, no further troubleshooting is required.
 - [b] If code 83 was logged, please review this section from the first step to find the error. Refer to section 72.3.2. If this is the second time through the procedure, call Detroit Diesel Customer Support Center (313-592-5800) or try a test ECM/ECU.

72.3 TROUBLESHOOTING FLASH CODE 83, PID 412/FMI 0

Flash Code 83, p 412/0 is used to identify EGR temperature high. These conditions are typically due to:

- ☐ EGR valve stuck open
- ☐ EGR valve stuck partly open
- ☐ Plugged EGR cooler

For all EGR related codes, always refer to section 19.18 and perform the exhaust gas recirculation system checks.

72.3.1 VNT and EGR Valve Hot Test

These same procedures may be found in the *Series 60 EGR Technician's Guide* 7SE60 as Test B.

Perform test as follows:

 WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. ☐ Always start and operate an engine in a well ventilated area. ☐ If operating an engine in an enclosed area, vent the exhaust to the outside. ☐ Do not modify or tamper with the exhaust system or emission control system.

1. Run the engine on a dynamometer to get the engine hot. If a dynamometer is not available, run the engine until hot ($> 170^{\circ}\text{F}$ (76°C) coolant temperature).
2. Activate the VPOD outputs to 90% and back to 7% using the DDDL. Visually inspect the VNT and EGR valve for proper rod travel (full travel to stops).

NOTE:

Repeat this step three times.

- [a] If the VNT is not functioning properly, please visit the *Detroit Diesel Technical Service Letter Web Page* at http://192.135.85.10/cust/sletr/revised_2004.asp and browse for Technical Service Letter 04 TS 16.
- [b] If the EGR valve is not functioning properly, replace the EGR valve. Refer to section 72.3.4.1.
- [c] If both the VNT and EGR valve have proper movement, the test is complete. Go to step 3.

3. Check for active codes.
 - [a] If there are multiple codes active, refer to section 72.3.2.
 - [b] If only code p 412/0 is active, refer to section 72.3.3.
 - [c] If no codes are active, troubleshooting is complete.

72.3.2 Check for Other Codes

1. Turn ignition ON.
2. Plug in diagnostic tool.
3. Read active codes.
 - [a] If flash code 63 s 60 is logged with p 412/0 or p 411/0, service that code first.
 - [b] If flash code 63 s 60 is not logged, continue this procedure. Refer to section 72.3.3.

72.3.3 Vehicle Air Test

The test for vehicle air supply pressure to VPOD input pressure to port 1 was performed during the exhaust gas recirculation system checks (refer to section 19.18).

1. If the test for vehicle air supply pressure to VPOD input pressure to port 1 (refer to section 19.18.2) performed during exhaust gas recirculation system basic checks did not pass, resolve low vehicle air pressure.
2. If the test for vehicle air system performed during exhaust gas recirculation system basic checks passed, replace the EGR valve and check for active codes. If p 412/0 is still active, refer to section 72.3.4.

72.3.4 Check EGR Thermocouple Resistance

Check the EGR Temperature Sensor as follows:

1. Bridge sensor pins 1 and 2.
2. Check the EGR Temperature Sensor with an ohm-meter at one of the temperatures listed in Table 72-1.

Temperature	Ohms
100°C (212°F)	14370 to 1190 ohms
0°C (32°F)	657 to 1003 ohms

Table 72-1 Testing the EGR Temperature Sensor

- [a] If the ohms are the same as those in the table, the EGR Temperature Sensor is good. Refer to section 72.3.4.1.
- [b] If the ohms are not the same, replace the sensor and refer to section 72.3.4.1.

72.3.4.1 Verify Repairs

Perform the following steps to verify repairs for the EGR valve:

1. Connect all connectors.
2. Start and run the engine.
3. Road test the engine.
 - [a] If code 83 was not logged, no further troubleshooting is required.
 - [b] If code 83 was logged, please review this section from the first step to find the error. Refer to section 72.3.2. If this is the second time through the procedure, call Detroit Diesel Customer Support Center (313-592-5800) or try a test ECM/ECU.

73 FLASH CODE 86 - PSG SENSOR HIGH

Section	Page
73.1 DESCRIPTION OF FLASH CODE 86, PID 73, 108/FMI 3	73-3
73.2 TROUBLESHOOTING FLASH CODE 86, PID 73, 108/FMI 3	73-4

73.1 DESCRIPTION OF FLASH CODE 86, PID 73, 108/FMI 3

See Figure 73-1 for a schematic of the PSG system.

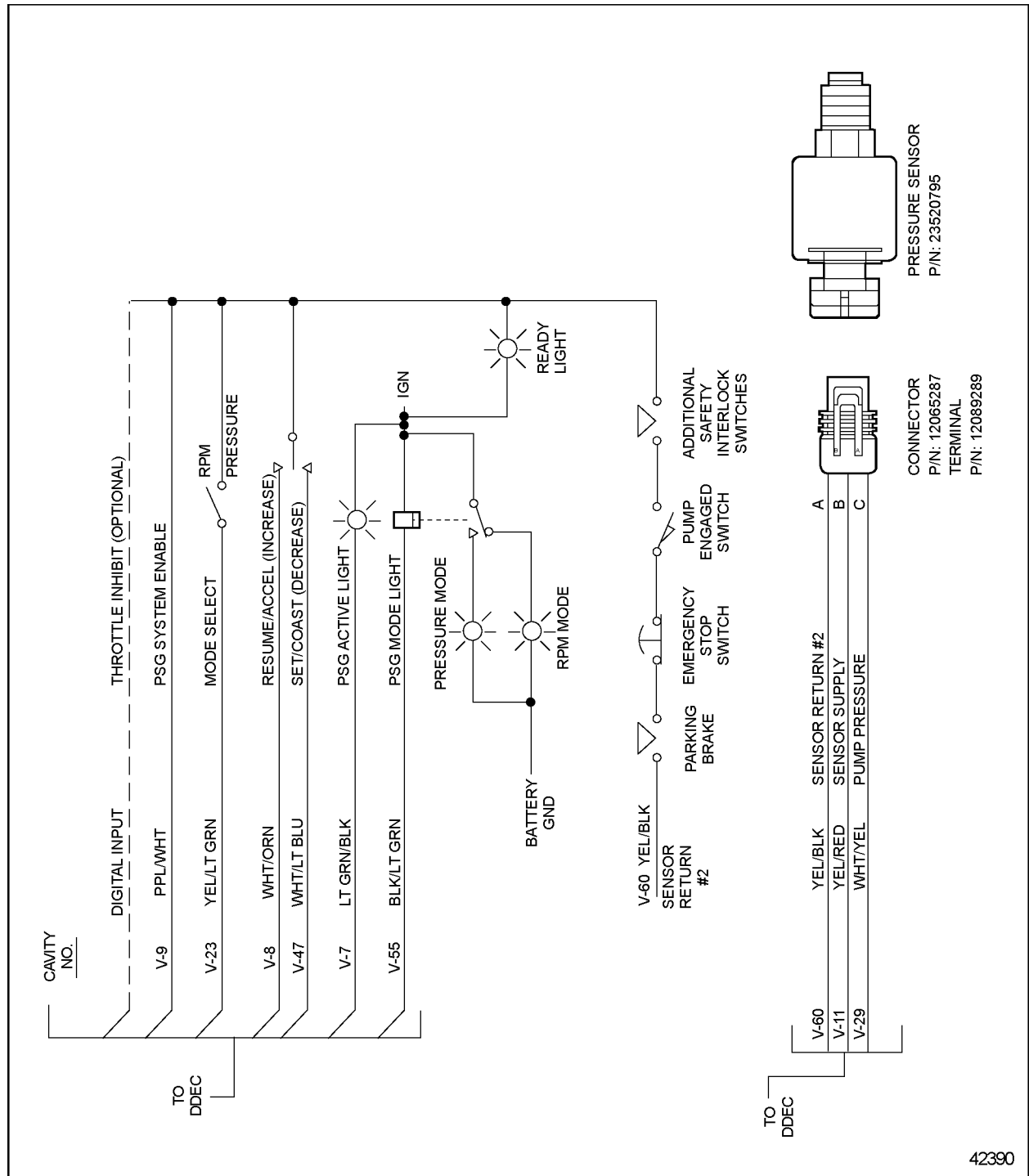


Figure 73-1 Pressure Sensor Governor System — Vehicle Interface Harness Connector

The Pressure Sensor Governor (PSG) is an optional DDEC feature designed primarily for the fire truck application. PSG is a unique governor system which electronically controls engine speeds based on one of two selected modes of operation.

The SAE J1587 equivalent code for Flash Code 86 is p 073/3.

Flash Code 86 indicates that the pump pressure circuit failed high.

73.2 TROUBLESHOOTING FLASH CODE 86, PID 73, 108/FMI 3

The following procedure will troubleshoot Flash Code 86.

73.2.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in diagnostic tool.
3. Read active codes.
 - [a] If active code p 73/3 was logged, and no other codes were logged, refer to section 73.2.3.
 - [b] If active code p 73/4 and any other codes were logged, refer to section 73.2.4.
 - [c] If active code p 108/3 was logged, refer to section 73.2.2.
 - [d] If any codes other than p 73/3 and p 108/3 were logged, refer to section 77.

73.2.2 Check Barometric Pressure Sensor

Check for a faulty Barometric Pressure Sensor as follows:

1. Turn the ignition ON but leave the engine OFF.
2. Using Detroit Diesel Diagnostic Link (DDDL) or a Diagnostic Data Reader (DDR) compare Barometric Pressure to Air Inlet Pressure.
 - [a] If they are within 4.1 kPa (0.6 psi) the sensor is not faulty and has not caused the code.
 - [b] If the differential is greater, replace the Barometric Pressure Sensor and check for codes. If there are no codes your troubleshooting is complete. If there are still codes, refer to section 73.2.3.

73.2.3 Sensor Check

Perform the following steps to check the pressure sensor.

1. Turn ignition OFF.
2. Disconnect the Pressure Sensor.
3. Turn ignition ON.

4. Start engine and operate in the PRESSURE mode.
5. Read active codes.
 - [a] If active code 73/3 and any other codes were logged, refer to section 73.2.5.
 - [b] If active code 73/4 and any other codes except 73/3 were logged, refer to section 73.2.4.

73.2.4 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn vehicle ignition OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU. See Figure 73-3 and see Figure 73-2.
3. Install a jumper wire between pins A and B of the PSG sensor harness connector.

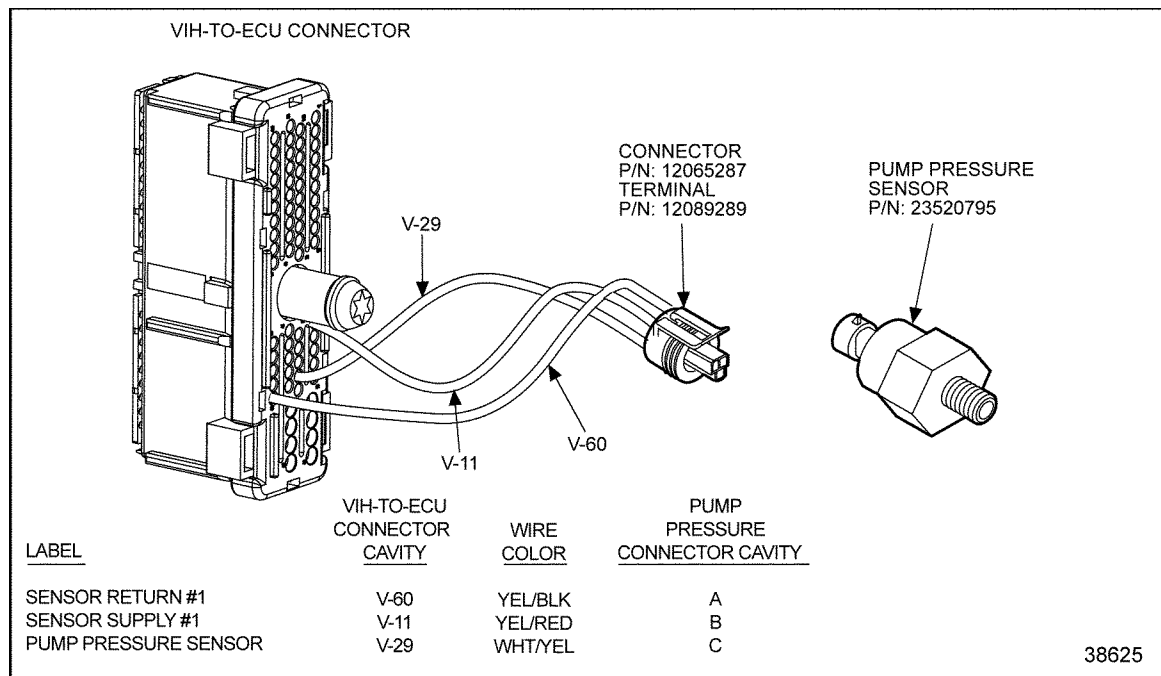


Figure 73-2 Pump Pressure Sensor

4. Measure resistance between sockets V-29 and V-60 on the vehicle harness connectors.

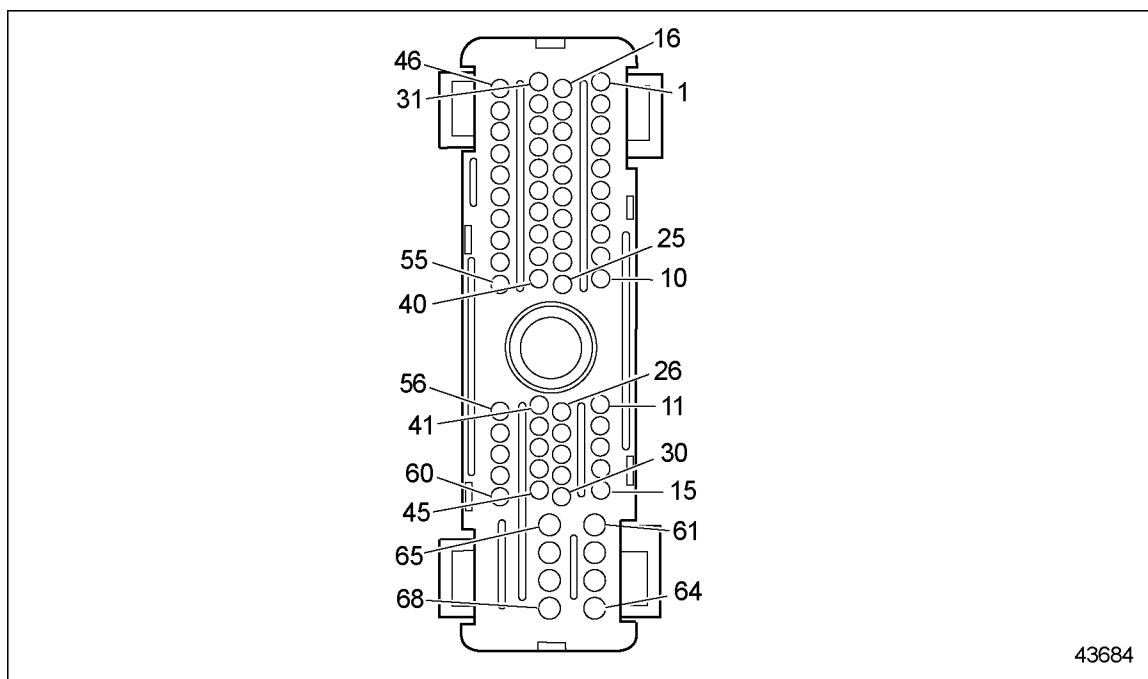


Figure 73-3 ECM/ECU Vehicle Harness Connector

- [a] If the resistance measurement is less than or equal to 5 Ω , go to step 5.
- [b] If the resistance measurement is greater than 5 Ω , or open, the return line (circuit V-60) is open. Repair the open and refer to section 73.2.7.1.
5. Inspect terminals at the sensor connector (both the sensor and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If the terminals and connectors are damaged, repair them and refer to section 73.2.7.1.
 - [b] If the terminals and connectors are not damaged, replace the sensor and refer to section 73.2.7.1.

