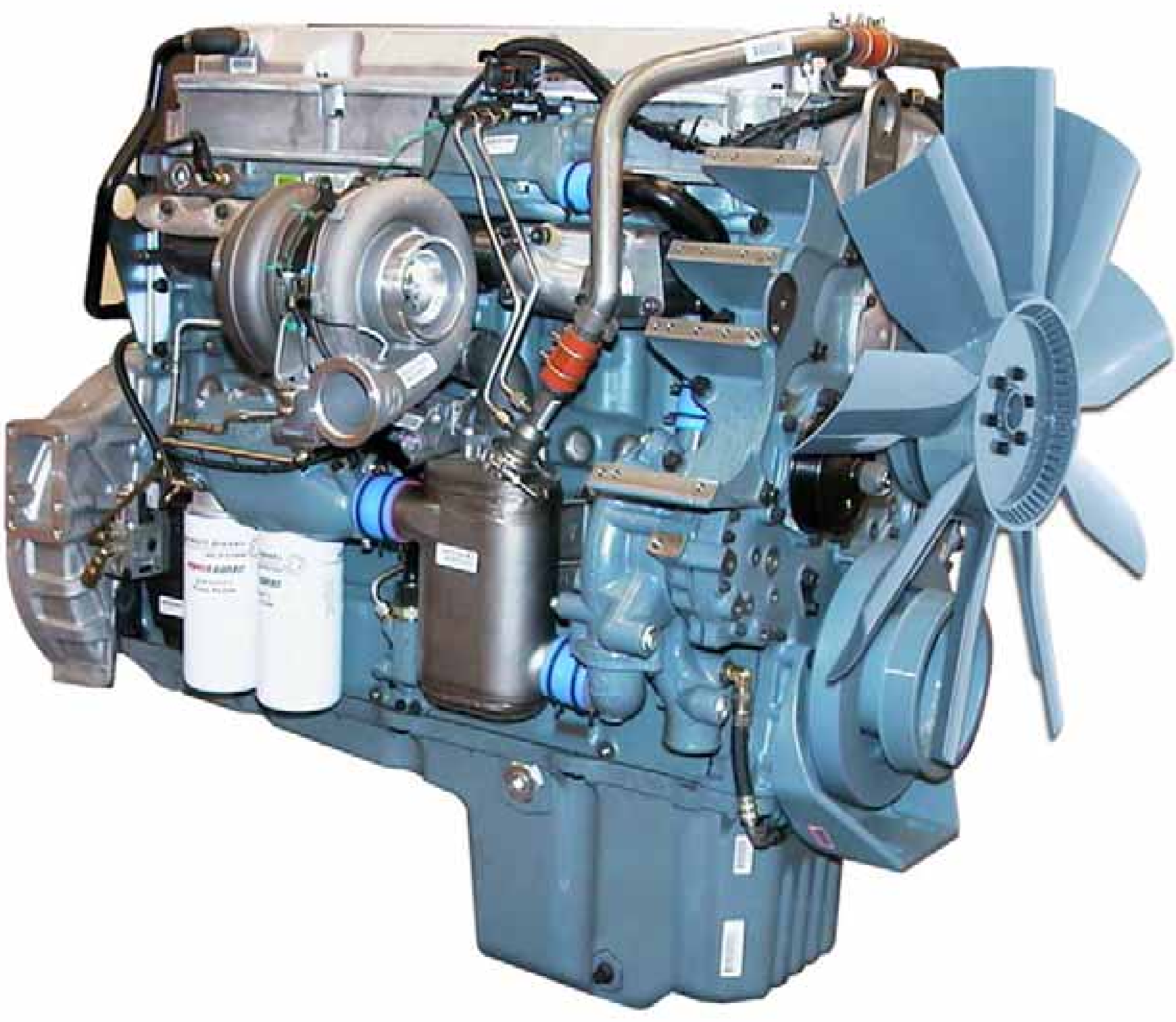
DETROIT DIESEL

SERIES 60



Series 60 EGR Technician's Manual

ATTENTION

The information in this document is accurate as of **June 2005** and is subject to change without notice. This manual is to be used in conjunction with the *DDEC III/IV Single ECM Troubleshooting Guide* and the *DDEC V Single ECU Troubleshooting Guide*.

A LETTER TO TECHNICIANS

The Series 60 engine is entering its 18th year!

Since its introduction in 1987, over 729,000 Series 60 engines have been introduced in the market. The technological changes that have occurred during those 14 years have resulted in a different type of engine, requiring a different class of technicians. Today's technician is required to have computer skills, excellent comprehension of the written word and possess an extensive diagnostic understanding of the various technological systems and components. Today's technician 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, today's technicians must become specialized in multiple areas. This manual is designed with that thought in mind. This Series 60 EGR Technician's Guide will provide you with concentrated information that will allow you to excel in EGR technology.

The *Series 60 EGR Technician's Guide* supports the October 2002 through current production Series 60 EGR engines. Acronyms are used throughout this guide, acronyms which support both the DDEC IV and DDEC V system. To avoid any confusion, please refer to the acronym chart listed in Table A-1 to better understand the meaning and intended use of each acronym.

After completing this guide you will:

- Understand the function of the Series 60 EGR engine components and their interdependence
- Understand Series 60 EGR operating modes
- Recognize the logic, component, and protection codes logged within the ECM/ECU
- Learn the acceptable pressure output values from a Variable Pressure Output Device (VPOD)
- Be able to record, playback, save, and e-mail a DDDL snapshot
- Apply your understanding of the EGR system logic to review DDDL diagnostic snapshots

TABLE OF CONTENTS

1 INTRODUCTION

The *Series 60 EGR Technician's Guide* is intended to be used by a qualified service technician familiar with Detroit Diesel electronically controlled (DDEC) diesel engines and to provide a better understanding of the EGR system to improve the diagnosing of a Series 60® EGR system.

Prerequisites for effective diagnosis include the following topics:

- Knowledge of both the engine and vehicle principles of operation.
- Ability to perform and to understand service manual and troubleshooting manual procedures.
- Availability and training to use gages and diagnostic test equipment.
- Familiarization of the computer software associated with DDC products.

An essential tool to properly diagnose and troubleshoot a DDEC IV or DDEC V Series 60 EGR engine is the Detroit Diesel Diagnostic Link® (DDDL).

This tool will provide you all the help you will need as it contains proper troubleshooting information for all products.

NOTE:
It is absolutely **critical** that you understand the EGR system to be qualified to offer any type of proper diagnostics. Do not **waste time** trying to troubleshoot a DDC product, you are not qualified to troubleshoot. Your company may incur wasted labor hours. If you are qualified to perform a troubleshooting task and have spent more than one hour on that task, **STOP**, and contact the Detroit Diesel Customer Support Center at 313-592-5800. Once you have discussed your options with a customer support center person, you can perform the required tests and evaluations. Please keep in contact with your customer support person. Doing so allows you to stay on track.

BASICS

The following listed items should be checked prior to starting any troubleshooting:

- ☐ Ensure that the 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 the ECM/ECU for worn isolators, debris or bolts lodged between ECM/ECU and cylinder block.
- ☐ Ensure the fuel supply shut-off valve is set to *full on*.
- ☐ Check that the fuel filter is secure and tight.
- ☐ Check for a restricted air filter.
- ☐ Inspect truck frontal area for air flow restriction through the CAC and radiator.
- ☐ Ensure that the fuel tank level is correct and that the fuel tank is full.
- ☐ Look for any vehicle damage.
- ☐ Investigate any prior repairs, if applicable.
- ☐ Check for broken wiring connectors.
- ☐ 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.
- ☐ Check for 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 that 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.

OPERATOR INFORMATION

This section should serve as a guideline for the technician.

- Intermittent Problems - Talk to the operator/driver. **Be specific!**
- Develop your own Driver Questionnaire (see Figure 1-1).

NOTE:
A full page copy of the questionnaire can be found in Appendix C.

Engine Diagnostic Questionnaire RO #

Customer Name: ____________________

Contact Person:____________________

LOW POWER/POOR FUEL ECONOMY:

Does check engine light come on? Yes No

Does the engine miss, run rough, hard starting? Miss Run Rough Hard Starting

Power Loss sudden or has decreased with time? Sudden Decreased with time

Excessive engine exhaust smoke (see #3)? Yes No

If yes, what color? Black Blue White

Heard any unusual engine noise? Yes ____________________ No

Power loss occurs on Foot Cruise Both

Have injectors been replaced recently? Yes No

When was last tune up? Mileage____________________Date____________________

Comments: ____________________

ANY INTERMITTENT PROBLEMS:

Last time it happened:____________________

Does the check engine light come on? Yes No

Does the problem occur only in damp or rainy conditions? Yes No

When the vehicle hits a bump or rough road? Yes No

Does the engine: Miss Drop to idle Quit running Gauge Sweep Hard Starting

Comments: ____________________

e.g. Does the driver do anything to correct the problem?

SMOKING:

Where is the smoke coming from?____________________

What color is the smoke? Blue Black White Bl/White

When does it smoke? Start-up Cold Eng. Hot Eng. U.Load

Have you noticed any oil consumption? Yes No

Have you noticed a miss in the engine? Yes No

Was the smoke intermittent?- Start all at once? Been getting worse over time?

Comments: ____________________

COOLANT LOSS

Has the oil level risen? Yes No

Have you noticed any coolant leaks? Yes No

How often do you add coolant?____________________How Much?____________________

What kind of collant do you use?____________________

What kind of inhibitor do you use?____________________

Comments: ____________________

OIL CONSUMPTION:

How much oil are you adding?____________________How often (miles)?____________________

Have you noticed any oil leaks? Yes No

Have you noticed any smoke out the exhaust? Yes No

At Idle Light or no load Heavy load

How often do you change oil?____________________What Brand?____________________

Have you changed brands recently? Yes No

How & when do you check your oil?____________________

Comments: ____________________

44272

Figure 1-1 Drivers Questionnaire

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. Use this and the response as a guideline. Refer to *Questionnaire Response Guideline* found on page 1–6.

1. How often does the problem occur? Can you and the driver take the vehicle and demonstrate the problem in less than 30 minutes?
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 at a specific engine operating altitude? If so, at what altitude?
7. Does the problem occur only when above or below specific outside temperatures? In what temperature range?
8. Does the problem occur during other conditions e.g. during or after rain, spray washing, snow?
9. Did the problem occur at a specific vehicle speed? If so, at what vehicle speed?
10. Does the problem occur at specific engine RPM? If so, at what engine RPM?

Questionnaire Response Guideline

The following are typical responses to the Driver Questionnaire:

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. If the problem is repeatable, take the vehicle for a drive with the DDDL connected and note the conditions when the problem occurs. Be prepared to take snapshot data using the DDDL. **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.
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 DDDL snapshot feature.
5. Operate the engine at this temperature while attempting to duplicate the problem. Use the snapshot feature on the DDDL.
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 DDDL (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 DDC Customer Support Center at 313-592-5800.

2 DDEC IV COMPONENTS

The primary purpose of the EGR system is to reduce engine exhaust gas emissions in accordance with EPA regulations by allowing a percentage of the exhaust gases to remix with the air coming into the intake manifold. Engine exhaust gases will dilute the incoming air by displacing some of the oxygen in the air being supplied through the intake manifold. Less oxygen results in a slower fuel burn which reduces the peak cylinder temperature permitting reduced nitrogen oxides (NOx) emissions. Figure 2-1 illustrates how the components of a EGR system function.

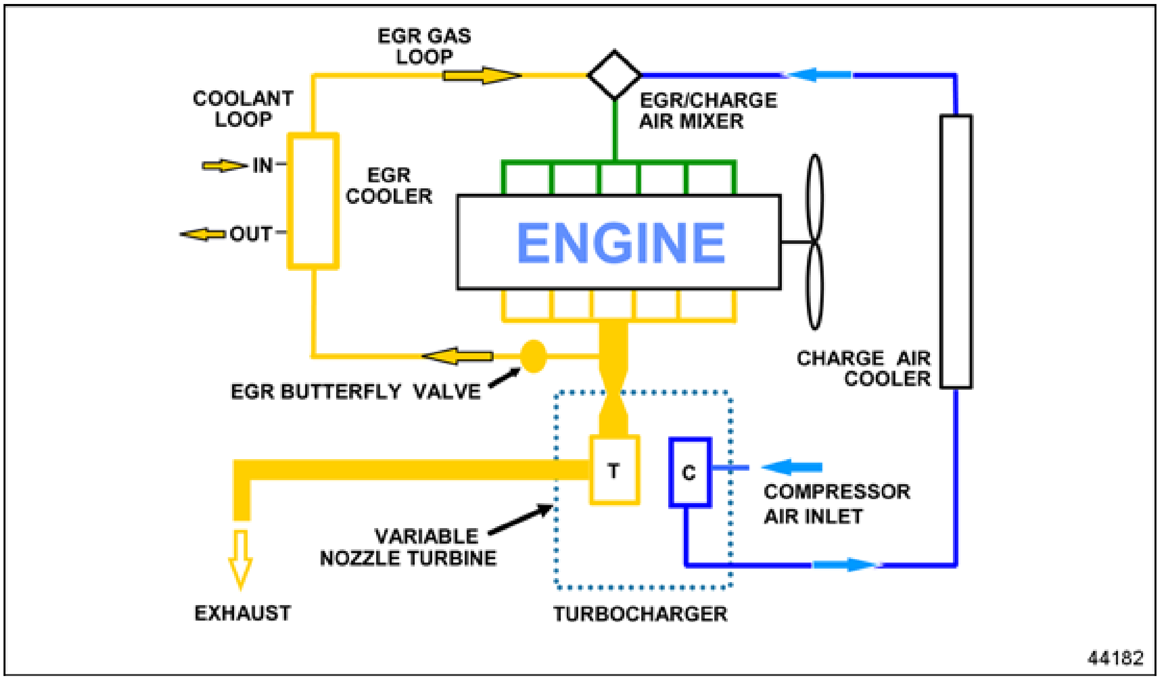
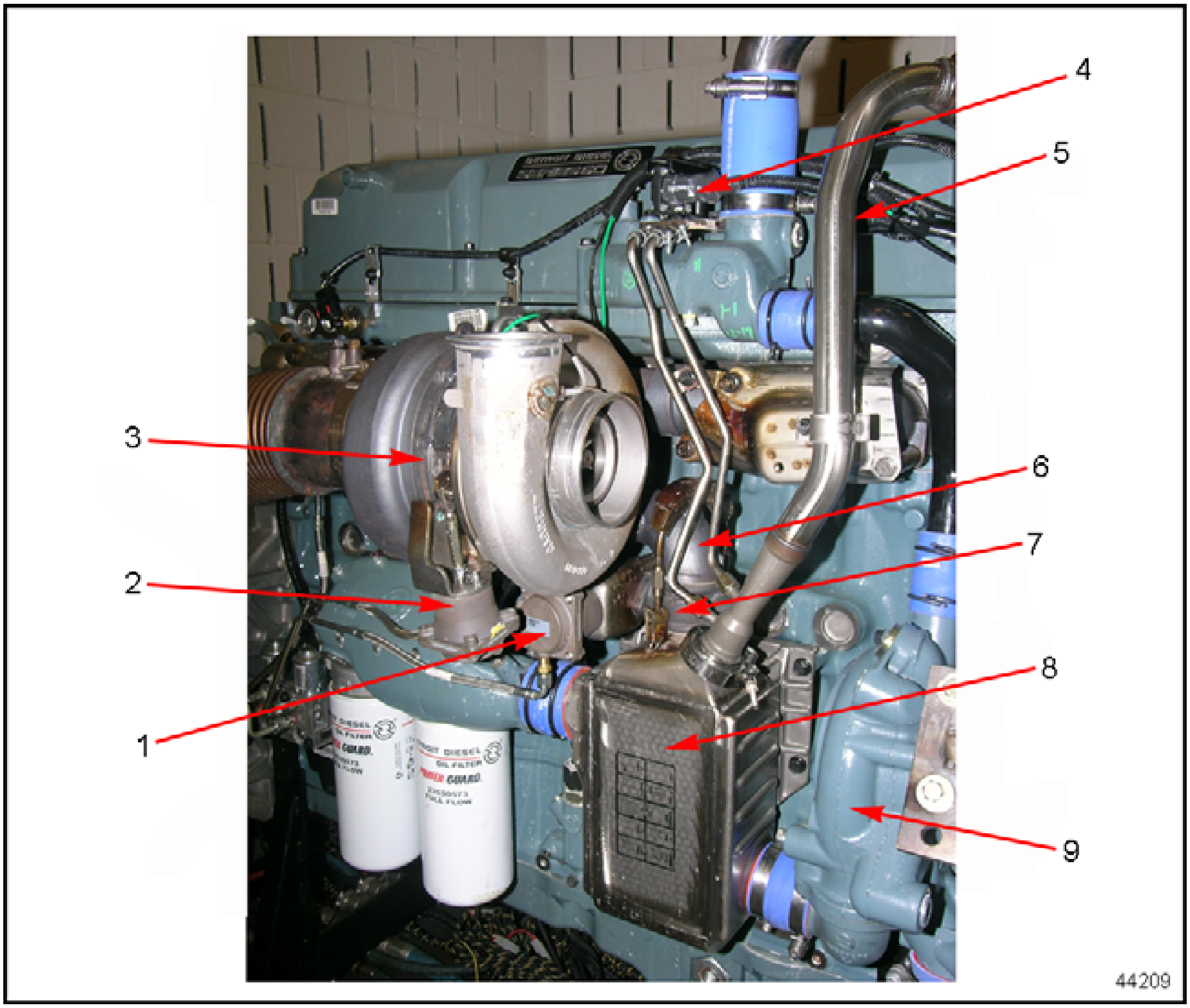


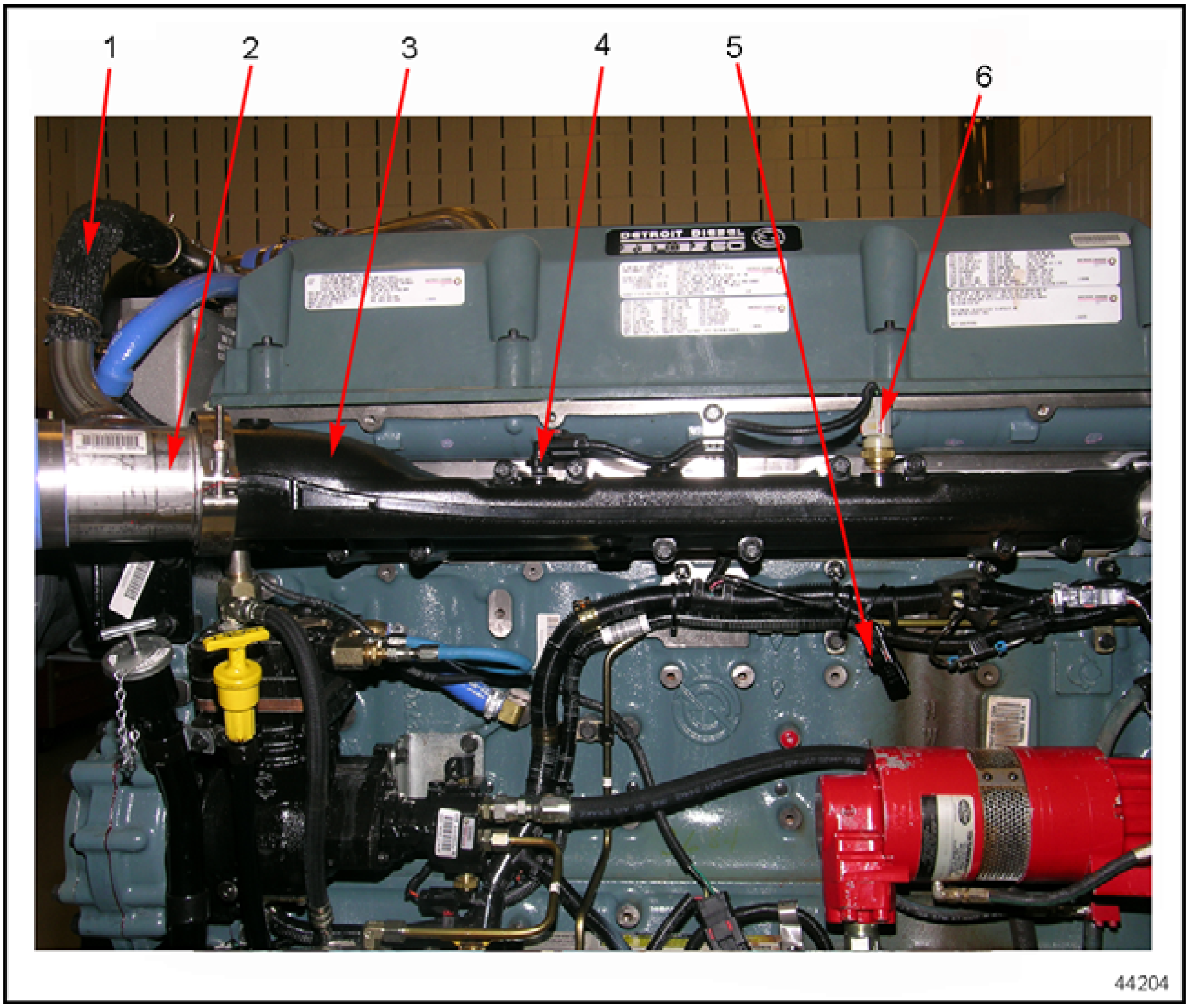
Figure 2-1 EGR System

To familiarize yourself with the pre-2004 DDEC IV EGR components, review Figure 2-2 and Figure 2-3 .



1. EGR Valve Actuator
2. VNT Actuator
3. VNT Turbocharger
4. Delta Pressure Sensor
5. EGR Gas Delivery Pipe
6. S Pipe
7. EGR Valve
8. EGR Cooler
9. High Flow Water Pump

Figure 2-2 Pre-2004 Right Side View

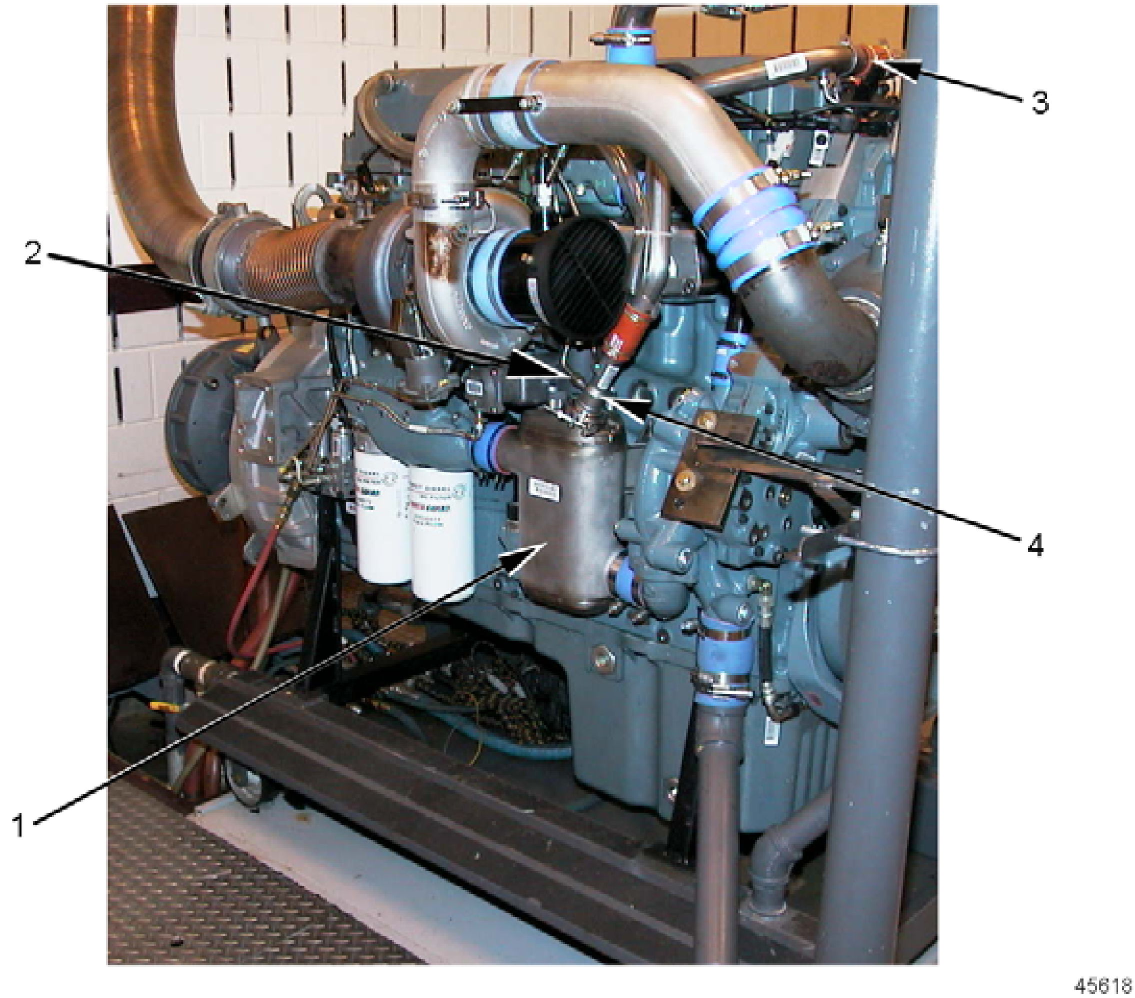


1. EGR Gas Delivery Pipe
2. EGR Mixer
3. Intake Manifold
4. Intake Manifold Air Temperature Sensor
5. Barometric Pressure Sensor
6. Turbo Boost Pressure Sensor

Figure 2-3 Pre-2004 Left Side View

An enhancement program has been launched to upgrade production 2004 DDEC IV EGR engines. For detailed information, please visit the *Detroit Diesel Technical Information Web Page* at http://192.135.85.10/public/sp/spnav.asp and browse for 18SP597. Figure 2-4 illustrates some of the enhancements such as tube and shell EGR cooler, redesigned delivery pipe, EGR valve, and venturi tube.

NOTE:
You may also access 18SP documents after logging into the DDC Extranet by clicking on ***Support, On-Highway, Service Information, Special Publications (18SPs).***



1. Tube and Shell EGR Cooler
2. EGR Valve
3. Delivery Pipe
4. Venturi Tube

Figure 2-4 Enhanced DDEC IV 2004 EGR Engine

FUNCTIONALITY OF THE EGR COMPONENTS

This section will present and discuss specific EGR components which collectively as a system allow the engine to meet emission standards.

DDEC IV Electronic Control Module

The Electronic Control Module (ECM) is the backbone for engine management. The ECM receives electronic inputs during vehicle operation via engine and vehicle mounted sensors.

Refer to Appendix E for a view of the DDEC IV ECM and related harness connectors.

DDEC IV ECM engine management benifits are:

- Excellent engine performance
- Optimum fuel economy
- Emission levels that meet current laws without after treatment
- Engine diagnostics
- Simple programming

Variable Pressure Output Device (VPOD)

There are two VPODs which control the VNT and EGR valve. See Figure 2-5. The location of the VPODs are application dependent.

Two system components are required for proper operation of EGR valve and VNT control system.

- 12V or 24V power supply
- DDEC IV ECM: PWM#2 (Y1) EGR and PWM#4 (X2) VNT

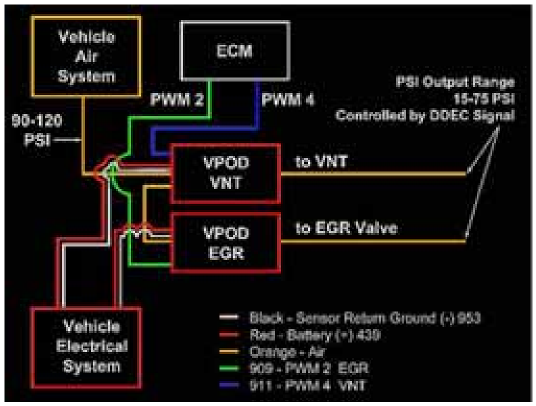


Figure 2-5 EGR Valve and VNT Control System

During engine EGR operation, the VPODs provide modulated air pressure to the pneumatic actuators which change the position of the VNT vanes and the position of the EGR valve. The results of the VNT vanes being able to adjust are:

- Enhanced air/fuel ratio during engine acceleration
- A proper mix of exhaust gas with intake charge air
    - More vane closure increases the EGR flow rate (PWM % is high).
    - Less vane closure decreases the EGR flow rate (PWM % is low).
- Enhanced engine brake capability.

The following conditions are present when vane positions are at 90% PWM. See Figure 2-6

- Regulated air pressure to the VNT actuator from the VPOD is at the maximum.
- Regulated exhaust restriction is at the maximum.
- EGR flow is at maximum while operating in EGR mode

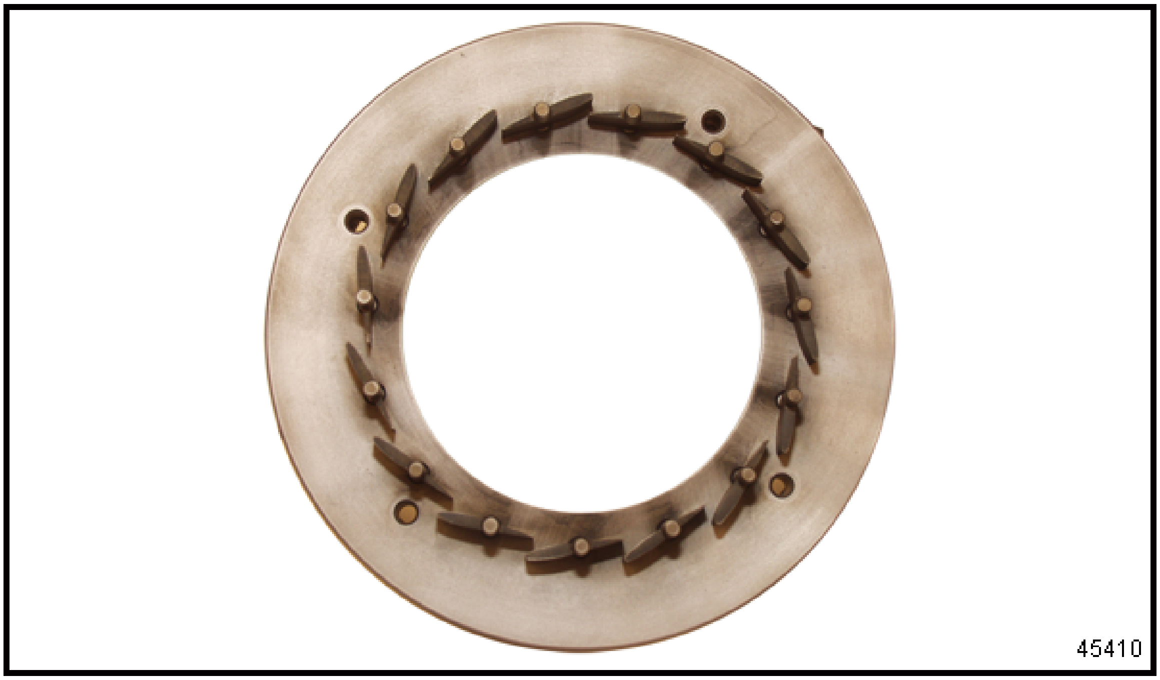


Figure 2-6 Maximum Regulated Air Pressure to the VNT

The following conditions are present when the vane positions are at 50% PWM. See Figure 2-7

- Regulated air pressure is supplied to the VNT actuator from the VPOD
- Exhaust gas restriction is moderate
- EGR flow is increased while operating in EGR Mode

Figure 2-7 Regulated Air Pressure to the VNT

The following conditions are present when the vane positions are at 7% PWM. See Figure 2-8

- Air pressure is not supplied to the VNT actuator from the VPOD
- Exhaust gas restriction is minimal
- EGR flow is minimal while operating in EGR Mode

Figure 2-8 No Air Pressure to the VNT

Variable Nozzle Turbocharger

Variable nozzle turbocharger (VNT), see Figure 2-9, uses a high pressure pneumatic actuator to regulate and control turbine vanes. There is no wastegate with this system. The VNT actuator is mounted on a bracket attached to the turbocharger and receives air pressure from engine-mounted VPODs. VNT actuator connects via a rod to the pin joint of the turbine external arm. Rotation of external arm simultaneously rotates several pivoting nozzle vanes positioned inside turbine housing at the outer periphery of turbine wheel. This adjusts turbocharger speed, boost and EGR flow in accordance with DDEC engine management control.

NOTE:
VNT actuator is spring loaded. If air pressure is lost the actuator will open the VNT vanes resulting in low/no boost.

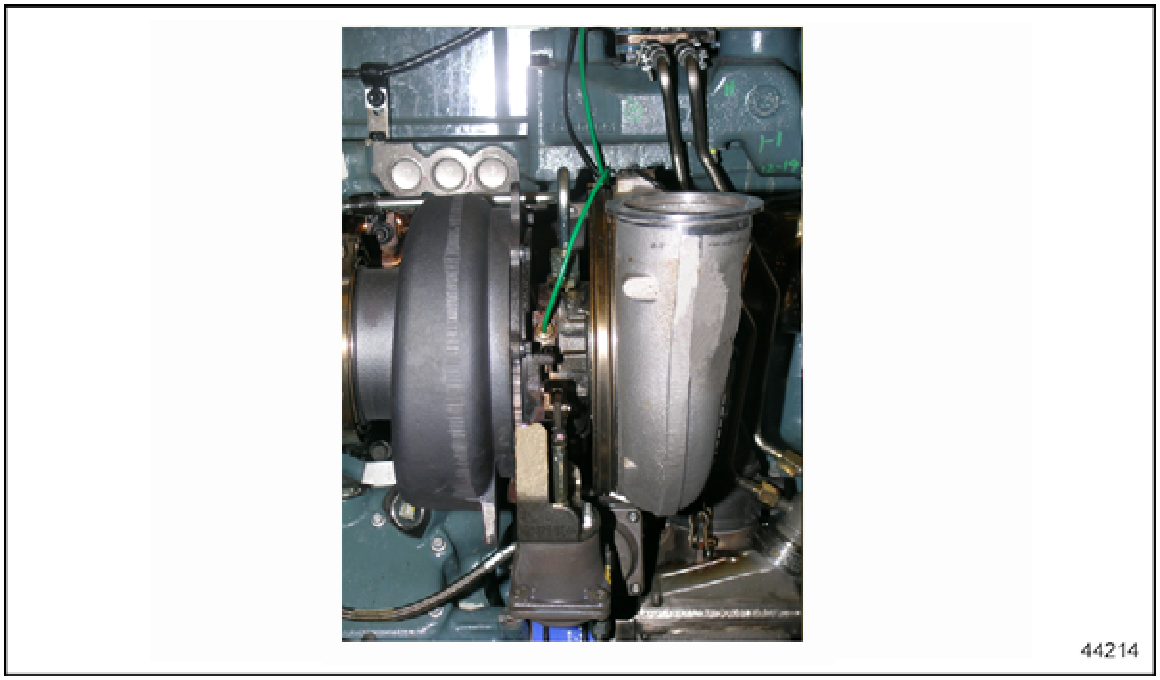


Figure 2-9 Variable Nozzle Turbocharger

Turbocharger Boost Sensor

Turbocharger Boost Sensor (TBS), see Figure 2-10, is used to monitor air pressure in the intake manifold. DDEC IV uses this air pressure data for fuel management during engine acceleration. The TBS sensor is supplied a 5-volt reference signal by ECM and returns a voltage signal to the ECM relative to turbo boost pressure. Return voltage increases as boost pressure increases. Operating values are 0.10-5.0 V during normal engine operation.

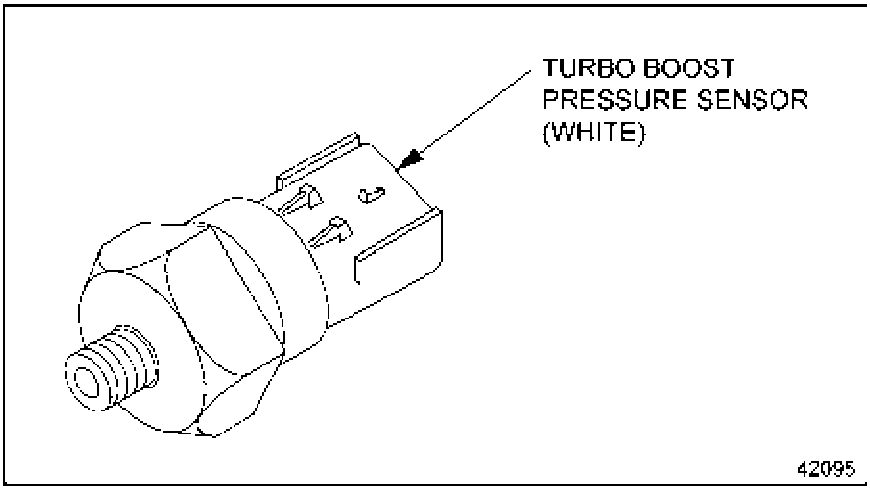


Figure 2-10 Turbocharger Boost Sensor

EGR Valve

EGR valve position is controlled by the ECM. The ECM continuously monitors all engine operation modes and performs self diagnostic checks of RPM, load, altitude, air temperature, etc. and uses this information to determine the EGR valve position. The ECM changes EGR valve position by regulating air pressure output from the VPOD to an actuator mounted to EGR valve. The EGR valve outlet is connected to the EGR cooler and recirculates a fraction of the engine exhaust gases to the intake manifold for purposes of engine emission control. When the EGR valve is closed, exhaust flows from the exhaust manifold, past the turbine wheel into the VNT and out exhaust system in traditional way. See Figure 2-11 to view a pre-2004 EGR valve and see Figure 2-12 to view enhanced EGR valve.