73.2.5 Check for Short to +5 Volts

Perform the following steps to check for a short to the +5 volts.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connectors at the ECM/ECU.
3. Measure resistance between sockets V-11 and V-29 on the vehicle harness connector.
 - [a] If the resistance measurement is greater than 100 Ω or open, refer to section 73.2.6.
 - [b] If the resistance measurement is less than or equal to 100 Ω , the signal line (#749) is shorted to the engine +5 volt line (#916). Repair the short and refer to section 73.2.7.1.

73.2.6 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM/ECU.
2. Disconnect the vehicle harness and 5-way power connectors at the ECM/ECU.
3. Measure resistance between socket V-29 on the engine harness connector and battery (+).
4. Measure resistance between socket V-29 of the vehicle harness connector, V-61 and V-65..
 - [a] If the resistance measurement for all readings is greater than 100 Ω or open, 5.
 - [b] If the resistance measurement is less than or equal to 100 Ω , a short exists between the signal line (V-29) and battery (+). Repair short and reinsert fuses. Refer to section 73.2.7.1.
5. Inspect terminals at the ECM/ECU connectors (both ECM/ECU and harness side) for damage: bent, corroded, and unseated pins or sockets.
 - [a] If terminals and connectors are damaged, repair them. Refer to section 73.2.7.1.
 - [b] If terminals and connectors are not damaged, install a test ECM/ECU. Refer to section 73.2.7.

73.2.7 Final Check

Perform the following steps to do a final check.

1. Reconnect all connectors.
2. Turn vehicle ignition ON.
3. Clear codes.
4. Start and run the engine for one minute.
5. Stop engine.
6. Check diagnostic tool for active codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If active code 73/3 is logged, install a test ECM/ECU. Refer to section 73.2.7.1.
 - [c] If any codes except code 73/3 are logged, refer to section 17.3, to service other codes.

73.2.7.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check diagnostic tool for inactive codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code 73/3 is not logged, and other codes are logged, refer to section 17.3, to service other codes.
 - [c] If code 73/3 is logged, and other codes are logged, all system diagnostics are complete. Review this section from the first step to find the problem. Refer to section 73.2.1.

74 FLASH CODE 87 - PSG SENSOR LOW

Section	Page
74.1 DESCRIPTION OF FLASH CODE 87, PID 73/FMI 4	74-3
74.2 TROUBLESHOOTING FLASH CODE 87, PID 73/FMI 4	74-4

74.1 DESCRIPTION OF FLASH CODE 87, PID 73/FMI 4

See Figure 74-1 for a schematic of the PSG system.

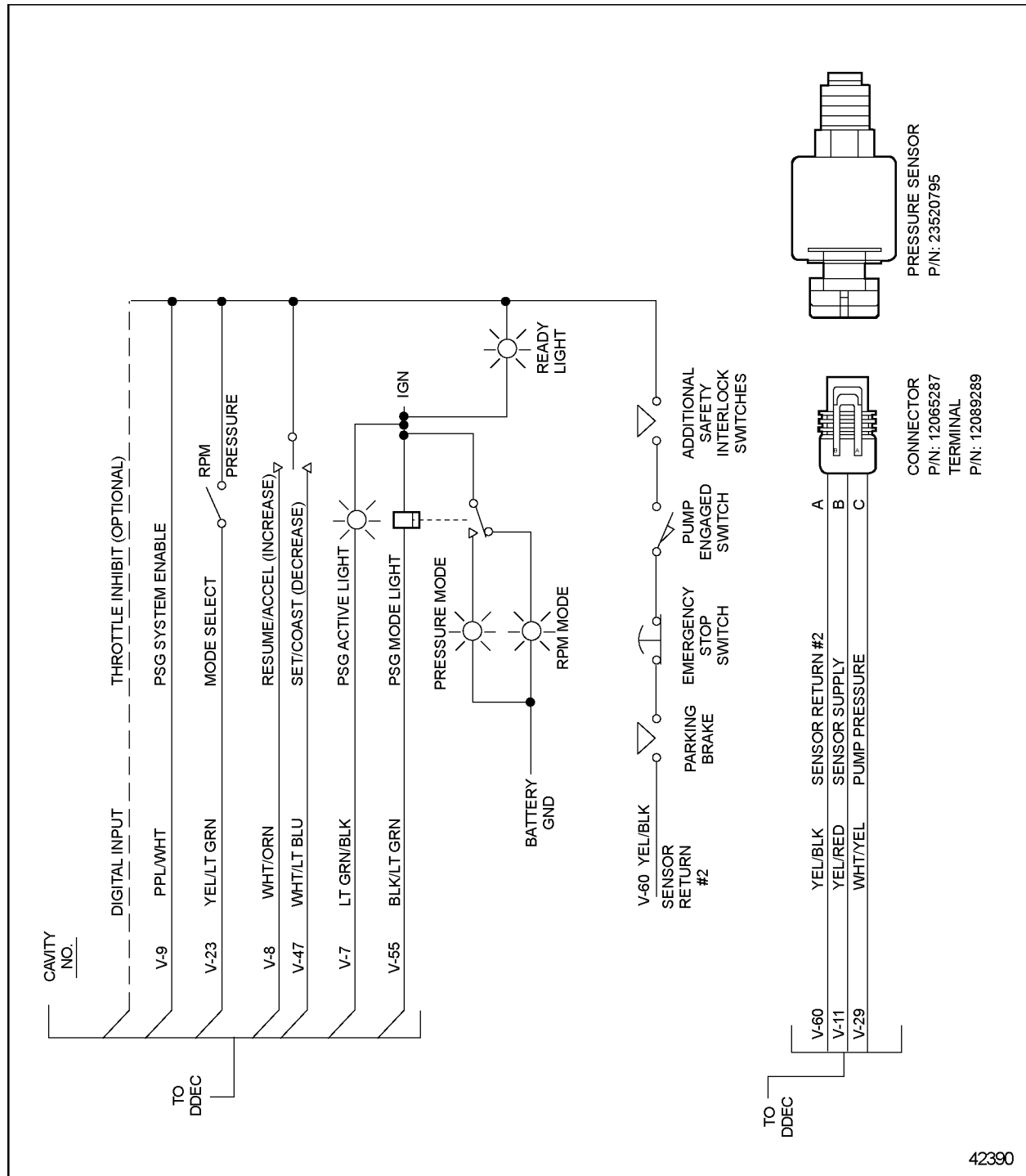


Figure 74-1 Pressure Sensor Governor System — Vehicle Interface Harness Connector

The Pressure Sensor Governor (PSG) is an optional DDEC feature designed primarily for the fire truck application. PSG is a unique governor system which electronically controls engine speeds based on one of two selected modes of operation.

The SAE J1587 equivalent code for Flash Code 87 is p 073/4.

Flash Code 87 p 73/4 indicates that the pump pressure sensor input voltage is low. The signal volts dropped below 5% (normally = <0.25 volts) of the sensor supply.

74.2 TROUBLESHOOTING FLASH CODE 87, PID 73/FMI 4

The signal volts dropped below 5% (normally = <0.25 volts) of the sensor supply.

74.2.1 Multiple Code and Sensor Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in diagnostic tool. Read the codes.
 - [a] If codes p 73/4, 100/3 or 4, 102/3 or 4, 110/3 or 4, 174/3 or 4 or 175/3 or 4 are logged, refer to section 77.
 - [b] If code p 73/4 is logged and no other codes are logged or if code p 73/4 is logged, and none of the following codes are logged: 100/3 or 4, 102/3 or 4, 110/3 or 4, 174/3 or 4 or 175/3 or 4, go to step 3.
3. Turn ignition OFF.

4. Disconnect the pump pressure sensor connector and install a jumper between sockets B and C of the pump pressure sensor transducer connector. See Figure 74-2.

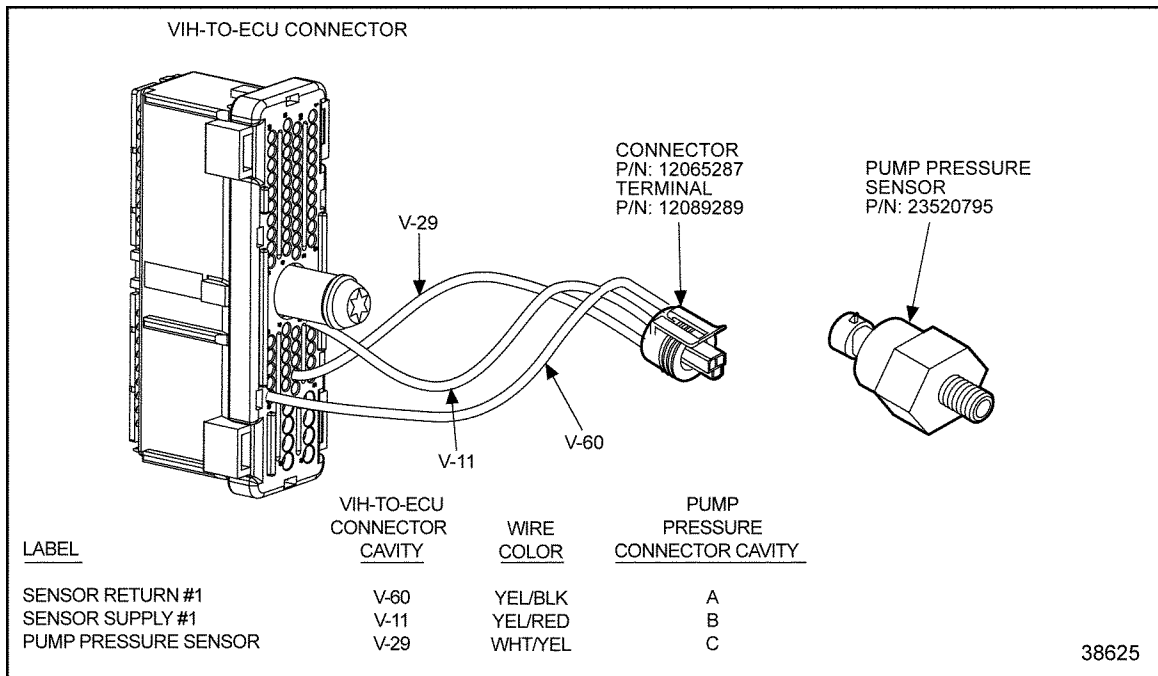


Figure 74-2 Pump Pressure Sensor

5. Turn ignition ON.
6. Start engine and operate in the PRESSURE mode.
7. Read active codes.
 - [a] If code p 73/3 and any other code except p 73/4 display, check to ensure the ECM/ECU and PSG sensor connectors are wired properly. If wired properly, refer to section 74.2.2.
 - [b] If code p 73/4 and any other codes display, refer to section 74.2.3.

74.2.2 Check Pressure Governor System Sensor Connectors

Perform the following steps to check the sensor connectors.

1. Turn ignition OFF.
2. Inspect terminals at the pump pressure sensor connectors (sensor and harness side) for damaged, bent, corroded, and unseated pins or sockets.
 - [a] If the terminals and connectors are not damaged, replace the sensor. Refer to section 74.2.4.1.
 - [b] If the terminals and connectors are damaged, repair them. Refer to section 74.2.4.1.

74.2.3 Check for Short to Return and Battery (-)

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Remove vehicle interface harness connector (30-pin).
4. Turn ignition ON.
5. Measure resistance between V-60 and V-29.
 - [a] If the measured resistance is less than 1,000 Ω , the wires are shorted to each other. Replace the harness.
 - [b] If the measured resistance is greater than 1,000 Ω , go to step 6.
6. Measure resistance between V-29 and battery ground.
 - [a] If the measured resistance is less than 1,000 Ω , the V-29 wire is shorted to the battery. Replace the harness and refer to section 74.2.4.1.
 - [b] If the measured resistance is greater than 1,000 Ω , refer to section 74.2.4.

74.2.4 Check for 5 Volt Open

Perform the following steps to check for a 5 volt open.

1. Plug in the 30-pin connector for the vehicle sensor harness.
2. Turn ignition ON.
3. Measure voltage between cavity V-11 and V-60 of the transducer connector.
 - [a] If the measurement is less than 4.5 volts, wire V-11 is open. Repair the open or replace the harness. Refer to section 74.2.4.1.
 - [b] If the measurement is between 4.5 and 5.5 volts, the signal wire V-29 is open. Repair the wire and refer to section 74.2.4.1.

74.2.4.1 Verify Repairs

Perform the following steps to verify repairs.

1. Plug in all connectors.
2. Start and run the engine.
3. Plug in your diagnostic tool and read the codes.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If code p 73/4 is logged, review this section to find the error. Then, contact the Detroit Diesel Customer Support Center (313-592-5800).

75 FLASH CODE 89 – AECL SENSOR FAULT OR FUEL INLET RESTRICTION HIGH

Section	Page
75.1 DESCRIPTION OF FLASH CODE 89, PID 111/FMI 12 & PID 95/FMI 0 .	75-3
75.2 TROUBLESHOOTING FLASH CODE 89, PID 111/12	75-3
75.3 TROUBLESHOOTING FLASH CODE 89, PID 95/FMI 0	75-4

75.1 DESCRIPTION OF FLASH CODE 89, PID 111/FMI 12 & PID 95/FMI 0

The SAE J1587 equivalent code for Flash Code 89 is p 111/12, ACLS/AECL Sensor fault.

Technically, code p 111/12 should not occur. It is logged if the ECM/ECU reports the ACLS/AECL Sensor immersed in coolant with the second (lower level) sensor out of coolant.

The SAE J1587 equivalent code for Flash Code 89 is also p 95/0, fuel inlet restriction high.

Flash Code 89 p 95/0 indicates the fuel inlet restriction has exceeded recommended limits.

75.2 TROUBLESHOOTING FLASH CODE 89, PID 111/12

Troubleshoot Flash Code 89 p 111/1 for an ACLS/AECL Sensor fault using the following procedures.

75.2.1 ACLS/AECL Sensor Check

The following procedure will troubleshoot the ACLS/AECL Sensor:

1. Remove the ACLS/AECL Sensor and clean (or replace) the probe. See Figure 75-1
2. If the code cannot be cleared, inspect all the grounds associated with the ACLS/AECL Sensor.
3. Ensure the alternator in the unit has a good clean ground path to the battery.

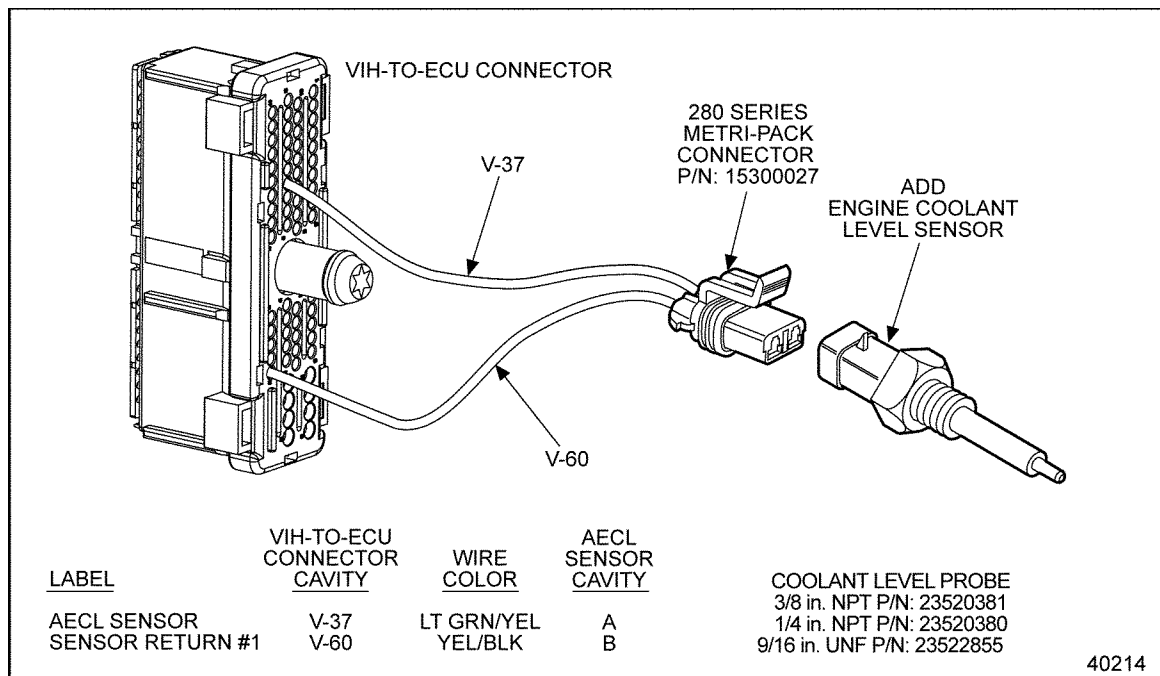


Figure 75-1 Add Engine Coolant Level Sensor

75.3 TROUBLESHOOTING FLASH CODE 89, PID 95/FMI 0

Troubleshoot Flash Code 89 p 95/0 indicating that the fuel inlet restriction has exceeded recommended limits using the following procedures.

75.3.1 Check Fuel Inlet Restriction

The following procedure will troubleshoot the fuel inlet restriction:

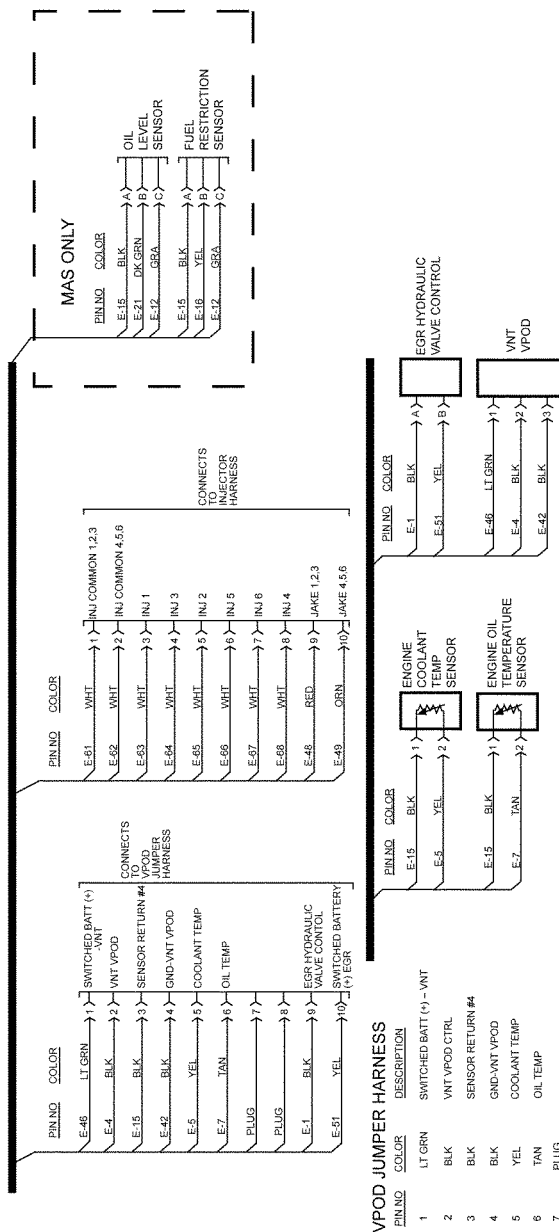
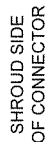
1. Check the fuel filters and replace if plugged or dirty.
2. Refer to the mechanical troubleshooting section of this manual for the reasons for high fuel inlet restriction.

76 ENGINE HARNESS

Section	Page
76.1 TROUBLESHOOTING THE ENGINE HARNESS	76-3

PIN NO. WIRE COLOR

E-1	BLK	EGR HYDRAULIC VALVE CONTROL
E-2	WHT	AIR TEMP
E-3	BLK	SPARE
E-4	BLK	VNT VPOD CONTROL
E-5	YEL	ENGINE COOLANT TEMP
E-6	SPARE	SPARE
E-7	TAN	ENGINE OIL TEMP
E-8	SPARE	SPARE
E-9	GRN	SUPPLY FUEL TEMP
E-10	DK GRN	EGR TEMP
E-11	SPARE	SPARE
E-12	GRA	SENSOR SUPPLY
E-13	BLK	SENSOR RETURN
E-14	BLK	SENSOR RETURN
E-15	YEL	FUEL RESTRICTION - MAS
E-16	PURPLE	TRS-
E-17	PURPLE	DK GRN
E-18	DK GRN	LT BLU
E-19	WHT	SRS+
E-20	WHT	SRS-
E-21	DK GRN	OIL LEVEL - MAS
E-22	DK BLU	TURBO COMPRESSOR TEMP OUT
E-23	SPARE	SPARE
E-24	SPARE	SPARE
E-25	SPARE	SENSOR SUPPLY
E-26	SPARE	GROUND - SPARE
E-27	SPARE	GROUND - SPARE
E-28	SPARE	GROUND - SPARE
E-29	SPARE	GROUND - SPARE
E-30	SPARE	ENGINE OIL PRESSURE
E-31	BRN	SPARE
E-32	SPARE	SPARE
E-33	SPARE	TURBO SPEED SENSOR+
E-34	BRN	TURBO SPEED SENSOR-
E-35	BLK	SPARE
E-36	BLK	SPARE
E-37	PNK	BAROMETRIC PRESSURE
E-38	DK BLU	EGR DELTA PRESSURE
E-39	LT GRN	INTAKE MANIFOLD PRESSURE
E-40	SPARE	CAN2+
E-41	SPARE	SPARE
E-42	BLK	GROUND - VNT VPOD
E-43	SPARE	GROUND - SPARE
E-44	SPARE	GROUND - SPARE
E-45	SPARE	GROUND - SPARE
E-46	SPARE	SWITCHED BATTERY+ - VNT
E-47	SPARE	SPARE
E-48	RED	JAKE MEDHI
E-49	ORN	JAKE LOWHI
E-50	SPARE	SPARE
E-51	YEL	SWITCHED BATTERY+ - EGR VALVE
E-52	SPARE	SWITCHED BATTERY (+) - SPARE
E-53	SPARE	SPARE
E-54	CAN2-	CAN2- SHIELD
E-55	BLK	SPARE
E-56	SPARE	SPARE
E-57	SPARE	SPARE
E-58	SPARE	EXTERNAL RTC BATTERY+
E-59	SPARE	GROUND PIN, SPARE
E-60	SPARE	GROUND PIN, SPARE
E-61	WHT	S60 COMMON CYL #1,2,3
E-62	WHT	S60 COMMON CYL #4,5,6
E-63	WHT	S60 CYL #1
E-64	WHT	S60 CYL #3
E-65	WHT	S60 CYL #5
E-66	WHT	S60 CYL #2
E-67	WHT	S60 CYL #6
E-68	WHT	S60 CYL #4

EGR HYDRAULIC VALVE CTRL
SWITCHED BATT (+) - EGR

76.1 TROUBLESHOOTING THE ENGINE HARNESS

Referral to this section indicates a fault within the Engine Harness (see the Figure on the previous page) affecting signals of various sensors used by the DDEC system.

The following procedure will troubleshoot the Engine Harness.

76.1.1 Check for Low Battery Voltage

Perform the following steps to check for low battery voltage.

1. Plug in the diagnostic tool.
2. Check for codes.
 - [a] If Flash Code p 168/1 is logged, refer to section 48.2.
 - [b] If code p 168/1 is not logged, refer to section 76.1.2.

76.1.2 Check for +5 Volts

Perform the following steps to check for +5 volts.

1. Turn vehicle ignition switch OFF.
2. Disconnect the Oil Pressure Sensor/Engine Oil Pressure Sensor (OPS/EOP Sensor) and Turbo Boost Sensor/Intake Manifold Pressure Sensor (TBS/IMP Sensor) connectors.
3. Turn vehicle ignition switch ON.
4. At each sensor harness connector, measure voltage between socket E-12 (red lead-socket 3) and socket E-15 (black lead-socket 1).
 - [a] If the voltage measurement is between 4.7 and 5.2 volts, the voltage reading is correct. Check voltage at the next connector. If all connector voltage readings are correct, refer to section 76.1.3.
 - [b] If the voltage measurement is less than 4.7 volts at any or all connectors, refer to section 76.1.4.
 - [c] If the voltage measurement is greater than 5.2 volts at all connectors, refer to section 76.1.6.

76.1.3 Check ECM/ECU Connectors

Perform the following steps to check the ECM/ECU connectors.

1. Check terminals at the ECM/ECU engine harness connector (both the ECM/ECU and harness side) for damaged, bent, corroded and unseated pins or sockets.
 - [a] If the terminals and connectors are not damaged, go to step 2.
 - [b] If the terminals and connectors are damaged, repair them. Refer to section 76.1.6.1.

2. Check all sensors, especially OPS/EOP Sensor, TBS/IMP Sensor, and TPS/AP Sensor (on vehicle system), this indicates that there is no problem on the Engine Harness. Refer to section 77.

76.1.4 Check for +5 volts or Return Open

Perform the following steps to check for +5 volts or return open.

1. Turn vehicle ignition switch OFF.
2. Disconnect the engine harness connector at the ECM/ECU.
3. Install a jumper wire between sockets 1 and 3 of any sensor connector that reads less than 4.7 volts. Refer to section 76.1.2.
4. Measure resistance between sockets E-12 and E-15 of the engine harness connector.
 - [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 76.1.5.
 - [b] If the resistance measurement is greater than 5 Ω or open, either the engine +5 volt line (E-12) or the return line (E-15) is open. Repair the open and refer to section 76.1.6.1.

76.1.5 Check for Short to Ground

Perform the following steps to check for short to ground.

1. Turn vehicle ignition switch OFF.
2. Remove jumper wire.
3. Measure resistance between sockets 1 and 3 of the sensor connector.
4. Measure resistance between socket C of the sensor connector and a good ground.
 - [a] If the resistance measurement for both readings is greater than 1,000 Ω , or open, refer to section 76.1.3.
 - [b] If either resistance measurement is less than or equal to 1,000 Ω , the engine +5 volt line (E-12) is shorted to either the sensor return line (E-15) or to chassis ground. Repair the short and refer to section 76.1.6.1.

76.1.6 Check for Short to Battery

Perform the following steps to check for a short to battery.

1. Turn vehicle ignition switch OFF.
2. Remove both fuses to the ECM/ECU.
3. Disconnect both connectors at the ECM/ECU.
4. Measure resistance between socket E-12 on the engine harness connector and V-15 on the vehicle harness connector.

5. Measure resistance between socket E-12 on the engine harness connector and the battery (+).
 - [a] If the resistance measurement for both readings is greater than 1,000 Ω , or open, refer to section 76.1.3.
 - [b] If either resistance measurement is less than or equal to 1,000 Ω , a short exists between sockets where reading was taken. Repair the short and refer to section 76.1.6.1.

76.1.6.1 Verify Repairs

Perform the following steps to verify repairs.

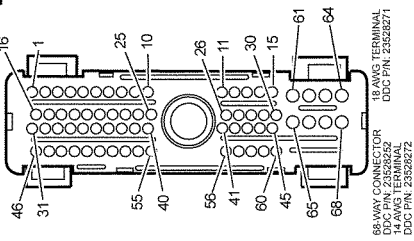
1. Turn vehicle ignition switch OFF.
2. Reconnect all connectors.
3. Reconnect fuses (or circuit breakers) if previously disconnected.
4. Turn ignition ON.
5. Clear codes.
6. If Amber Warning Lamp (CEL/AWL) does not stay on, start engine and run for one minute.
7. Stop engine.
8. Read inactive codes with the diagnostic tool.
 - [a] If no codes are logged, troubleshooting is complete.
 - [b] If codes that brought you to this section are still logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 76.1.1.
 - [c] If codes except those which brought you to this section are logged, refer to section 17.3.