NOTE:
The EGR actuator is spring loaded. If air pressure is lost the actuator will close the EGR valve resulting in no EGR flow.

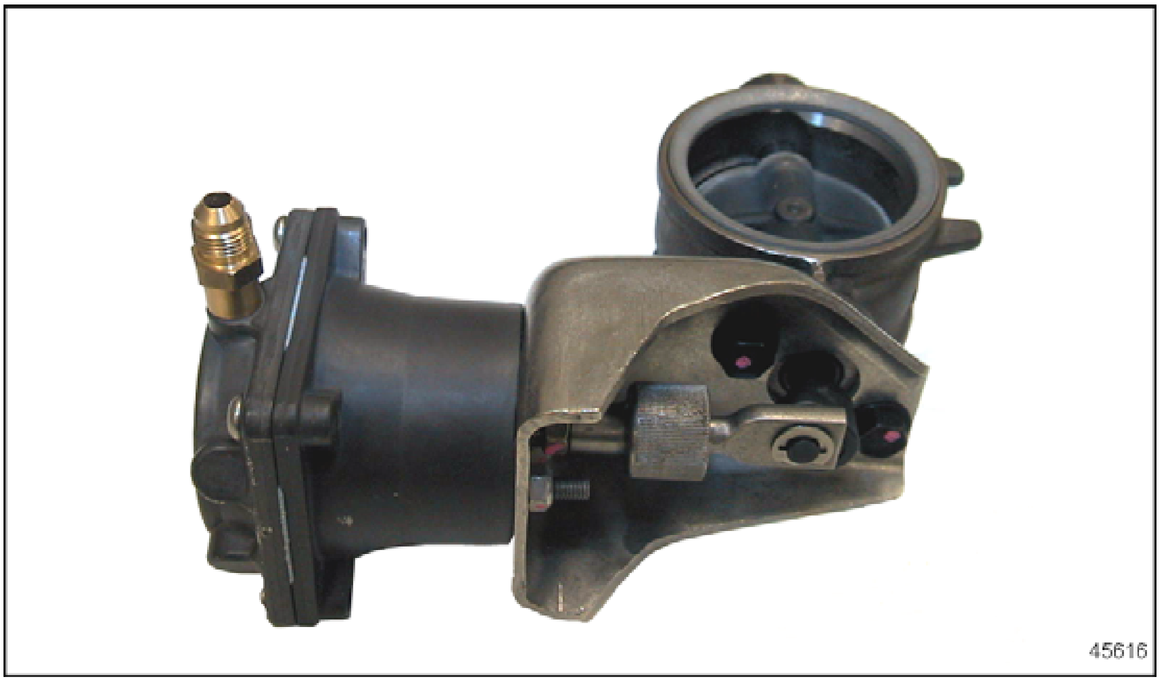


Figure 2-11 Pre-2004 EGR Valve

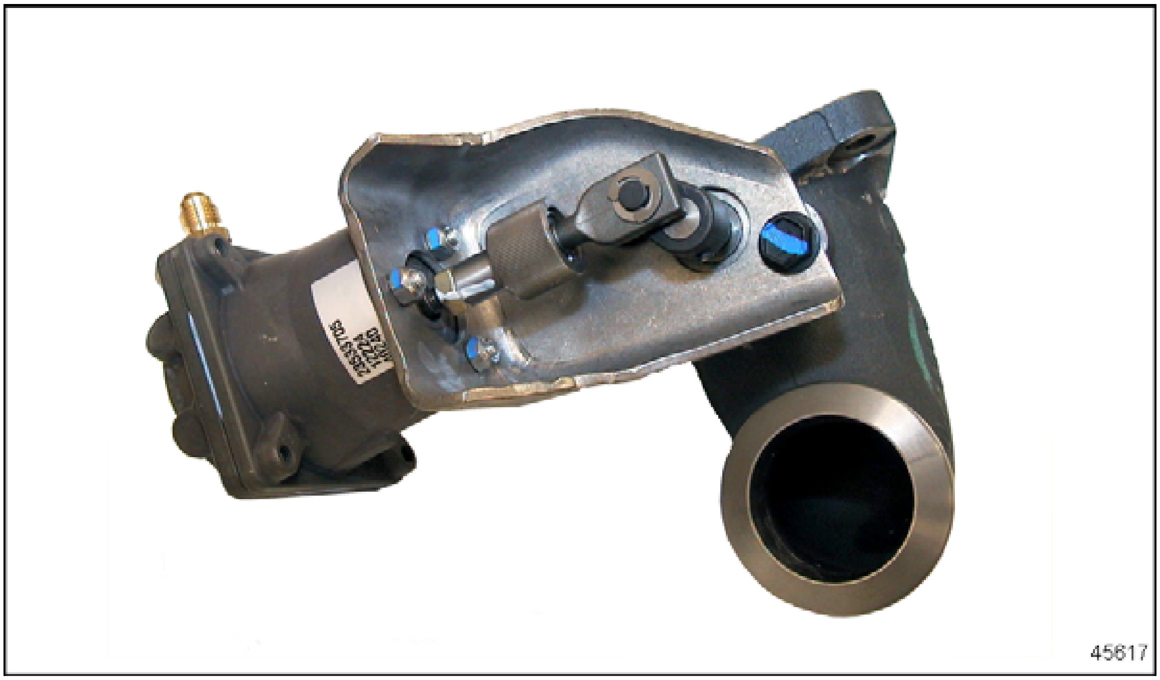


Figure 2-12 Enhanced EGR Valve

EGR Valve Actuator

The EGR valve actuator (see Figure 2-13) regulates EGR butterfly valve.

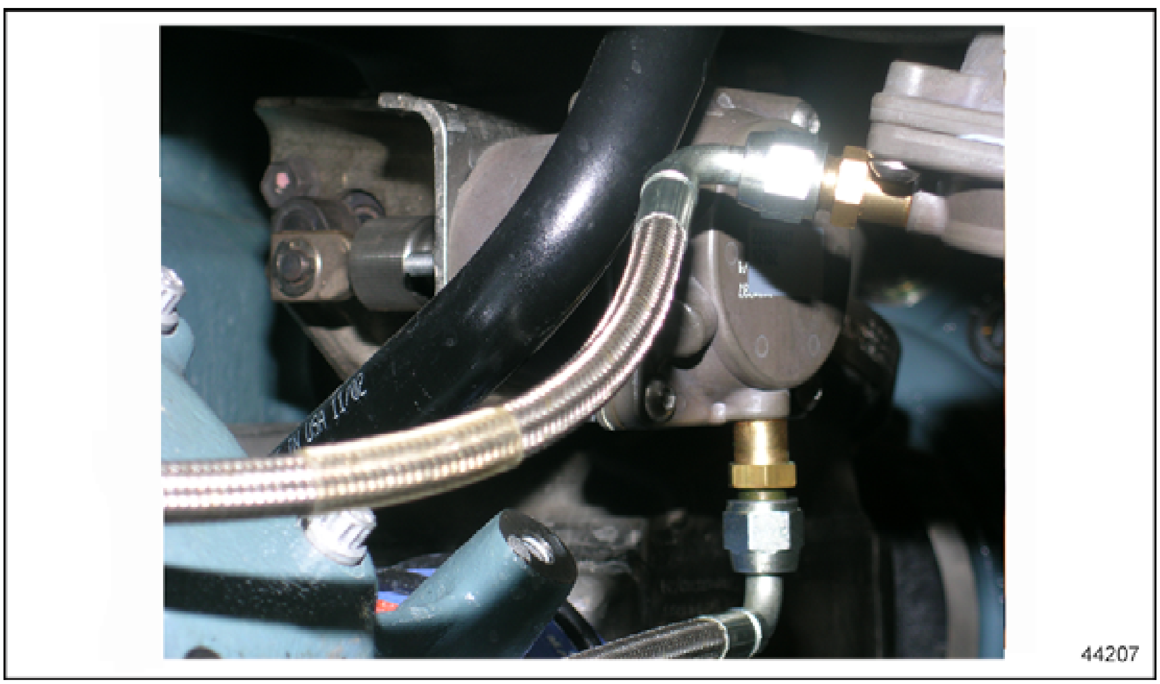
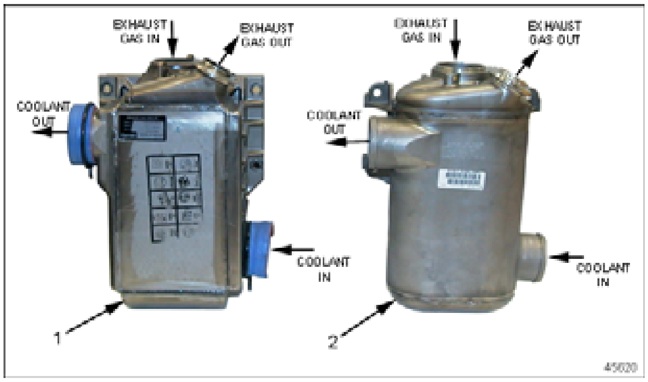


Figure 2-13 EGR Valve Actuator

EGR Cooler

The primary purpose of an EGR cooler is to cool exhaust gases. Coolant that flows through the cooler removes heat from exhaust gases that enter the EGR cooler. See Figure 2-14. See Figure 2-15 for a view of the current EGR cooler.



1. Pre-2004 EGR Cooler
2. Enhanced EGR Cooler

Figure 2-14 Pre-2004 EGR Cooler and Enhanced EGR Cooler

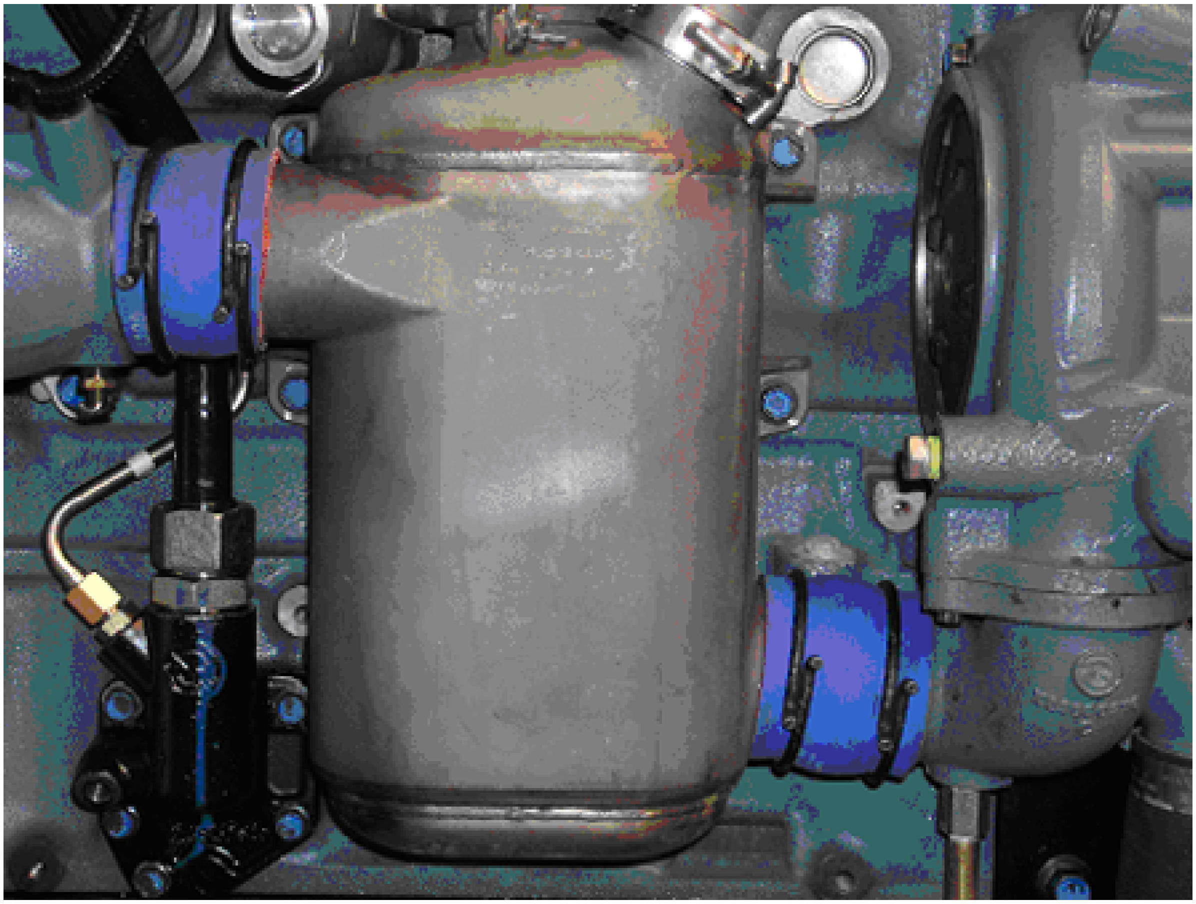


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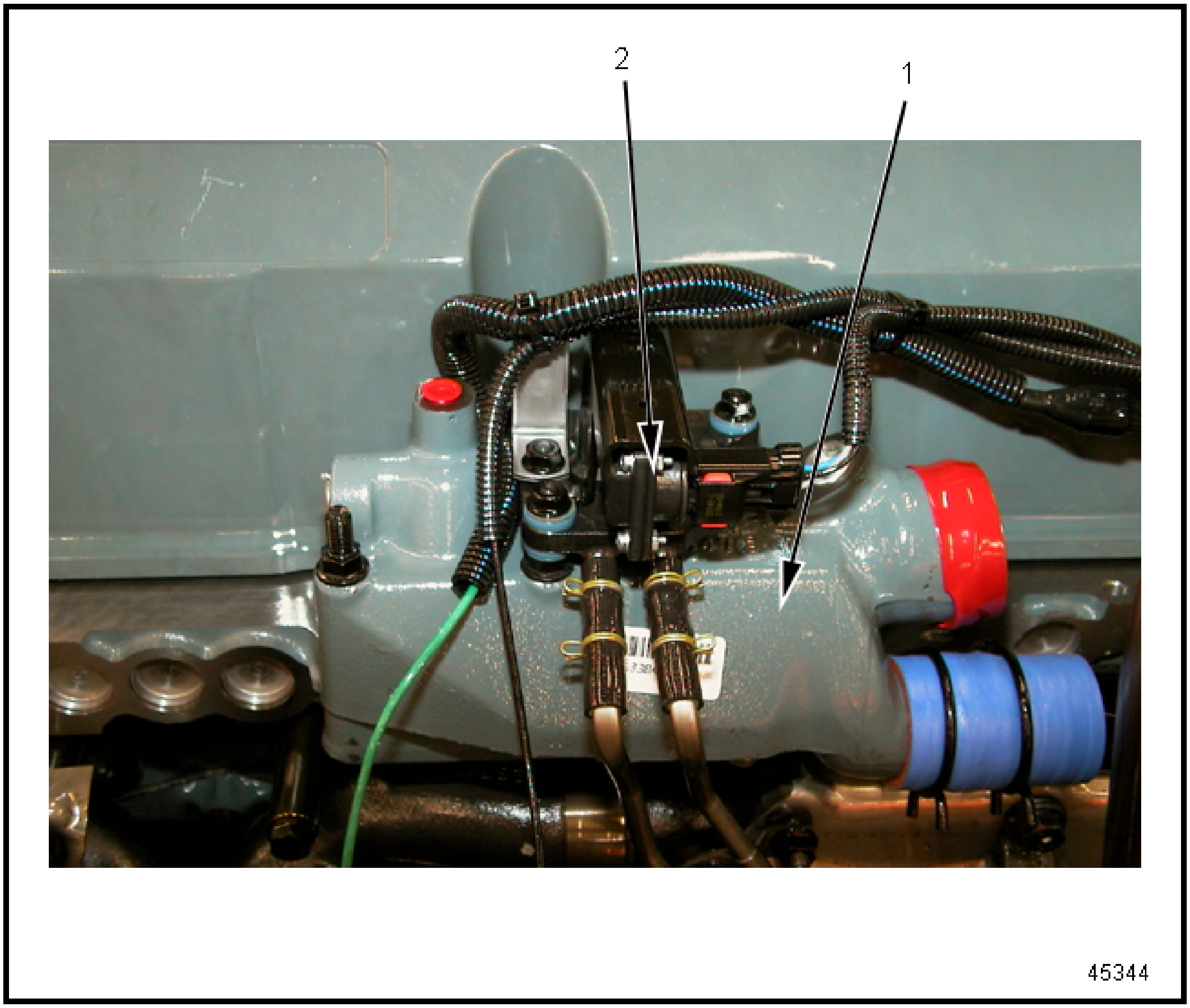
Figure 2-15 View of Current EGR Cooler

Cooling is accomplished by directing exhaust gas past the cooling tubes in the EGR cooler. The EGR cooler core transfers the heat from the exhaust gases to the engine cooling system as the gases are sent to the EGR/charge air mixer. The gases are then mixed with incoming air from the charge air cooler before being sent to the intake manifold.

Delta P Sensor

The Delta P Sensor monitors the pressure differential across the venturi (in the EGR delivery pipe at the EGR cooler outlet) and uses the delta pressure and exhaust temperature to determine the rate of EGR flow. See Figure 2-16. The sensor is supplied a 5-volt reference signal from the ECM and returns a voltage signal to ECM relative to pressure difference across the Venturi tube. Return sensor voltage increases as pressure differential increases during engine operation (operating values are 0.23-4.77 V).



1. Thermostat Housing
2. Delta P Sensor

Figure 2-16 Delta P Sensor

Venturi Tube/Delivery Pipe

A Venturi tube with a port at each end is attached to the EGR delivery pipe at the EGR cooler outlet. The ports are connected to the Delta P Sensor to monitor the pressure differential across the venturi as EGR gases flow through EGR delivery pipe to the charge-air mixer. See Figure 2-17 to view pre-2004 delivery pipe and see Figure 2-18 to view enhanced delivery pipe. The ECM uses this information along with temperature and density of exhaust gases to determine precise EGR mass flow rate. See Figure 2-19 for pre-2004 venturi tube and see Figure 2-20 for enhanced venturi tube.

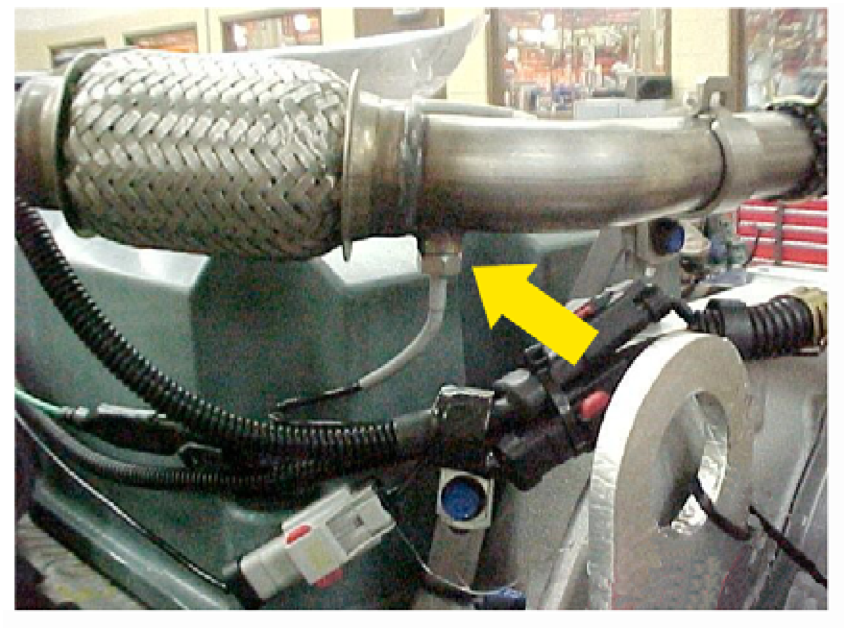


Figure 2-17 Pre-2004 Delivery Pipe

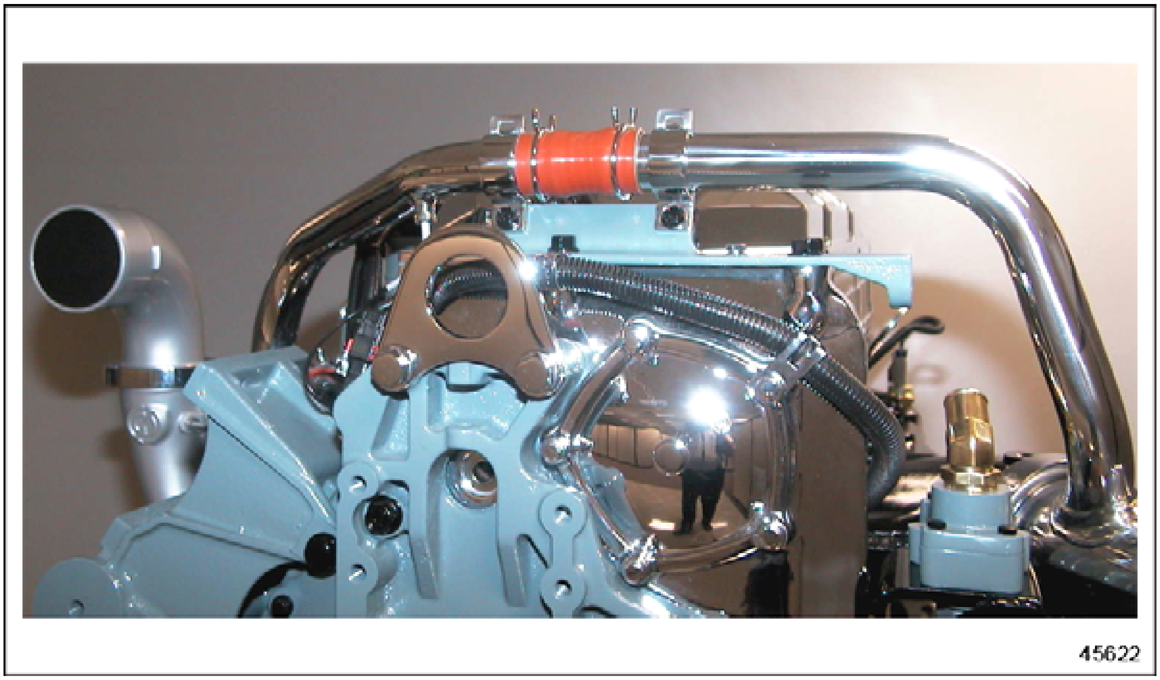


Figure 2-18 Enhanced Delivery Pipe

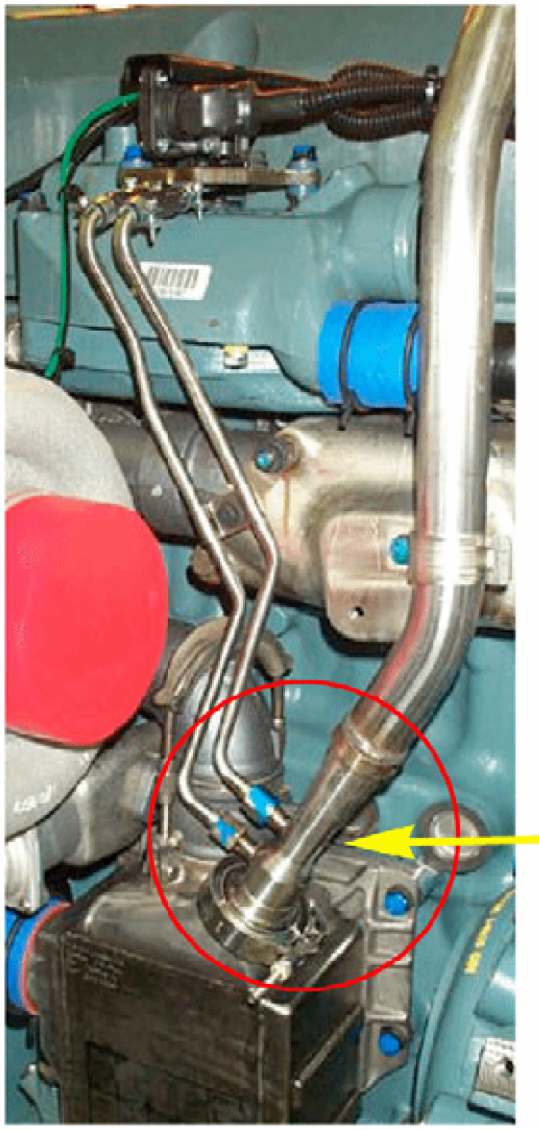


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Figure 2-19 Pre-2004 Venturi Tube

Figure 2-20 Enhanced Venturi Tube

EGR Temperature Sensor

ECM uses the EGR Temperature Sensor to monitor exhaust gas temperatures in the EGR delivery pipe and uses exhaust temperature and delta pressure across the Venturi tube to determine rate of EGR flow. Temperature sensor is supplied a 5-volt reference signal from the ECM and returns a voltage signal to the ECM relative to exhaust gas temperatures in the EGR delivery pipe. Sensor return voltage decreases as exhaust gas temperature increases (sensor operating values are 0.10-5.0 V). See Figure 2-21 to view the sensor with connector.

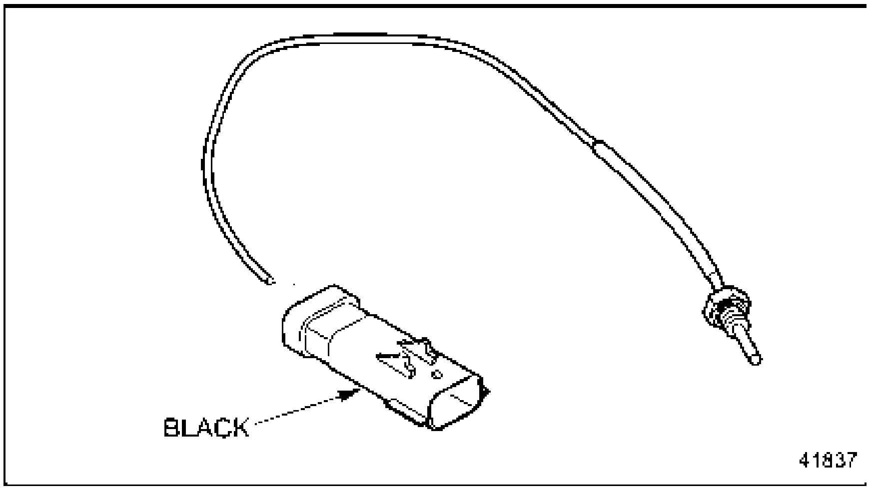


Figure 2-21 EGR Tempertaure Sensor

EGR Mixer

The EGR air mixer combines exhaust gases with the fresh air supply flowing from the charge air cooler. Once the air has passed through the EGR mixer, the intake manifold diffuses EGR gases evenly to each cylinder. Sensors are mounted within the intake manifold to monitor air temperature and boost pressure. See Figure 2-22 for a view of the pre-2004 EGR mixer and see Figure 2-23 for a view of the enhanced EGR mixer.

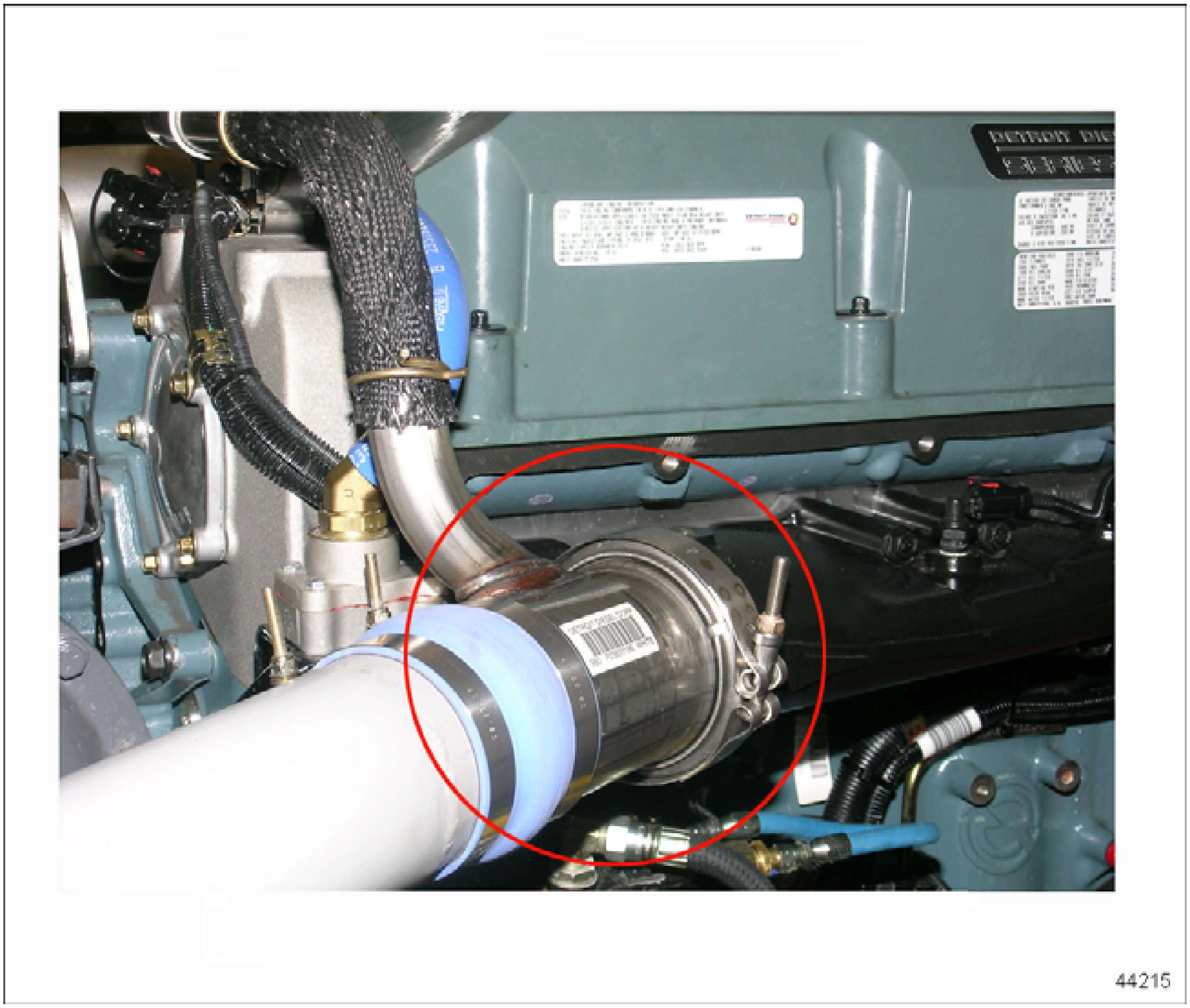


Figure 2-22 Pre-2004 EGR Mixer

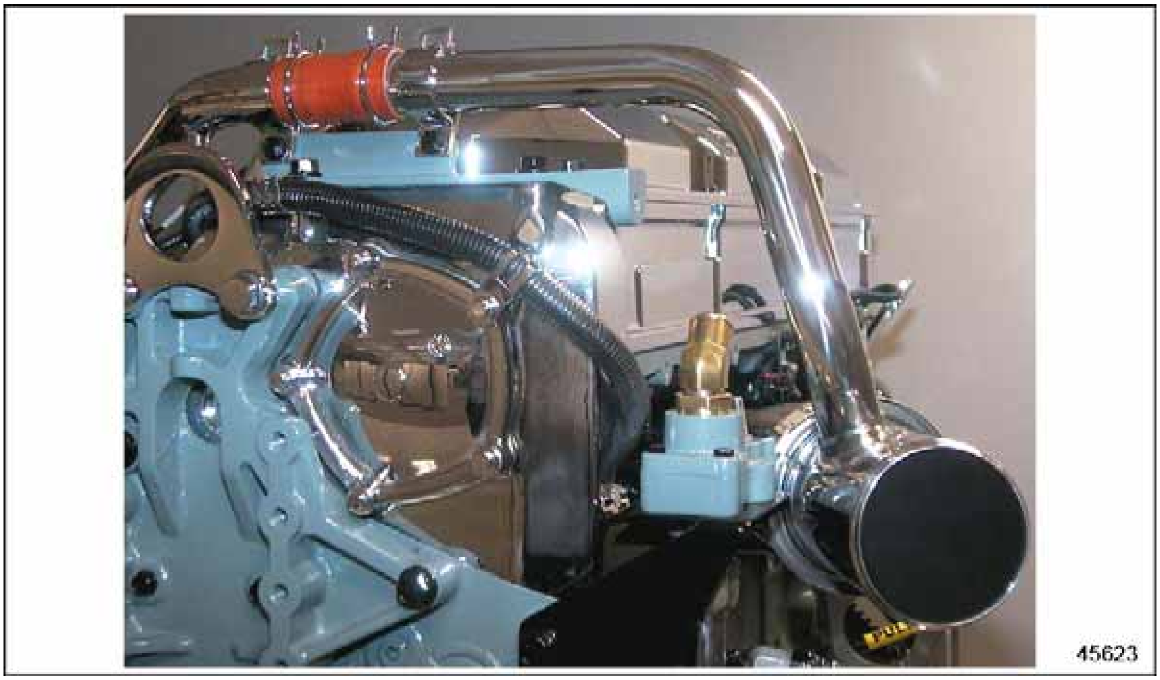


Figure 2-23 Enhanced EGR Air Mixer

Charge Air Cooler

The Charge air cooler (CAC) is mounted in front of the cooling system radiator which is connected to the turbocharger and the intake manifold. Compressed air leaving the turbocharger is directed through the CAC before it goes to the EGR air mixer to be mixed with EGR exhaust gases entering the intake manifold.

Cooling is accomplished by incoming fresh air flowing past the tubes and fins of charge air cooler. Compressed intake charge air flowing inside the CAC core transfers heat to the tubes and fins where it is transferred to the outside air.

The CAC is used to the reduce temperature of the compressed air leaving the turbocharger before entering the intake manifold allowing for a more dense charge of air to be delivered to engine.

Turbocharger Compressor Inlet Temperature Sensor

Turbocharger Compressor Inlet Temperature Senor (TCI) is a DDC part and is installed by the truck manufacturer within piping between the air filter and turbocharger inlet. The TCI sensor which is used to control EGR operation in high humidity and heat conditions that may cause damage to the engine is monitored by DDEC. The ECM will log a fault code for one or more functions of this sensor. Each sensor mode is supplied a 5 V reference signal by the ECM and returns a voltage signal to the ECM relative to temperature and humidity. Return voltage from the TCI sensor increases as atmospheric humidity increases and return voltage decreases as air inlet temperature increases.

The TCI operating values during normal engine operation are 0.23-4.93 V.

High Flow Water Pump

The EGR engine uses a high flow water pump to improve the coolant flow for added heat dissipation.

NOTE:
The high flow water pump is not interchangeable between EGR and non-EGR engines.

3 OPERATIONAL MODES

New terminology has been introduced as a result of the Series 60 EGR engine.

Boost Mode — Boost Mode is when the engine is generating power with **NO EGR** flowing. The EGR valve position is closed and the vanes in the turbocharger adjust to achieve a desired boost level. Boost levels are similiar to 'pre-EGR' engines.

Transition from Boost to EGR Mode — Transition from Boost to EGR Mode is when the engine is generating power using boost pressure and DDEC requests the EGR to begin flow.

EGR Mode — EGR Mode occurs when DDEC is flowing EGR at a desired rate to maintain proper engine operation. The EGR valve position is open and vanes in the turbocharger adjust to achieve the desired EGR rate. Typically boost levels are higher under this operating mode when compared to 'pre-EGR' engines.

EGR Control Mode — EGR Control Mode occurs when the DDEC engine sensors are performing normally and all engine parameters are within calibration limits as determined by the sensor readings. These readings enable DDEC to accurately control exhaust gas flow.

Transition from EGR to Boost — Transition from EGR to Boost Mode occurs when the engine is generating power while flowing EGR and DDEC requests to close the EGR valve and generate power based upon boost pressure.

Braking Mode — Braking Mode occurs when the engine is absorbing energy (power) through an internal engine-braking device. The power for the engine brake is accomplished by activating the desired number of cylinders and adjusting the vanes in the turbocharger to achieve the desired boost level. The EGR valve position is closed during brake mode.