77 VEHICLE INTERFACE HARNESS

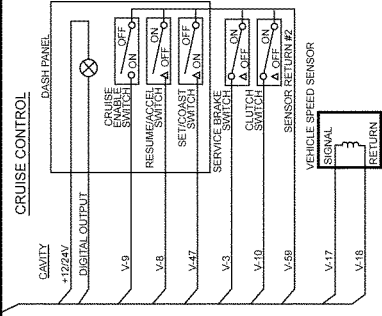
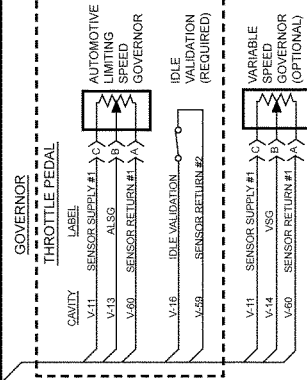
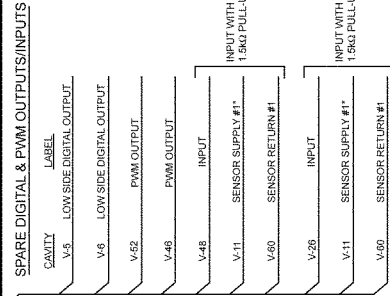
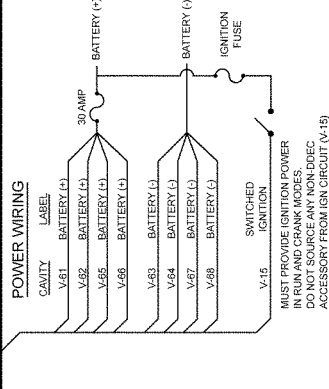
Section	Page
77.1 TROUBLESHOOTING THE VEHICLE INTERFACE HARNESS +5 VOLT SUPPLY	77-3

CAVITY

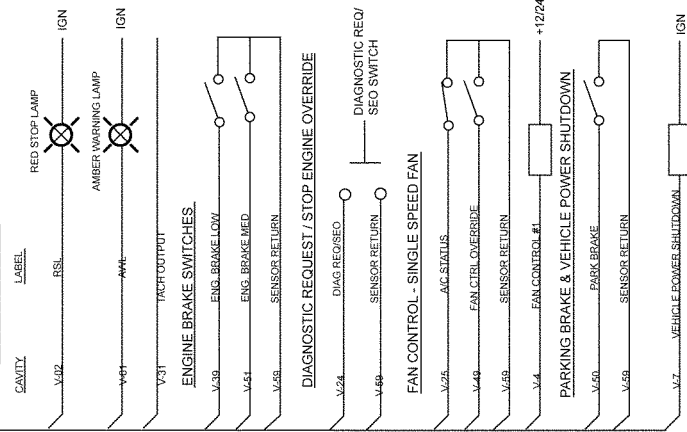
V-1	AMBER WARNING LAMP
V-2	RED STOP LAMP
V-3	SERVICE BRAKE RELEASED
V-4	FAN CONTROL #1
V-5	DIGITAL OUTPUT
V-6	DIGITAL OUTPUT
V-7	VEHICLE PWR SHUTDOWN
V-8	RESUME/ACCEL
V-9	CRUISE ENABLE
V-10	CLUTCH RELEASED
V-11	SENSOR SUPPLY #1
V-12	SENSOR SUPPLY #2
V-13	THROTTLE POSITION
V-14	VSS
V-15	IGNITION
V-16	IDLE VALIDATION
V-17	VEHICLE SPEED SENSOR (+)
V-18	VEHICLE SPEED SENSOR (-)
V-19	NO CONNECTION
V-20	NO CONNECTION
V-21	NO CONNECTION
V-22	AIR FILTER RESTRICTION
V-23	EXHAUST TEMPERATURE
V-24	SEDIATING REQUEST
V-25	A/C STATUS
V-26	ANALOG INPUT - 1.5k Ω PULLUP
V-27	TURBO COMPRESSOR IN TEMP
V-28	NO CONNECTION
V-29	EXHAUST BACK PRESSURE OR FIRE TRUCK PUMP PRESSURE
V-30	NO CONNECTION
V-31	TACHOMETER
V-32	FREQUENCY - SPARE
V-33	FREQUENCY - SPARE
V-34	NO CONNECTION
V-35	NO CONNECTION
V-36	NO CONNECTION
V-37	ADD COOLANT LEVEL
V-38	COOLANT LEVEL - SHUTDOWN
V-39	ENGINE BRAKE LOW
V-40	OIL ALARM
V-41	AUX SHUTDOWN #1
V-42	OIL THERMOSTAT
V-43	J 1939 DL (+)
V-44	J 1939 DL SHIELD
V-45	NO CONNECTION
V-46	PWM OUTPUT
V-47	SET/COAST
V-48	ANALOG INPUT - 1.5k Ω PULLUP
V-49	FAN CONTROL OVERRIDE
V-50	PARK BRAKE
V-51	ENG BRAKE MED
V-52	PWM OUTPUT
V-53	ETHER START
V-54	OIL STARTER
V-55	OIL ACTIVE LAMP
V-56	J 1587 +
V-57	J 1587 -
V-58	J 1939 DL (-)
V-59	SENSOR RETURN #2
V-60	SENSOR RETURN #1
V-61	+12V / +24V
V-62	+12V / +24V
V-63	BATTERY GROUND
V-64	BATTERY GROUND
V-65	+12V / +24V
V-66	+12V / +24V
V-67	BATTERY GROUND
V-68	BATTERY GROUND



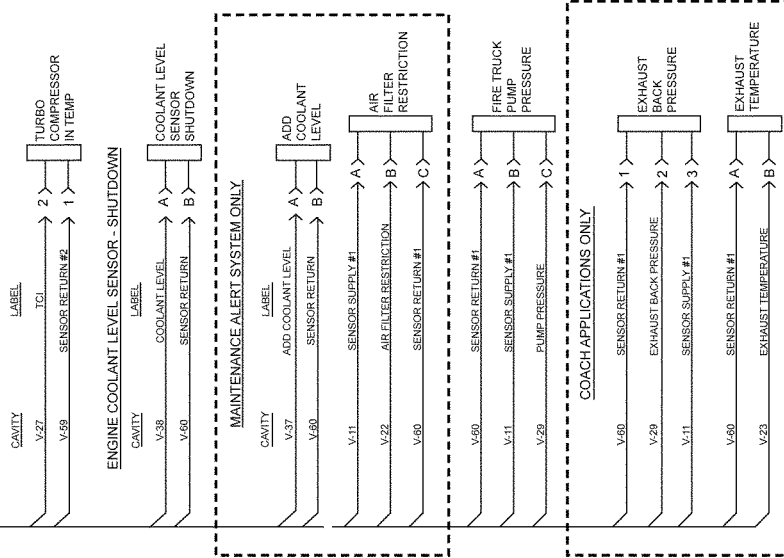
SHROUD SIDE OF CONNECTOR



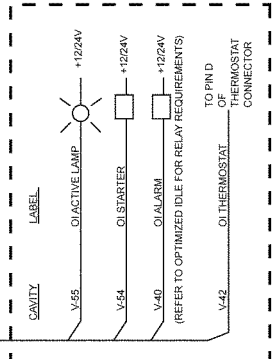
INSTRUMENT PANEL



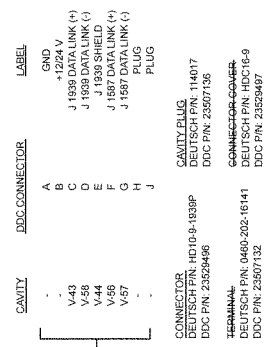
TURBO COMPRESSOR IN TEMP



OPTIMIZED IDLE (OPTIONAL)



DIAGNOSTIC CONNECTOR



DDEC V **VEHICLE INTERFACE HARNESS**

77.1 TROUBLESHOOTING THE VEHICLE INTERFACE HARNESS +5 VOLT SUPPLY

Referral to this section indicates a fault within the Vehicle Interface Harness (VIH). See the Figure on the previous page.

NOTE:

It is suggested that the vehicle interface module be installed for test. If the fault(s) clear, you may wish to contact the vehicle manufacturer for instructions on troubleshooting. Otherwise, continue with this section.

The following procedure will troubleshoot vehicle harness.

77.1.1 Check for Low Battery Voltage

Plug in the diagnostic tool to check for low battery voltage. If code p 168/1 is logged, refer to section 48.2.1. If code p 168/1 is not logged, refer to section 77.1.2.

77.1.2 Check for +5 Volts

Perform the following steps to check for +5 volts at the Throttle Position Sensor/Accelerator Pedal Sensor (TPS/AP Sensor):

1. Turn vehicle ignition switch OFF.
2. Disconnect the TPS/AP Sensor (disconnect the VSG and PSG, if applicable).
3. Turn vehicle ignition switch ON.
4. Measure voltage on the TPS/AP Sensor harness connector, pin C (red lead) to pin A (black lead), and pin A to pin B at the PSG connector, if applicable.
 - [a] If the voltage measurement is between 4.7 and 5.2 volts, the voltage reading is correct. Check voltage at the next connector. If all connector voltage readings are correct, refer to section 77.1.5.
 - [b] If the voltage measurement is less than 4.7 volts, refer to section 77.1.3.
 - [c] If the voltage measurement is greater than 5.2 volts at all connectors, refer to section 77.1.8.

77.1.3 Check for +5 Volts or Return Open

Perform the following steps to check for +5 volts or return open:

1. Turn vehicle ignition switch OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU.
3. Install a jumper wire between pins V-11 and V-60 of the TPS harness connector.
4. Measure resistance between sockets V-11 and V-60 of the vehicle harness connector.

- [a] If the resistance measurement is less than or equal to 5 Ω , refer to section 77.1.4.
- [b] If the resistance measurement is greater than 5 Ω or open, either the vehicle +5 volt line (V-11) or the sensor return line (V-60) is open. Refer to section 77.1.8.1.

77.1.4 Check for +5 Short to Ground

Perform the following steps to check for +5 short to ground:

1. Remove jumper wire.
2. Measure resistance between pins A and C of the TPS/AP Sensor harness connector.
3. Measure resistance between pin C of the TPS/AP Sensor harness connector and a good ground (battery-).
 - [a] If the resistance measurement for both readings is greater than 1,000 Ω , or open, refer to section 77.1.7.
 - [b] If either resistance measurement is less than or equal to 1,000 Ω , wire (V-11) is shorted to wire (V-60), or battery ground. Repair the short and refer to section 77.1.8.1.

77.1.5 Vehicle Harness 5V Check TPS

Perform the following steps to check TPS/AP Sensor:

1. Turn vehicle ignition switch OFF.
2. Reconnect the TPS/AP Sensor connector.
3. Turn vehicle ignition switch ON.
4. Select Throttle Sensor percentage on the diagnostic tool.
5. Observe throttle percentage at both no throttle and full throttle (engine not running).
 - [a] If the percentage is between 0 and 100%, refer to section 77.1.7.
 - [b] If not getting a reading between 0 and 100%, refer to section 77.1.6.

77.1.6 Vehicle Harness 5V Check Throttle Position Sensor Connectors

Perform the following steps to check TPS connectors.

1. Turn vehicle ignition switch OFF.
2. Disconnect the TPS/AP Sensor.
3. Inspect terminals at the TPS/AP Sensor connectors (sensor side and harness side) for damage; bent, corroded and unseated pins or sockets.
 - [a] If the terminals and connectors are not damaged, replace TPS/AP Sensor. Refer to section 77.1.8.1.
 - [b] If the terminals and connectors are damaged, repair them. Refer to section 77.1.8.1.

77.1.7 Check ECM/ECU Connectors

Perform the following steps to check the ECM/ECU connectors.

1. Turn vehicle ignition switch OFF.
2. Disconnect the vehicle harness connector at the ECM/ECU (if not already disconnected).
3. Check terminals at the ECM/ECU vehicle harness connector (both the ECM/ECU and harness side) for damage; bent, corroded and unseated pins or sockets (especially terminals V-60, V-11, V-13). Install new terminal if in doubt.
 - [a] If the terminals and connectors are not damaged, refer to section 76.1.2.
 - [b] If the terminals and connectors are damaged, repair them. Refer to section 77.1.8.1.

77.1.8 Check for Short to Battery (+)

Perform the following steps to check for a short to battery (+).

1. Turn vehicle ignition switch OFF.
2. Remove both fuses or circuit breakers to the ECM/ECU.
3. Disconnect the vehicle harness connectors at the ECM/ECU.
4. Measure resistance between sockets V-11 and V-15 on the vehicle harness connector.
5. Measure resistance between socket V-11 on the vehicle harness connector and the battery (+).
 - [a] If the resistance measurement for all readings is greater than 1,000 Ω , or open, refer to section 77.1.7.
 - [b] If the resistance measurement is less than 1,000 Ω , a short exists between the vehicle +5 volt line V-11 and the lines where less than 1,000 was read (+Battery or V-15). Repair the short and refer to section 77.1.8.1.

77.1.8.1 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition switch OFF.
2. Reconnect all connectors.
3. Reconnect fuses (or circuit breakers) if previously disconnected.
4. Turn ignition ON.
5. Clear codes.
6. If Amber Warning Lamp (CEL/AWL) does not stay on, start engine and run for one minute.
7. Stop engine.
8. Read inactive codes with the diagnostic tool.

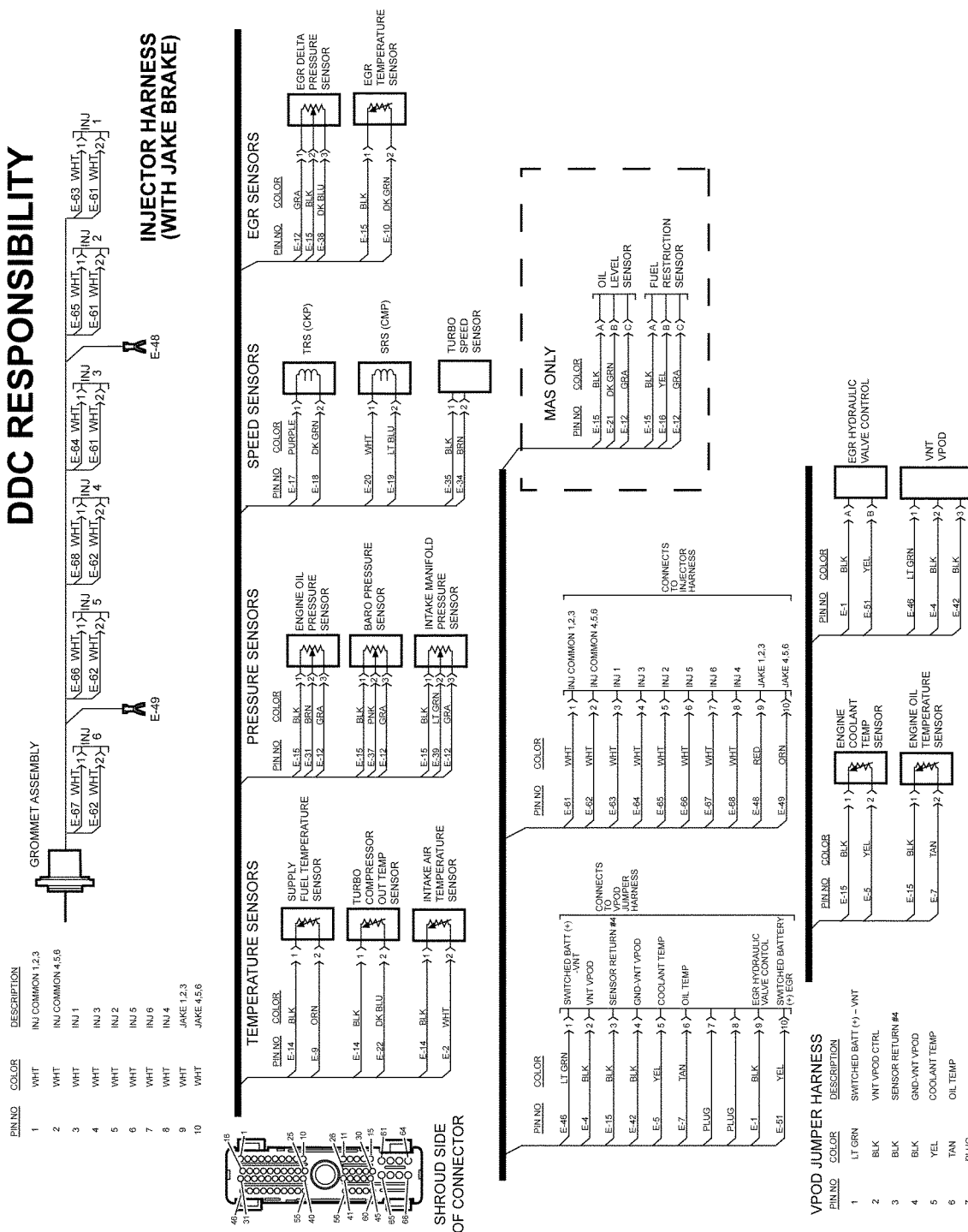
- [a] If no codes are logged, troubleshooting is complete.
- [b] If codes that brought you to this section are still logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 77.1.1.
- [c] If codes except those that brought you to this section are logged, refer to section 17.3.

78 ENGINE WIRING SCHEMATICS

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78.1 ENGINE HARNESS	78-3
78.2 INJECTOR HARNESS WIRING SCHEMATIC	78-3
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PIN NO. WIRE COLOR

E-1	BLK	EGR HYDRAULIC VALVE CONTROL
E-2	WHT	AIR TEMP
E-3	SPARE	SPARE
E-4	BLK	VNT VPOD CONTROL
E-5	YEL	ENGINE COOLANT TEMP
E-6	SPARE	SPARE
E-7	TAN	ENGINE OIL TEMP
E-8	SPARE	SPARE
E-9	GRN	SUPPLY FUEL TEMP
E-10	DK GRN	EGR TEMP
E-11	SPARE	SPARE
E-12	GRA	SENSOR SUPPLY
E-13	BLK	SENSOR RETURN
E-14	BLK	SENSOR RETURN
E-15	YEL	FUEL RESTRICTION - MAS
E-16	PURPLE	TRS-
E-17	PURPLE	DK GRN
E-18	DK GRN	LT BLU
E-19	WHT	SRS+
E-20	WHT	SRS-
E-21	DK GRN	OIL LEVEL - MAS
E-22	DK BLU	TURBO COMPRESSOR TEMP OUT
E-23	SPARE	SPARE
E-24	SPARE	SPARE
E-25	SPARE	SENSOR SUPPLY
E-26	SPARE	GROUND - SPARE
E-27	SPARE	GROUND - SPARE
E-28	SPARE	GROUND - SPARE
E-29	SPARE	GROUND - SPARE
E-30	SPARE	ENGINE OIL PRESSURE
E-31	BRN	SPARE
E-32	SPARE	SPARE
E-33	SPARE	TURBO SPEED SENSOR+
E-34	BRN	TURBO SPEED SENSOR-
E-35	BLK	SPARE
E-36	SPARE	SPARE
E-37	PNK	BAROMETRIC PRESSURE
E-38	DK BLU	EGR DELTA PRESSURE
E-39	LT GRN	INTAKE MANIFOLD PRESSURE
E-40	SPARE	CAN2+
E-41	SPARE	SPARE
E-42	BLK	GROUND - VNT VPOD
E-43	SPARE	GROUND - SPARE
E-44	SPARE	GROUND - SPARE
E-45	SPARE	GROUND - SPARE
E-46	SPARE	SWITCHED BATTERY+ - VNT
E-47	SPARE	SPARE
E-48	RED	JAKE MEDHI
E-49	ORN	JAKE LOWHI
E-50	SPARE	SPARE
E-51	YEL	SWITCHED BATTERY+ - EGR VALVE
E-52	SPARE	SWITCHED BATTERY (+) - SPARE
E-53	SPARE	SPARE
E-54	CAN2-	CAN2- SHIELD
E-55	BLK	SPARE
E-56	SPARE	SPARE
E-57	SPARE	SPARE
E-58	SPARE	EXTERNAL RTC BATTERY+
E-59	SPARE	GROUND PIN, SPARE
E-60	SPARE	GROUND PIN, SPARE
E-61	WHT	S60 COMMON CYL #1,2,3
E-62	WHT	S60 COMMON CYL #4,5,6
E-63	WHT	S60 CYL #1
E-64	WHT	S60 CYL #3
E-65	WHT	S60 CYL #5
E-66	WHT	S60 CYL #2
E-67	WHT	S60 CYL #6
E-68	WHT	S60 CYL #4



VPOD - JUMPER HARNESS

PIN NO	COLOR	DESCRIPTION
1	LT GRN	SWITCHED BATT (+) - VNT
2	BLK	VNT VP0D CTRL
3	BLK	SENSOR RETURN #4
4	BLK	GND-VNT VP0D
5	YEL	COOLANT TEMP
6	TAN	OIL TEMP
7	PLUG	
8	PLUG	
9	BLK	EGR HYDRAULIC VALVE CTRL
10	YEL	SWITCHED BATT (+)-EGR

78.1 ENGINE HARNESS

See the Figure on the previous page for the Engine Harness.

78.2 INJECTOR HARNESS WIRING SCHEMATIC

See Figure 78-1 for an overview of the Series 60 Injector Harness with Jake Brake.

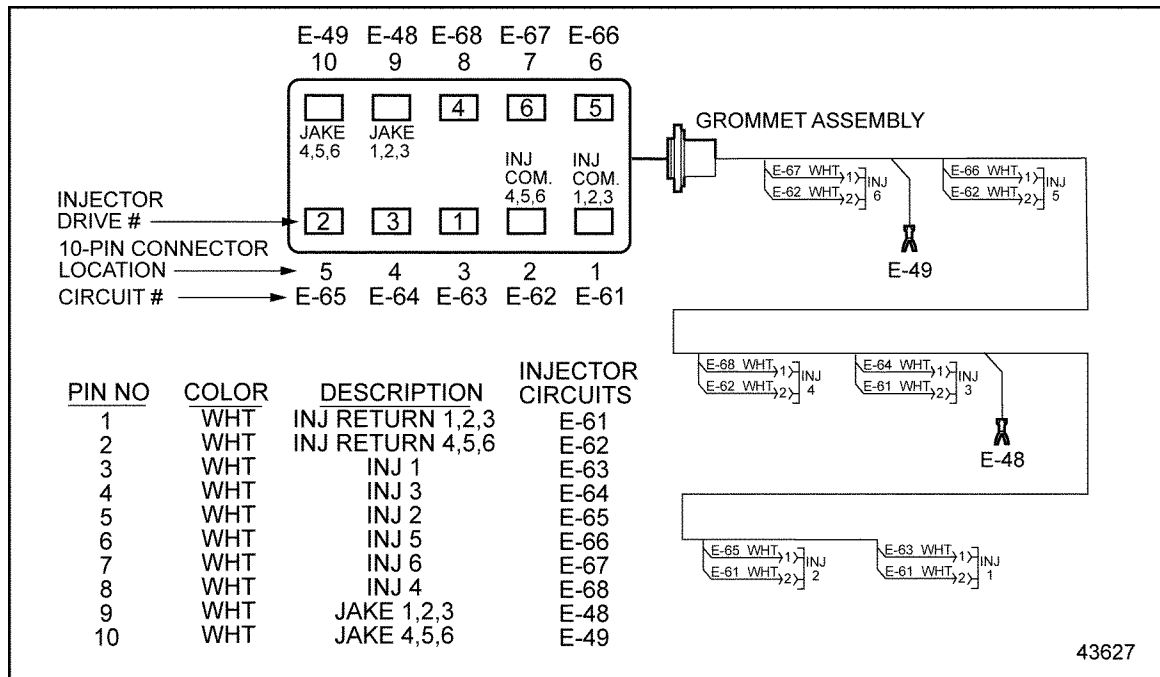


Figure 78-1 **Series 60 Injector Harness with Jake Brake**

78.3 EGR TEMPERATURE SENSOR, DELTA P SENSOR, TEMPERATURE SENSORS, PRESSURE SENSORS, AND SPEED SENSORS SCHEMATICS

The following sections have most of the sensor schematics.

78.3.1 EGR Temp and Delta P Sensor Schematic

See Figure 78-2 for the EGR Temperature and Delta P Sensor schematic.

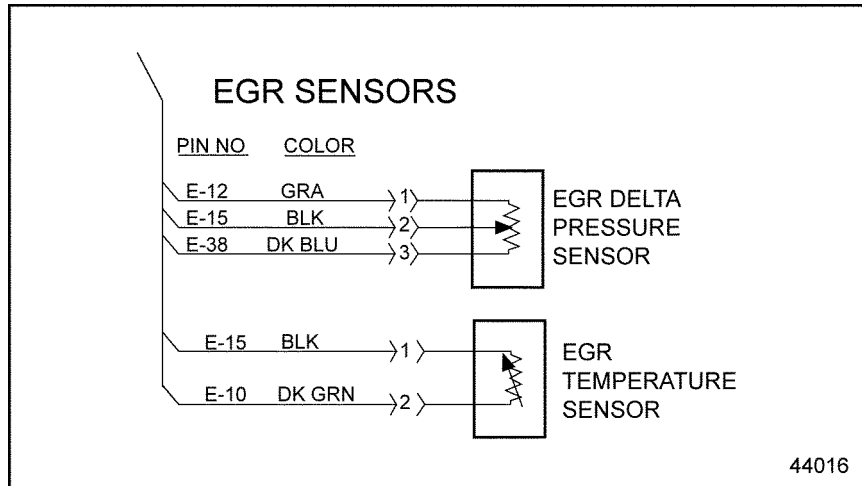


Figure 78-2 EGR Temperature and Delta P Sensor Schematic

78.3.2 Speed Sensors Schematic

See Figure 78-3 for the speed sensors schematic.

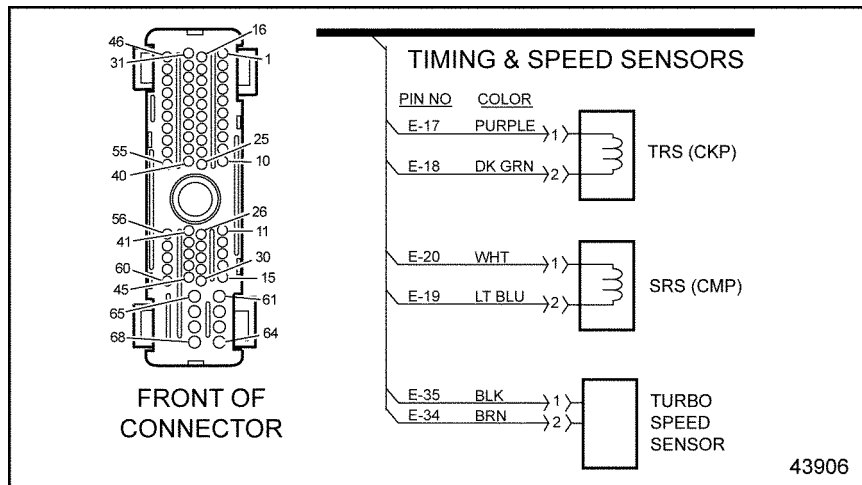


Figure 78-3 Speed Sensors Schematic

78.3.3 Pressure Sensors Schematic

See Figure 78-4 for the pressure sensors schematic.

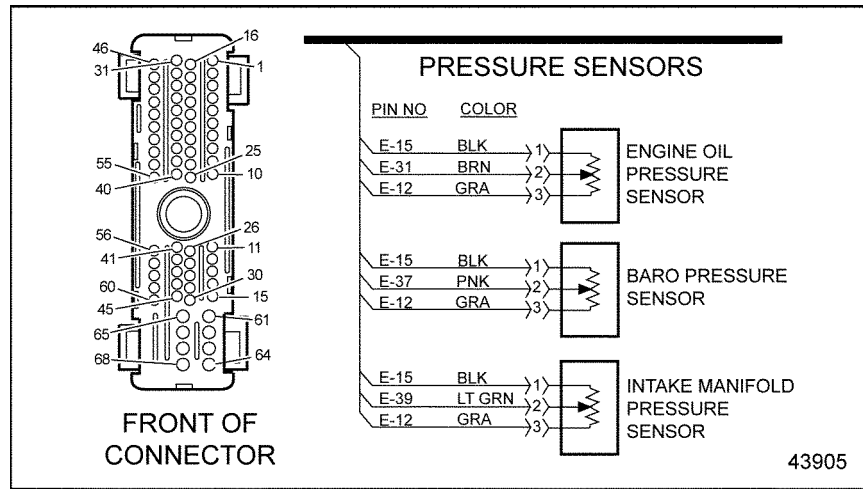


Figure 78-4 Pressure Sensors Schematic

78.3.4 Temperature Sensors Schematic

See Figure 78-5 for the temperature sensor schematic.

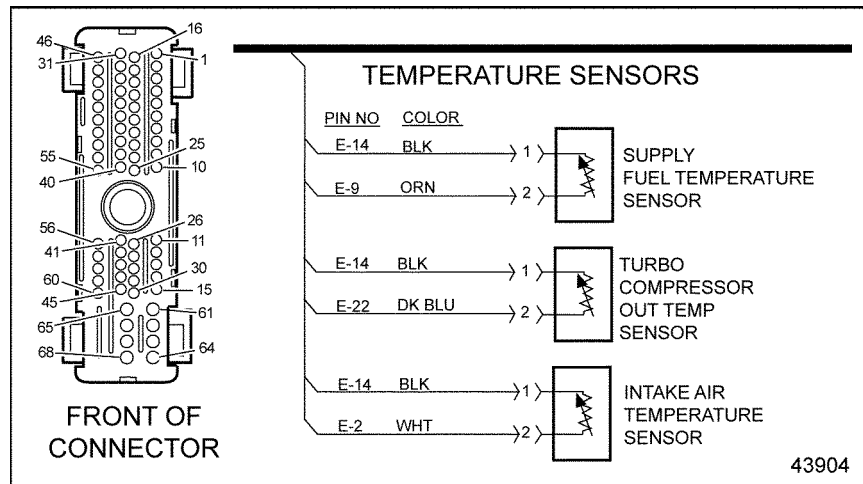


Figure 78-5 Temperature Sensors Schematic

78.4 VPOD, INJECTOR, AND MAS SCHEMATIC

See Figure 78-6 for the VPOD, injector harness, and MAS schematic.