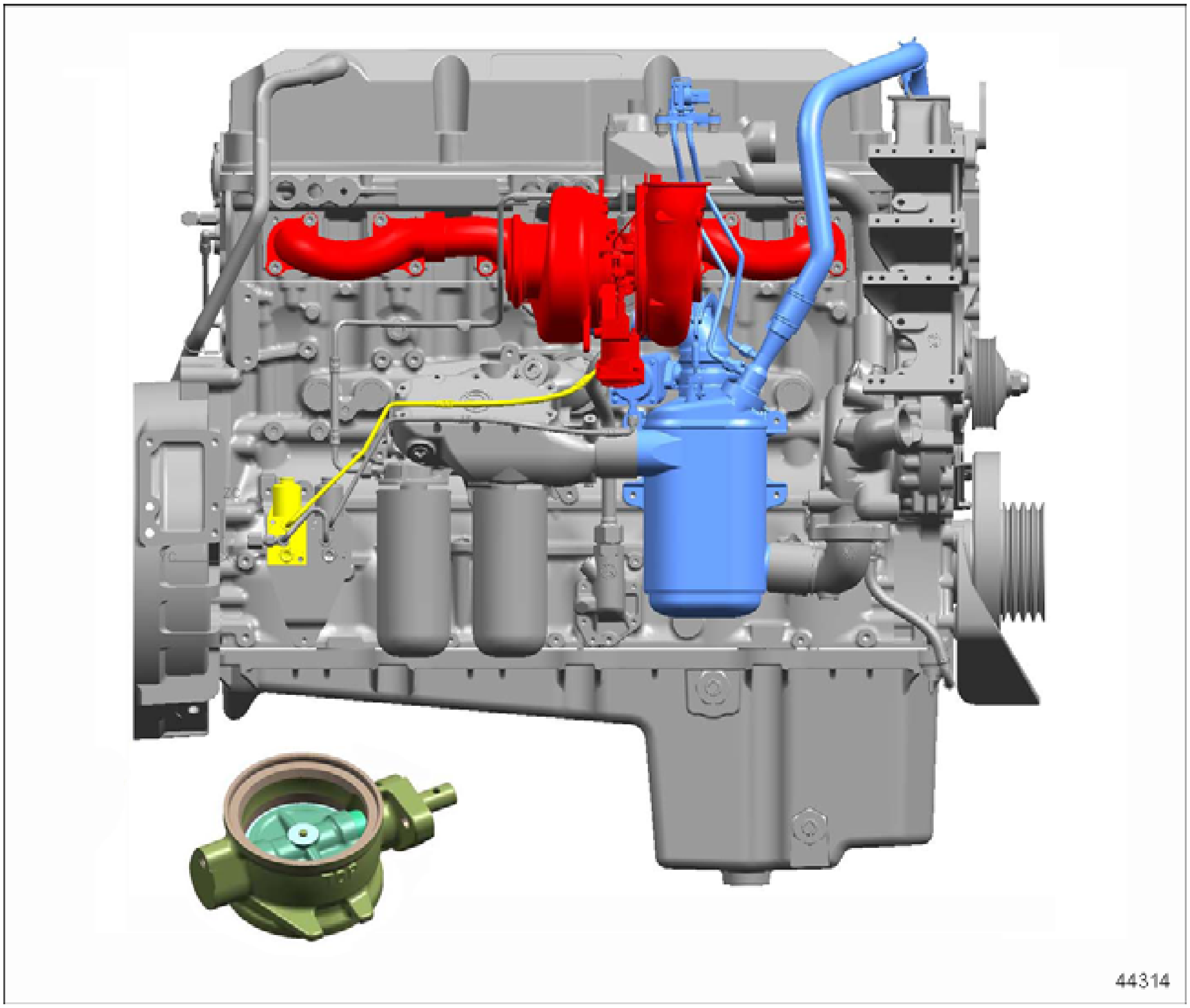
Altitude — The engine will transition between EGR and boost mode at an altitude of 6500 ft. Altitude is determined by the Barometric Pressure Sensor located on the engine. See Figure 2-3.

Condensation Protection— In very cold ambient (i.e. < 30F) conditions the engine will operate in a "condensation protection" mode. EGR is disabled during this mode requiring a slower turbo speed. The engine will sound "different". During this mode of operation the operator will notice a lower "boost" reading compared to when EGR is active, however there is NO reduction of power.

BOOST MODE

During boost mode the following occurs (see Figure 3-1):

- EGR valve closed
- No EGR flowing through the EGR cooler or delivery pipe
- VNT vane position controlled by intake manifold boost pressure and limited by the turbocharger speed



Red = Exhaust Gas

Yellow= Vehicle Air (VPODs)

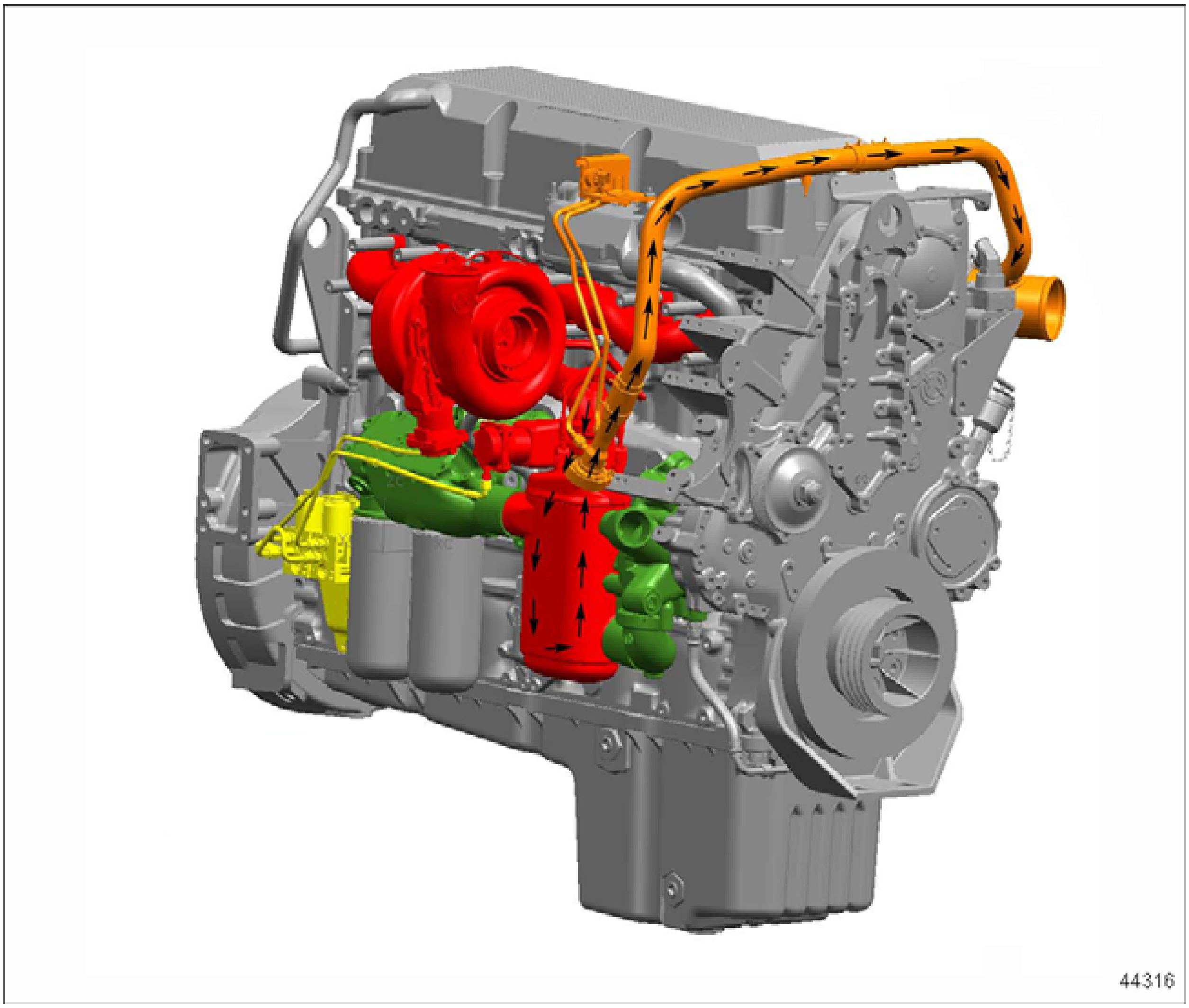
Blue= No EGR Flow

Figure 3-1 Boost Mode EGR Valve Closed

The VNT vane position is adjusted by the VNT actuator air pressure which is regulated by the VPOD. The VPOD determines the correct air pressure via voltage signal from the DDEC V ECM.

Air pressure supplied by the EGR VPOD to the EGR actuator opens the butterfly valve. See Figure 3-2.

Once the EGR butterfly valve opens, the EGR gases flow through the EGR cooler and into the delivery pipe.



Red = Exhaust Gas

Yellow= Vehicle Air (VPODs)

Orange= Cooled Exhaust Gas

Green= Coolant Flow

Figure 3-2 EGR Mode

BOOST MODE OPERATION

A typical boost mode operation consists of:

- □ Accelerating a vehicle from a stationary position and shifting up through the transmission gears
- □ Performing engine brake operation
- □ The vehicle must be at or above 6500 ft of altitude
- □ High ambient humidity to prevent condensation of EGR gases in the intake manifold

TRANSITION FROM BOOST MODE TO EGR MODE

The EGR valve is actuated by the ECM. Initiation of EGR requires minimum engine speed and boost pressure (air flow) in order to transition into EGR mode without an abrupt drop in air/fuel ratio.

Once minimum RPM and boost levels are attained the ECM sends a signal via PWM #2, see Figure 3-3, to initiate the valve opening event by providing air pressure to the EGR actuator.

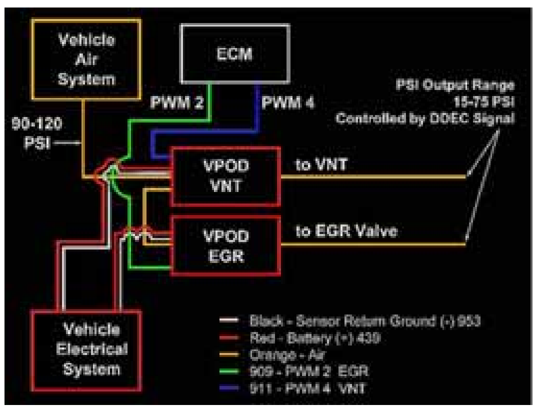


Figure 3-3 Transition from Boost Mode to EGR Mode

EGR MODE

Figure 3-4 illustrates EGR coolant flow.

Exhaust gas enters the EGR cooler at high temperatures and is cooled by the engine coolant system to increase the density of the gas.

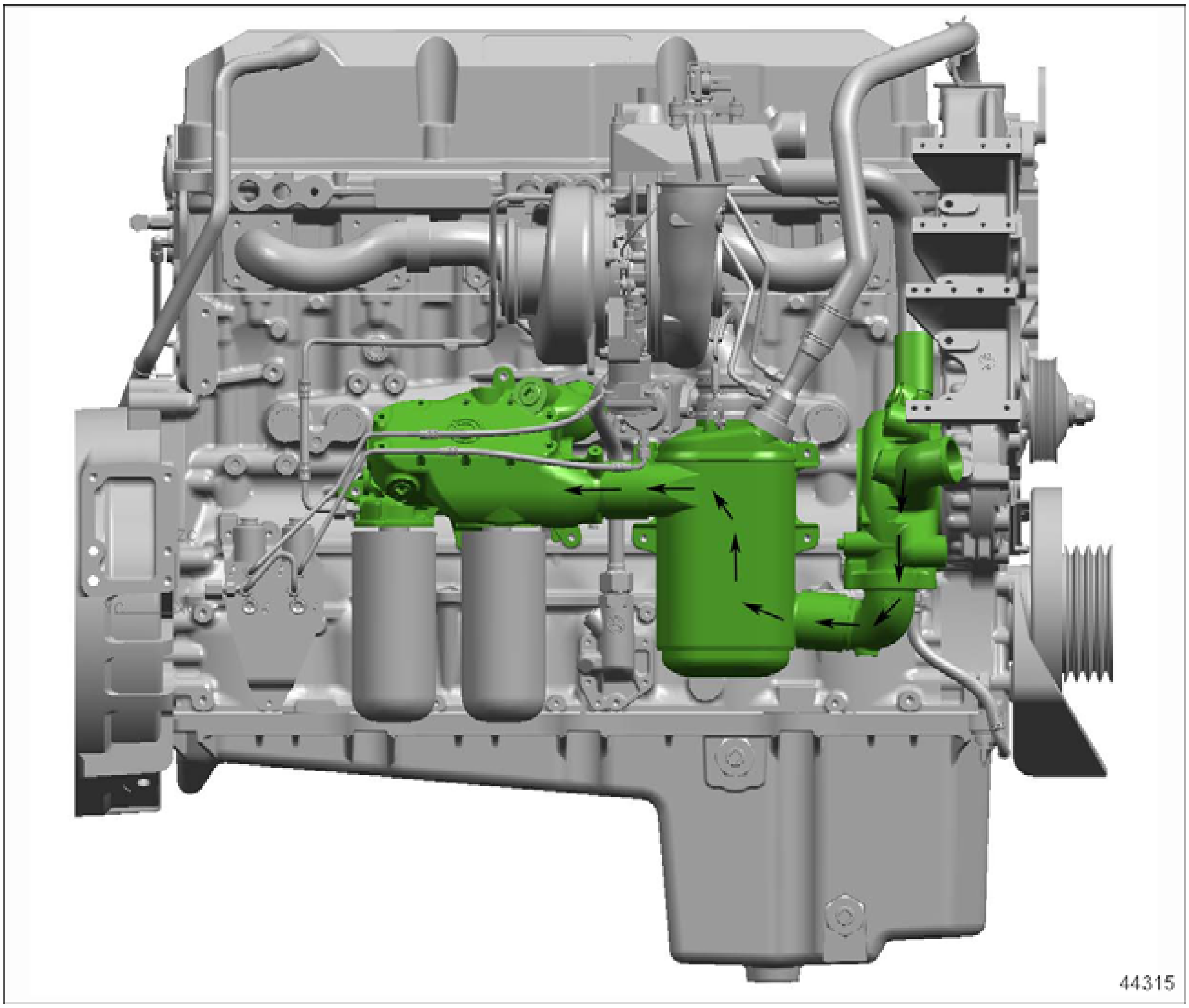


Figure 3-4 Coolant Flow through the EGR Cooler

See Figure 3-5 for EGR measurement.

Once exhaust gases begin flow through the EGR cooler and past the venturi, pressure levels are measured from the two venturi taps or ports. The delta pressure measurement, in conjunction with the EGR temperature determines the EGR flow rate.

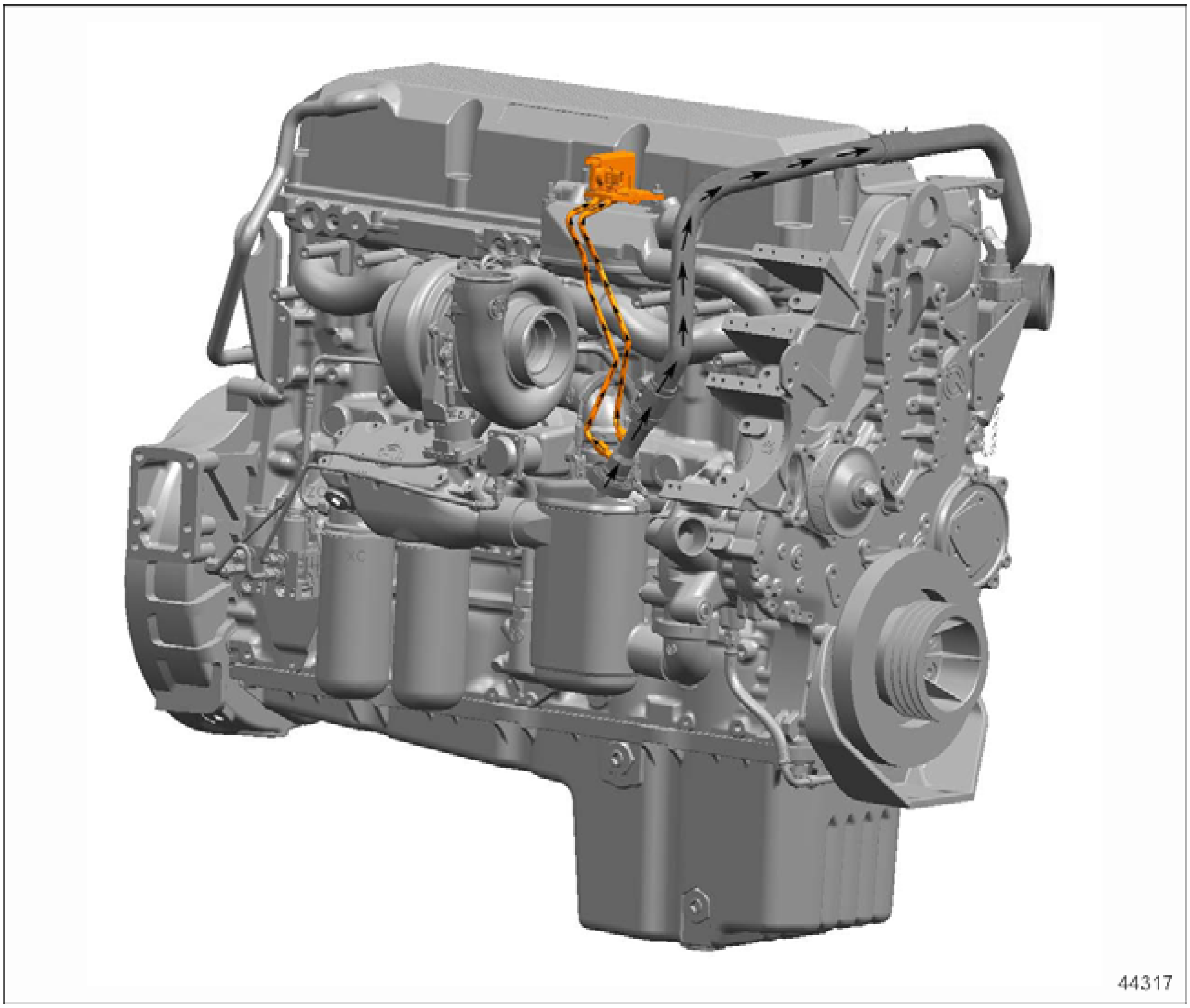


Figure 3-5 EGR Measurement

See Figure 3-7 for VNT control flow.

The VNT turbocharger is the mechanism used to change the EGR rate

The VNT is controlled via the DDEC PWM #4, see Figure 3-6, which regulates the air pressure to change the VNT vane position.

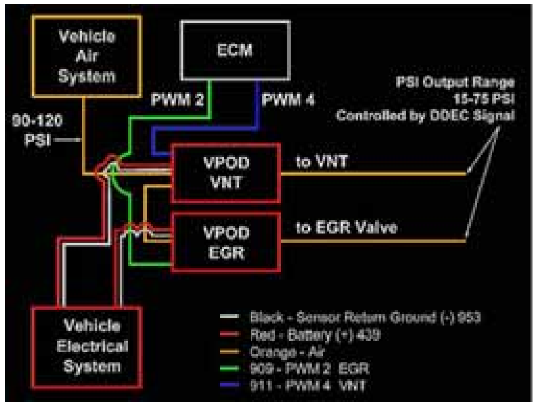
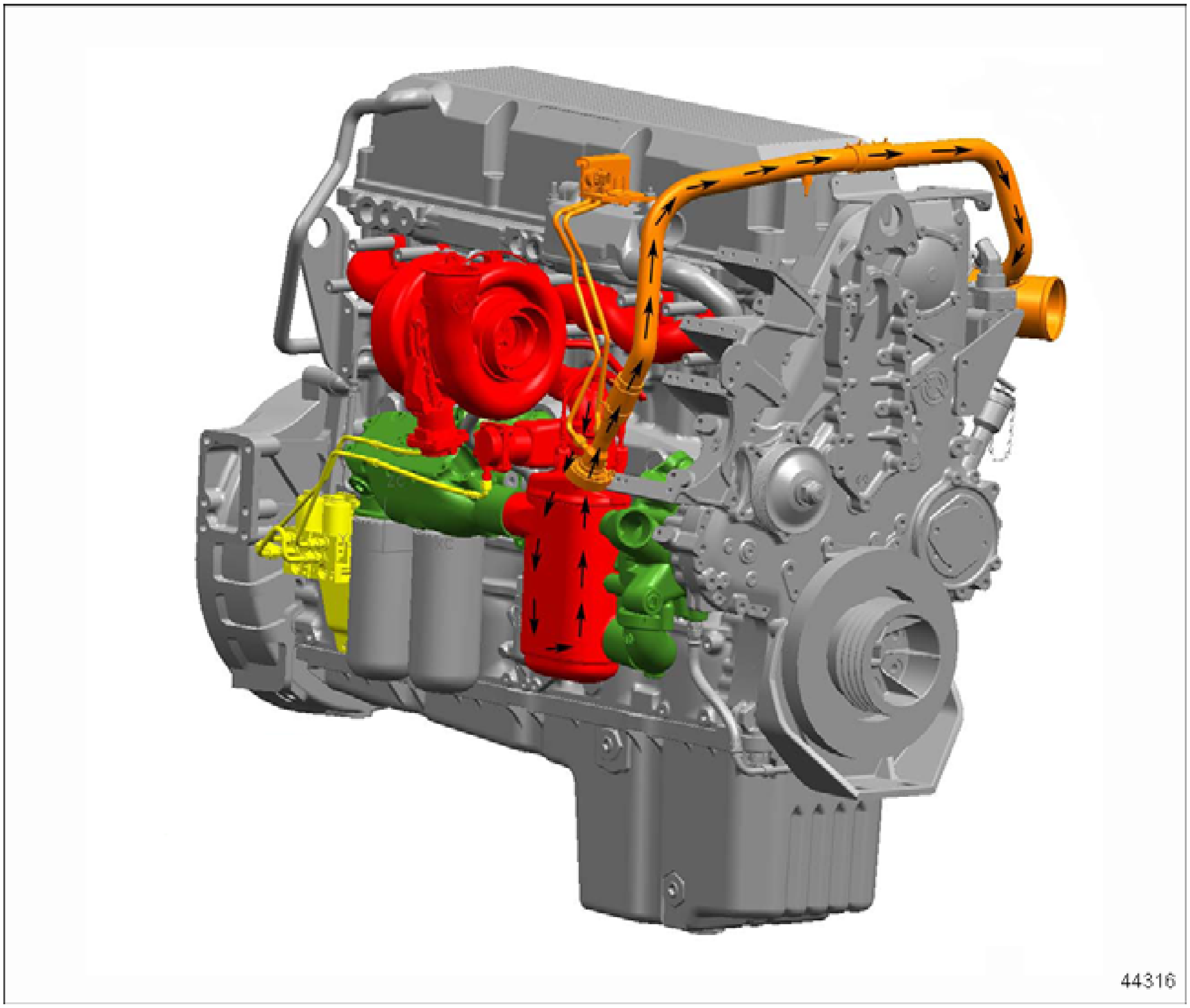


Figure 3-6 EGR Valve and VNT Control System

Changes to the vane position, either closing or opening, result in an increase or decrease to the EGR flow rate. See Figure 3-7.



Red = Exhaust Gas

Orange= Cooled Exhaust Gas

Yellow= Vehicle Air (VPODs)

Green= Coolant Flow

Figure 3-7 VNT Control Flow

4 DDEC IV DIAGNOSTIC CODES

This section supports the DDEC IV fault codes/diagnostic trouble codes (DTC) recorded during EGR engine operation.

The diagnostic trouble codes are generated in the ECM when a condition exists that prevents the engine from operating at peak efficiency. The DTC will help guide the technician to the **condition**. The technician will require a knowledge of the system and proper tools to diagnose the components.

Three primary codes exist; they are Component, Logic, and Engine Protection.

Logic Codes — This code is activated when specific conditions occur within a given amount of time that the calibration determines is not “normal.” For example: If the ECM commands the EGR valve to open or close, the ECM monitors the EGR flow devices for confirmation that flow has begun or ended. **Logic codes identify a condition NOT a component.**

Component/Sensor Codes — This code is activated when a specific component failure exists. This is most commonly seen as a high volt or low volt code for a specific device. The failure can generally be found within the component or wiring for that component.

Engine Protection Codes — This code is activated when a engine operating condition exists that can cause immediate damage to the engine and the engine should be shut down until the condition is corrected to prevent additional damage.

DDEC IV CODE DESCRIPTIONS

To read codes, use the Detroit Diesel Diagnostic Link (DDDL). The DDDL will display active and inactive fault codes which are listed in the following color coded chart.

- Blue = Logic Codes
- Yellow= Component/Sensor Codes
- Red= Engine Protection Codes

DDC Code # (Flashed)	PID	SID	FMI	Description
11	187	-	4	Variable Speed Governor Sensor Voltage Low
12	187	-	3	Variable Speed Governor Sensor Voltage High
13	111	-	4	Coolant Level Sensor Input Voltage Low
14	110	-	3	Coolant Temperature Sensor Input Voltage High
14	175	-	3	Oil Temperature Sensor Input Voltage High
15	110	-	4	Coolant Temperature Sensor Input Voltage Low
15	175	-	4	Oil Temperature Sensor Input Voltage Low
16	111	-	3	Coolant Level Sensor Input Voltage High
17	354	-	3	Relative Humidity Sensor Circuit Failed High
18	354	-	4	Relative Humidity Sensor Circuit Failed Low
21	91	-	3	Throttle Position Sensor Input Voltage High
22	91	-	4	Throttle Position Sensor Input Voltage Low
23	174	-	3	Fuel Temperature Sensor Input Voltage High
24	174	-	4	Fuel Temperature Sensor Input Voltage Low
25	-	-	-	Reserved for “No Codes"
26	-	25	11	Aux. Shutdown #1 Active
26	-	61	11	Aux. Shutdown #2 Active
27	105	-	3	Intake Manifold Temperature Sensor Input Voltage High
27	171	-	3	Ambient Air Temperature Sensor Input Voltage High
28	105	-	4	Intake Manifold Temperature Sensor Input Voltage Low
28	171	-	4	Ambient Air Temperature Sensor Input Voltage Low
29	351	-	4	TCI Temperature Circuit Failed Low
29	404	-	4	TCO Out Sensor Input Voltage Low
31	-	51	3	Aux. Output #3 Open Circuit (High Side) - S3
31	-	51	4	Aux. Output #3 Short To Ground (High Side) - S3
31	-	51	7	Aux. Output #3 Mechanical System Fail - S3
31	-	52	3	Aux. Output #4 Open Circuit (High Side) - T3
31	-	52	4	Aux. Output #4 Short to Ground (High Side) - T3
31	-	52	7	Aux. Output #4 Mechanical System Failure - T3
32	-	238	3	SEL Short to Battery (+)
32	-	238	4	SEL Open Circuit

DDC Code # (Flashed)	PID	SID	FMI	Description
32	-	239	3	CEL Short to Battery (+)
32	-	239	4	CEL Open Circuit
33	102	-	3	Turbo Boost Pressure Sensor Input Voltage High
34	102	-	4	Turbo Boost Pressure Sensor Input Voltage Low
35	100	-	3	Oil Pressure Sensor Input Voltage Low
36	100	-	4	Oil Pressure Sensor Input Voltage Low
37	94	-	3	Fuel Pressure Sensor Input Voltage High
38	94	-	4	Fuel Pressure Sensor Input Voltage Low
39	-	146	2	EGR Leak - Boost Power
39	-	146	12	EGR Leak - Boost Jake
39	-	146	7	EGR Valve Not Responding
39	-	147	2	Low or High Boost-Boost Mode VNT Vanes not responding-Boost Mode
39	-	147	7	Excessive EGR Flow-EGR Mode VNT Vanes not responding-EGR Mode
39	-	147	11	VNT Vanes at Max-Jake Mode
39	-	147	12	Low or High Boost during Jake Operation VNT Vanes not repsonding-Jake Mode
39	-	147	14	EGR Flow too Low
41	-	21	0	Too Many SRS (missing TRS)
42	-	21	1	Too few SRS (missing SRS)
43	111	-	1	Coolant Level Low
44	105	-	0	Intake Manifold Temperature High
44	110	-	0	Coolant Temperature High
44	172	-	0	Air Inlet Temperature High
44	175	-	0	Oil Temperature High
-	105	-	14	Inlet Manifold Temperature Derate
-	110	-	14	Coolant Temperature Derate
45	100	-	1	Oil Pressure Low
46	168	-	1	ECM Battery Voltage Low
46	-	214	1	RTC Backup Battery Voltage Low
46	-	232	1	Sensor Supply Voltage Low
47	102	-	0	Turbo Boost Pressure High
47	106	-	0	Air Inlet Pressure High
48	106	-	1	Air Inlet Pressure Low
48	411	-	1	EGR OPD Low
48	412	-	1	EGR Temperature Low
49	404	-	0	Turbo Compressor Out Temperature High
-	404	-	14	TCO Temperature Derate
51	404	-	3	Turbo Compressor Out Temperature Sensor Input Voltage High
52	-	254	12	A/D Conversion Fail
53	-	253	2	Nonvolatile Checksum Incorrect

DDC Code # (Flashed)	PID	SID	FMI	Description
53	-	253	12	EEPROM Write Error
53	-	253	13	Out of Calibration
54	84	-	12	Vehicle Speed Sensor Fault
55	-	216	14	Other ECM Fault
55	-	231	12	J1939 Data Link Fault
56	-	250	12	J1587 Data Link Fault
57	-	249	12	J1922 Data Link Fault
58	92	-	0	Torque Overload
61	-	xxx	0	Injector xxx Response Time Long
62	-	26	3	Aux. Output #1 Short to Battery (+) - F3
62	-	26	4	Aux. Output #1 Open Circuit - F3
62	-	26	7	Aux. Output #1 Mechanical System Not Responding Properly - F3
62	-	40	3	Aux. Output #2 Short to Battery (+) - A2
62	-	40	4	Aux. Output #2 Open Circuit - A2
62	-	40	7	Aux. Output #2 Mechanical System Not Responding Properly - A2
62	-	53	3	Aux. Output #5 Short to Battery (+) - W3
62	-	53	4	Aux. Output #5 Open Circuit - W3
62	-	53	7	Aux. Output #5 Mechanical System Not Responding Properly - W3
62	-	54	3	Aux. Output #6 Short to Battery (+) - X3
62	-	54	4	Aux. Output #6 Open Circuit - X3
62	-	54	7	Aux. Output #6 Mechanical System Not Responding Properly - X3
62	-	55	3	Aux. Output #7 Short to Battery (+) - Y3
62	-	55	4	Aux. Output #7 Open Circuit - Y3
62	-	55	7	Aux. Output #7 Mechanical System Not Responding Properly - Y3
62	-	56	3	Aux. Output #8 Short to Battery (+) - A1
62	-	56	4	Aux. Output #8 Open Circuit - A1
62	-	56	7	Aux. Output #8 Mechanical System Not Responding Properly - A1
63	-	57	0	PWM #1 Above Normal Range
63	-	57	1	PWM #1 Below Normal Range
63	-	57	3	PWM #1 Short to Battery (+)
63	-	57	4	PWM #1 Open Circuit
63	-	58	0	PWM #2 Above Normal Range
63	-	58	1	PWM #2 Below Normal Range
63	-	58	3	PWM #2 Short to Battery (+)
63	-	58	4	PWM #2 Open Circuit
63	-	59	0	PWM #3 Above Normal Range
63	-	59	1	PWM #3 Below Normal Range
63	-	59	3	PWM #3 Short to Battery (+)

DDC Code # (Flashed)	PID	SID	FMI	Description
63	-	59	4	PWM #3 Open Circuit
63	-	60	0	PWM #4 Above Normal Range
63	-	60	1	PWM #4 Below Normal Range
63	-	60	3	PWM #4 Short to Battery (+)
63	-	60	4	PWM #4 Open Circuit
64	103	-	0	Turbo Overspeed
64	103	-	8	Turbo Speed Sensor Input Failure - Abnormal Period
67	106	-	3	Air Inlet Pressure Sensor Input Voltage High
67	106	-	4	Air Inlet Pressure Sensor Input Voltage Low
68	-	230	5	TPS Idle Validation Circuit Fault (open circuit)
68	-	230	6	TPS Idle Validation Circuit Fault (short to ground)
71	-	xxx	1	Injector xxx Response Time Short
72	84	-	0	Vehicle Overspeed
72	84	-	11	Vehicle Overspeed (Absolute)
73	-	151	14	ESS Transmission Stuck in Gear
73	-	226	11	Transmission Neutral Switch Failure (ESS Transmission)
73	-	227	2	Aux Analog Input Data Erratic, Intermittent, or Incorrect (ESS Transmission)
73	-	227	3	Aux Analog Input #1 Voltage High (ESS Transmission)
73	-	227	4	Aux Analog Input #1 Voltage Low (ESS Transmission)
74	70	-	4	Optimized Idle Safety Loop Short to Ground
74	99	-	0	Oil Filter Restriction High
75	168	-	0	ECM Battery Voltage High
75	-	214	0	RTC Backup Battery Voltage High
75	-	232	0	Sensor Supply Voltage High
76	121	-	0	Engine Overspeed With Engine Brake
77	100	-	0	Engine Oil Pressure High
77	102	-	1	Turbo Boost Pressure Low
77	108	-	0	Barometric Pressure High
77	108	-	1	Barometric Pressure Low
77	174	-	0	Fuel Temperature High
77	354	-	0	Relative Humidity Above Range
77	354	-	1	Relative Humidity Below Range
78	86	-	14	Cruise Control/Adaptive Cruise Control Fault
81	411	—	3	EGR Delta pressure circuit failed high
81	412	—	3	EGR temperature circuit failed high
81	412	—	9	EGR temperature smart sensor not responding
82	-	412	9	EGR Temperature Smart Sensor not Responding
82	-	412	12	EGR Temperature Smart Sensor Failed

DDC Code # (Flashed)	PID	SID	FMI	Description
82	411	—	4	EGR Delta pressure circuit failed low
82	412	—	4	EGR Temperture circuit failed low
83	73	-	0	Pump Pressure High
83	411	-	0	EGR Delta Pressure High
83	412	-	0	EGR Temperature High
85	190	-	0	Engine Overspeed
85	190	-	14	Engine Overspeed Signal
86	73	-	3	Pump Pressure Sensor Input Voltage High
86	108	-	3	Barometric Pressure Sensor Input Voltage High
87	73	-	4	Pump Pressure Sensor Input Voltage Low
87	108	-	4	Barometric Pressure Sensor Input Voltage Low

LOGIC CODES (MECHANICAL FAILURES)

Logic codes indicate the detection of mechanical failures by the DDEC system. The response will be a Flash Code.

Diagnosing Flash Code 39

Failure Mode: **SID 146, FMI 7 — EGR Valve Not Responding**

Indicates: **EGR flow requested by DDEC and no EGR flow detected.**

SID 146, FMI 7 will be set by the ECM if, the signal from the Delta P sensor and EGR temperature sensor indicate EGR flow is below a minimum allowable flow when the ECM is in "EGR Mode" for a period greater than 50 seconds.

Response: The CEL will be illuminated and the system will be forced into "Boost Mode" (EGR is Disabled) for the remainder of the ignition cycle.

Possible Causes:

- □ Defective Delta P sensor
- □ EGR valve mechanical failure (closed)
- □ Exhaust leaking at the S Pipe
- □ Exhaust leaking at the EGR valve
- □ Leaking air lines from the VPOD to the actuators (insufficient air supply)
- □ Leaking or low vehicle air supply to the VPODs
- □ Plugged Delta P ports
- □ Plugged EGR cooler
- □ VPOD mechanical failure
- □ VNT vanes stuck in an open position

Failure Mode: **SID 146, FMI 2 — EGR Leak (Boost Mode)**

Indicates: **No EGR flow requested by DDEC and EGR flow detected.**

SID 146, FMI 2 will be set by the ECM if, the signal from the Delta P sensor and EGR temperature sensor indicate EGR flow is above a maximum allowable flow when the ECM is in “Boost Mode” for a period greater than 50 seconds.

Response: The CEL will illuminate and a fault message will be generated.

Possible Causes:

- □ Defective Delta P sensor
- □ EGR valve mechanical failure (open)
- □ Plugged Delta P lines

Failure Mode: **SID 146, FMI 12 — EGR Leak (Boost Jake)**

Indicates: **No EGR flow requested by DDEC and EGR flow is detected while braking.**

SID 146, FMI 12 will be set by the ECM if, the signal from the Delta P sensor and EGR temperature sensor indicate EGR flow is above a maximum allowable flow when the ECM is in “Jake Mode” for a period greater than 50 seconds.

Response: The CEL will illuminate and a fault message will be generated.

Possible Causes:

- □ Defective Delta P sensor
- □ EGR valve mechanical failure (open)
- □ Plugged Delta P lines

Failure Mode: **SID147, FMI 2 — Low or High Boost-Boost Mode/VNT Vanes Not Responding-Boost Power**

Indicates: **Low boost or high boost.**

SID147, FMI 2 will be set by the ECM if, the signal from the manifold pressure sensor indicates "Actual Boost" is above "Desired Boost" OR "Actual Boost" is below "Minimum Boost" when the ECM is in "Boost Mode" for a period greater than 50 seconds.

Response: The CEL will illuminate and a fault message will be generated.

Possible Causes:

- □ Defective VPOD
- □ Delivery pipe leakage
- □ Exhaust system (manifold) leakage
- □ Leaks in charge cooler system (CAC, hoses, tubes, or clamps)
- □ Leaking or low air supply to VPOD
- □ Low fuel pressure
- □ Mechanical failure, turbocharger actuator
- □ Mechanical failure, VNT vane set
- □ Restricted air intake including air filter

Failure Mode: **SID 147, FMI 7 — Excessive EGR Flow-EGR Mode/VNT Vanes Not Responding-EGR Mode**

Indicates: **EGR flow requested by DDEC and excessive EGR flow detected.**

SID 147, FMI 7 will be set by the ECM if, the signal from the Delta P sensor and EGR temperature sensor indicate EGR flow is above a desired flow for a period greater than 50 seconds.

Response: The CEL will be illuminated and the system will be forced into "Boost Mode" (EGR is Disabled) for the remainder of the ignition cycle.

Possible Causes:

- □ Defective or leaking VPOD
- □ Delta P sensor system measurement incorrect
- □ Mechanical failure, EGR valve
- □ Mechanical failure, turbocharger actuator
- □ Mechanical failure, VNT vane set

Failure Mode: **SID147, FMI 12 — Low or High Boost During Jake Operation/VNT Vanes Not Responding-Boost Jake**

Indicates: **Low boost or high boost while braking.**

SID147, FMI 12 will be set by the ECM if, the signal from the manifold pressure sensor indicates "Actual Boost" is above "Desired Boost" OR "Actual Boost" is below "Minimum Boost" when the ECM is in "Jake Mode" for a period greater than 50 seconds.

Response: The CEL will illuminate and a fault message will be generated.