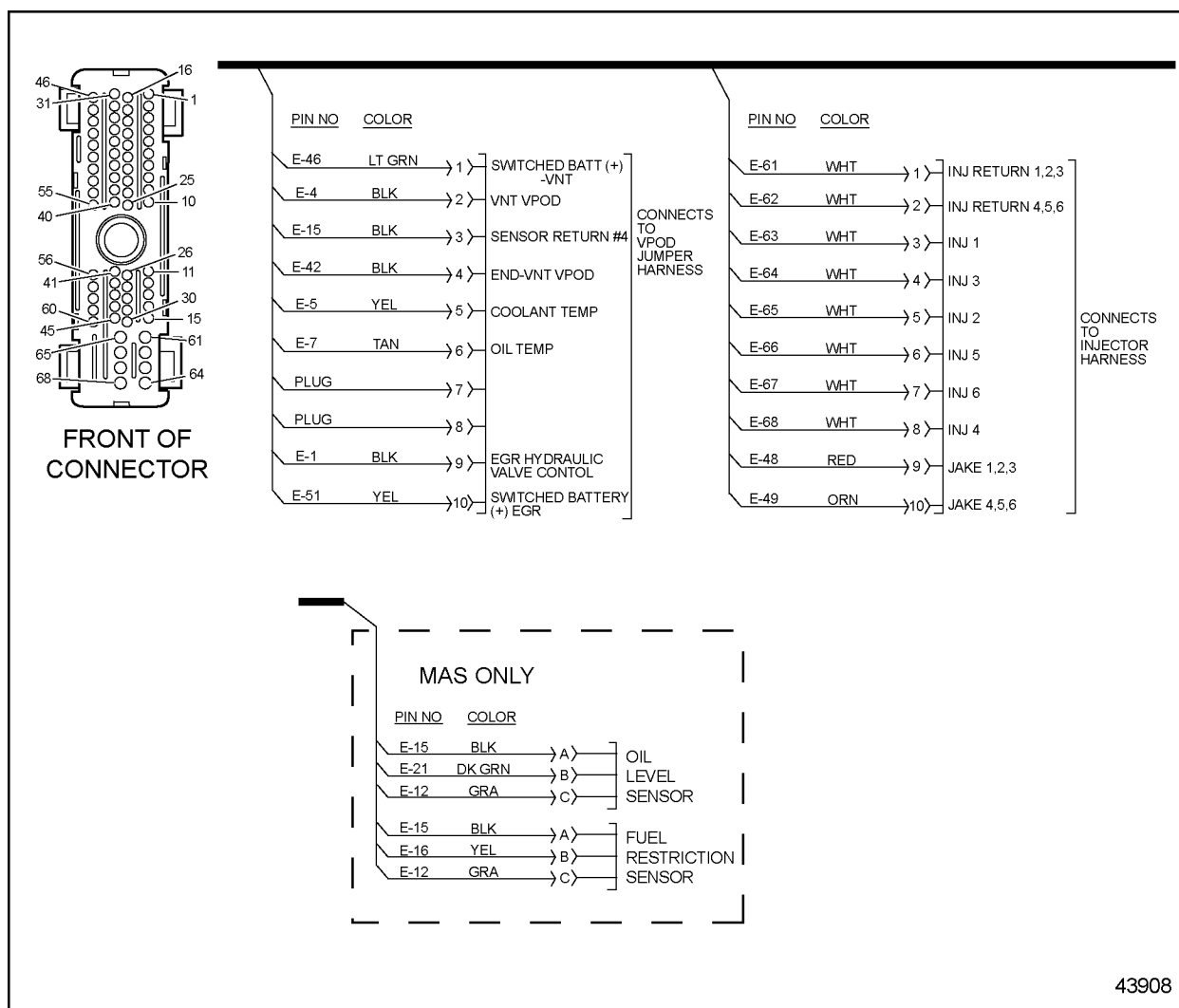


Figure 78-6 VPOD, Injector, and MAS Schematic

78.5 VPOD, COOLANT, OIL TEMPERATURE, EGR, AND VNT VPOD SCHEMATIC

See Figure 78-7 for the VPOD, Engine Coolant Temperature Sensor, Engine Oil Temperature Sensor, EGR hydraulic valve control, and VNT VPOD schematic.

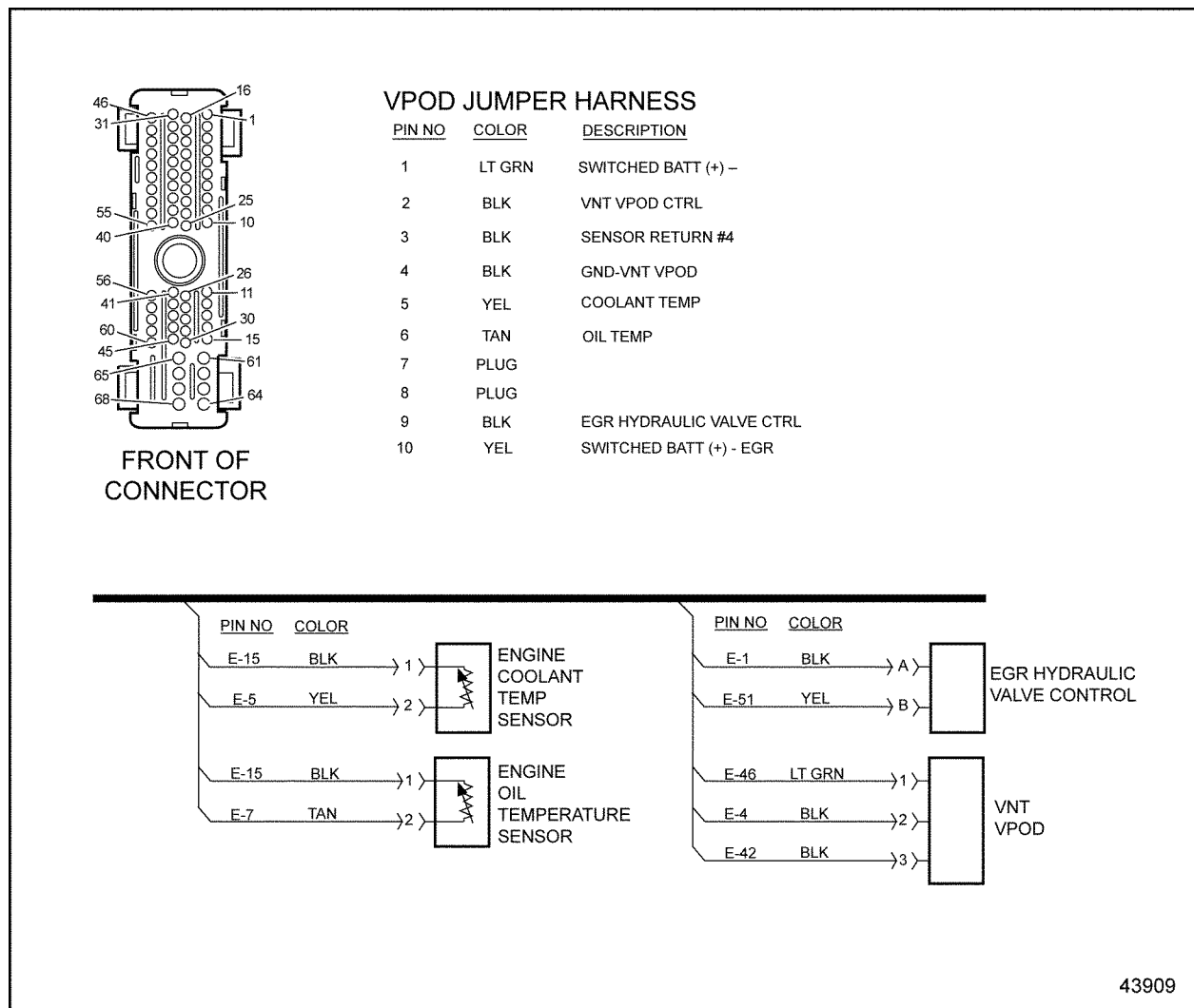


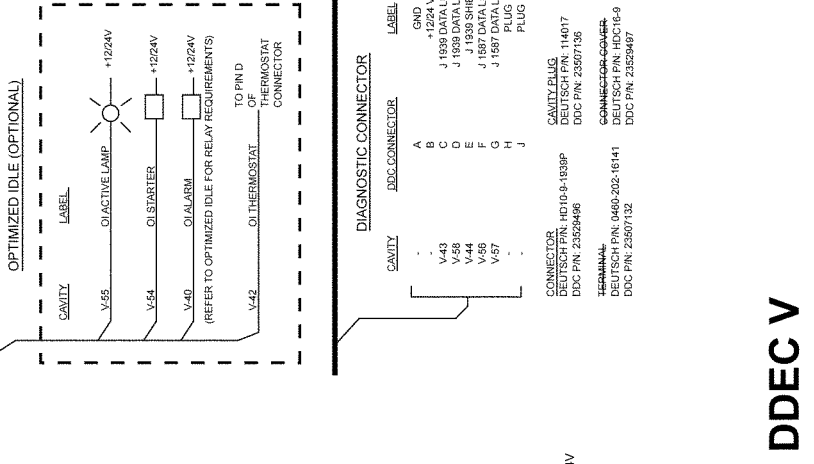
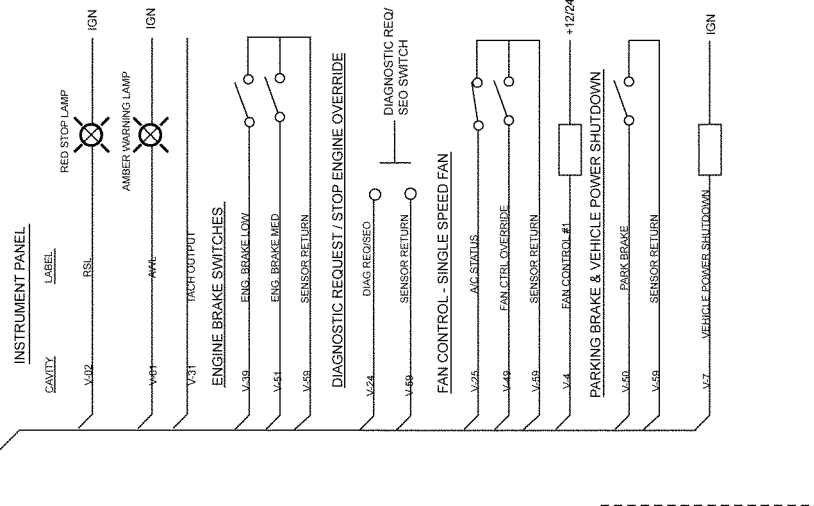
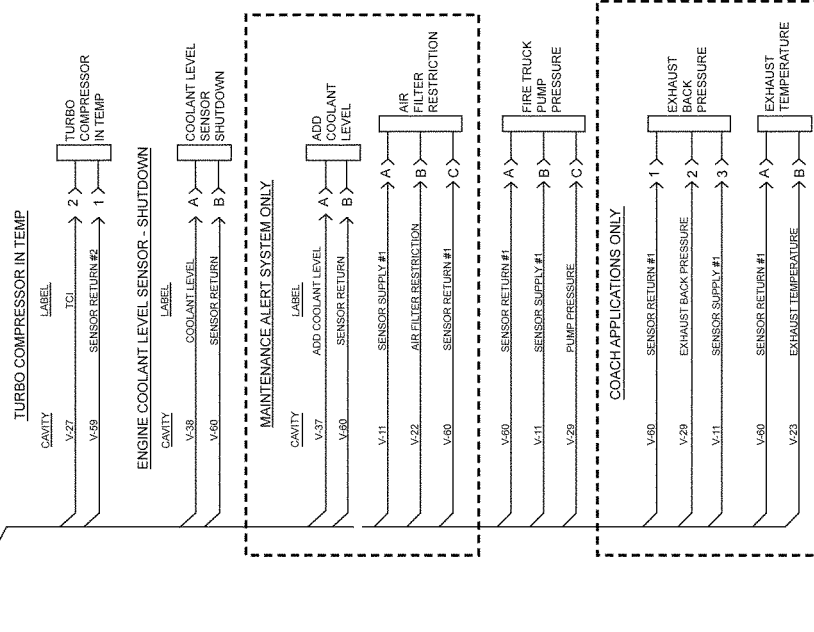
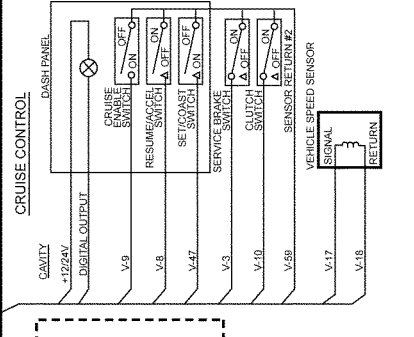
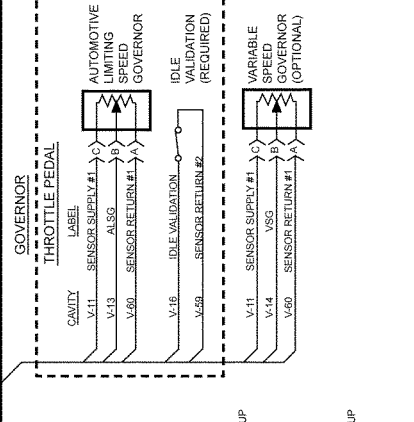
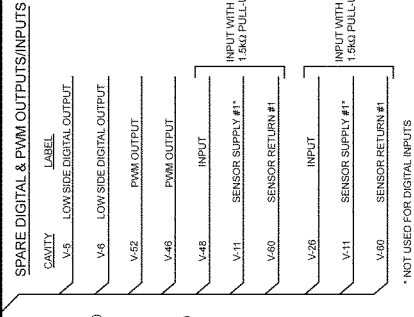
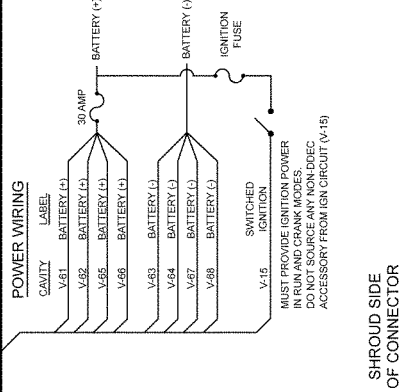
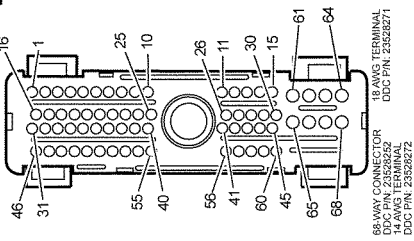
Figure 78-7 VPOD, Coolant, Oil Temperature, EGR, and VNT VPOD Schematic

79 VEHICLE WIRING SCHEMATICS

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CAVITY

V-1	AMBER WARNING LAMP
V-2	RED STOP LAMP
V-3	SERVICE BRAKE RELEASED
V-4	FAN CONTROL #1
V-5	DIGITAL OUTPUT
V-6	VEHICLE PWR SHUTDOWN
V-7	RESUME/ACCEL
V-8	CRUISE ENABLE
V-9	CLUTCH RELEASED
V-10	SENSOR SUPPLY #1
V-11	SENSOR SUPPLY #2
V-12	THROTTLE POSITION
V-13	VSS
V-14	IGNITION
V-15	IDLE VALIDATION
V-16	VEHICLE SPEED SENSOR (+)
V-17	VEHICLE SPEED SENSOR (-)
V-18	NO CONNECTION
V-19	NO CONNECTION
V-20	NO CONNECTION
V-21	NO CONNECTION
V-22	AIR FILTER RESTRICTION
V-23	EXHAUST TEMPERATURE
V-24	SEODIAG REQUEST
V-25	A/C STATUS
V-26	ANALOG INPUT - 1.5k Ω PULLUP
V-27	TURBO COMPRESSOR IN TEMP
V-28	NO CONNECTION
V-29	EXHAUST BACK PRESSURE OR FIRE TRUCK PUMP PRESSURE
V-30	NO CONNECTION
V-31	TACHOMETER
V-32	FREQUENCY - SPARE
V-33	FREQUENCY - SPARE
V-34	NO CONNECTION
V-35	NO CONNECTION
V-36	NO CONNECTION
V-37	ADD COOLANT LEVEL
V-38	COOLANT LEVEL - SHUTDOWN
V-39	ENGINE BRAKE LOW
V-40	O/L ALARM
V-41	AUX SHUTDOWN #1
V-42	O/I THERMOSTAT
V-43	J 1939 DL (+)
V-44	J 1939 DL SHIELD
V-45	NO CONNECTION
V-46	PWM OUTPUT
V-47	SET/COAST
V-48	ANALOG INPUT - 1.5k Ω PULLUP
V-49	FAN CONTROL OVERRIDE
V-50	PARK BRAKE
V-51	ENG BRAKE MED
V-52	PWM OUTPUT
V-53	ETHER START
V-54	O/I STARTER
V-55	O/I ACTIVE LAMP
V-56	J 1587 +
V-57	J 1939 DL (-)
V-58	SENSOR RETURN #2
V-59	SENSOR RETURN #1
V-60	+12V / +24V
V-61	+12V / +24V
V-62	+12V / +24V
V-63	BATTERY GROUND
V-64	BATTERY GROUND
V-65	+12V / +24V
V-66	+12V / +24V
V-67	BATTERY GROUND
V-68	BATTERY GROUND



DDEC V **VEHICLE INTERFACE HARNESS**

79.1 VEHICLE INTERFACE HARNESS

See the Figure on the previous page for the VIH schematic.