Possible Causes:

- □ Defective VPOD
- □ Exhaust leaks at "S" pipe or exhaust manifold
- □ Leaks in charge air cooler system (CAC, hoses, tubes, or clamps)
- □ Leaking or low air supply to VPOD
- □ Mechanical failure, EGR valve
- □ Mechanical failure, turbocharger actuator
- □ Mechanical failure, turbocharger failure
- □ Mechanical failure, VNT vane set
- □ Restricted air intake including air filter

Failure Mode: **SID 147, FMI 14 — EGR Flow Too Low**

Indicates: **EGR flow requested by DDEC and insufficient EGR flow detected.**

SID 147, FMI 14 will be set by the ECM if, the signal from the Delta P sensor and EGR temperature sensor indicate EGR flow is below a desired flow for a period greater than 50 seconds.

Response: The CEL will illuminate and a fault message will be generated.

Possible Causes:

- □ Defective Delta P sensor
- □ EGR cooler restriction
- □ EGR valve leaks
- □ EGR valve mechanical failure
- □ Exhaust leaking at the S pipe
- □ Leaking air lines from the VPOD to the actuators (insufficient air supply)
- □ Leaking or low vehicle air supply to the VPODs
- □ Plugged Delta P ports
- □ VPOD mechanical failure
- □ VNT vanes/actuator — mechanical failure

Diagnosing Flash Code 49

Failure Mode: **FMI 0— Turbo Compressor Out Temperature High**

Indicates: **Turbocharger Compressor Inlet temperature or Turbocharger Compressor Outlet temperature exceeds calibrated limits.**

Response: Red Stop Lamp (RSL) will illuminate and fault message will be generated.

Probable Causes:

- □ Restricted air filter
- □ EGR valve stuck open
- □ High exhaust back pressure

Sensor Codes

Specific sensor failures and the system response are listed below:

Barometric Pressure Sensor

Failure Modes: PID 108, FMI 3 - Voltage High and FMI 4 - Voltage Low

Response: The CEL will be illuminated and the engine will be forced into boost mode. The turbocharger vane position will be forced open at idle to reduce turbocharger response.

Turbo Boost Pressure Sensor

Failure Modes: PID 102, FMI 3 - Voltage High and FMI 4 - Voltage Low

Response: The CEL will be illuminated and the system will be forced into boost mode. The turbocharger vane position will be set to a calibrated value to protect the engine and will be torque limited during this fault.

Intake Manifold Temperature Sensor

Failure Modes: PID 105, FMI 3 - Voltage High and FMI 4 - Voltage Low

Response: The CEL will be illuminated and the temperature will be set to a fixed value.

Turbo Compressor Outlet Temperature Sensor

Failure Modes: PID 404, FMI 3 - Voltage High and FMI 4 - Voltage Low

Response: The CEL will be illuminated and the engine will be torque limited to protect the turbocharger and charge air cooler.

EGR Delta-Pressure Sensor

Failure Modes: PID 411, FMI 3 - Voltage High and FMI 4 - Voltage Low

Response: The CEL will be illuminated and the system will be forced into boost mode. The engine will be torque limited during this fault.

EGR Temperature Sensor

Failure Modes: PID 412, FMI 3 - Voltage High and FMI 4 - Voltage Low

Response: The CEL will be illuminated and the temperature will be set to a fixed value.

Turbo Compressor Inlet Temperature Sensor

Failure Modes: PID 351, FMI 3 - Voltage High and FMI 4 - Voltage Low

Response: The CEL will be illuminated and the temperature will be set to a fixed value.

Relative Humidity Sensor

Failure Modes: PID 354, FMI 3 - Voltage High and FMI 4 - Voltage Low

Response: The CEL will be illuminated and the sensor will be set to a fixed value.

Coolant Temperature Sensor

Failure Modes: PID 110, FMI 3 - Voltage High and FMI 4 - Voltage Low

Response: The CEL will be illuminated and the temperature will be set to a fixed value.

Turbo Speed Sensor

Failure Modes: PID 103, FMI 8 - Abnormal Period

Response: The CEL will be illuminated and the system will be forced into boost mode. The VNT vane position will be restricted so the vane will not close beyond a calibrated position. The engine will be torque limited during this fault.

Ambient Air Temperature Sensor

Failure Modes: PID 171, FMI 3 - Voltage High and FMI 4 - Voltage Low

Response: The CEL will be illuminated and the temperature will be set to a calibrated value.

Protection Codes

Engine Protection Codes

When these codes are logged and turn on both the check engine and stop engine lights. This alerts the operator that continued engine operation under those conditions will result in engine damage.

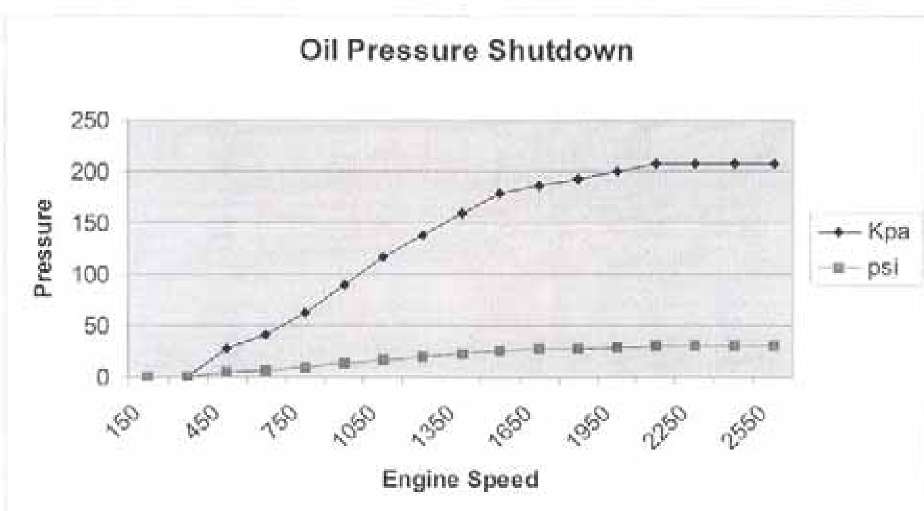
Coolant Temperature High

PID 110 FMI 0 indicates the coolant temperature has risen above the programmed value in the ECM. The temperature limits are listed in Table 4-1.

Oil Pressure Low

PID 100 FMI 1 indicates that the oil pressure has dropped below a programmed value of 30 seconds. Both CEL and SEL will illuminate.

The Series 60 pressure limit parameters and listed below. See Figure 4-1.



	150	300	450	600	750	900	1050	1200	1350	1500	1650	1800	1950	2100
Kpa	0	0	27.5	41	62.1	89.7	117.3	138	159	179.3	186.2	193.11	200	207
psi	0	0	4	6	9	13	17	20	23	26	27	28	29	30

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Figure 4-1 Oil Pressure Shutdown

Coolant Level Low

PID 111 FMI 1

When the coolant level has fallen below the Coolant Level Sensor for 30 seconds, the CEL and SEL will illuminate.

Oil Temperature High

PID 175 FMI 0 indicates that the oil temperature has risen above the programmed value in the ECM. The CEL will illuminate at 239° F (115° C) and the SEL will illuminate at 250° F (121° C).

Listed in Table 4-1 are the vehicle performance temperature limits.

Year	Start Derate	EGR Off	CEL	SEL
Coolant Temperature				
2002	214° F (101° C)	221° F (105° C)	223° F (106° C)	225° F (107° C)
2004	219° F (103° C)	228° F (108° C)	227° F 108(° C)	229° F (109° C)
Compressor Discharge Temperatureat Sea Level				
2002	453° F (223° C)	—	554° F 290° C)	—
2004	445° F (229° C)	—	515° F (268° C)	—
Intake Manifold Temperature				
2002	201° F (93° C)	213° F (100° C)	218° F (103° C)	—
2004	203° F (95° C)	216° F (102° C)	212° F (100° C)	—
Oil Temperature				
2002	239° F (115° C)	—	239° F (115° C)	250° F (121° C)
2004	243° F (117° C)	—	244° F (117° C)	253° F (122° C)

Table 4-1 Temperature Limits

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5 DDEC IV TESTING

The following pages identify a logical troubleshooting flow for specific operational concerns. The complaints and diagnostics are based on conditions identified by the DDC Customer Support Center at 313-592-5800. Information in this publication is accurate as of March 2004.

NOTE:
Prior to performing any DDEC IV troubleshooting or testing procedures, please ensure that the engine's EGR system has been modified. Please refer to:

- Service Information Letter 04 TS-32. For detailed information, 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-32".
- Service Information Letter 04 TS-62. For detailed information, 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-62".

NOTE:
You may also access these TS letters after logging into the DDC Extranet by clicking on **Support, On-highway, Service Information, Service Information Letters, 2004–to-2006**

Troubleshooting Task

- Intermittent Black Smoke
- Power Loss Under Heavy Pull
- Low Boost Under Cold Ambient Conditions
- Derate Codes 110 and 404 FMI 14
- Flash Code 39
- Exhaust Fumes
- Slobbering
- Engine Vibration
- Engine Backfire, Engine Misfire, Intermittent Exhaust Smoke

Testing Procedures are:

- Test A
- Test B
- Exhaust Gas Recirculation System Basic Checks
- Poor performance, high exhaust temperatures, high soot levels, SID 147 codes, and black exhaust smoke checks. For detailed information, 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 05 TS-01.

Intermittent Black Smoke

Perform the following steps for **Intermittent Black Smoke**.

1. Check for Flash Codes. If Flash Codes were logged, diagnose the logged codes first.
2. Visually inspect the air filter for restrictions. If the air filter is clogged or dirty, replace the air filter.
3. Visually inspect the air inlet hoses for soft or collapsed areas. If the air inlet hoses are damaged, replace as necessary.
4. Visually inspect the air inlet for restrictions. If the air inlet has restrictions, clean as necessary.
5. Perform “Test A” in the “Testing Procedure” section.
6. Perform the checks in the “Exhaust Gas Recirculation System Basic Checks” section. Refer to the “Exhaust Gas Recirculation System Basic Checks for Series 60 Engines” section of the *DDDEC III/IV Single ECM Troubleshooting Guide, (6SE497).*
7. Test drive the vehicle with DDDL and perform a snapshot. Analyze the snapshot.
8. Perform “Test B” in the “Testing Procedure” section.

Power Loss Under Heavy Pull

With power loss under heavy pull and in extreme cold ambient conditions, the engine will operate in **Condensation Protection**. During this mode of operation, the engine **boost** will be reduced and there is no reduction of power. Operating in this mode is a normal operating condition and will not affect engine life or performance.

NOTE:
Trucks operating with winter fronts will experience this condition less often. DDC's recommendations have not changed regarding winter front usage.

Perform the following steps for **Power Loss Under Heavy Pull**.

1. Check for diagnostic trouble codes. If Fault Codes are logged, diagnose the logged codes first.
2. Visually inspect the air filter restrictions. If the air filter is clogged or dirty, replace the air filter.
3. Visually inspect the air inlet hoses for soft or collapsed areas. If the air inlet hoses are damaged, replace as necessary.
4. Visually inspect the air inlet for restrictions. If the air inlet has restrictions, clean as necessary.
5. Visually inspect the entire length of the breather tube for kinks. If the breather tube has kinks, repair as necessary.
6. Measure the fuel pressure under heavy loads.
   [a] If the fuel pressure was spiking or decreasing, perform step 7.
   [b] If the fuel pressure was not spiking or decreasing, testing is complete.
7. Remove the fuel pump.
   [a] If the fuel pump is damaged, replace the fuel pump.
   [b] If the fuel pump is not damaged, perform step 8.
8. Remove the fuel injectors and inspect for combustion passing the seat.
   [a] If seats are damaged, replace as necessary.

NOTE:
The fuel injector may need to be replaced also.

   [b] If the seats are not damaged, testing is complete.

Low Boost Under Cold Ambient Conditions

In extreme cold ambient conditions, the engine will operate in **Condensation Protection**. During this mode of operation, the engine **boost** will be reduced and there is no reduction of power. Operating in this mode is a normal operating condition and will not affect engine life or performance.

NOTE:
Trucks operating with winter fronts will experience this condition less often. DDC's recommendations have not changed regarding winter front usage.

For low boost under cold ambient conditions, clear fault codes and return the engine to service

Flash Codes 14 and 29

Perform the following steps for codes indicating a derate condition, Flash Codes 14 (PID 110/FMI14 and Flash Code 29 (PID 404/FMI 14).

1. Determine if derate is typical operation (refer to Appendix D, *Service Information Letter* 03 TS-23).

NOTE:
During **Typical** engine operating conditions, the engine will derate to prevent damage. Higher ambient temperatures and loads will increase the frequency of DDEC applying this derate logic. If the derate is occurring only occasionally, this is **Typical**. If the derate occurs more than **Typical** for given operating conditions, continue investigation for possible defects.

   [a] If considered **Typical**, clear Fault Codes and return the engine to service.

   [b] If determined to be abnormal frequency, perform step 2.

2. Remove the water pump and inspect the pump impeller.

   [a] If the impeller is damaged, replace the water pump.

   [b] If the impeller is not damaged, reuse the water pump and replace the EGR cooler.

Flash Code 39

Perform the following steps for Flash Code 39 (SID 146/FMI 2, 7 or 12).

1. Perform the checks in the "Exhaust Gas Recirculation System Basic Checks" section.
2. Perform Test A in the "Testing Procedures" section.
3. Test drive the vehicle with DDDL and perform a snapshot. Analyze the snapshot.
4. Inspect the VPOD air supply for leaks. If the VPOD air supply has leaks, repair the leak.
5. Perform Test B in the "Testing Procedures" section.

Exhaust Fumes

Perform the following steps for **Exhaust Fumes**.

1. Visually inspect the exhaust system for leaks (e.g. exhaust manifold, S-pipe, and turbocharger).
   [a] If exhaust leaks were detected, repair as necessary.
   [b] If no exhaust leaks were detected, perform step 2.
2. Tighten all S-pipe clamps to the proper torque specification.
3. Reprogram the ECM.

Slobbering

Perform the following steps for **Slobbering**.

1. Visually inspect the entire length of the breather tube for kinks.
   [a] If the breather tube is damaged, repair as necessary.
   [b] If the breather tube is not damaged, perform step 2.
2. Perform a DDC Extraction of DDEC Reports.

NOTE:
Review extraction for excessive idle time. Times of 35% and higher are considered excessive.

3. Drain the engine lubrication oil pan.
4. Refill the lubrication oil pan with 32 quarts of approved engine oil and visually inspect the oil dipstick marking.
   [a] If the oil dipstick marking is incorrect, replace the dipstick with a proper dipstick.
   [b] If the oil dipstick marking was correct, testing is complete.

Engine Vibration

Perform the following steps for **Engine Vibration**.

1. Using a 0.060 in. feeler gage, measure the clearance between the bottom of the steel engine mount and the rubber biscuit at the rear engine chassis mounts.
   [a] If the engine mount clearance is less than 0.060 in., replace the mount.
   [b] If the engine mount clearance is greater than 0.060 in., testing is complete.

Engine Backfire, Engine Misfire, Intermittent Exhaust Smoke

For engine backfire, engine misfire, and intermittent exhaust smoke reprogram the ECM.

TESTING PROCEDURES

NOTE:
If further repair, removal, and DDDL procedures are required when performing the testing procedures, please refer to the *Series 60 Service Manual, (6SE483)* or contact the EDS Support Line for DDDL specific questions.

Test A

Perform Test A 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 30 psi using special tool TLZ00100 or equivalent.
3. Monitor the boost psi using DDDL.
   [a] If the pressure is below 27 psi, visually inspect the CAC, hoses, and the delivery tube for leaks.
   [b] If the pressure is at 27 psi or higher, continue to step 4.
4. Activate EGR VPOD (PWM #2) to 90% using the DDDL.
5. Monitor the boost psi pressure for pressure drops when the EGR valve opens.

NOTE:
The pressure should have dropped significantly to approximately 9 psi.

   [a] If the air pressure dropped to 9 psi, no further testing is required and Test A has been completed.
   [b] If the pressure only dropped slightly, perform step 6 through step 8.
6. Physically inspect the EGR valve for a mechanical failure. If the EGR valve is not functioning correctly, replace the EGR valve.
7. Visually inspect the EGR cooler for restrictions. If the EGR cooler is restricted, replace the EGR cooler.
8. Visually check the delivery pipe for restrictions. Clean the pipe as necessary to remove restrictions.

Test B

Perform Test B 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° F [76° C] coolant temperature).
2. Activate the VPOD outputs to 90% and then back it down to 7% using the DDDL. Visually inspect the VNT and EGR valve for proper rod travel (full travel to stops).
   [a] If the VNT is not functioning properly, verify VNT vanes are moving freely. For detailed information, 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.
   [c] If both the VNT and EGR valve have proper movement the test is complete.

NOTE:
Repeat this step three times.

Exhaust Gas Recirculation System Basic Checks

Perform the following basic steps to check the exhaust gas recirculating system.

For all EGR related concerns (may include exhaust smoke complaints), 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:

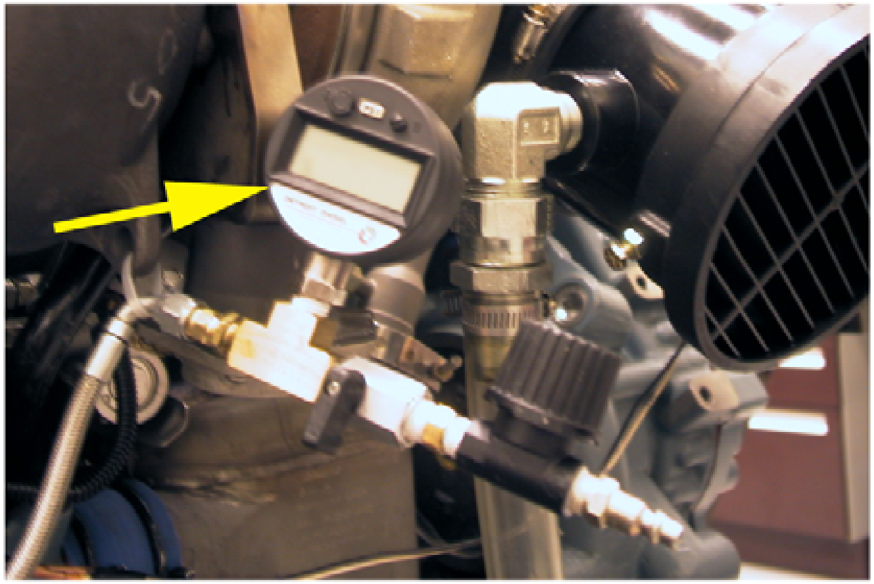
- □ 1,000 Ohm resistor (low watt)
- □ DDR suite 8 or DDDL version 4.2 or higher
- □ Volt Ohm Meter
- □ Pressure gage 0-200 psi
- □ Pressure gage 0-100 psi

Check Delta P Sensor and Barometric Sensor

Follow these steps to check the Delta P sensor:

1. Turn ignition ON.
2. Plug in DDDL or a DDR.
3. Read Delta P counts (EGR DPS)
   [a] If Delta P counts read 86-135, verify that the EGR pipes and hoses are correctly assembled from the EGR tube to the Delta P sensor. Reversed hoses or pipes will create black smoke and surging. Go to step 3[b].
   [b] Also inspect carefully for split or leaking pipes or hoses in the EGR mixer tube from the EGR cooler to the intake manifold. If hoses and pipes are correct, perform. check VPOD output pressure (refer to the next section).
   [c] If counts do not fall within the 86-135 range, replace Delta P sensor; then go to the “Verification” section.
4. Measure and record barometric sensor pressure and compare recorded value to the intake pressure sensor value.
   [a] If the sensor readings differ more than 4.14 kPa (0.6 psi), replace the barometric sensor.
   [b] If the sensor readings do not differ more than 4.14 kPa (0.6 psi), task is complete.

Check VPOD Output Pressure



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Follow these steps to check the VPOD input and output pressure:

NOTE:
Listen for air leaks at the VPOD during the test.

WARNING:

PERSONAL INJURY

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

1. Disconnect the air hoses from the EGR and VNT (Variable Nozzle Turbine) actuators.
2. Install pressure gauges (accurate to within 1.4 kPa [0.2 psi]) at the outlet of the EGR and VNT hoses. (Use two gauges, or test separately.)
3. Using the DDDL/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 steps 5[a] and 5[b].

5. Test: activating 90% duty cycle: Pressure = 485 - 515 kPa (70-75 psi).
   - [a] If the VPOD readings are as listed, check for active codes. Refer to the “Check for Active Codes” section.
   - [b] If the results in this step cannot be attained, check VPOD input pressure. Refer to the “Check VPOD Input Pressure” section.

NOTE:
Both activations must operate their component with full travel of the linkage to hit the stops.

Check Variable Output Pressure Device Input Pressure

Testing steps are as follows.

1. Measure the VPOD input pressure to port 1; ensure it is between 703-1296 kPa (90 – 120 psi).
   - [a] If the supply pressure is greater than 703-1296 kPa (90-120 psi), troubleshoot the vehicle air system until that result is obtained.
   - [b] If the supply pressure is greater than 703-1296 kPa (90-120 psi), check the VPOD part number (P/N) and supply voltage. Refer to the “Check Variable Output Pressure Device Part Number and Supply Voltage” section.
2. Perform a Check Variable Output Pressure Device Part Number and Supply Voltage .

Check Variable Output Pressure Device Part Number and Supply Voltage

The following checks should be performed for the VPOD part number and supply voltage:

1. Check the VPOD label to determine if it is +12V or +24V compatible.
2. Unplug VPOD's 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 volt ohm meter (VOM)
   - [a] Turn ignition switch ON.
   - [b] Measure voltage from pin 3 to pin 1.
   - [c] Plug in either DDDL or DDR and check ECM voltage.
3. Is the VPOD P/N and voltage, and ECM voltage correct?
   - [a] If the VPOD P/N and voltage are correct, check VPOD wiring. Refer to the “Check VPOD Wiring” section.
   - [b] If the VPOD P/N and voltage are not correct, contact the DDC Customer Support Center at 313-592-5800.

Check VPOD Wiring

The following checks should be performed for the VPOD wiring.

NOTE:
VPOD power should have been verified under the part number check. If not, refer to the "Check Variable Output Pressure Device part number and Supply Voltage" section.

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 DDDL or a DDR, activate the PWM #2 (EGR Valve) and PWM #4 (VNT), and ensure:
   - [a] Activating 11% duty cycle: VDC = 90% of the VPOD supply voltage ± 1 volt (e.g., voltage to VPOD = 13.8V * 0.9 = 12.42V; therefore 11.42V to 13.42V at PWM is acceptable).
   - [b] Activating 90% duty cycle: VDC = 10% of the VPOD supply voltage ± 1 volt. (e.g., voltage to VPOD = 13.8V * 0.1 = 1.38V, therefore 0.38V to 2.38V at PWM is acceptable.)
6. Note any air leakage when PWMs are activated to 90% and correct the leaks as needed.
   - [a] If both of the PWM voltage measurements are correct, replace the VPOD that had the wrong pressure reading.
   - [b] If the PWM voltage measurements are incorrect, and the wiring checks are okay, try a test ECM programmed for EGR, or contact the DDC Customer Support Center at 313-592-5800.

Check for Active Codes

Check for active codes as follows:

1. Turn ignition ON.
2. Plug in DDDL or a DDR.
3. Read active codes.
4. Record or print codes. Ensure that PID, SID, and FMI are recorded. Refer to the proper code section of the *DDEC III/IV Single ECM Troubleshooting Guide*, (6SE497) 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 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 to protect other engine components.

5. If the issue is not related to the EGR system components, or if assistance is needed, contact Detroit Diesel Customer Support Center at 313-592-5800.

Verification

Follow these steps to test:

1. Reassemble connectors or components.
2. Start and run the engine.
3. Perform a 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 Support Center at 313-592-5800.

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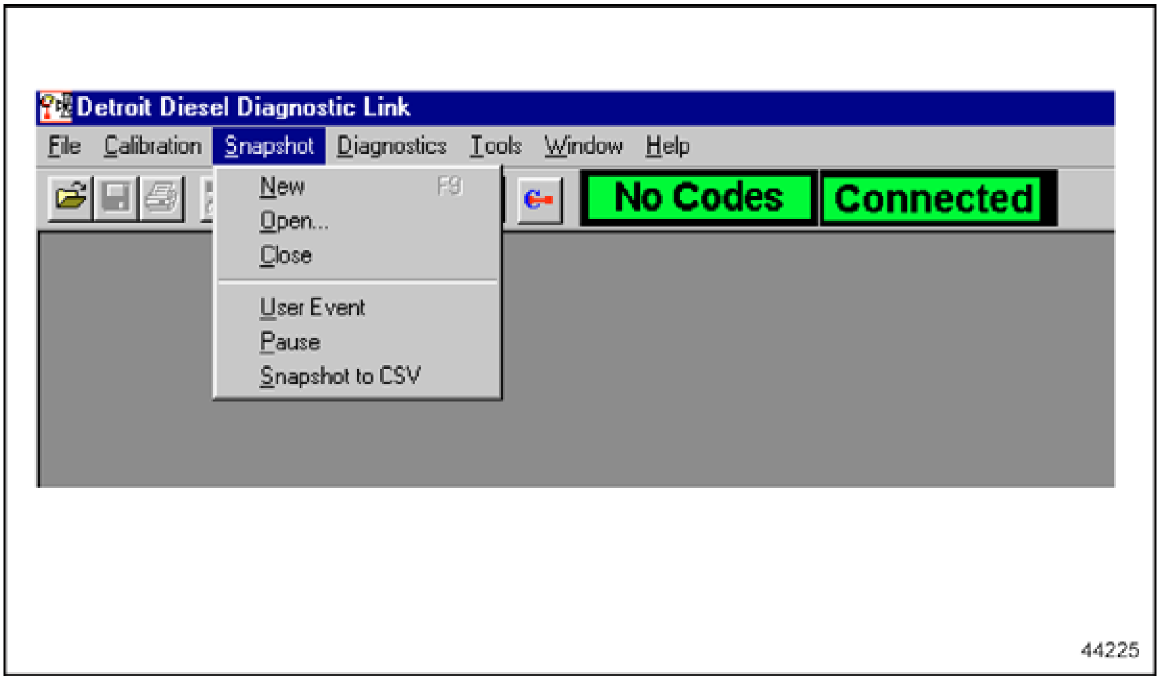
6 DDDL/SNAPSHOTS

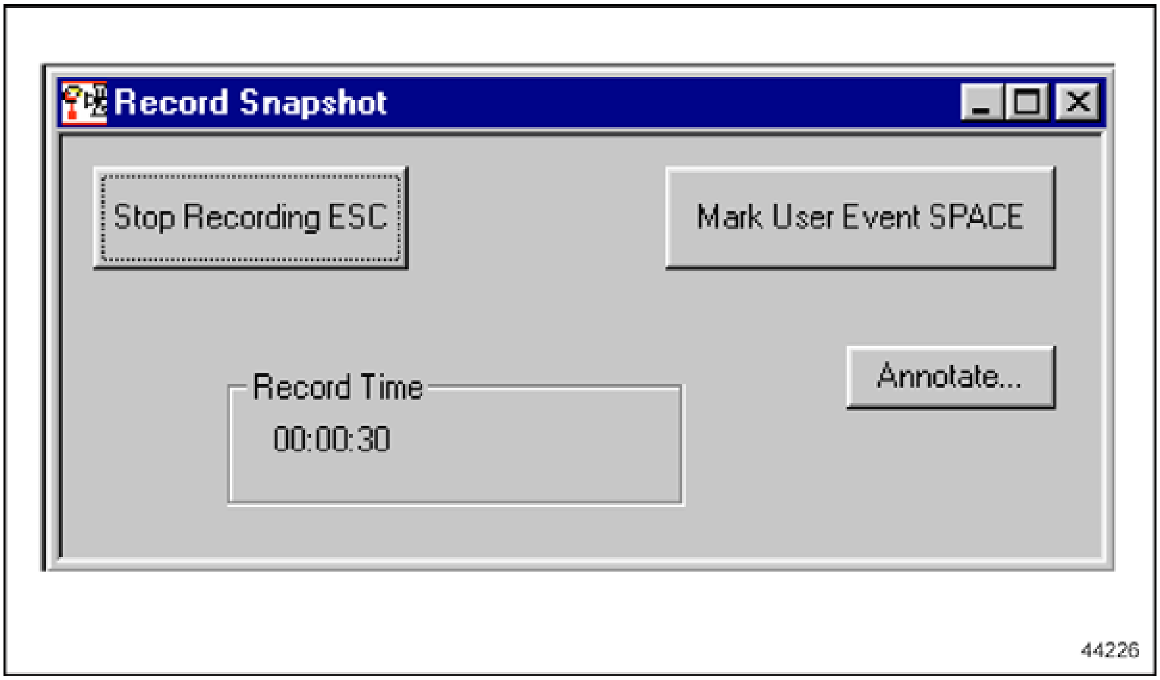
WORKING WITH DDDL SNAPSHOTS

Creating A Snapshot



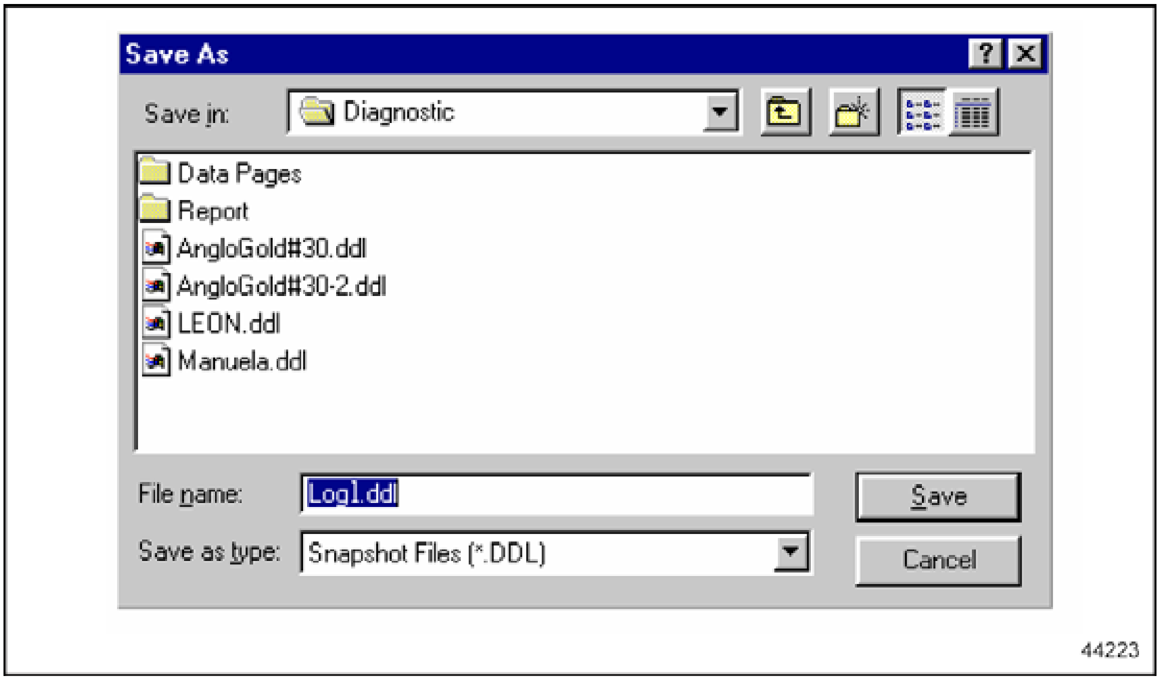
1. Use the proper steps to open DDDL and connect to the engine.
2. Go to the **Snapshot** drop-down menu and select the **New** option by clicking once with the left mouse button.
3. Upon choosing the **New** option a **Record Snapshot** box will appear in the upper left section of your screen.
4. The **Record Time** will be counting from the second you clicked on the **New** option.

5. Some important facts to remember about this feature:
   - □ All parameters broadcast by DDEC IV are recorded.
   - □ Any codes that occur during the snapshot are automatically marked.
   - □ There is no practical time limit for the snapshot, you just need enough room on your hard drive to save the file.
   - □ To mark an event other than a code, click once with the left mouse button on the **Mark User Event SPACE** box.
   - □ To insert additional comments about the snapshot click once with the left mouse button on the **Annotate** selection (version 4.1 or later).
6. When you have completed recording the data you wish to save, click once with the left mouse button on the **Stop Recording ESC box**.



7. Immediately upon selecting the **Stop Recording ESC** option a dialog box will appear asking if you wish to save your changes. If you want to save the recorded data to your hard drive, click once with the left mouse button on the **Yes** option. To discard the data recorded by the snapshot click on the **NO** option.

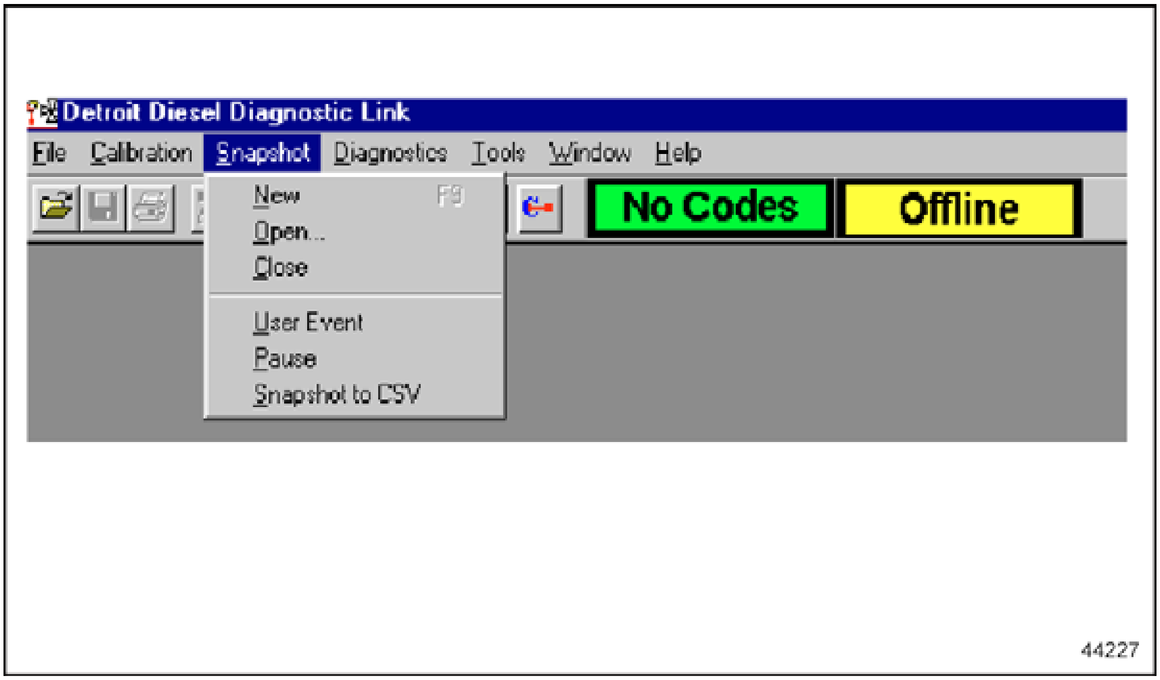
8. If you choose the **Yes** option the **Save As** dialog box will appear on your screen. A suggested file name will appear outlined in blue in the **File Name** box.



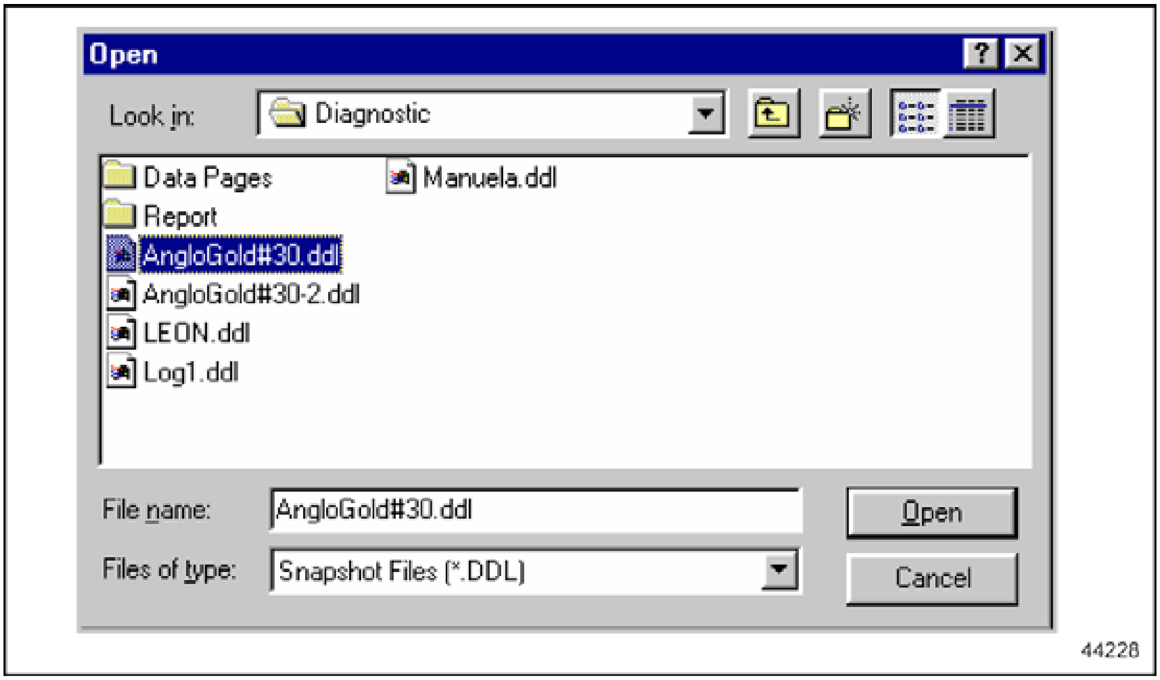
9. If you want to accept the suggested name for the file click once with the left mouse button on the **Save** option box. You may replace the suggested name by hitting the space bar once to clear the line. Type in the new file name before saving the file. You may also change the location of where the file is saved on your PC by changing the location designated in the **Save In** box. You may save the file to your **A** drive for example. Once the file has been saved the process is complete.