79.2 CRUISE CONTROL

See Figure 79-1 for the Cruise Control schematic.

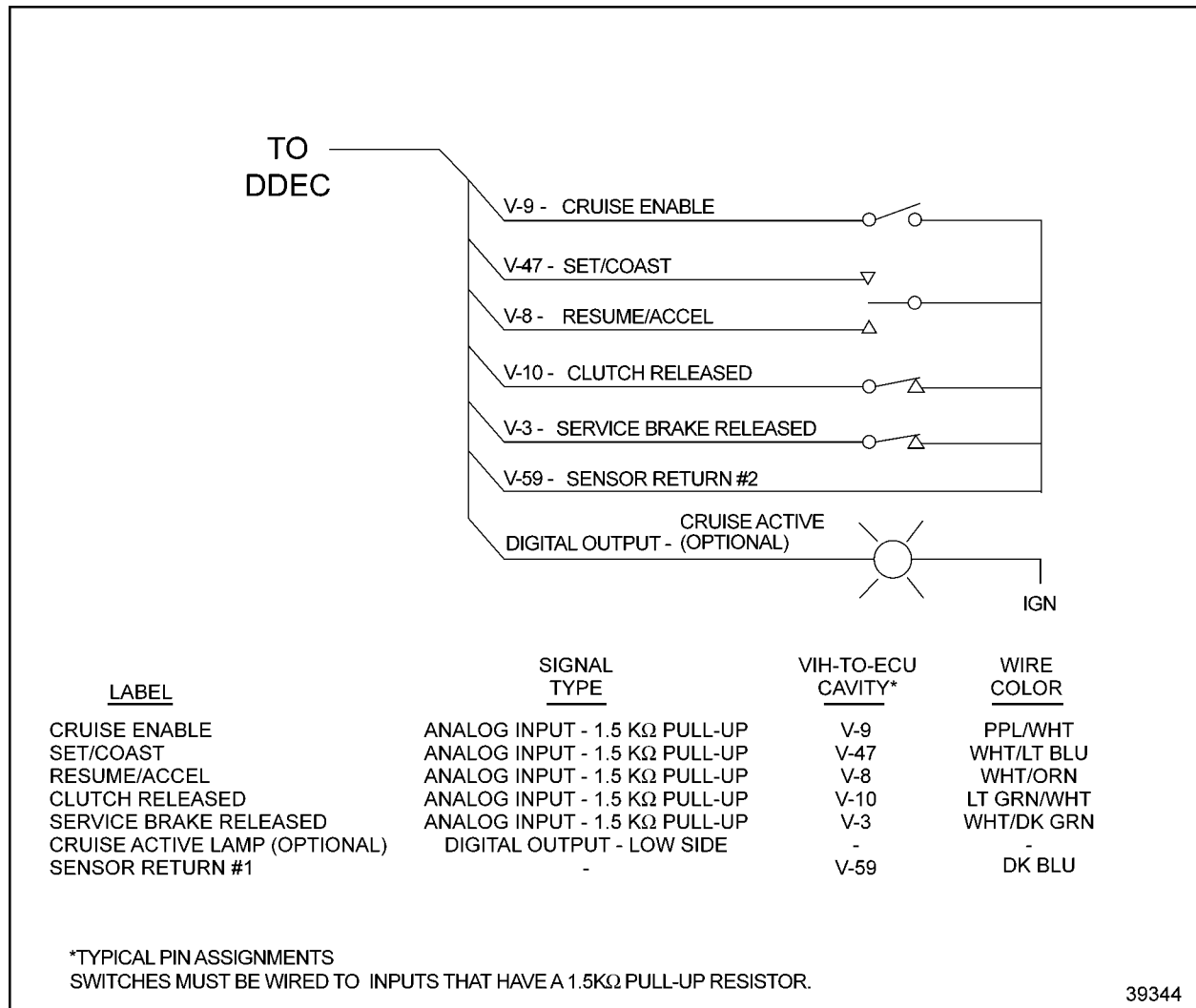


Figure 79-1 **Cruise Control**

79.3 ELECTRONIC FIRE COMMANDER

See Figure 79-2 for the EFC schmetic.

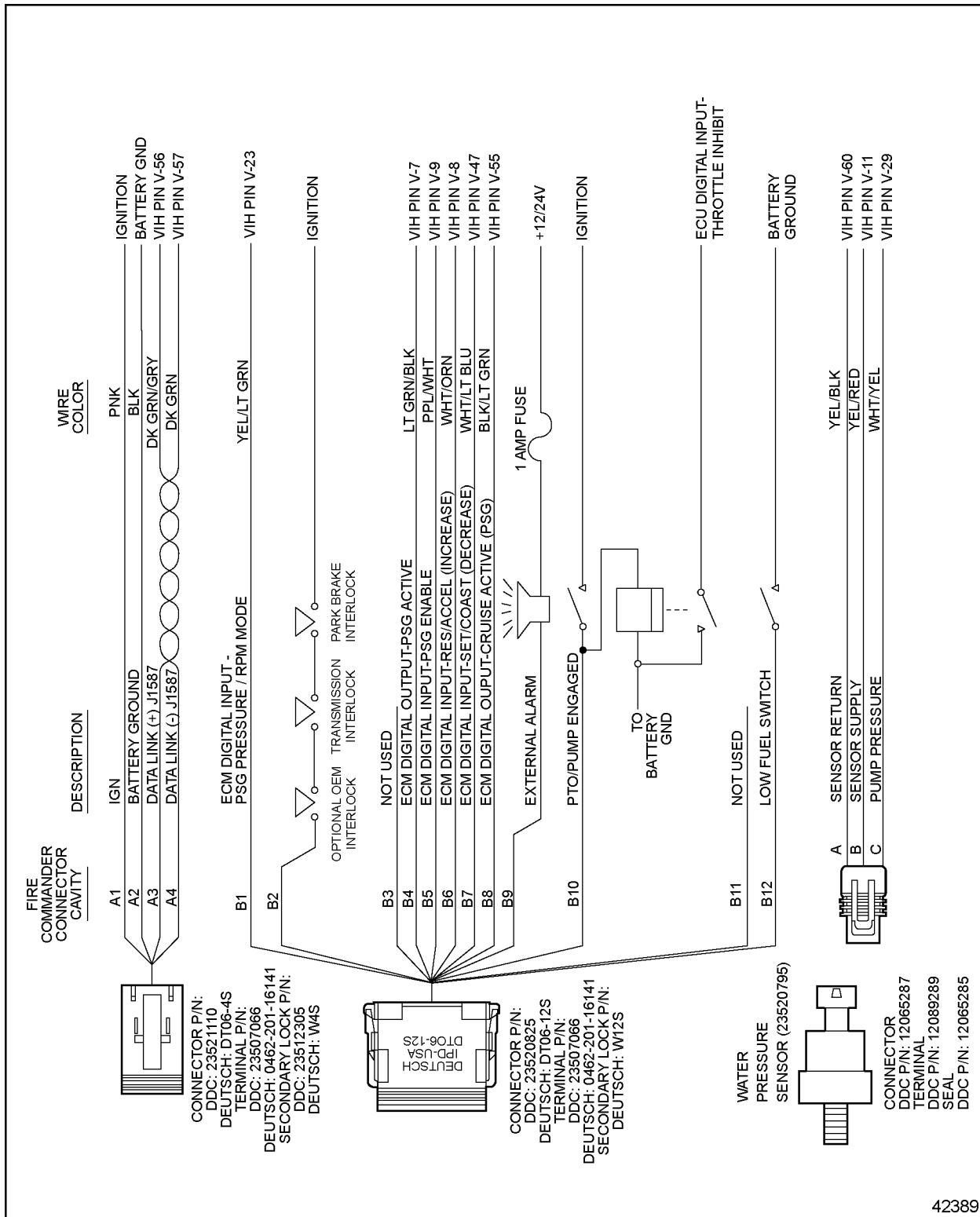


Figure 79-2 Electronic Fire Commander

79.4 ETHER START

See Figure 79-3 for a wiring diagram of the Ether Start system.

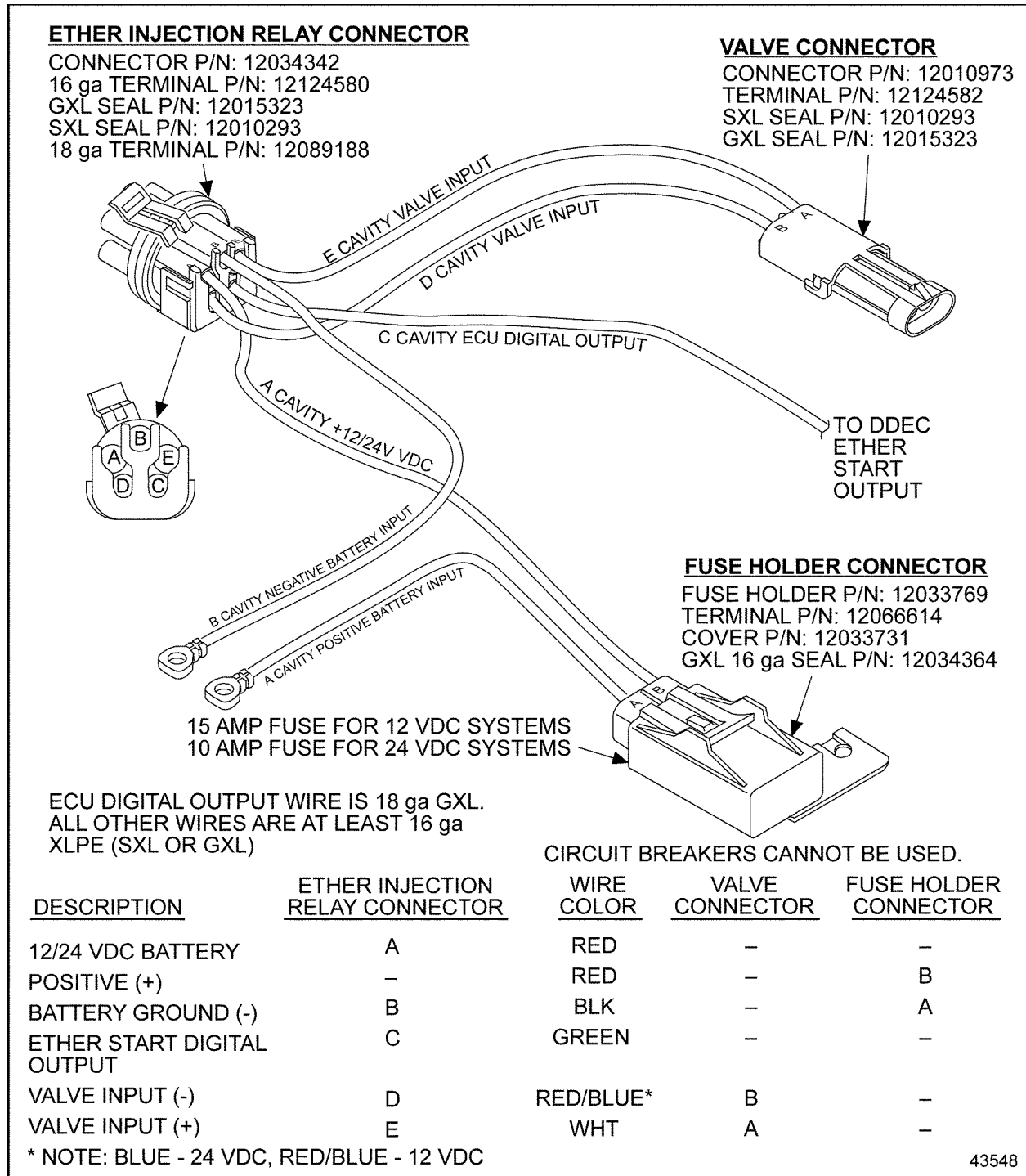


Figure 79-3 Ether Start Wiring

79.5 OPTIMIZED IDLE

See Figure 79-4 for the OI schematic.