USING SNAPSHOT REPLAY CONTROLS

1. To replay a snapshot, go to the **Snapshot** drop-down menu and select **Open**. You should not be connected to a vehicle when replaying a snapshot.

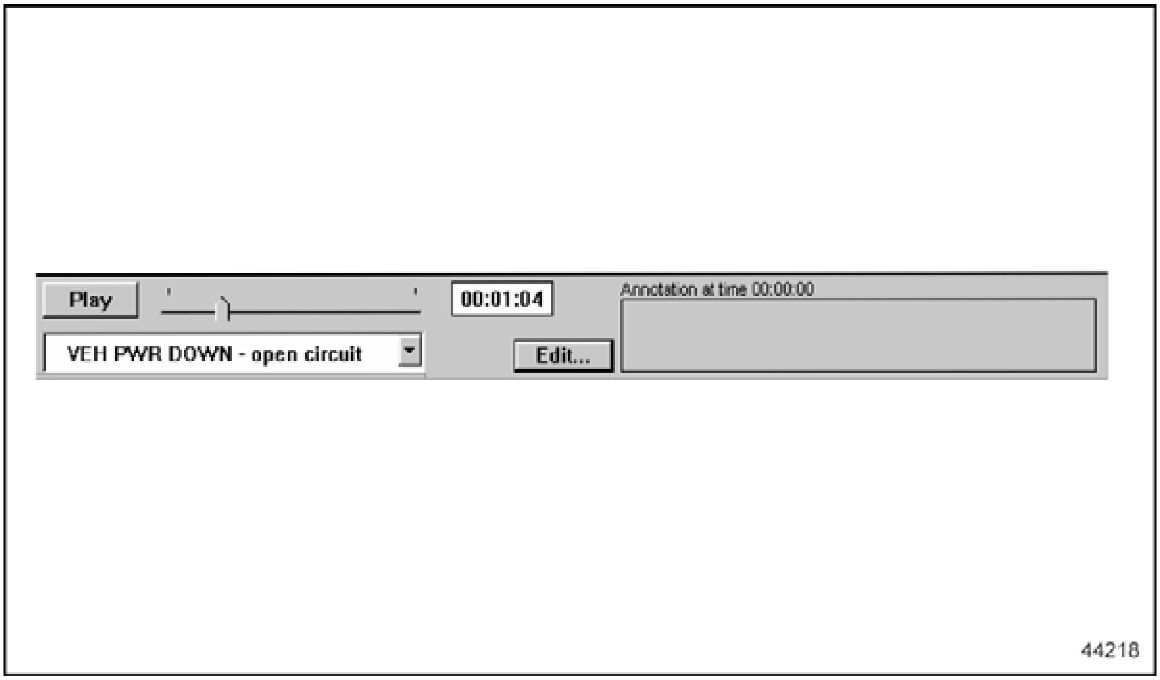


2. A dialog box will appear listing all the available snapshot files.



NOTE:
The default folder that snapshot files are saved in is C:\Detroit Diesel\Diagnostic and have a file extension of .ddl.

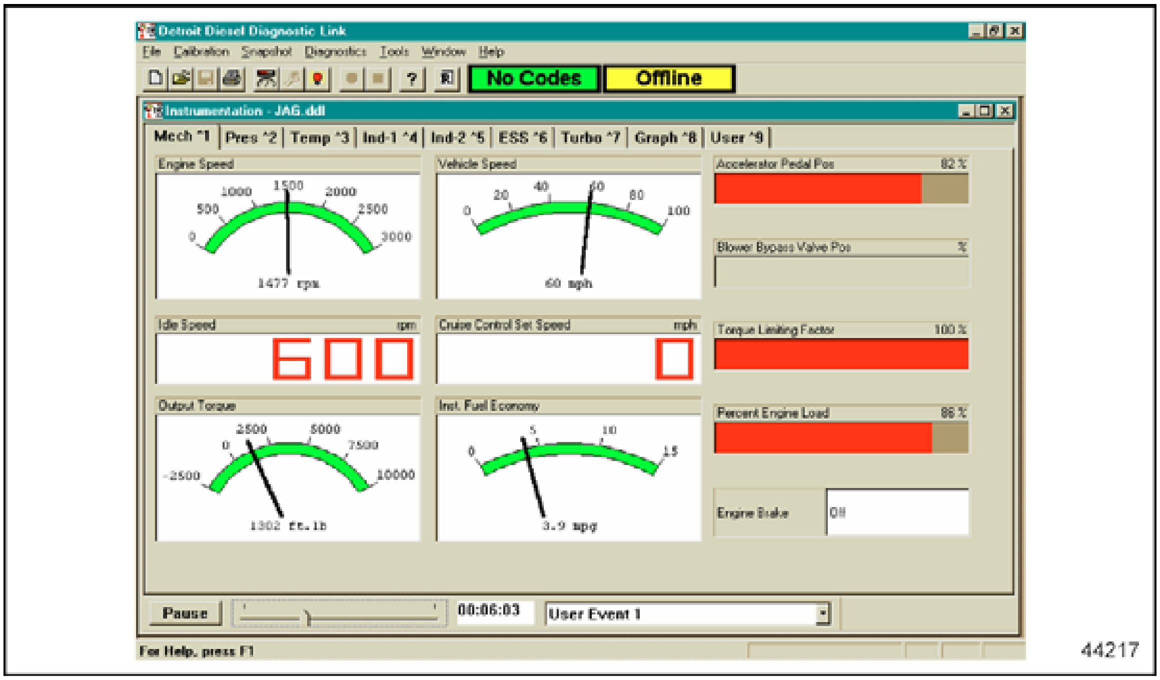
3. Highlight the file you wish to open with one click of the left mouse button. The selected file name will now appear in the **File Name** box.
4. Click once with the left mouse button on the **Open** box in the lower right of the dialog box.
5. When you have opened a snapshot, replay controls will appear at the bottom of the DDDL window you opened.



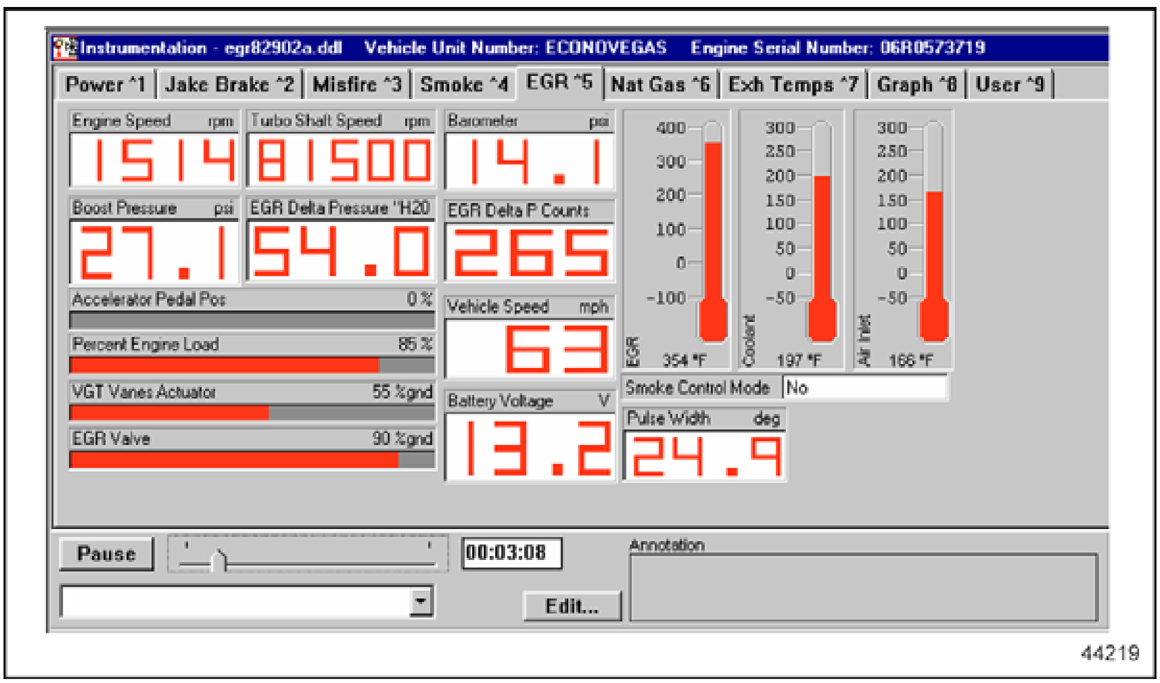
6. Start the replay of a snapshot by clicking on **Play**. The play button changes to **Pause** when a snapshot is replaying. While the snapshot is replaying, the replay slider next to the Play/Pause button moves showing the progress of the replay, and the time box next to it shows the time since the 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.
7. 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.
8. 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.

NOTE:
Not all DDDL windows can be activated when replaying the snapshot feature. You cannot access the injector response time window or the cylinder cutout window in snapshot mode. Samples of windows that may be activated include:

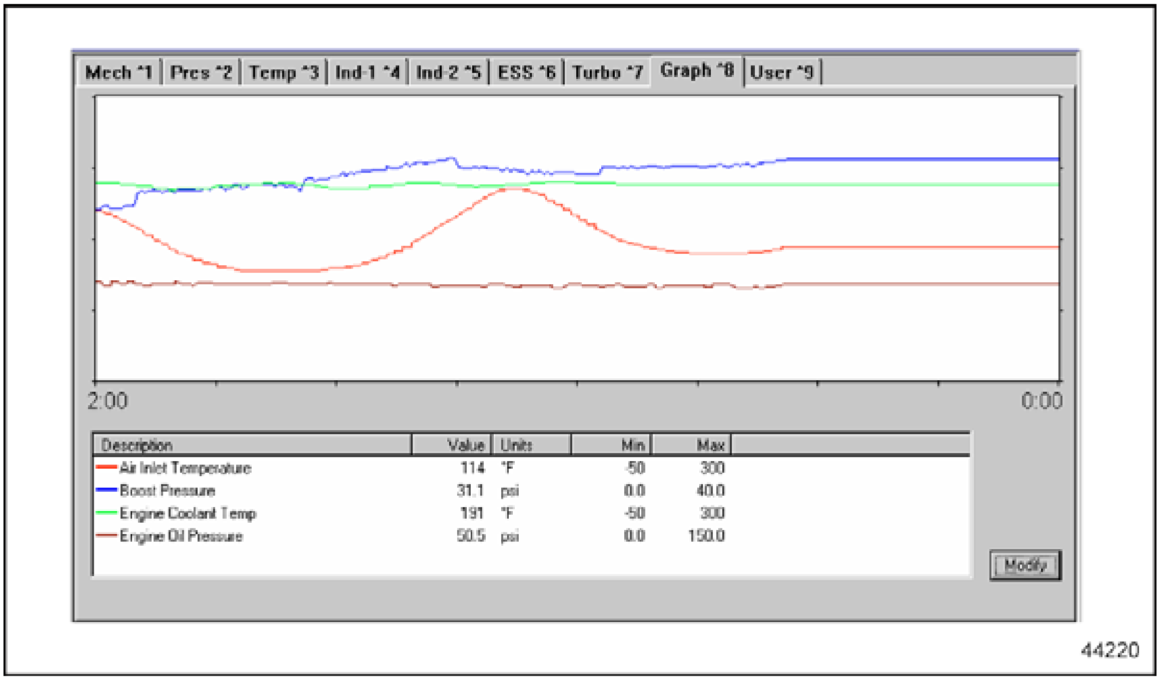
Normal Instrumentation Window



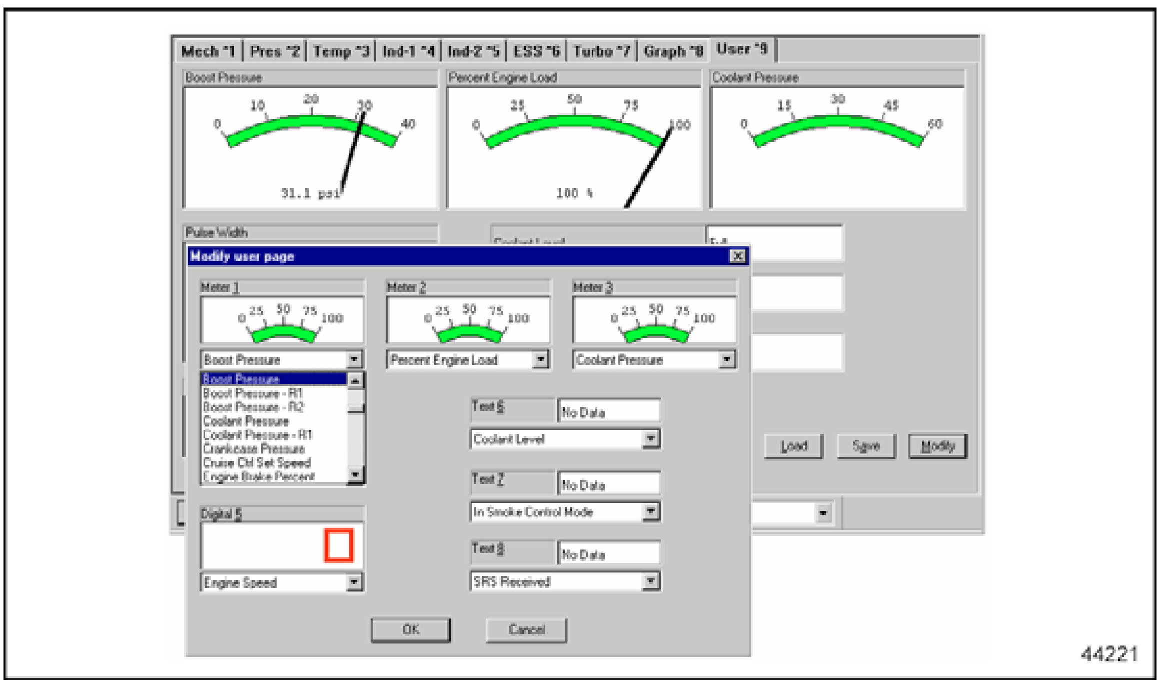
Diagnostic Instrumentation Window



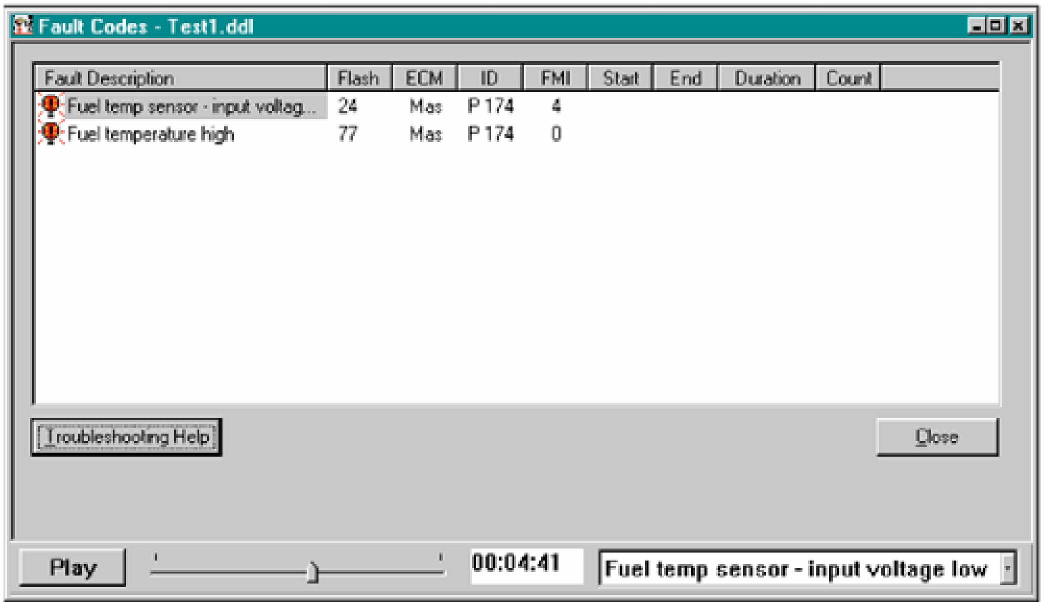
Graph Window



User Window



Fault Codes Window



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7 SNAPSHOT EXAMPLES

SNAPSHOT EXAMPLES

The following snapshots are intended to show you how to “interpret” the information recorded. Use the examples to try to determine what area contains the fault.

Due to the variety of operating conditions that affect actual EGR flow and Turbo boost or speed readings, the following examples **SHOULD NOT** be used as a good vs. bad criteria.

Each snapshot that follows was controlled during running on a chassis dynamometer.

Some **failures** were induced to display the logic used to determine what is wrong with a particular area of the engine.

- Idle operation with EGR. See Figure 7-1.
- Cold Idle operation without EGR flow. See Figure 7-2.
- Throttling without load, EGR is on and off. See Figure 7-3.
- 1500 rpm throttling no EGR. See Figure 7-4.
- EGR Valve stuck open. See Figure 7-5.
- 147 14, EGR Flow too Low. See Figure 7-6.
- 146 2 EGR leak – boost. See Figure 7-7.
- Leaking Charge Air Cooler. See Figure 7-8.
- Delta P port plugged (graph). See Figure 7-9.
- Normal Acceleration – Automatic Transmission. See Figure 7-10.
- Typical EGR flow loaded. See Figure 7-11.
- Normal Operation EGR off, Colder ambient. See Figure 7-12.
- Plugged Delta P port (EGR tab). See Figure 7-13.

Normal Engine Operation as Viewed With DDDL Snapshots

It is important to understand what **Normal** looks like During normal engine operation, all parameters should have smooth transitions.

Review the snapshots in this section for examples of normal engine operation.

EGR Flow at Idle

Detroit Diesel EGR Engines will flow EGR @ idle, as certain conditions are met. MY-2002 EGR engines will flow EGR for a short duration if DDEC determines a quick rise (snap-acceleration) in engine rpm's over time. Engine parameters programmed determine the duration of EGR flow. There is a time duration difference between MY-2002/03 - 2004.

Delta P Sensor and Piping

The Delta P sensor monitors the pressure differential across the venturi by readings from the two openings in the delivery pipe.

High Delta P with NO Flow Demand (PWM2 % = 7)

If the EGR valve is closed (7%) and the EGR temperature is between inlet manifold and engine temperature there should be little to no actual EGR flow. If the Delta P sensor is registering a high differential pressure in this condition:

- Check for the pressure signal pipe of hose to one side of the sensor is plugged or leaking (includes sensor mounting o rings).
- The sensor being defective is the least likely.
- Incorrectly wired (replacement sensor).

Low Delta P with Flow Demand (PWM2 % greater than 7 and less than 90)

If the EGR valve is open and the EGR temperature is elevated there should EGR flow.

If the Delta P sensor is registering a low differential pressure in this condition: it is likely that the pressure signal to both sides of the sensor are plugged or leaking Lastly, a defective sensor.

Stuck or Sticking VNT or EGR Valve Actuator

When the actuator is sticking, DDEC can't control turbocharger speed or EGR flow smoothly. Turbocharger speed and PWM 4- VNT % will fluctuate greatly. If the EGR actuator is sticking you are able to see EGR flow with the PWM2 % staying at 7% (which is closed). The engine's temperature can be a factor in this operation.

DDEC is attempting to control turbocharger speed and is overcompensating with PWM4 in an attempt to control turbocharger speed.

Turbocharger Speed Sensor Faults

Turbocharger speeds rarely exceed 100,000 rpm for any length of time. Speeds exceeding 100krpm and dropping rapidly is a warning sign. 30krpm changes in speed at 1 second intervals is almost impossible. Consider a false signal being sent to the ECM rather than this event actually occurring. The ECM is responding to the signals it is receiving from sensors.

Monitor the turbocharger speed and the engine boost, watch for normal, expected changes. Note in one of the next snap shot samples that the turbocharger speed reaches 108,000 rpm and boost is only 7.1psi. Turbo Speed Sensors (pn 23530252) that have a date code stamped on the sensor connector between 0703 to 3703 should be changed first if suspect then contact DDC Customer Support Center at 313-592-5800 for further assistance.

NOTE:
Remember that if a sensor fails and sends a signal to the ECM that is within a normal threshold for that sensor. No code will be generated however DDEC could try to respond to the false signal.

VPOD

The Variable Pressure Orfice (or Output) Device is used to control the pressure to the actuators used for the EGR valve and turbocharger vane position. The most common failure is external leakage of air. You can hear the leak when you activate the PWM for each VPOD.

Relative Humidity/Turbo Compressor Inlet Temperature Sensor

This sensor is a DDC part installed and wired by the OEM. Most faults here have been due to incorrectly wired 10 pin connector. The ECM will usually log a fault code for one or the other side this combination sensor.

Turbo Compressor Outlet Temperature

During heavy loaded operation the outlet of the turbo to the charge air cooler becomes very hot. Logic built into DDEC allows for derating of torque to reduce these temperatures to prevent charge air cooler failures. The derate code (flash code 49) of 404 14 logs without turning on the check engine light. This inactive code is stored to allow technicians the ability to assure the driver there is not any fault of failure and this operation is normal to the EGR system.

EGR Flow Troubleshooting Tips

EGR Flow Troubleshooting Tips

IF Delta P counts are	AND EGR Temp is	AND PWM 2 % is	Indicates	Possible Cause
86-135	< Coolant temp	7%	Normal operation: No flow requested, No flow detected	No failure
86-135	> Coolant Temp	>7%	high EGR temp suggests flow, No Delta P, Flow requested	BOTH delta P ports plugged or defective delta P
86-135	> Coolant Temp	7%	(Black smoke, No code) High EGR temp indicates flow No flow requested (7%), No delta P	BOTH failed delta P (or plugged ports) AND Leaking EGR Valve
>136	< Coolant temp	7%	Low EGR temp and no flow requested: Delta P high	ONE Delta P port plugged or leaking
86-135	< Coolant temp	>7%	Low Delta P and Low coolent temp=No Flow...Flow requested	EGR Valve stuck Closed/Plugged Cooler
>136	> Coolant Temp	7%	High delta P, High EGR temp = Flow...No flow requested	EGR Valve Stuck Open
>136	> Coolant Temp	>7%	Normal operation: High delta P, High EGR temp = Flow...Flow requested	No failure

< = Less than
> = Greater than

Indicates out of range condition

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Examples

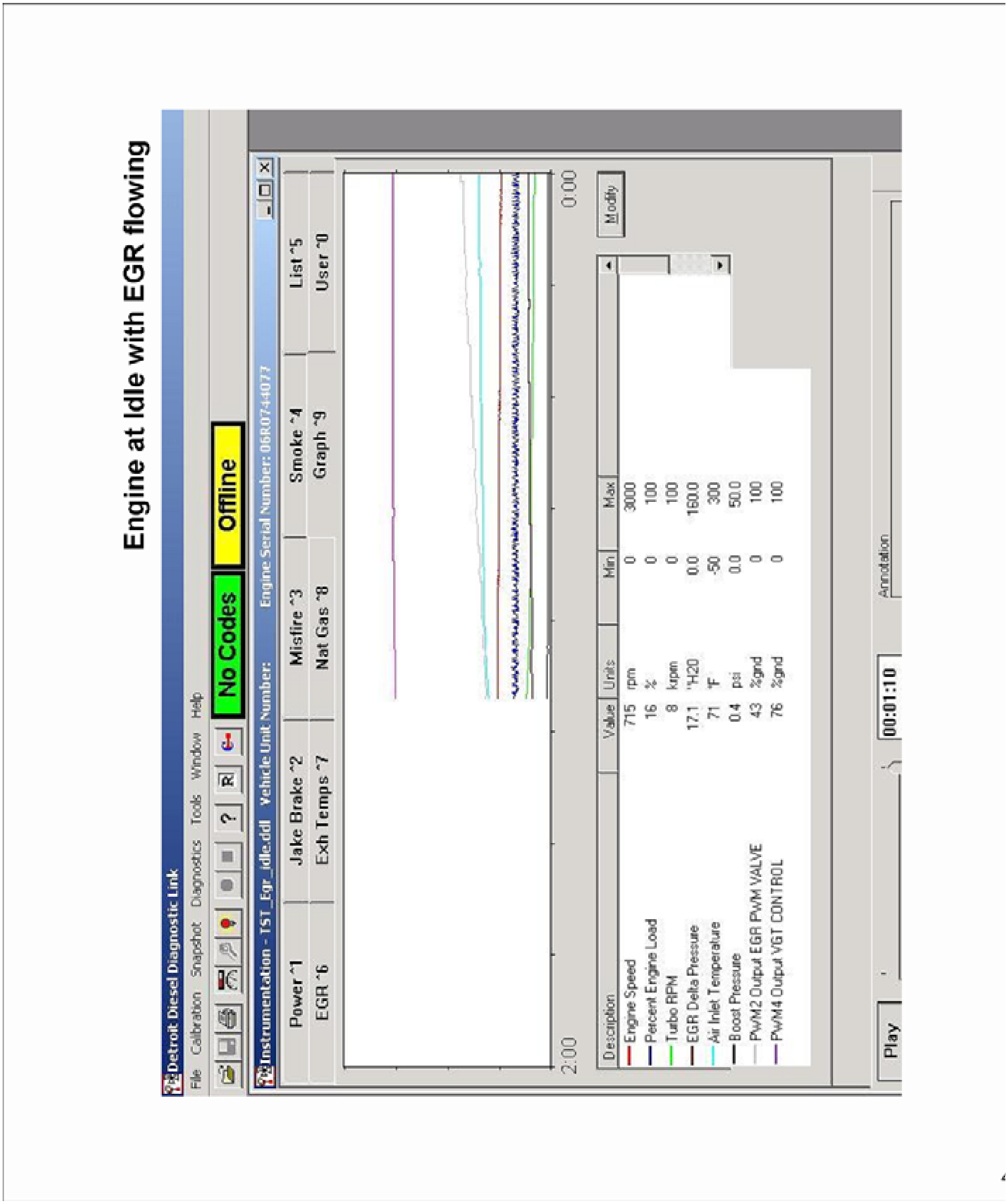

Figure 7-1 Engine at Idle with EGR Flowing

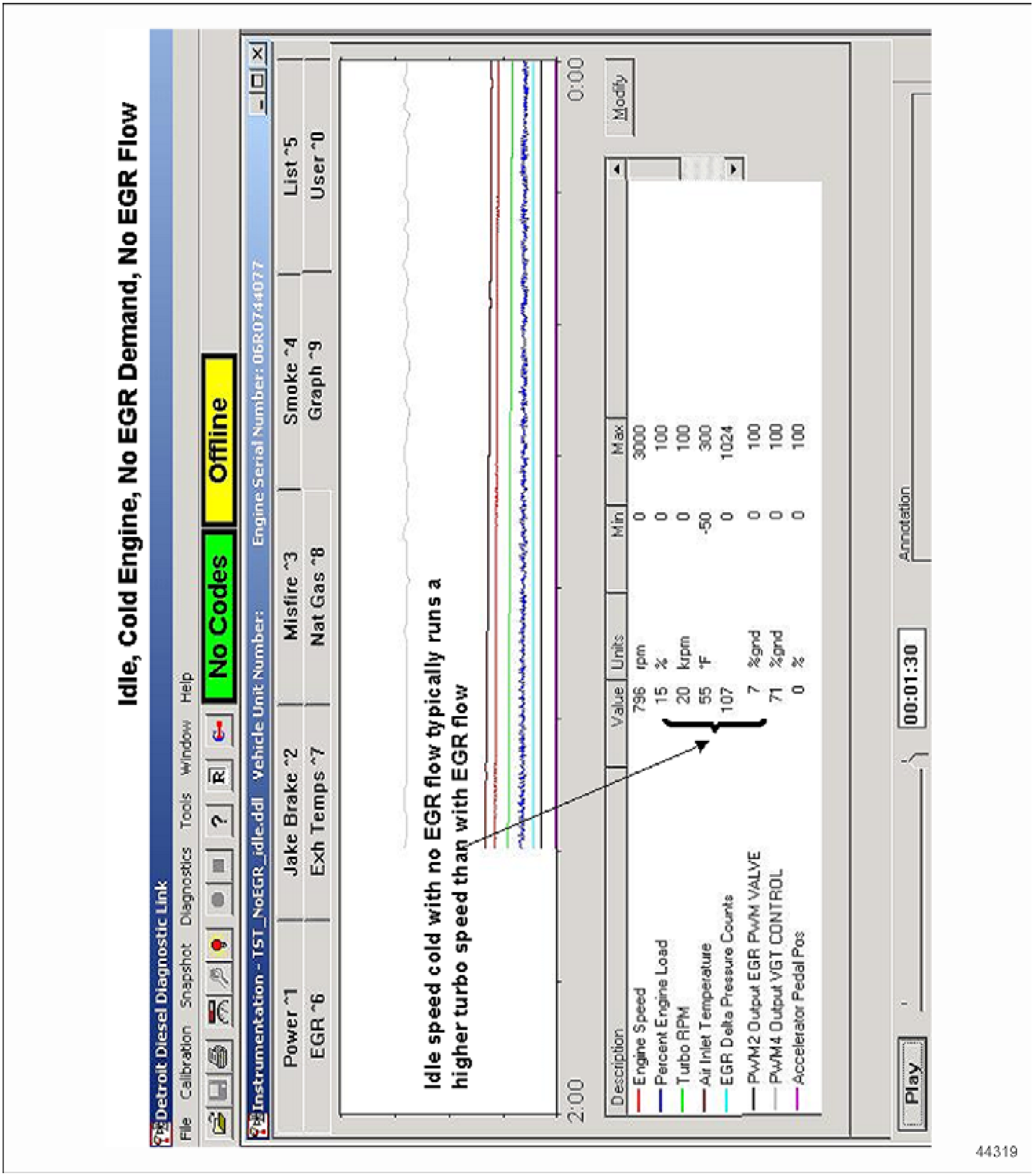

Figure 7-2 Idle — Cold Engine — No EGR Demand — No EGR Flow

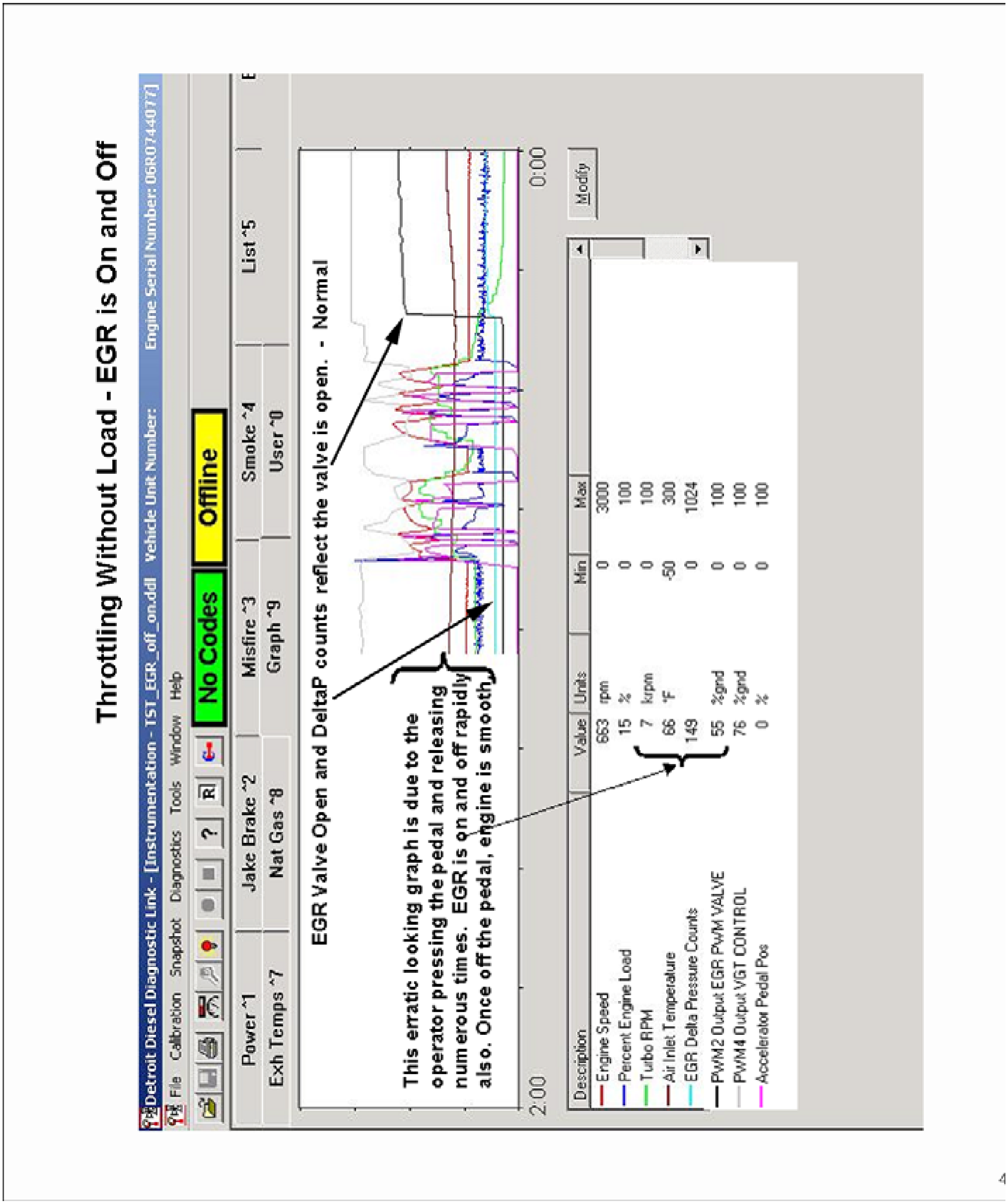

Figure 7-3 Throttling Without Load — EGR is On and Of

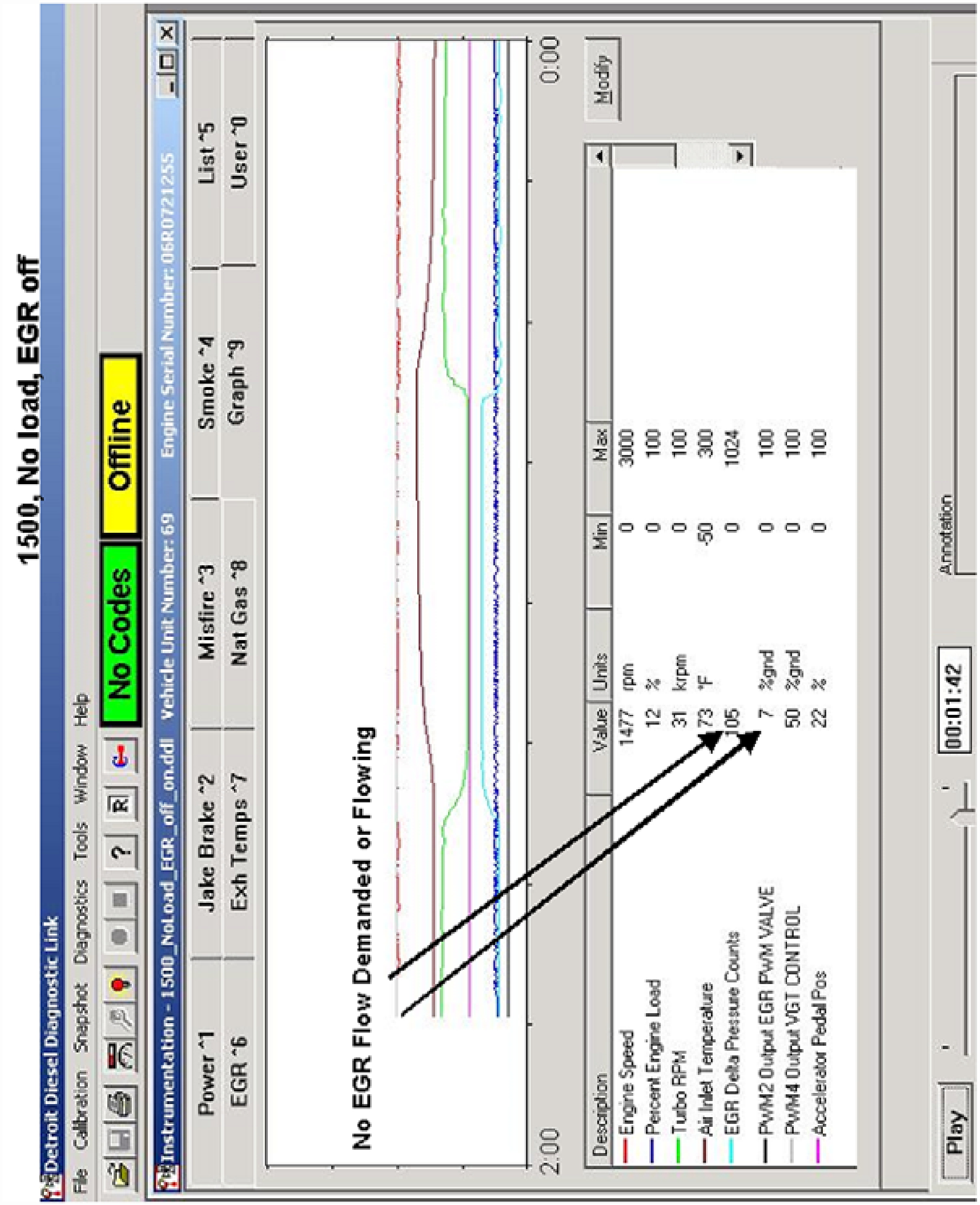

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Figure 7-4 1500 — No Load — EGR Off

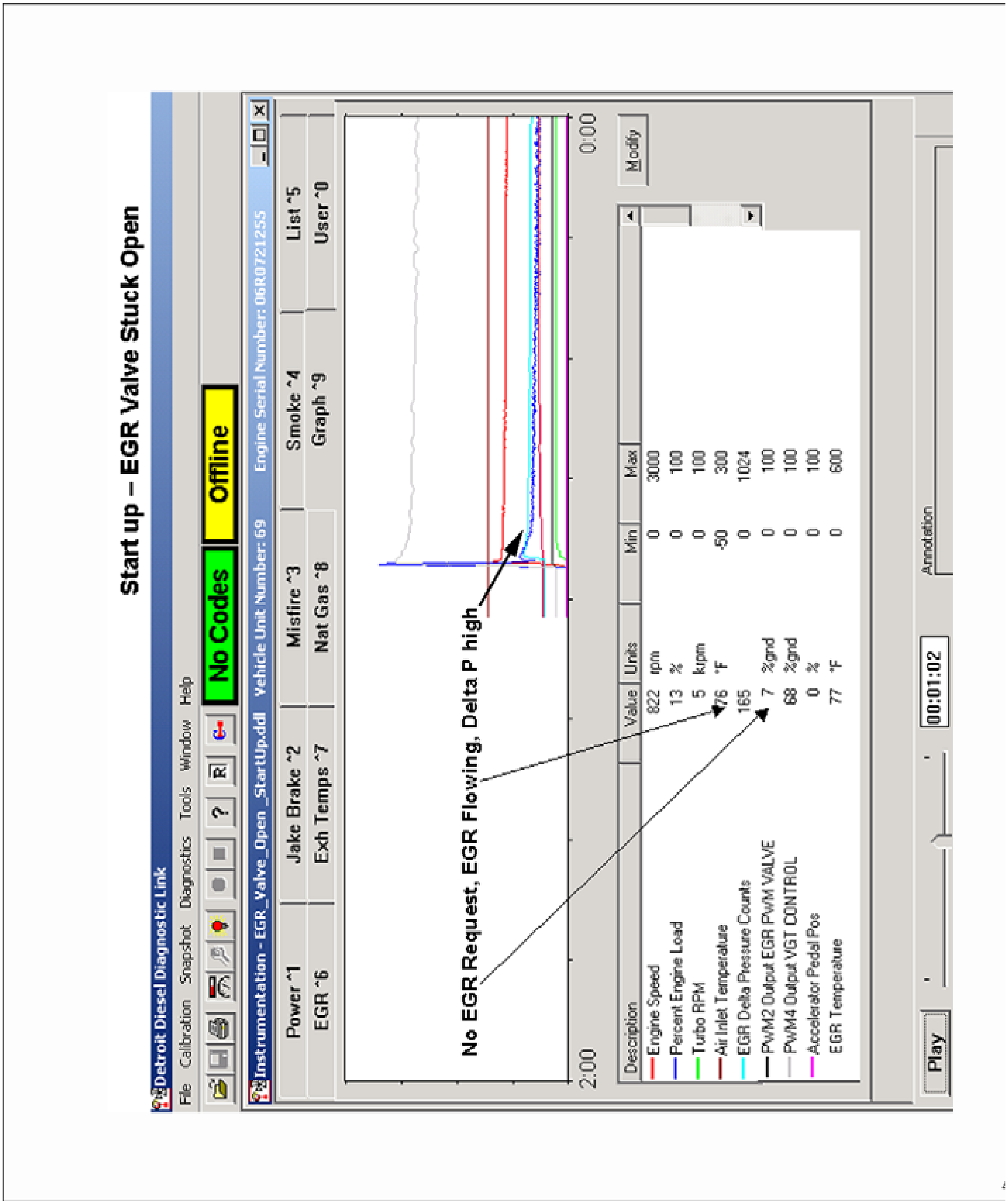

Figure 7-5 Start Up — EGR Valve Stuck Open

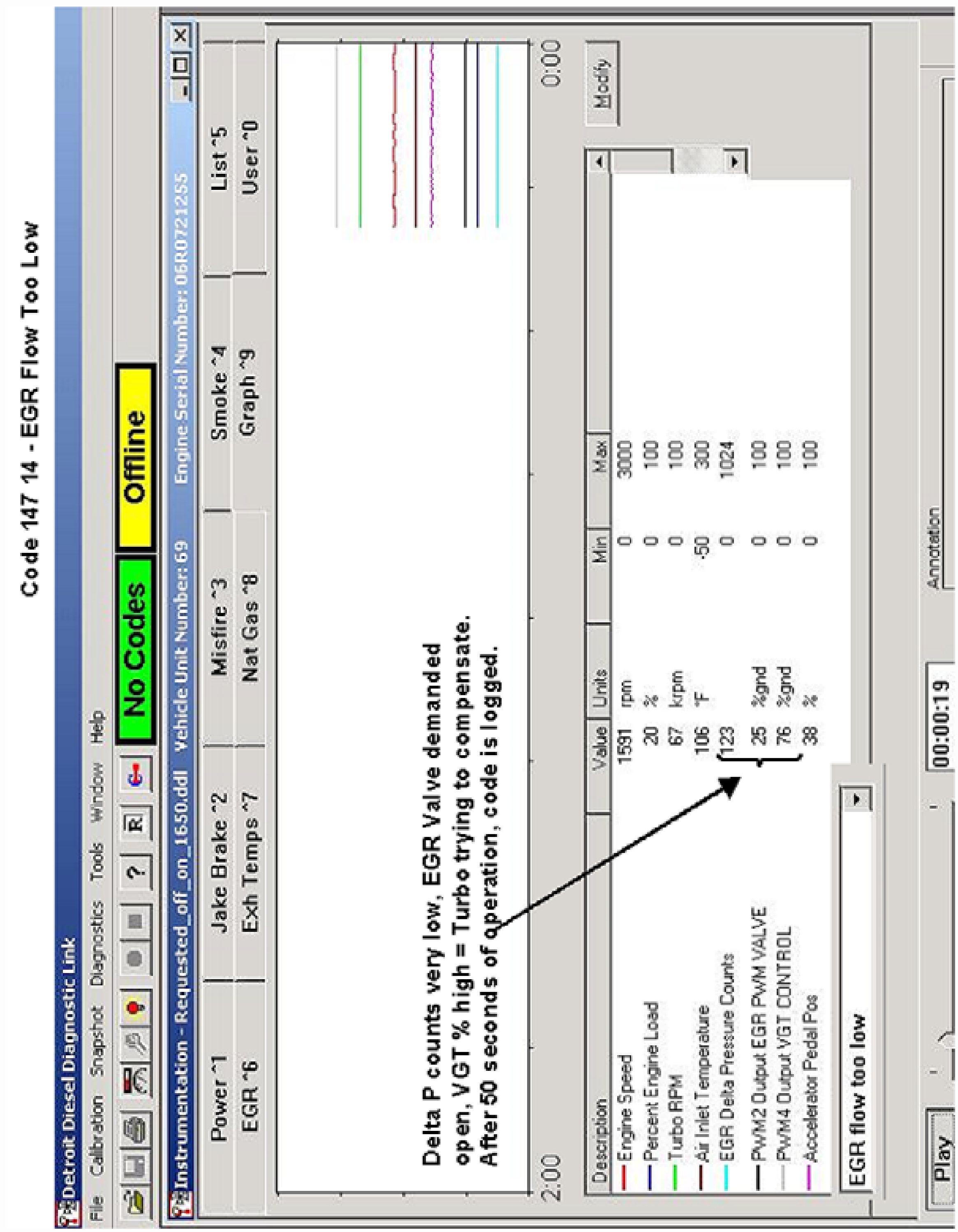

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Figure 7-6 Code 147 14 — EGR Flow Too Low

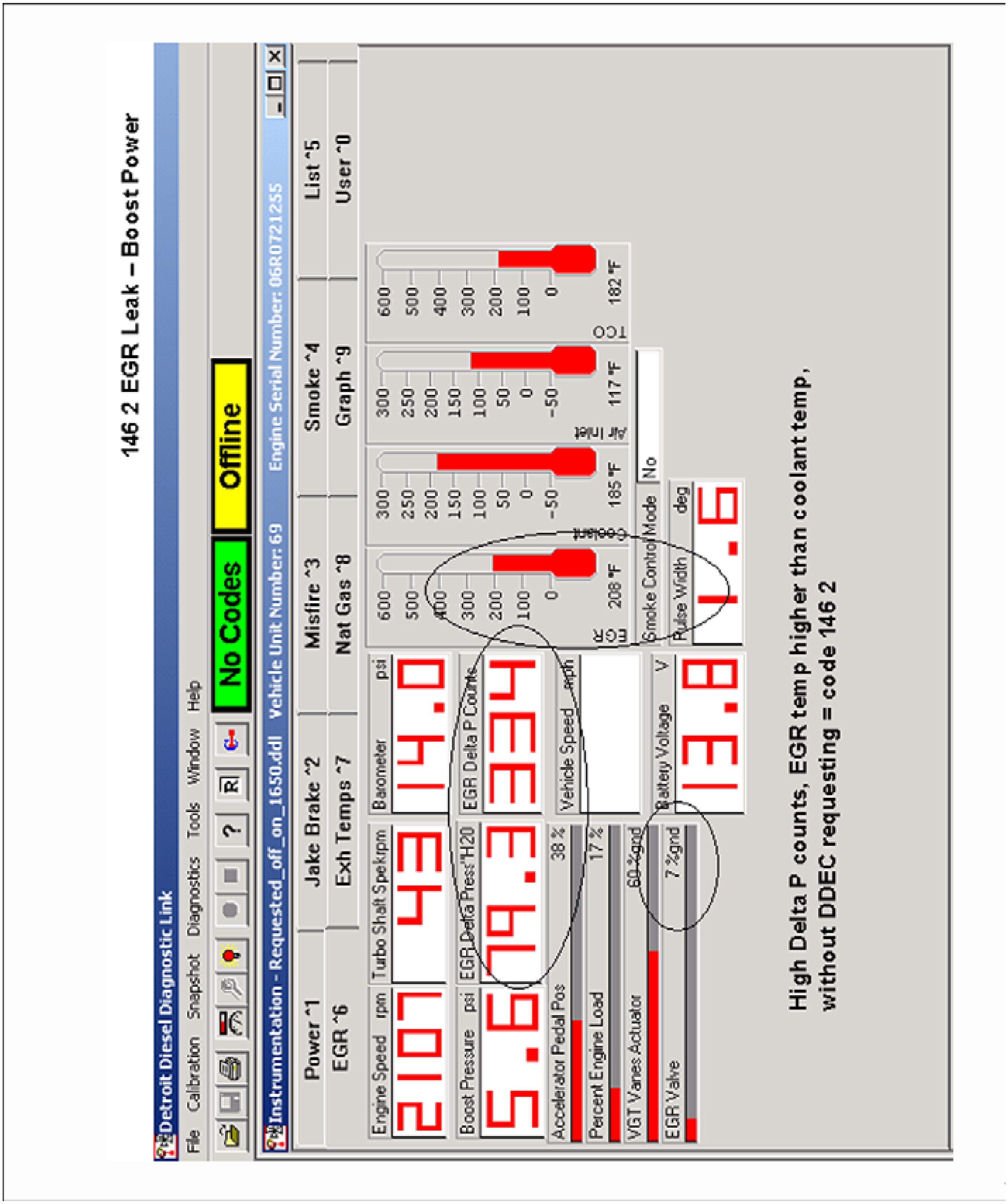

Figure 7-7 146 2 EGR Leak — Boost Power

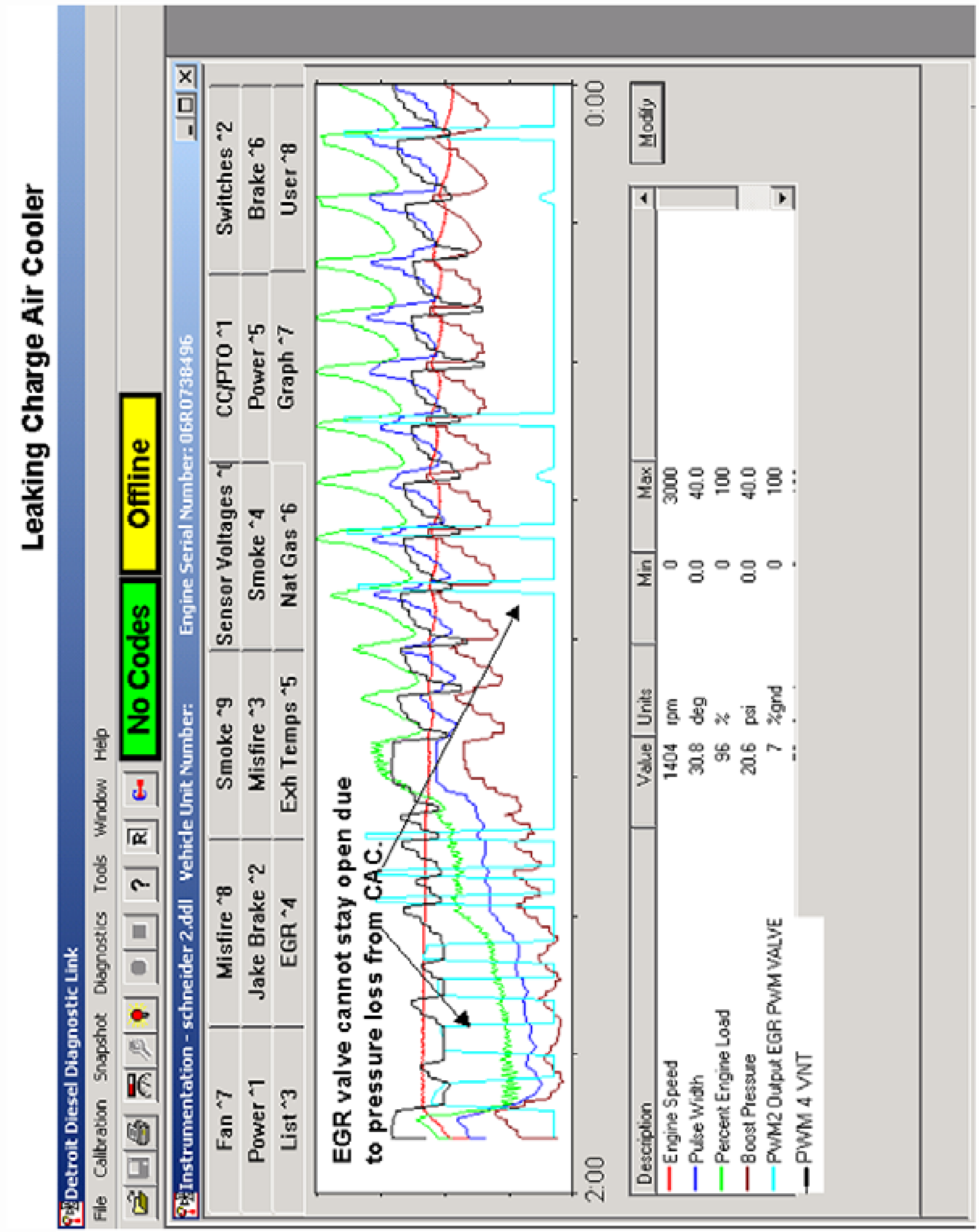

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Figure 7-8 Leaking Charge Air Cooler

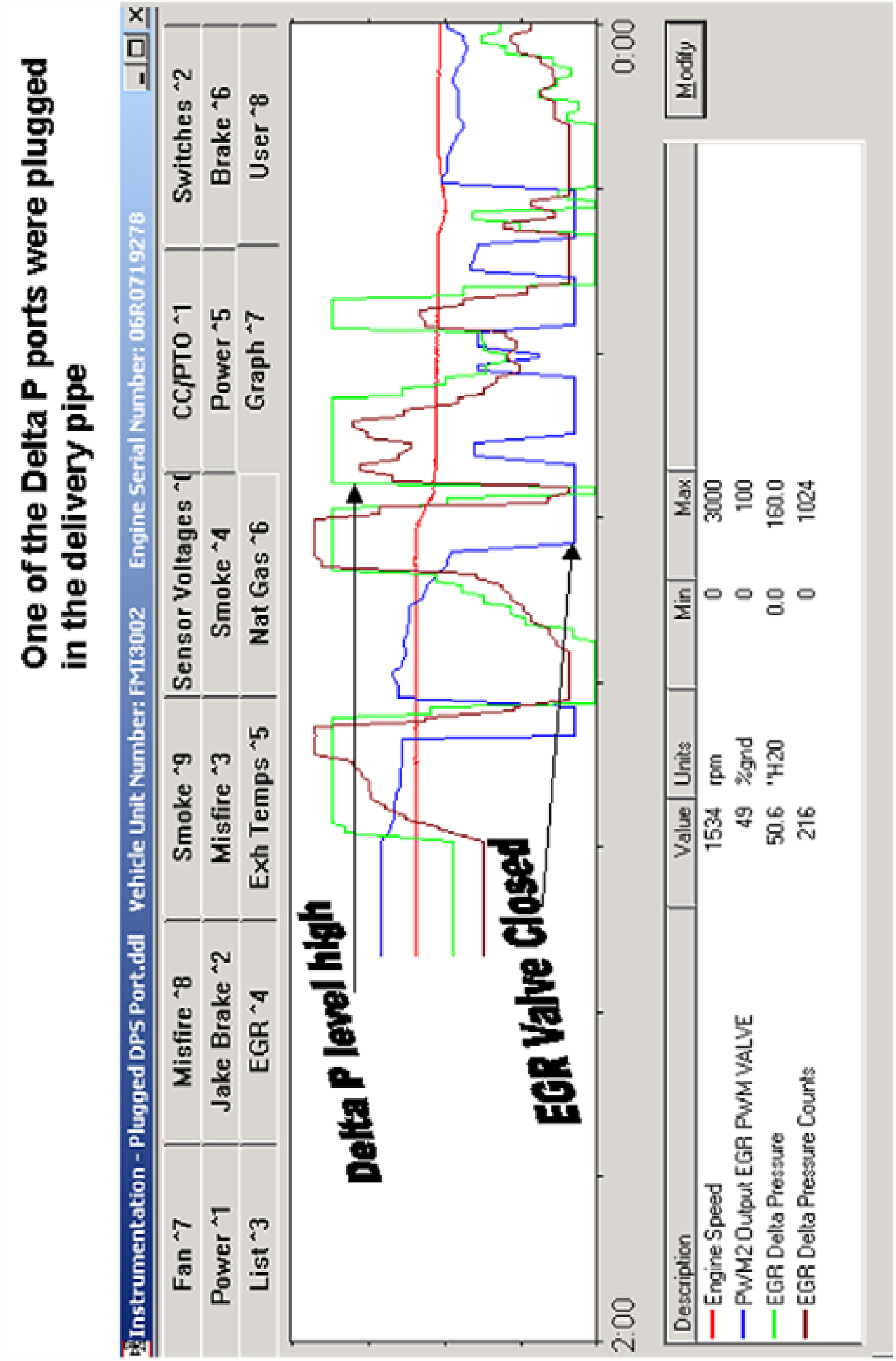

Figure 7-9 One of the Delta P Ports Plugged in the Delivery Pipe

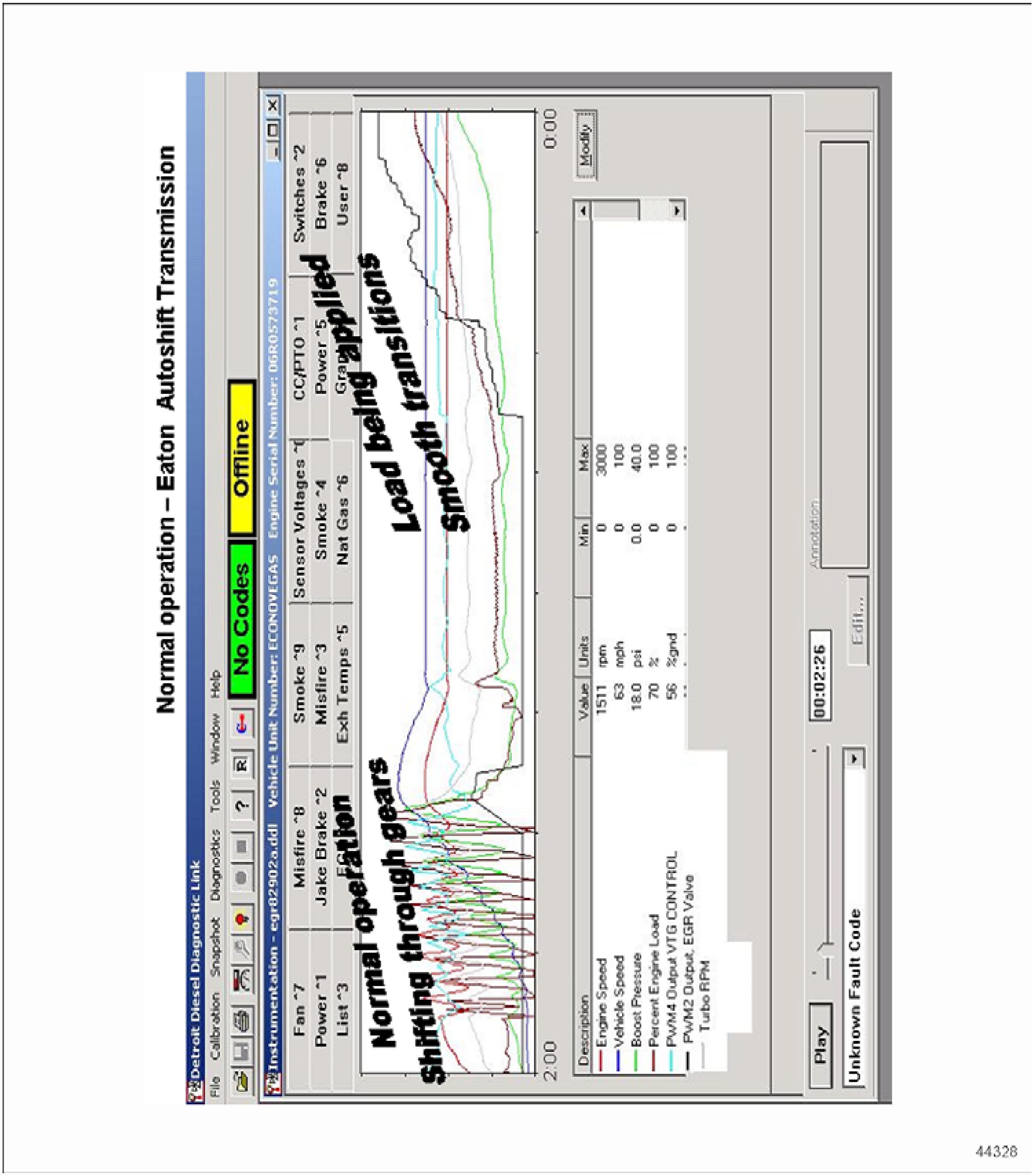

Figure 7-10 Normal Operation — Eaton Autoshift Transmission

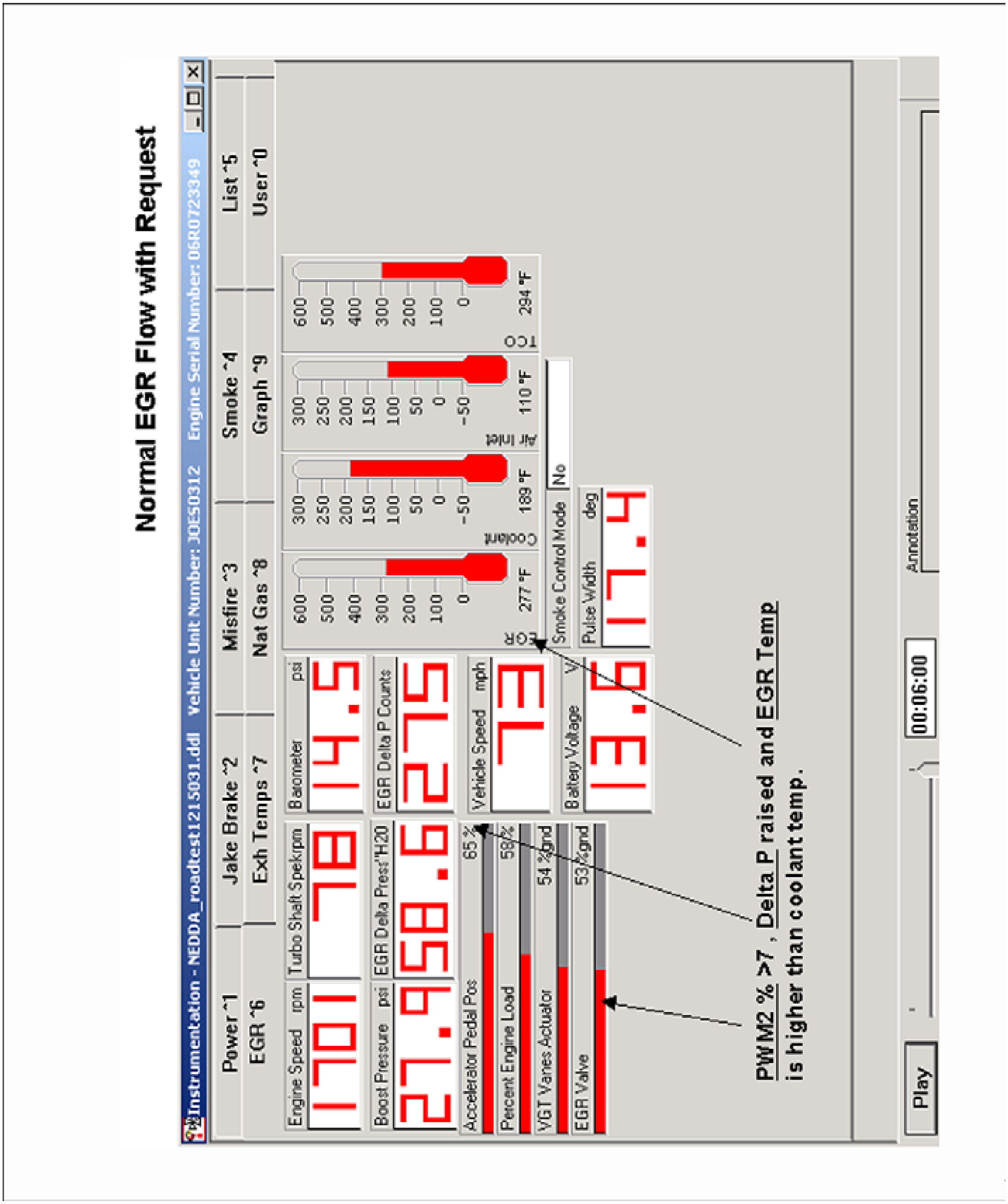

Figure 7-11 Normal EGR Flow with Request

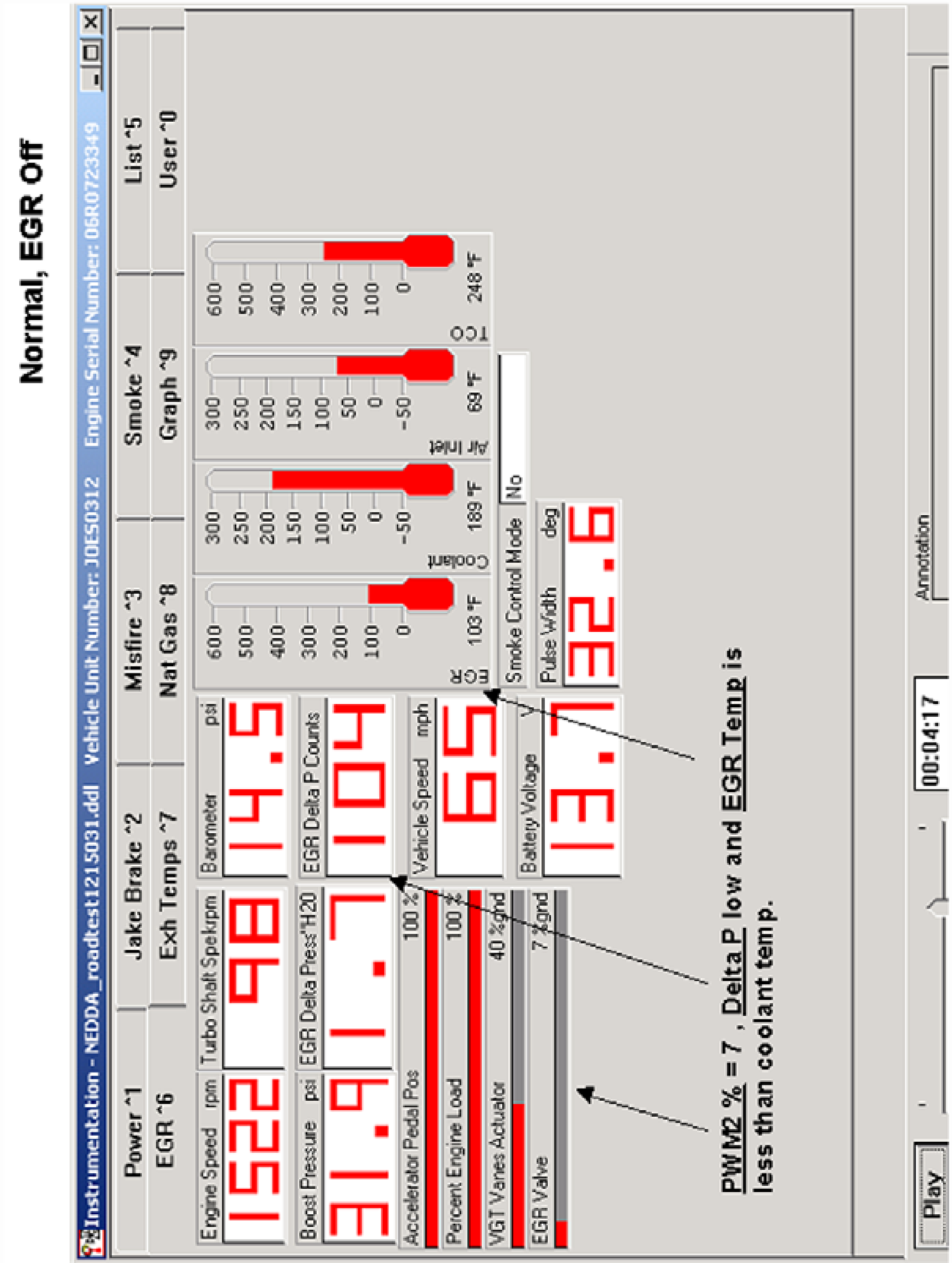

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Figure 7-12 Normal — EGR Off

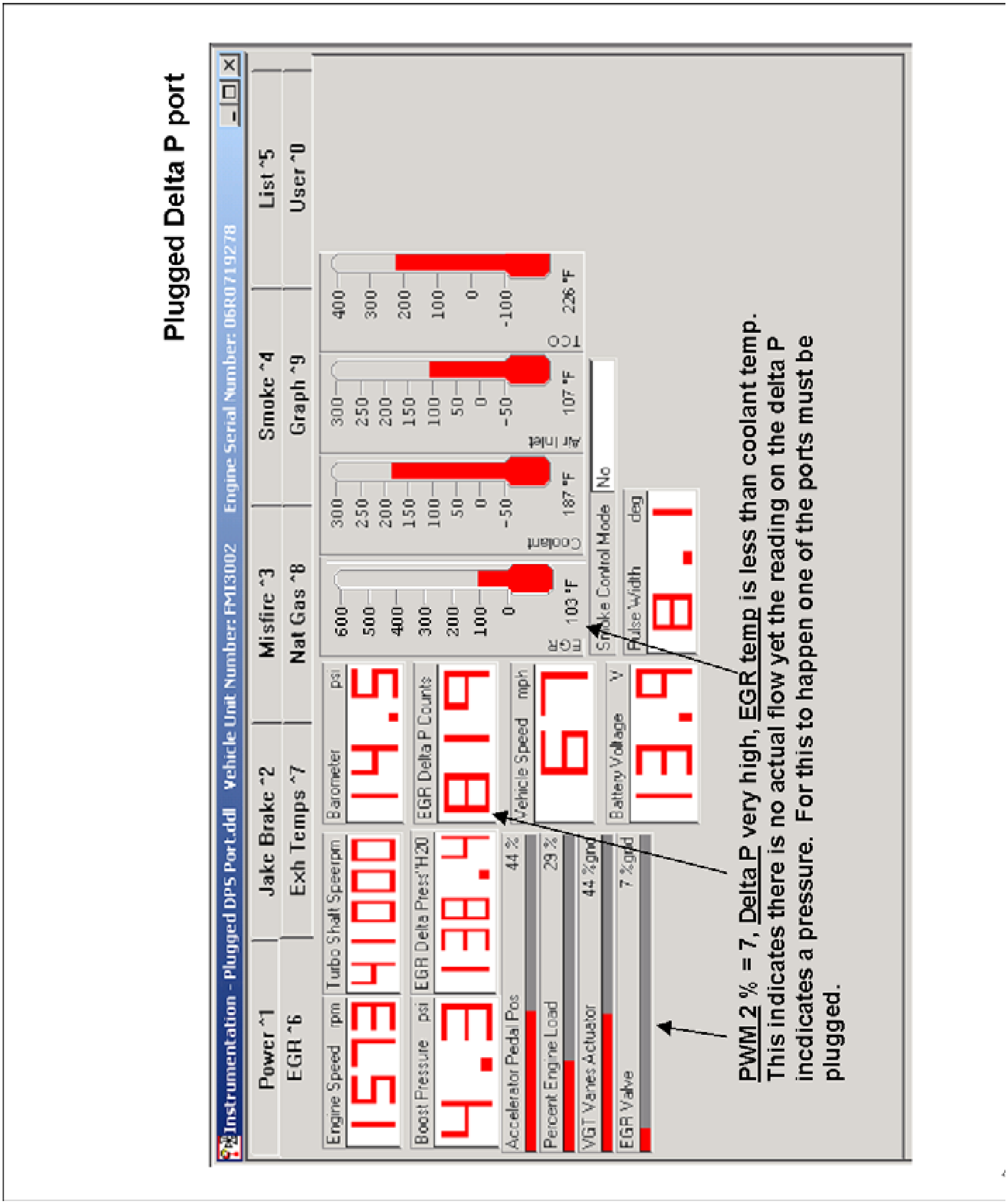

Figure 7-13 Plugged Delta P Port

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8 DDEC V COMPONENTS

There have been numerous enhancements, component redesigns, and EGR system modifications implemented to the 2004 Series 60 engine release. The following list highlights some of those improvements.

- An enhanced DDEC V ECU
- EGR Valve Hydraulic Actuator
- Three Bolt Flange on Tube and Shell EGR Cooler
- Improved Exhaust Manifold Sealing (Fey Rings)
- Exhaust Gas Delivery Pipe
- Flexible Bellow connecting the Upper Hot Pipe to the EGR Valve
- Single VPOD

OVERVIEW OF THE DDEC V EGR SYSTEM

The following subsections graphically illustrate the DDEC V EGR system.

EGR System

The primary purpose of the EGR system is to reduce engine exhaust gas emissions in accordance with EPA regulations by allowing a percentage of the exhaust gases to remix with the air coming into the intake manifold. Engine exhaust gases will dilute the incoming air by displacing some of the oxygen in the air being supplied through the intake manifold. Less oxygen results in a slower fuel burn which reduces the peak cylinder temperature permitting reduced nitrogen oxides (NOx) emissions.

Figure 8-1 graphically illustrates how the EGR components function to accomplish reduced NOx emissions.

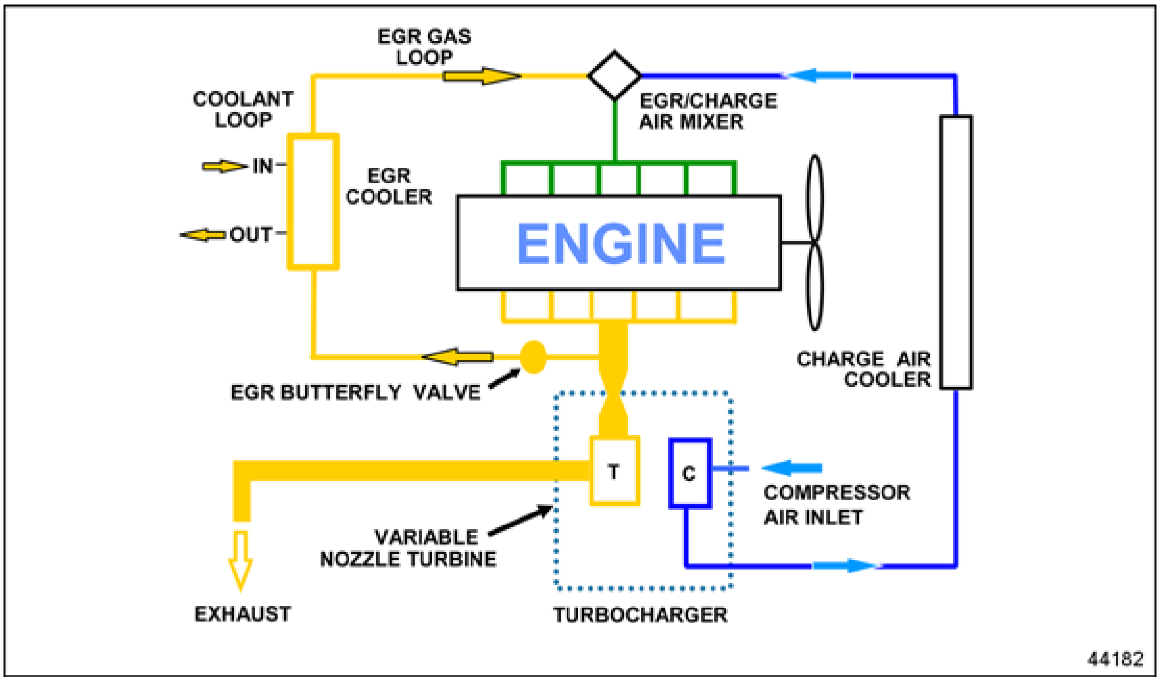


Figure 8-1 EGR Component Overview

There is one Variable Pressure Output Device (VPOD) which regulates the Variable Nozzle Turbo (VNT). Input values from the ECU regulates the VPOD air pressure which allows the VNT vanes to change position during engine operation. The VPOD also interfaces with other engine system components as illustrated in Figure 8-2.