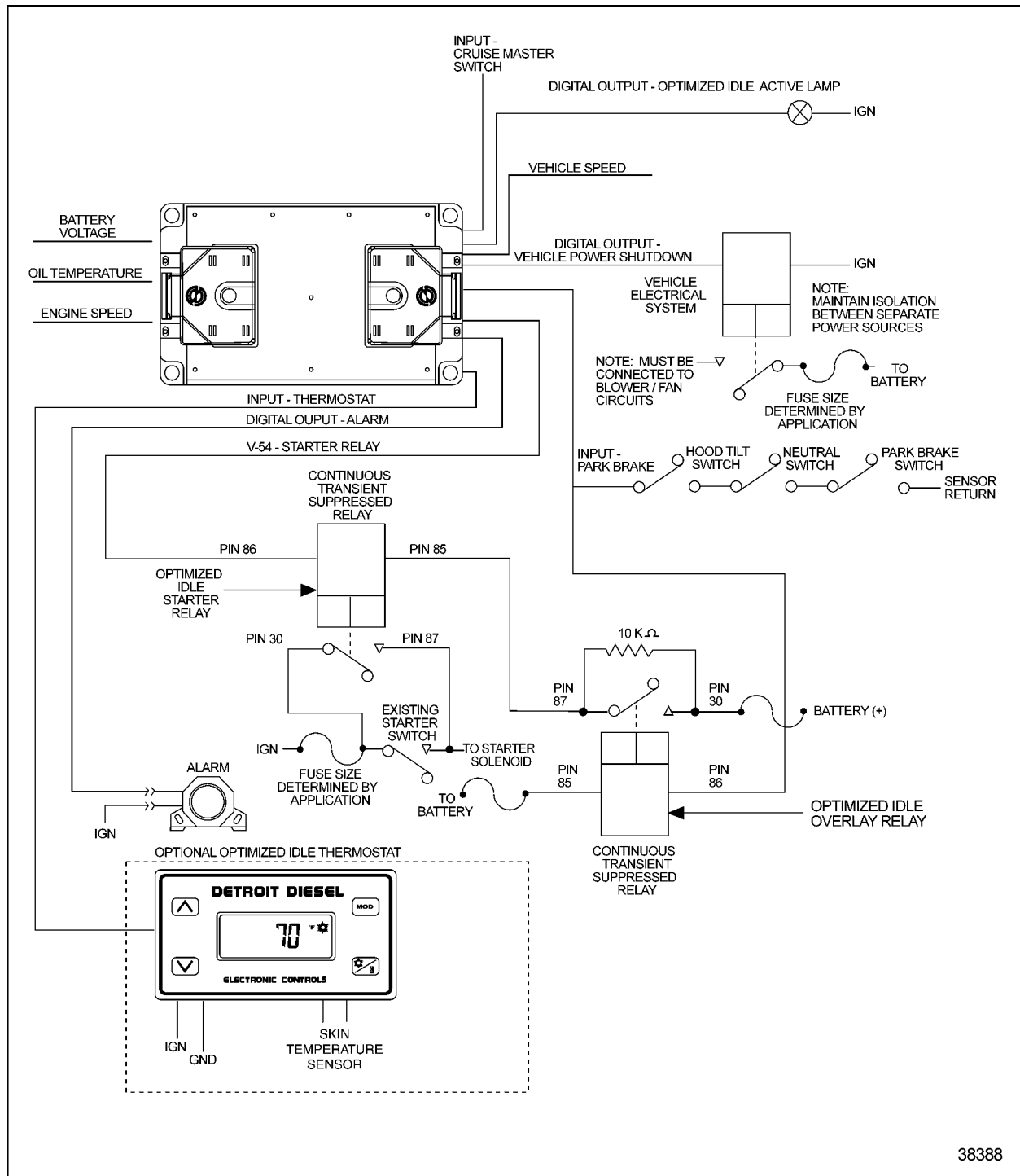


Figure 79-4 Optimized Idle

79.6 PRESSURE SENSOR GOVERNOR

See Figure 79-5 for the PSG schmetic.

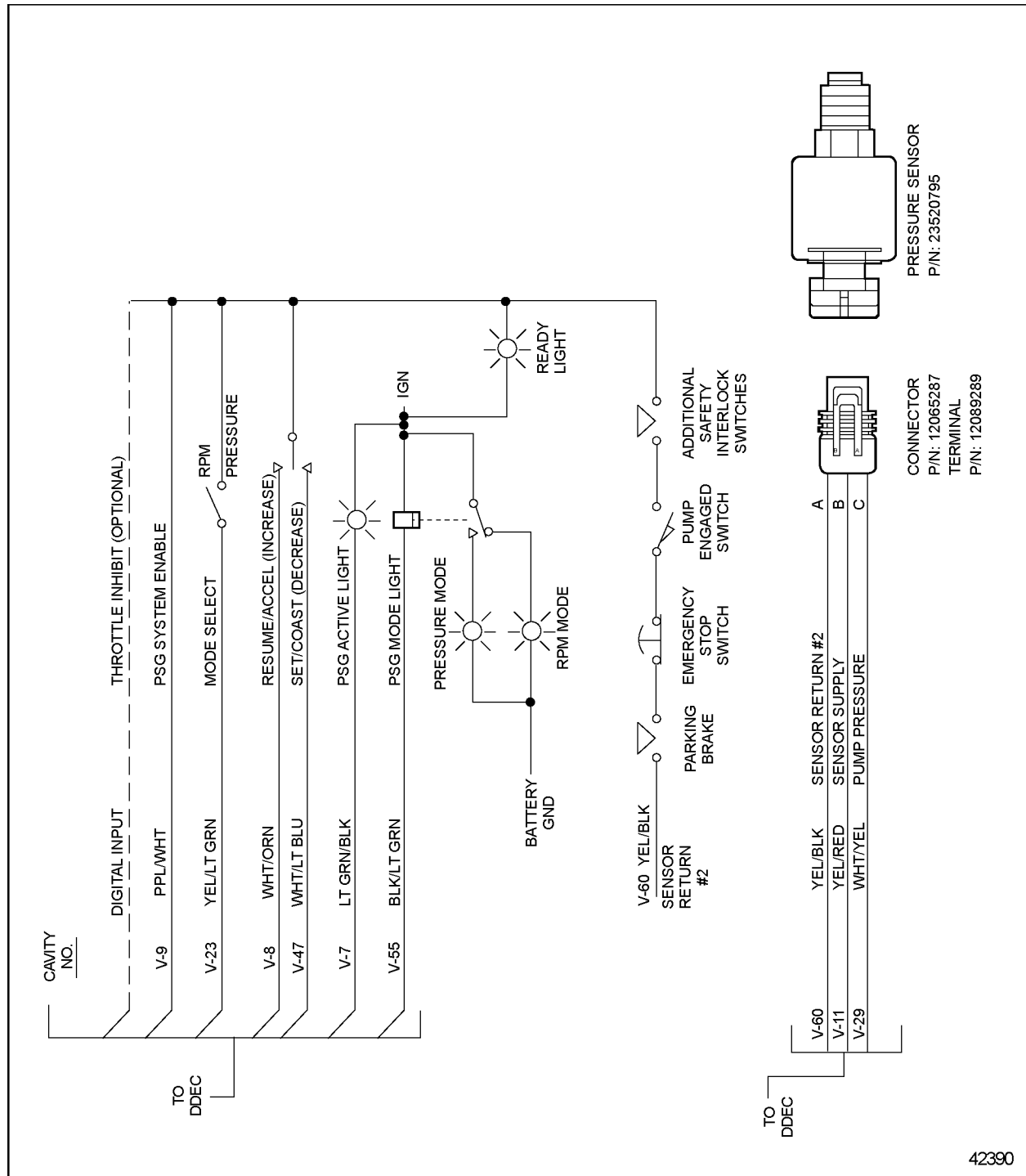


Figure 79-5 Pressure Sensor Governor

80 DDEC PRO-LINK/DDR OPERATION

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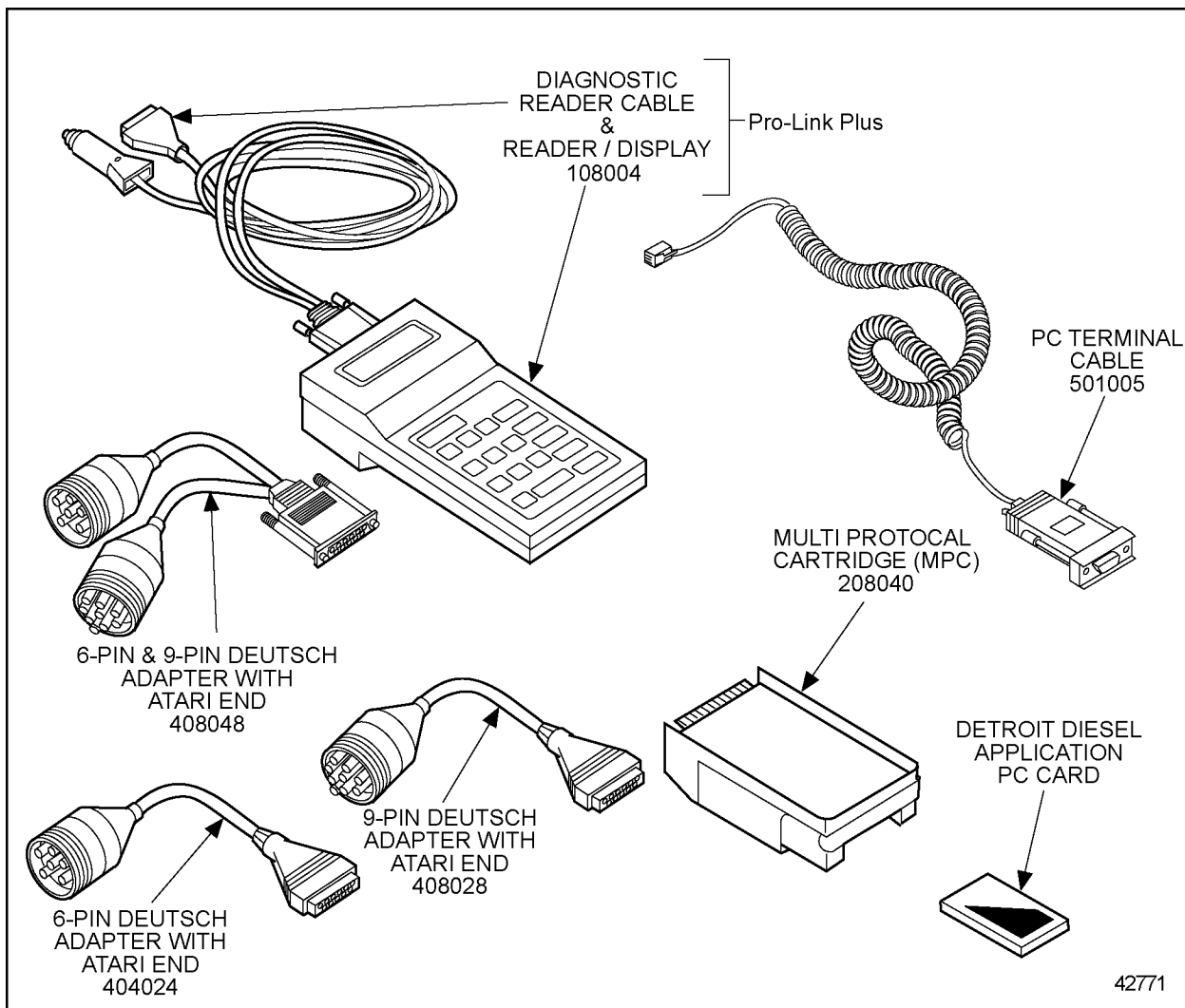


Figure 80-1 Pro-Link Plus/Diagnostic Data Reader Components

80.1 DDEC PRO-LINK OPERATION

The hand-held DDR/Pro-Link plugs into the Data Link Connector located in the Vehicle Interface Harness . This connection allows the DDR to receive data from the ECU. The DDR is used to display:

- Engine Description via the ENGINE DATA LIST menu
- Codes via the DIAGNOSTIC CODES menu
- View/reprogram certain operating parameters

A printout of the information displayed on the DDR can be obtained by attaching a printer.

NOTE:

Suite 9 is required for DDEC V.

The following procedures will suggest several ways to use the Pro-Link on the DDEC system, see Figure 80-1,

80.2 DIAGNOSTIC CODES

Start with the Menu Selection screen.

1. To call up active codes:
 - [a] Select ENGINE and ENTER three times.
2. To call up inactive codes:
 - [a] Select ENGINE and ENTER twice.
 - [b] Select INACTIVE CODES and ENTER.
3. To clear codes:
 - [a] Select ENGINE and push ENTER twice.
 - [b] Go down and select CLEAR CODES and ENTER.
 - [c] Left to YES, and ENTER.
 - [d] Wait and then push FUNC three times.
 - [e] Go to lines 1 and 2 of the Engine Data List, Active and Inactive Codes, and verify that both lines display NO.

80.3 CYLINDER CUTOUT SEQUENCE

Start with the Menu Selection screen.

1. Select ENGINE and ENTER.
2. Go down and select FUEL INJECTOR INFO and ENTER.
3. Go to CYLINDER CUTOUT and ENTER.
4. Select NEW TEST and ENTER, or REVIEW LAST TEST and ENTER.

5. Select IDLE and ENTER or 1000 RPM and ENTER.
6. Select AUTO and ENTER, or MANUAL and ENTER three times.
7. Test is now in progress.

NOTE:

Test results stay stored in the Pro-Link memory as long as the DDR remains powered up.

80.4 INJECTOR CALIBRATION UPDATE

Start with the Menu Selection screen.

1. Select ENGINE and ENTER.
2. Go down to FUEL INJECTOR INFO and ENTER.
3. Go down to CAL UPDATE and ENTER.
4. Select VIEW and ENTER or select UPDATE and ENTER.
5. Enter password: 0000 or xxxx and ENTER twice.
6. Enter new CAL # and ENTER. Use UP/DN arrow keys to select line.
7. When finished, select FUNC, select YES, ENTER and wait.
8. ENTER to continue.

80.5 REPROGRAM CALIBRATION

Start with the Menu Selection screen.

1. Select ENGINE and ENTER.
2. Down to CALIBRATION CHANGE and ENTER.
3. Select REPROGRAM CAL and ENTER.
4. Enter password: 0000 or xxxx and ENTER (xxxx=1 to 9 and A to Z).
5. Select menu to be changed with UP/DN arrow keys and ENTER twice.
6. Use RT/LT arrow keys to change a word or put in a new # and ENTER.
7. When finished, select FUNC.
8. SELECT ANOTHER MENU: left to YES and ENTER, or NO and ENTER.
9. Left to YES and ENTER.
10. Wait and then ENTER to continue.

80.6 SNAPSHOT SEQUENCE

Start with the Menu Selection screen.

1. Select PRO-LINK and ENTER.
2. Go up to SNAPSHOT and ENTER.
3. Go down to DATA UPDATE RATE and ENTER.
4. Type in NEW RATE and ENTER (.0 to 9.9 seconds), (90 frames will be recorded).
5. Up to TRIGGER SETUP and ENTER.
6. Select TRIGGER SOURCE and ENTER:
 - [a] Any Numeric Key
 - [b] Any code
 - [c] Specific PID
 - [d] Specific SID
7. Adjust TRIGGER POINT: NO, or select YES and ENTER; change trigger point with RT/LT arrow keys. ENTER.
8. WAITING FOR TRIGGER. When ready to take SNAPSHOT, apply the trigger. ANY NUMERIC KEY overrides all other triggers.
9. PROCESSING TRIGGER; Filling remaining frames (90 frames max). When all frames are filled, the first three lines of the TRIGGER FRAME, T, will display.
 - [a] To do SNAPSHOT after setup is done, do items 1, 2, and 8 only, or go to QUICK TRIGGER and ENTER.
 - [b] SNAPSHOT DATA stays stored in Pro-Link memory as long as the DDR remains powered up.

80.7 PRINT FUNCTION

Print custom data list of snapshot. The printer is attached to the DDR.

1. Select PROLINK. ENTER.
2. Select RS-232 SERIAL PORT. ENTER.
3. Select PRINTER OUTPUT. ENTER.
4. Arrow up or down to SNAPSHOT DATA. ENTER.
5. Right to CUSTOM. ENTER twice.
6. Select six items from data list using arrow up or down. ENTER after each selection.
- FUNC.
7. Type 001; ENTER; 090; ENTER.

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