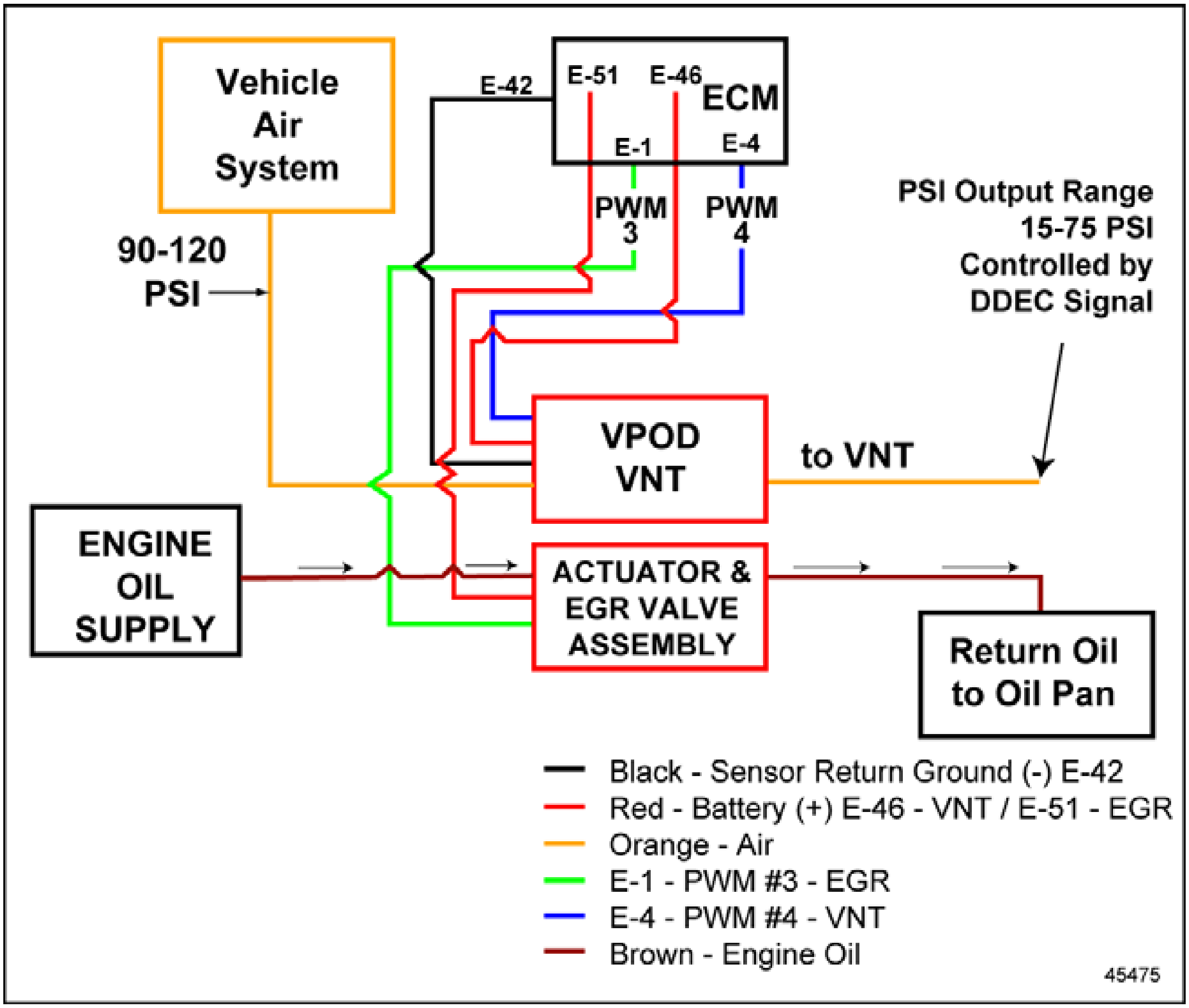
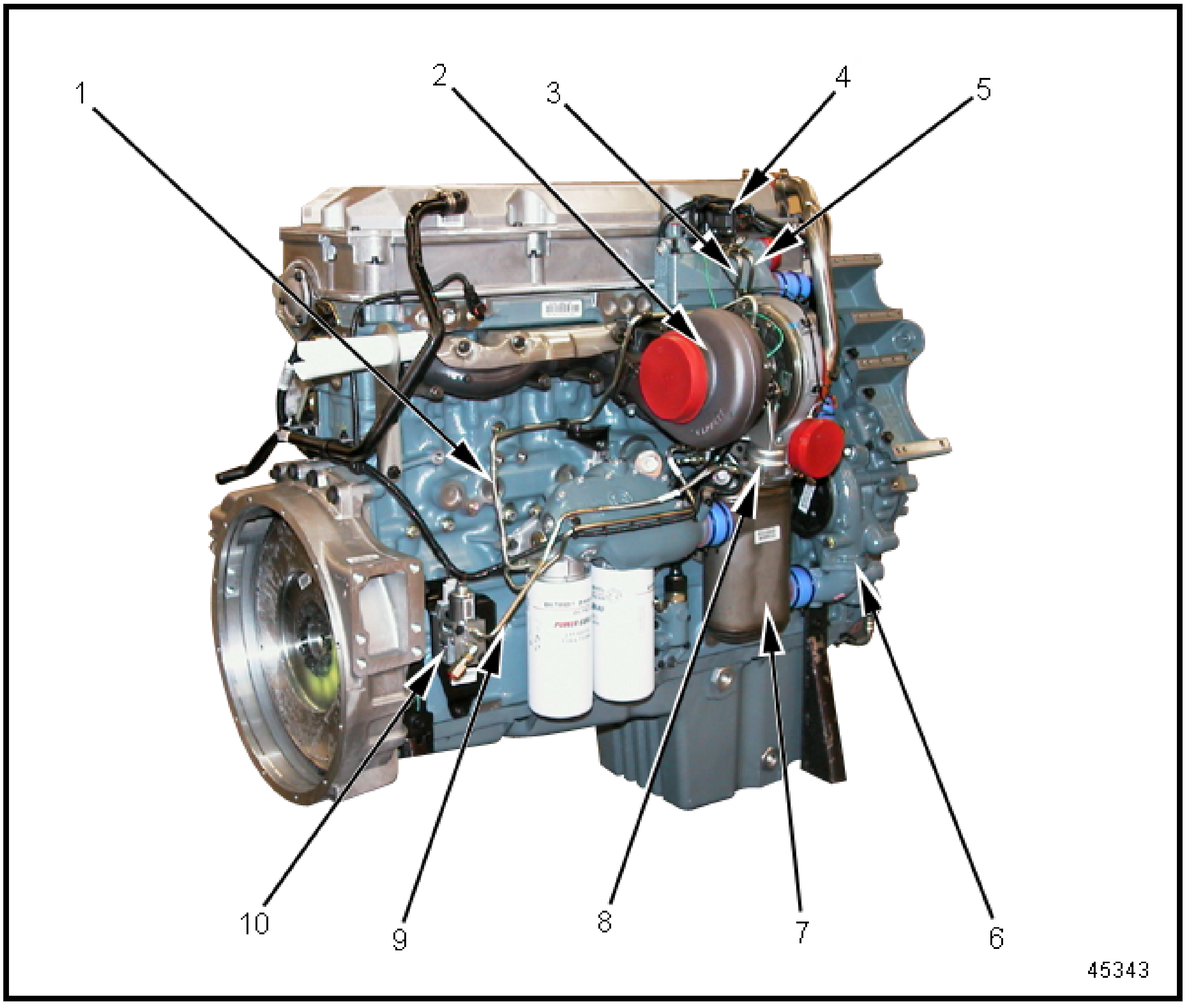


Figure 8-2 EGR Valve and VNT Control System

Detailed Views of the DDEC V EGR Components

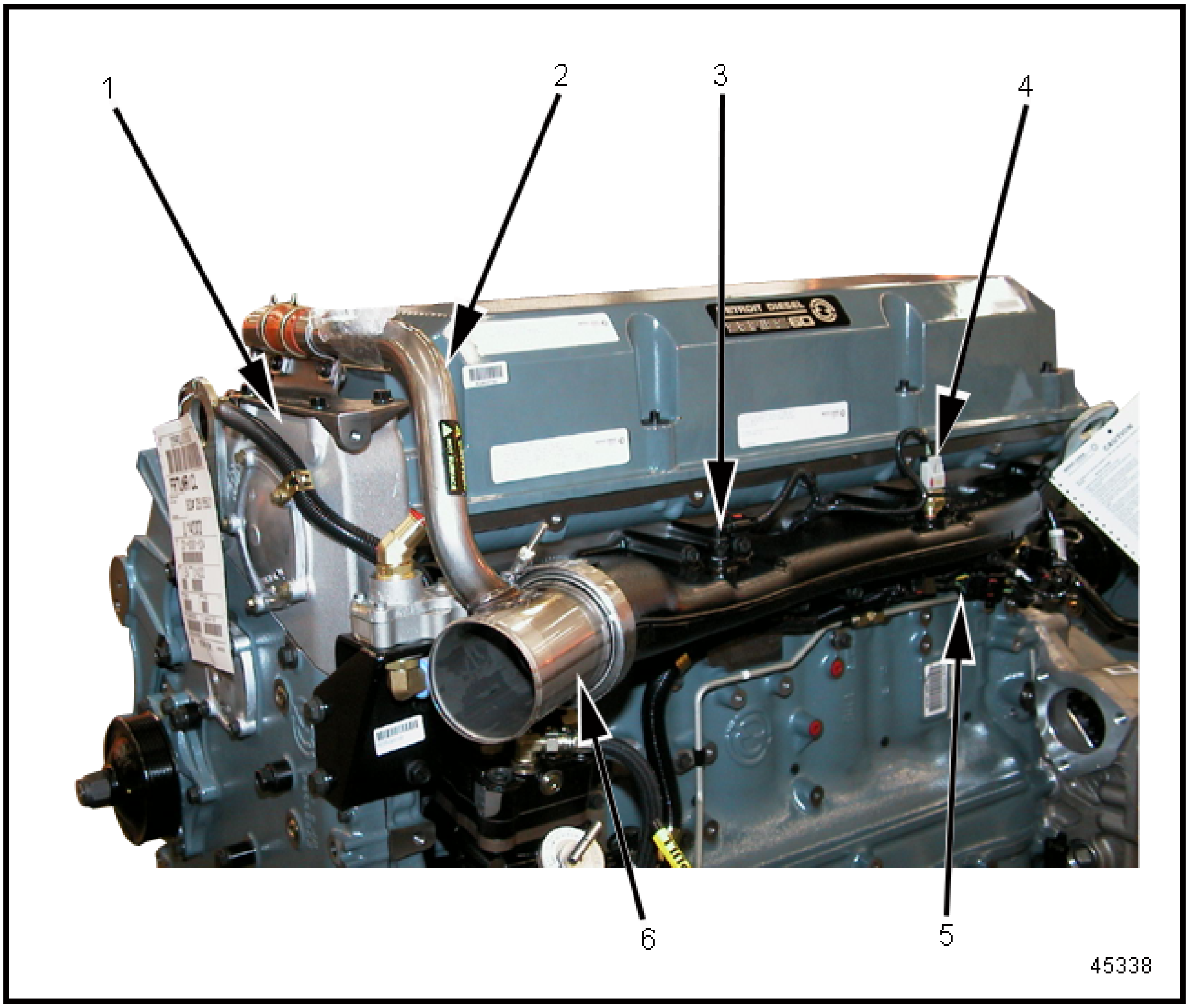
See Figure 8-3 for a right side engine view.



1. Turbocharger Oil Feed Line
2. Variable Nozzle Turbocharger (VNT)
3. Venturi to Delta P Sensor Line
4. Delta P Sensor
5. Venturi to Delta P Sensor Line
6. High Flow Water Pump
7. Tube and Shell EGR Cooler
8. VNT Actuator
9. VPOD Air Out to Turbocharger Actuator
10. Variable Pressure Output Device (VPOD)

Figure 8-3 Right Side Component Engine View

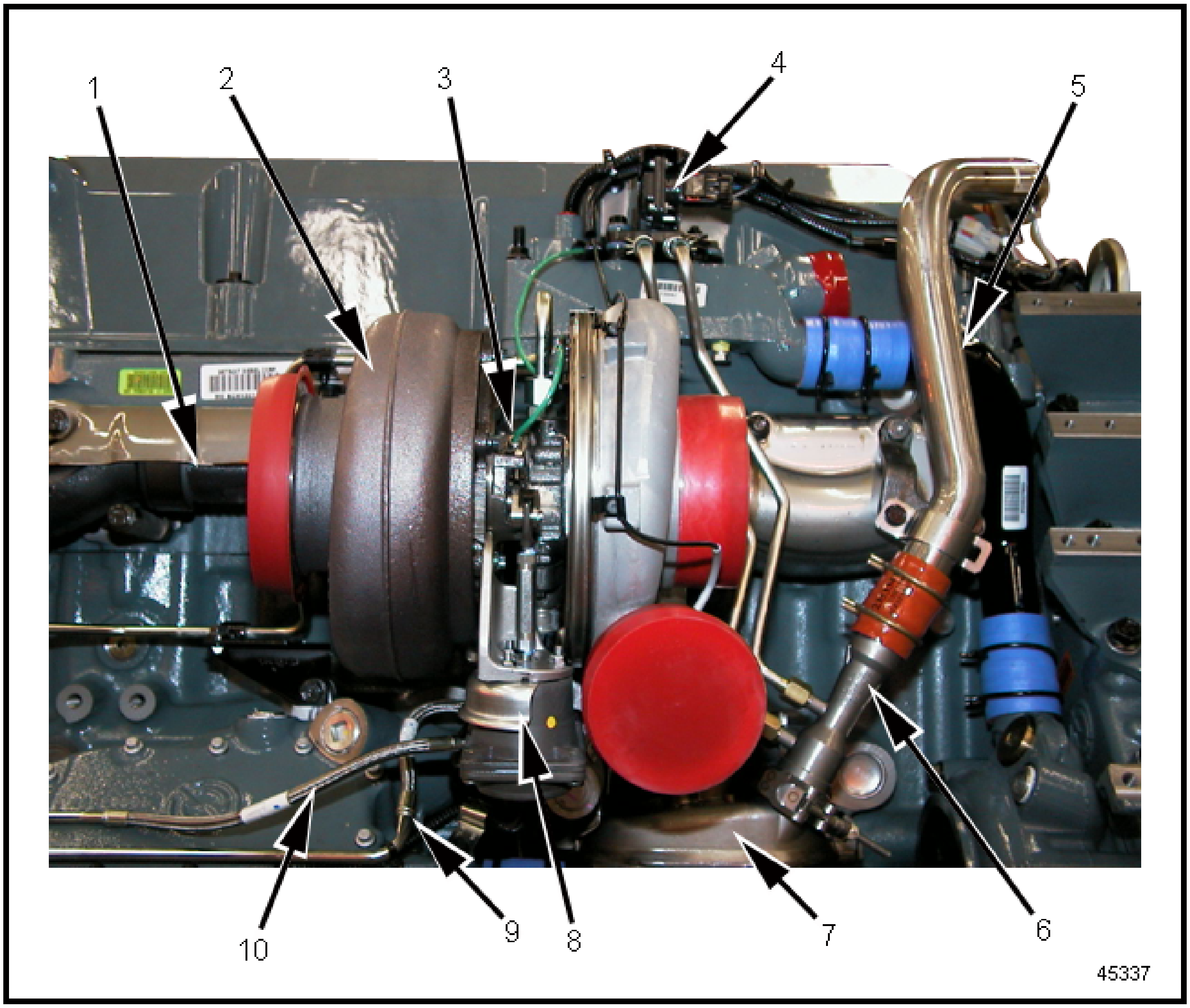
See Figure 8-4 for a left side engine view.



1. Camshaft Gear Cover
2. EGR Delivery Pipe
3. Intake Air Temperature Sensor (IAT Sensor)
4. Intake Manifold Pressure Sensor (IMP Sensor)
5. Barometric Pressure Sensor (Baro)
6. Charge Air Mixer

Figure 8-4 Left Side Component Engine View

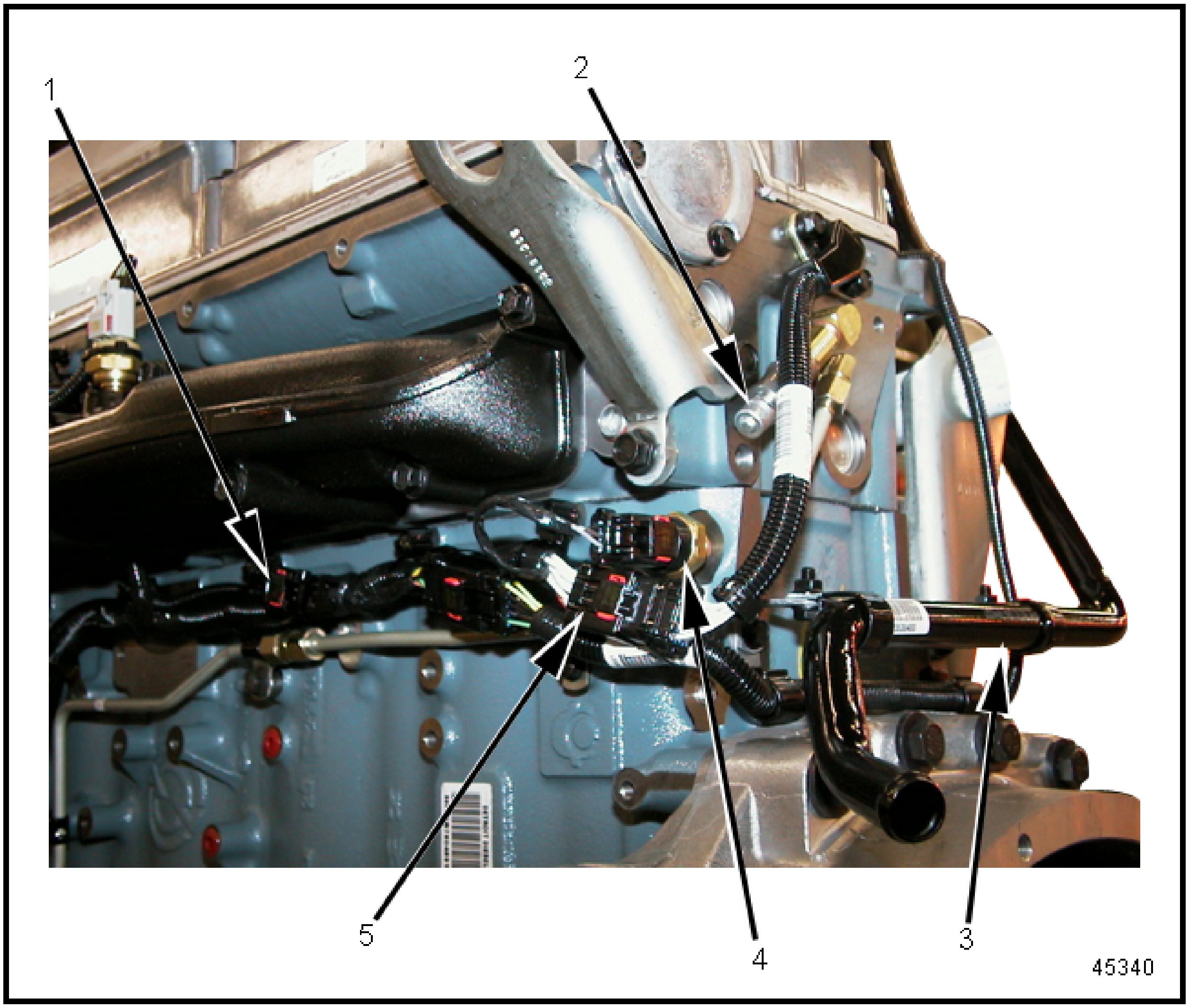
See Figure 8-5 for a detailed front right side engine view.



1. Exhaust Manifold with Fey Seals
2. Variable Nozzle Turbocharger (VNT)
3. Turbocharger Speed Sensor (TSS)
4. Delta P Sensor
5. EGR Delivery Pipe
6. Venturi Tube
7. EGR Tube and Shell Cooler
8. VNT Actuator
9. EGR Valve Control Oil Supply Line
10. VPOD-to-VNT Actuator Air Line

Figure 8-5 Front Right Side Component Engine View

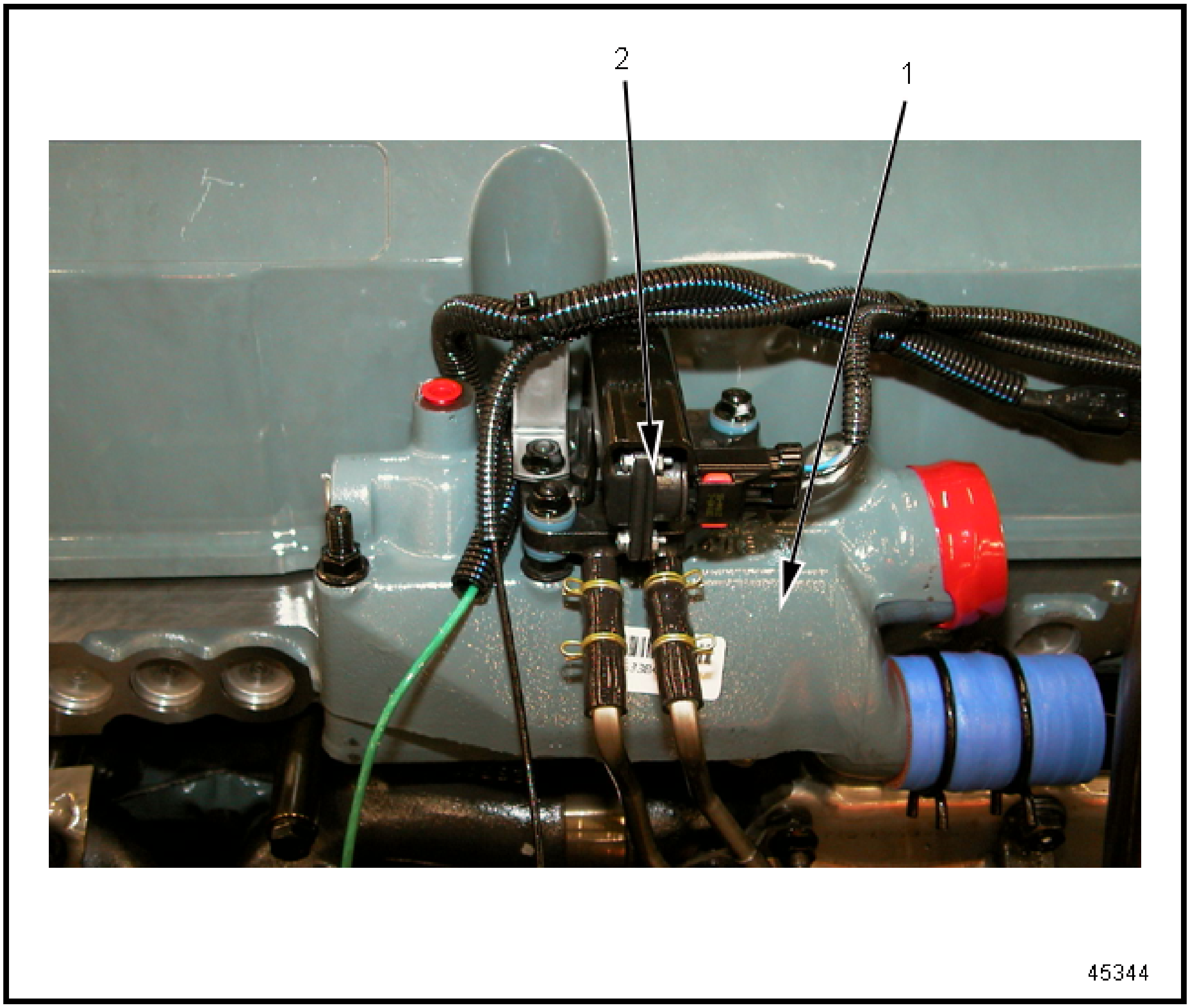
See Figure 8-6 for the lower rear right side engine components.



1. Barometric Pressure Sensor
2. Check Valve and Regulator Fitting for Return Fuel
3. Breather Tube
4. Engine Oil Pressure Sensor
5. Injector Harness Connector

Figure 8-6 Lower Rear Left Side Engine Components

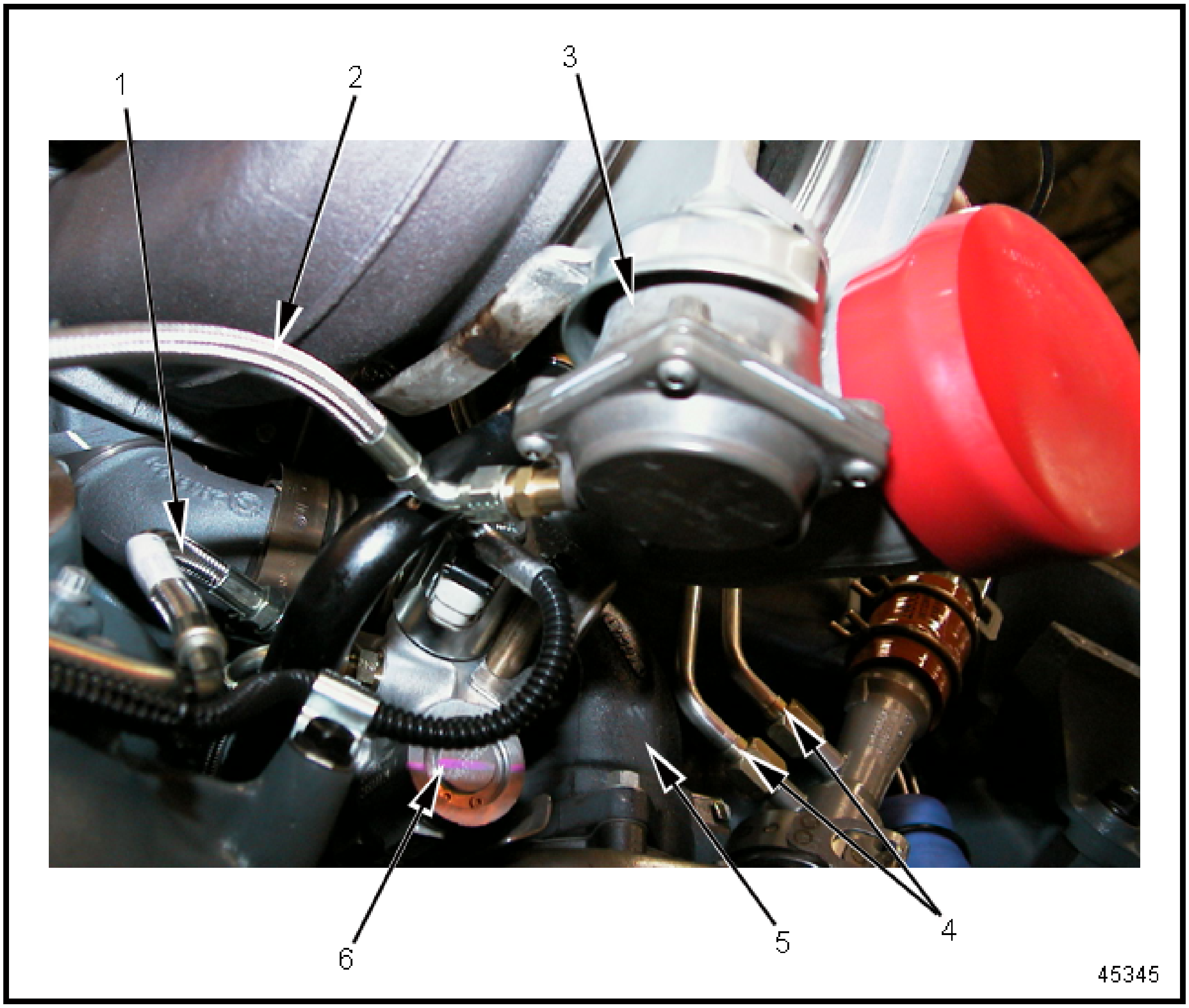
See Figure 8-7 a detailed view of the Delta P Sensor.



1.Thermostat Housing
2. Delta P Sensor

Figure 8-7 Delta P Sensor Location

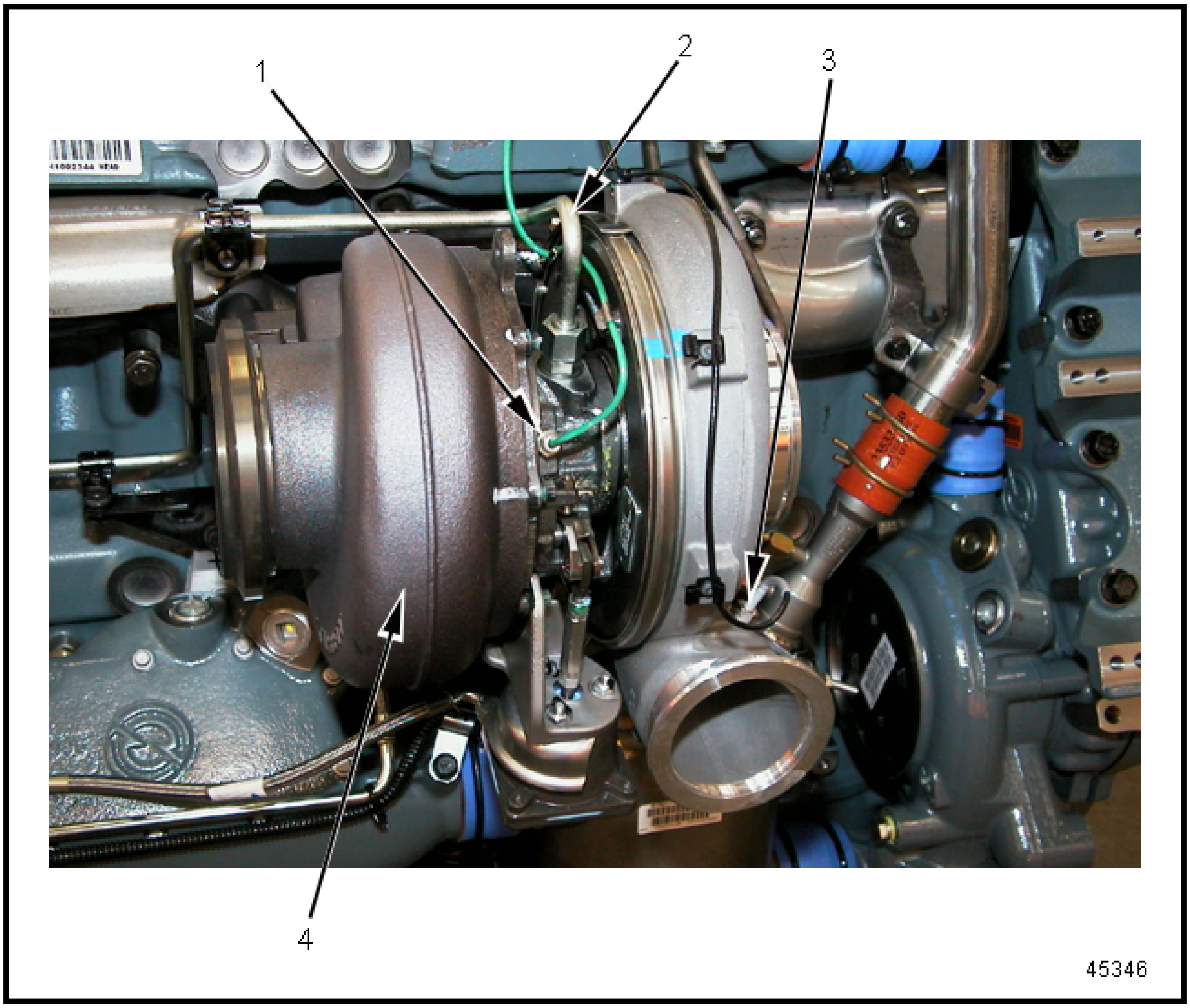
See Figure 8-8 for a detailed view of the VNT, EGR valve, and related components location.



1. EGR Control Valve Oil Supply Line
2. VNT Actuator Air Line
3. VNT Actuator
4. Delta P Sensor Lines
5. EGR Valve
6. EGR Valve Hydraulic Actuator

Figure 8-8 VNT and Related Components Location

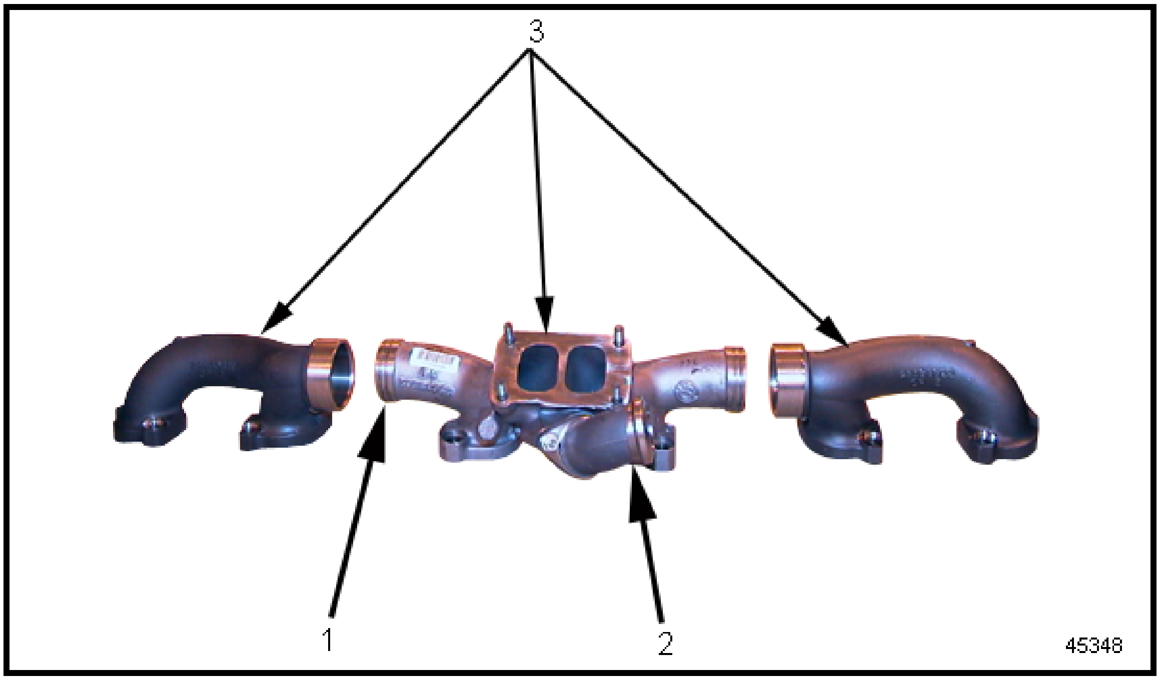
See Figure 8-9 for a detailed view of the VNT and related components.



1. Turbocharger Speed Sensor (TSS)
2. Turbocharger Oil Inlet Line
3. Turbocharger Compressor Outlet Temperature Sensor (TCOT)
4. Variable Nozzle Turbocharger (VNT)

Figure 8-9 VNT and Related Components

See Figure 8-10 for an exploded view of the Fey ring exhaust manifold.

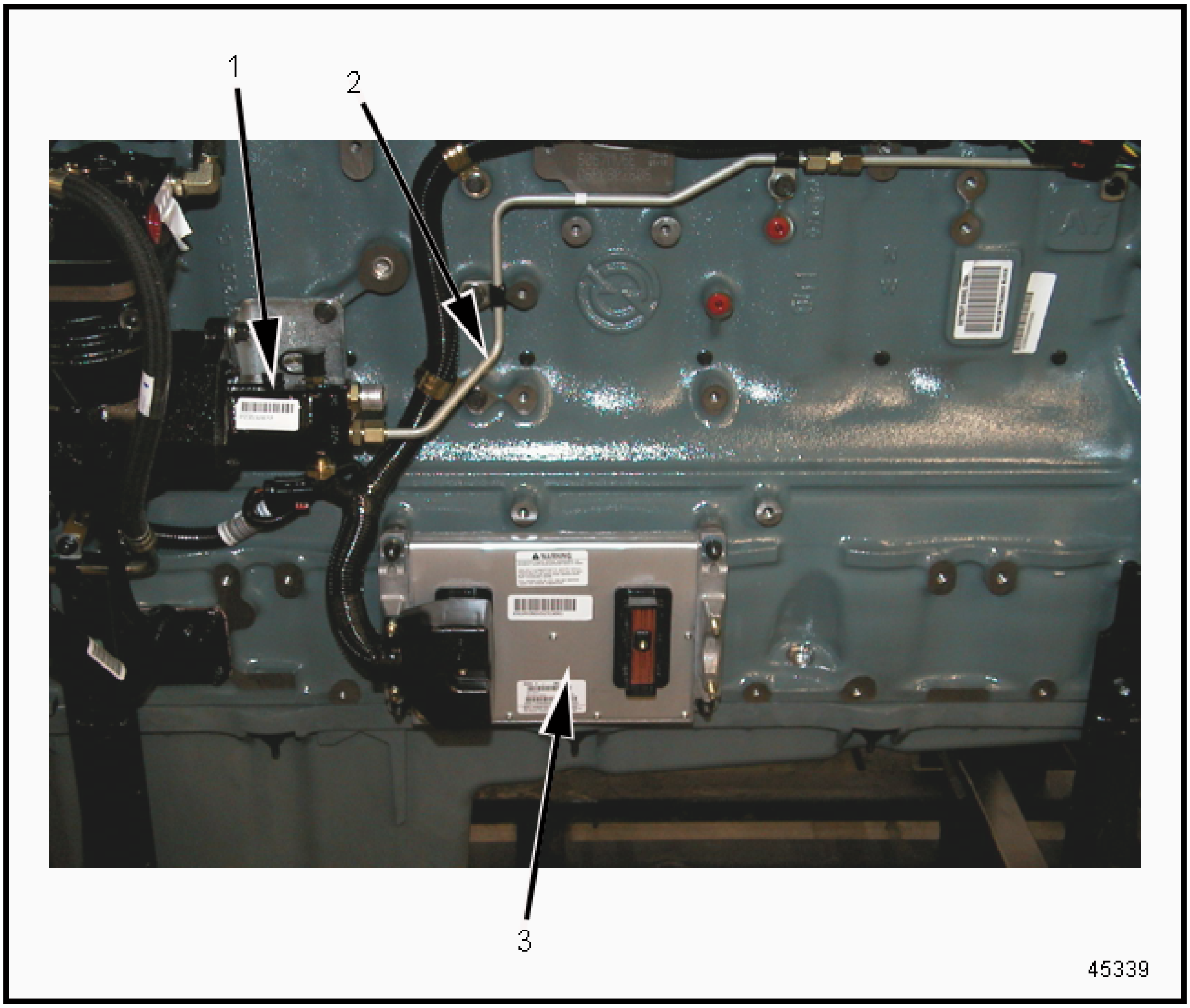


1. Fey Ring Grooves with Fey Rings
2. EGR Valve to Bellow Connector
3. Exhaust Manifold Assembly

Figure 8-10 Fey Ring Exhaust Manifold

DDEC V Electronic Control Unit

Figure 8-11 illustrates the location of the DDEC V ECU.



1. Fuel Pump
2. Fuel Pump Outlet Line
3. DDEC V ECU

Figure 8-11 DDEC V ECU

EGR Valve and Related Components

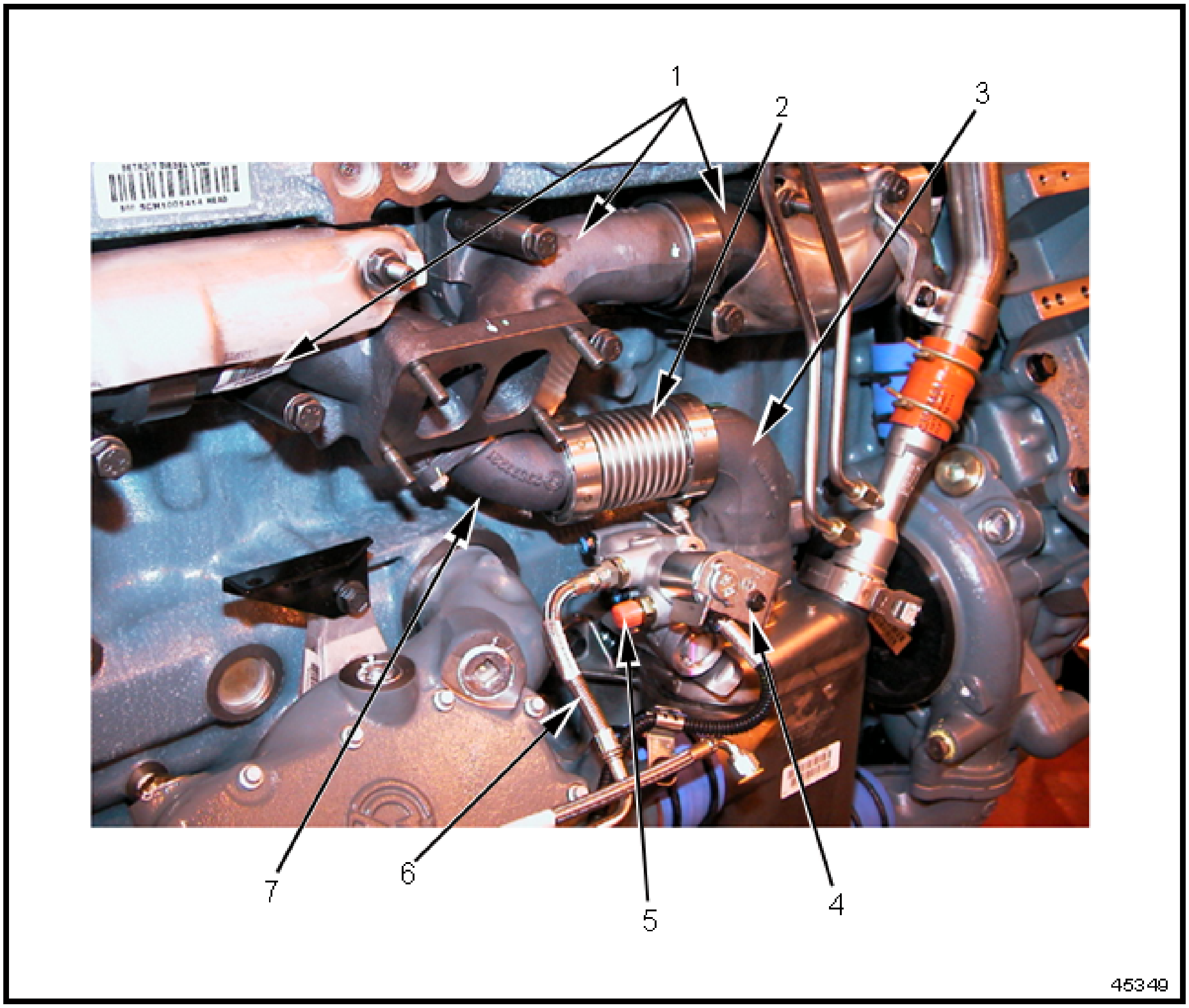
The EGR valve position is controlled by DDEC. The ECU continuously monitors all engine operation modes and performs self diagnostic checks of RPM, load, altitude, air temperature, etc. and uses this information to determine the valve position.

When the EGR valve is closed, exhaust gas will flow from the exhaust manifold or through the turbine wheel in the turbocharger, and out the exhaust system.

When the EGR valve is open, some of the exhaust gas is directed into the EGR cooler, through the delivery pipe, and into the intake manifold.

Top Right Side View of EGR Components

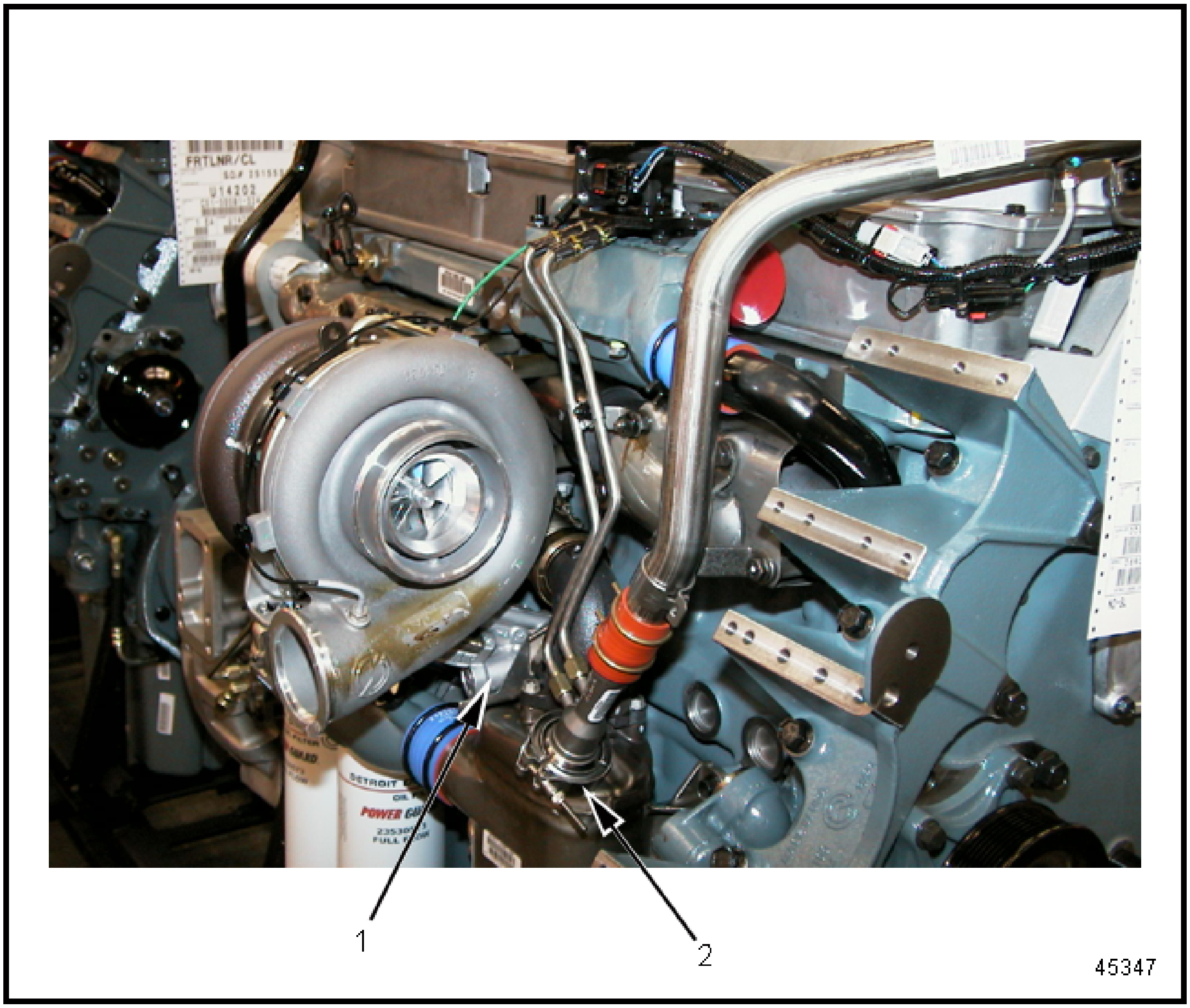
See Figure 8-12 for a detailed view of the EGR components.



1. Exhaust Manifold
2. Bellows
3. EGR Control Valve Body
4. EGR Control Valve Hydraulic Actuator
5. EGR Control Valve Oil Return Connector
6. EGR Control Valve Oil Supply Line
7. Exhaust Manifold Center Housing to Bellow Pipe

Figure 8-12 Top Right Side View of EGR Components

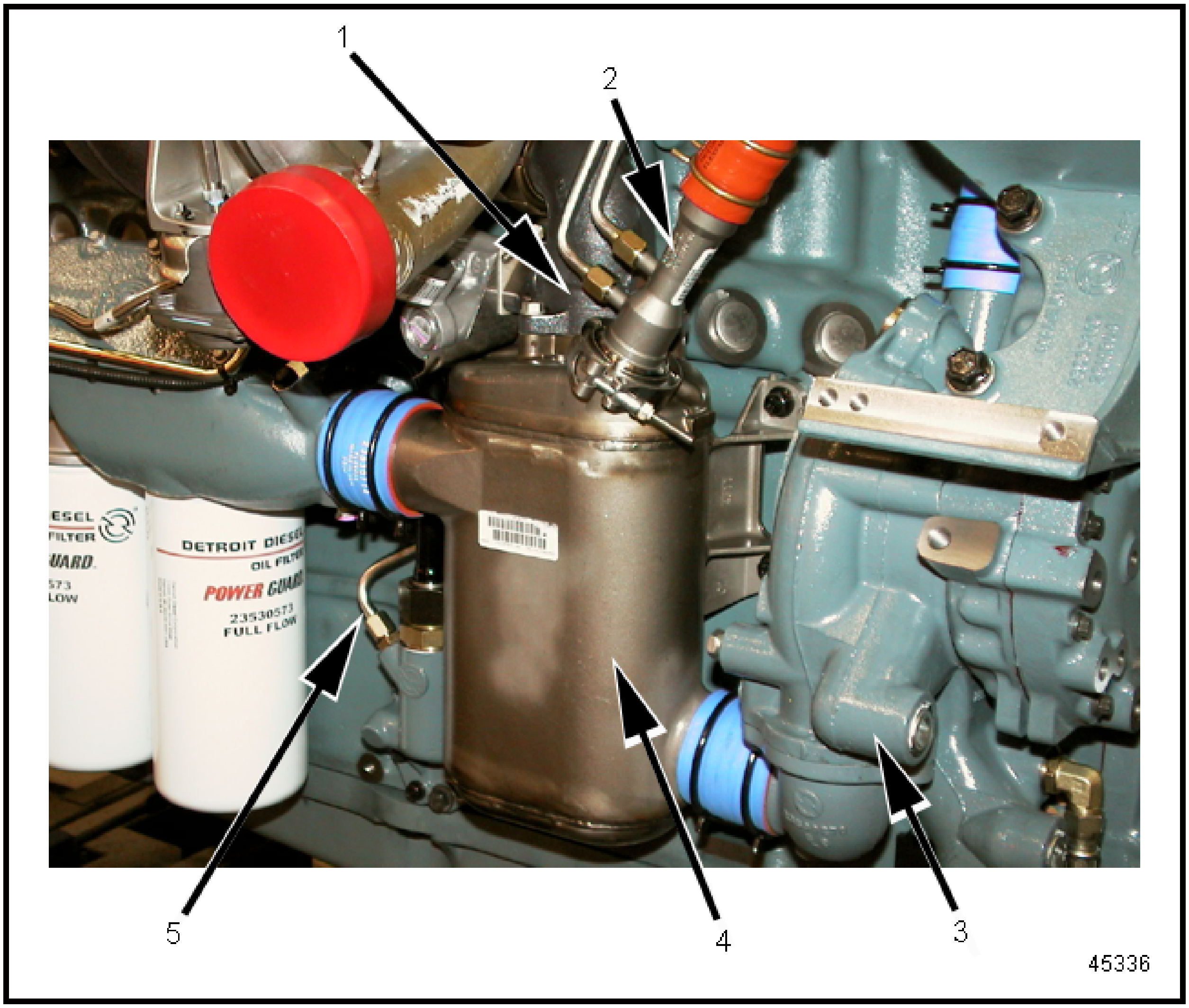
See Figure 8-13 for a detailed right side view of the EGR components.



1. EGR Control Valve Hydraulic Actuator
2. Delivery Pipe Connection

Figure 8-13 Front Right Side View of EGR Components

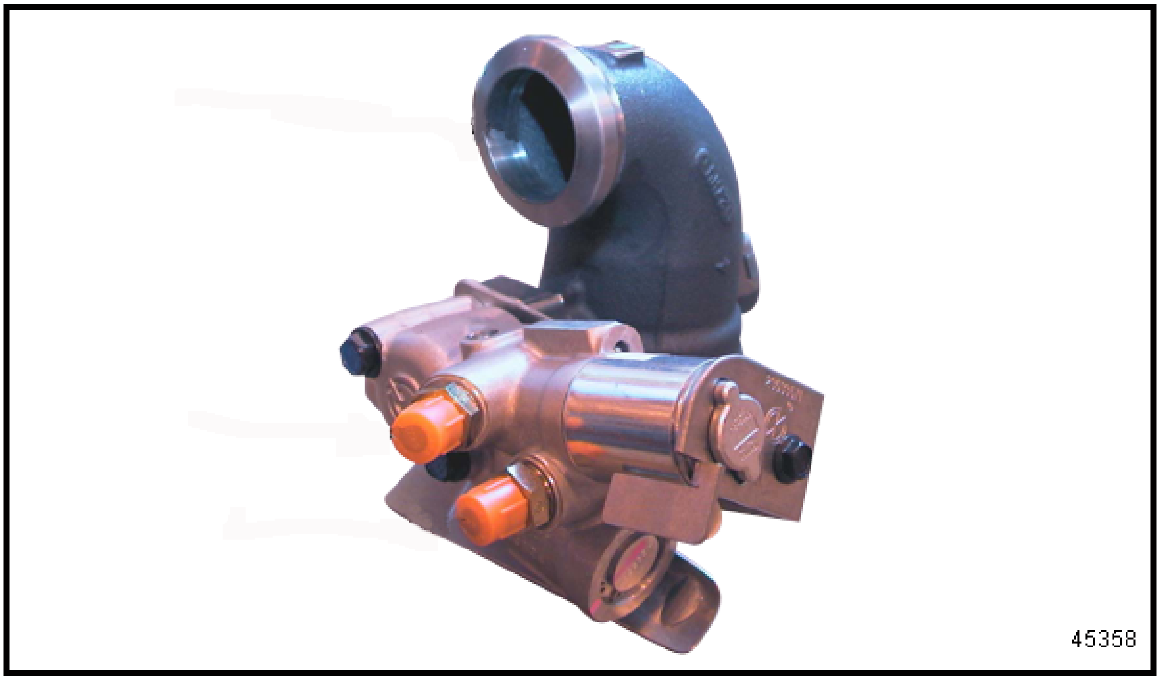
See Figure 8-14 for a detailed view of the EGR cooler and related components.



1. Bolt on EGR Valve
2. Venturi Tube
3. High Volume Water Pump
4. Tube and Shell EGR Cooler
5. EGR Control Valve Oil Return Line

Figure 8-14 EGR Cooler and Related Components

See Figure 8-15 for a view of the EGR valve.



1. EGR Valve Assembly
2. EGR Control Valve Oil Feed Connection
3. EGR Control Valve Oil Return Line Connection
4. EGR Control Valve Hydraulic Actuator

Figure 8-15 EGR Valve

FUNCTIONALITY OF EGR COMPONENTS

The following subsections detail the functions of specific EGR components.

DDEC V Electronic Control Unit

The Electronic Control Unit (ECU) provides overall engine management, self-diagnostic checks, and monitors other system components. System diagnostic checks are made at ignition-on and continue throughout all engine-operating modes.

A DDEC equipped engine is built with an electronically controlled fuel injection system which eliminates control racks or mechanical linkages requiring periodic adjust. Fuel economy and vehicle performance are also improved during cold starting and the increased initial idle speed allows for fast engine warm-up.

Horsepower, torque, idle, and engine speed are managed by the ECU. Such functionality eliminates the need for a mechanical governor. Mechanical governors are equipped with springs that require adjustments for idle and high-speed control.

The Accelerator Pedal Assembly (AP) eliminates the need for any throttle linkage eliminating throttle delay.

The DDEC V ECU has two 68-pin Tyco connectors; one for the engine and the other for the vehicle. There are two data links on the Vehicle Interface Harness (VIH). One link is based on SAE J1708 and the second is SAE J1939. The engine harness, is Controller Area Network (CAN) based and will be used for proprietary communications such as multi-ECU applications and DDC factory programming. See Figure B-3 for the Engine Harness and see Figure B-4 for the Vehicle Interface Harness.

Turbocharger Compressor Inlet Temperature Sensor

The Turbocharger Compressor Inlet Temperature Sensor (TCI) sensor is installed by the OEM within piping between the air filter and the turbocharger inlet. The TCI sensor along with other DDEC sensors are monitored by the ECU as a means of fuel management during normal operation.

The TCI sensor is supplied a 5-volt signal from the ECU and returns a voltage signal to the ECU relative to turbocharger compressor air inlet temperature. As return voltage decreases the air inlet temperature voltage increases. The TCI operating values during normal engine operation are 0.10-5.0 V.

Venturi Tube

The venturi tube with a port at each end is located in the EGR delivery pipe which is connected to the EGR cooler outlet. The Venturi tube ports are connected to the Delta P Sensor to monitor the pressure differential across the venturi as EGR exhaust gases flow through the EGR delivery pipe to the charge air mixer. DDEC V uses this information along with temperature and density of the exhaust gases to determine precise EGR Mass Flow Rate.

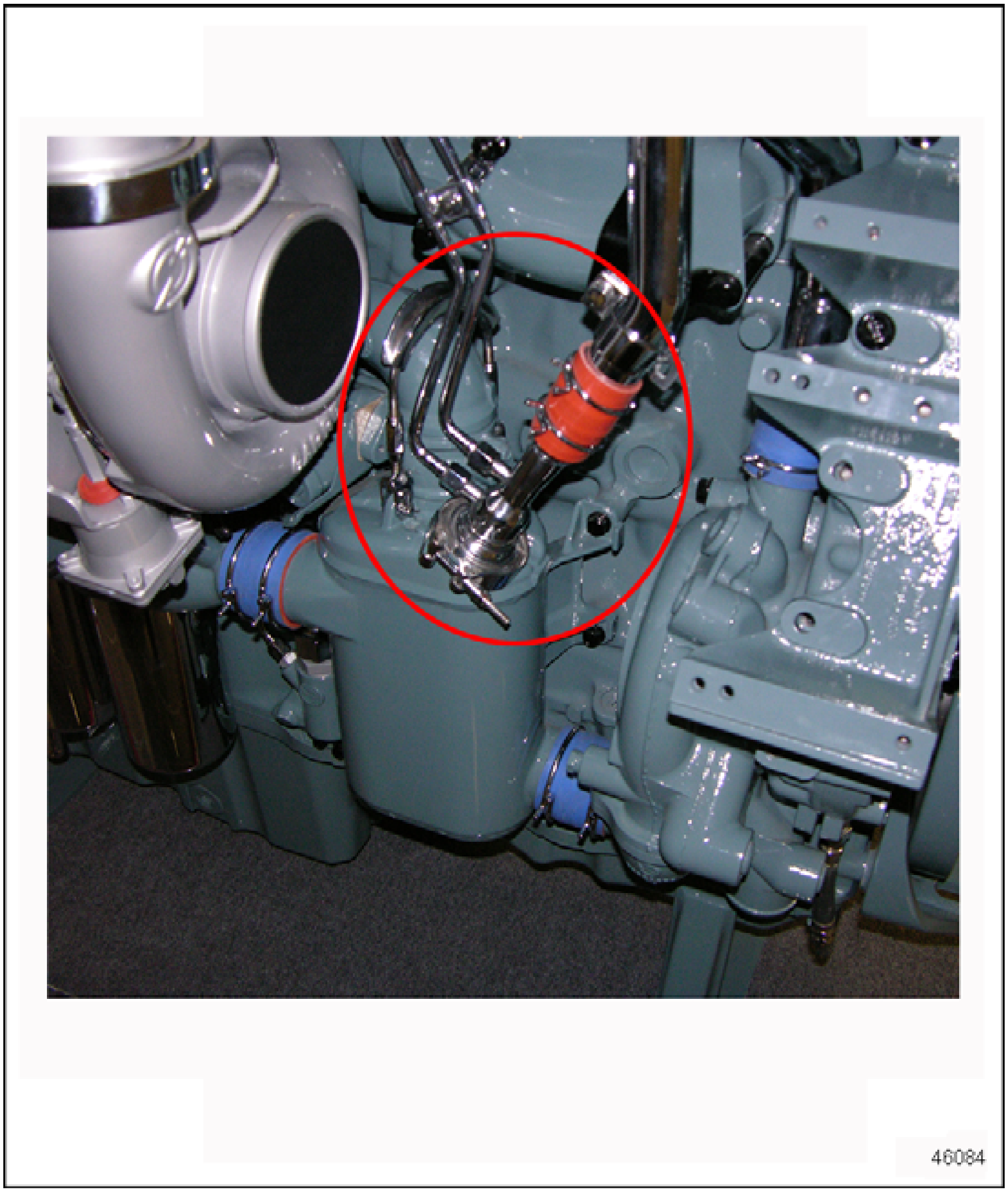


Figure 8-16 Venturi Tube

EGR Cooler

The primary purpose of the EGR cooler, see Figure 8-17, is to cool the engine exhaust gases prior to entering the intake manifold. Exhaust gas cooling is accomplished by the flow of exhaust gases through the EGR cooler tubes. The EGR cooler core then transfers the heat removed from the exhaust gases to the engine coolant. The cooled exhaust gases are then mixed with incoming air from the charge air cooler before being sent to the intake manifold.

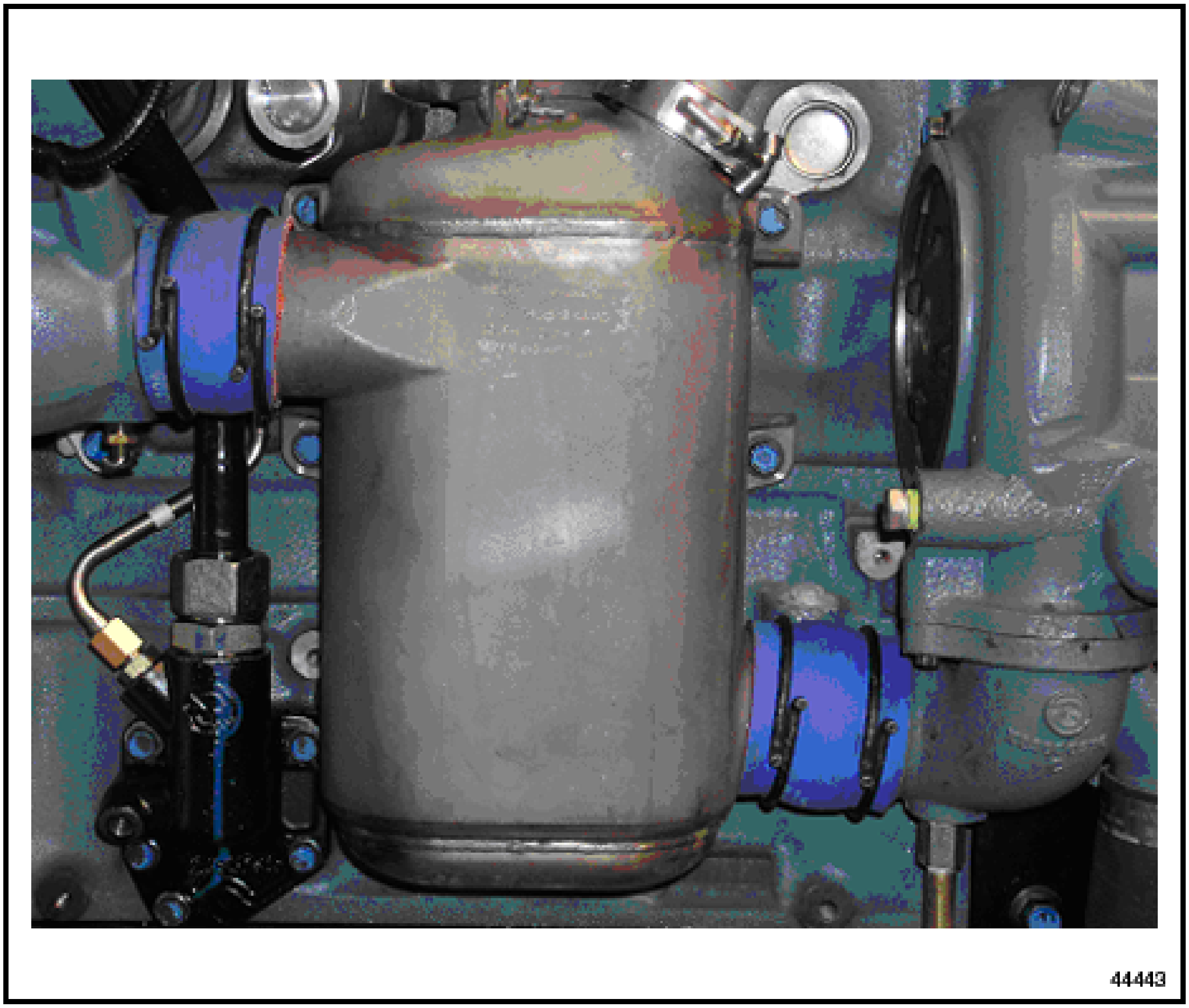


Figure 8-17 EGR Cooler

Charge Air Mixer

The charge air mixer, see Figure 8-18, combines exhaust gases into the fresh air supply flowing from the charge air cooler. Once the air has passed the charge air mixer, the intake manifold diffuses the EGR exhaust gases evenly to each cylinder. DDEC sensors are mounted in the intake manifold to monitor the air temperature and boost pressure.

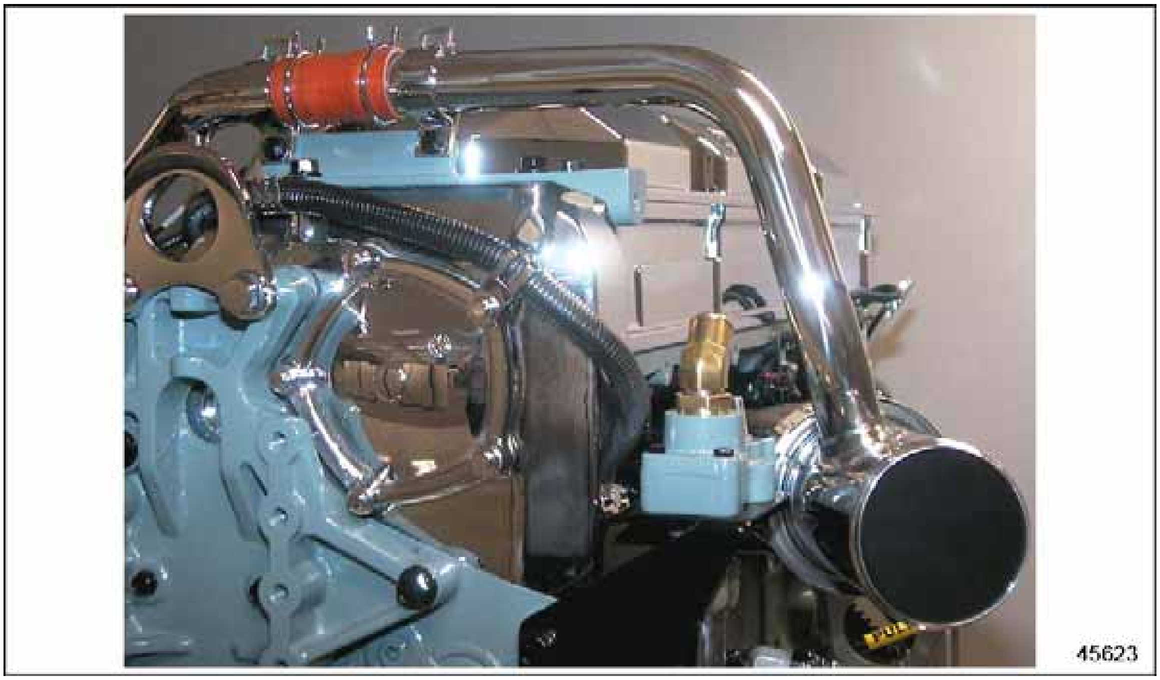


Figure 8-18 Charge Air Mixer

Charge Air Cooler

The Charge Air Cooler (CAC), see Figure 8-19, is mounted in front of the cooling system radiator and is connected to the turbocharger and intake manifold which permits a more dense charge of air to be delivered to the engine. The compressed air leaving the turbocharger is directed through the CAC before it flows into the CAC to be mixed with EGR exhaust gases before entering the intake manifold. Cooling is accomplished by incoming air flowing past the tubes and fins of the CAC. The compressed intake charge air flowing through the CAC core transfers the heat to the tubes and fins where it is dissipated to the outside air.

Figure 8-19 Charge Air Cooler

Variable Nozzle Turbocharger

Variable nozzle turbocharger (VNT), see Figure 8-20, uses an actuator to regulate and control turbine vanes. There is no wastegate with this system. The VNT actuator is mounted on a bracket attached to the turbocharger and receives air pressure from engine-mounted VPOD. The VNT actuator connects via a rod to the pin joint of the turbine external arm. Rotation of the external arm simultaneously rotates several pivoting nozzle vanes positioned inside the turbine housing at the outer periphery of the turbine wheel. This adjusts turbocharger speed, boost and EGR flow in accordance with DDEC engine management control.

NOTE:
VNT actuator is spring loaded. If air pressure is lost the actuator will open the VNT vanes resulting in low/no boost.

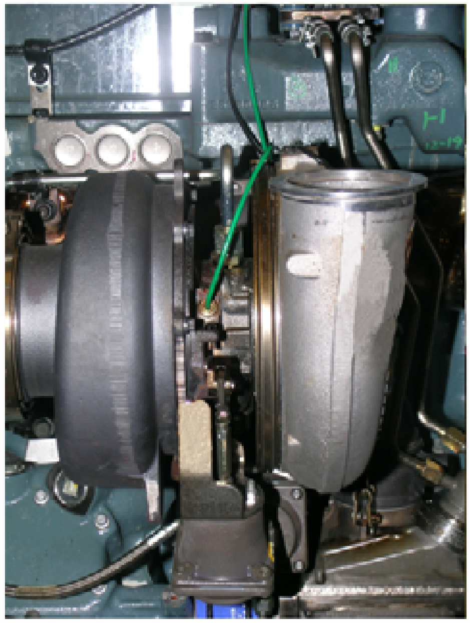


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Figure 8-20 VNT Actuator

Variable Pressure Output Device

There is one VPOD which controls the VNT. See Figure 8-21. The location of the VPOD is application dependent.

Two system components are required for proper operation of the EGR valve and the VNT control system.

- 12V or 24V Power Supply
- DDEC V ECU: PWM#3 (E1) EGR and PWM#4 (E4) VNT

NOTE:
VNT is fully open at 7% and closed at 90%

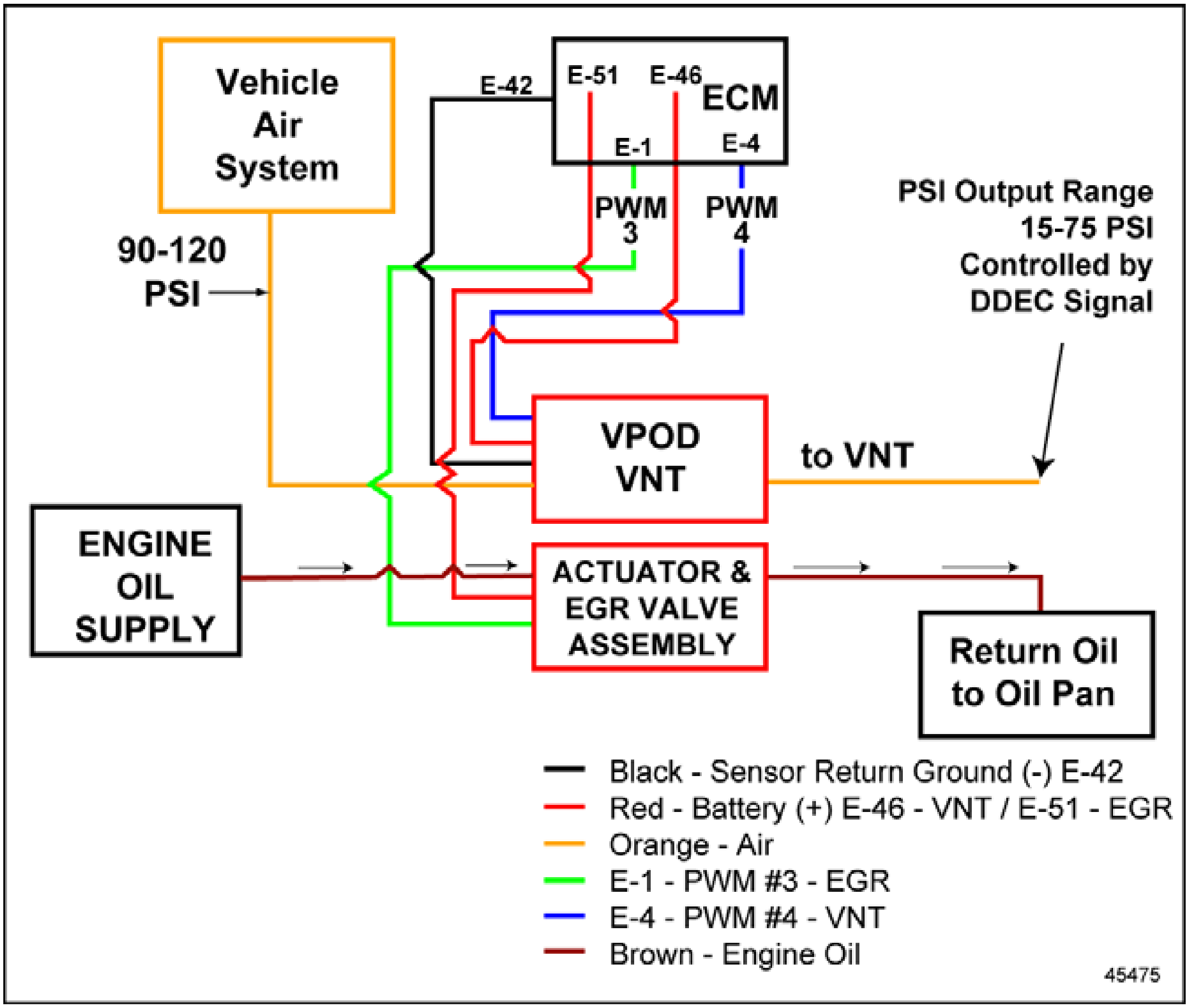


Figure 8-21 EGR Valve and VNT Control System

Hydraulically Actuated EGR Valve

The EGR valve is hydraulically actuated using engine oil and eliminates the need for an EGR VPOD. The butterfly valve design is still used to control the exhaust gas flow through the EGR cooler. The ECU continuously monitors all engine operation modes and performs self diagnostic checks for engine RPM, engine load, altitude, incoming air temperature, and uses this information to determine the EGR valve position. The ECU changes the EGR valve position via a PWM to the solenoid in the actuator. See Figure 8-22.

NOTE:
When installing a new hydraulic actuator or EGR valve, manually closing the valve during installation will make the first start up easier. Once the engine has started and oil pressure through the actuator has equalized, operation will be normal.

The EGR valve operating values are 0-12 V or 0-24 V depending on vehicle electrical system.

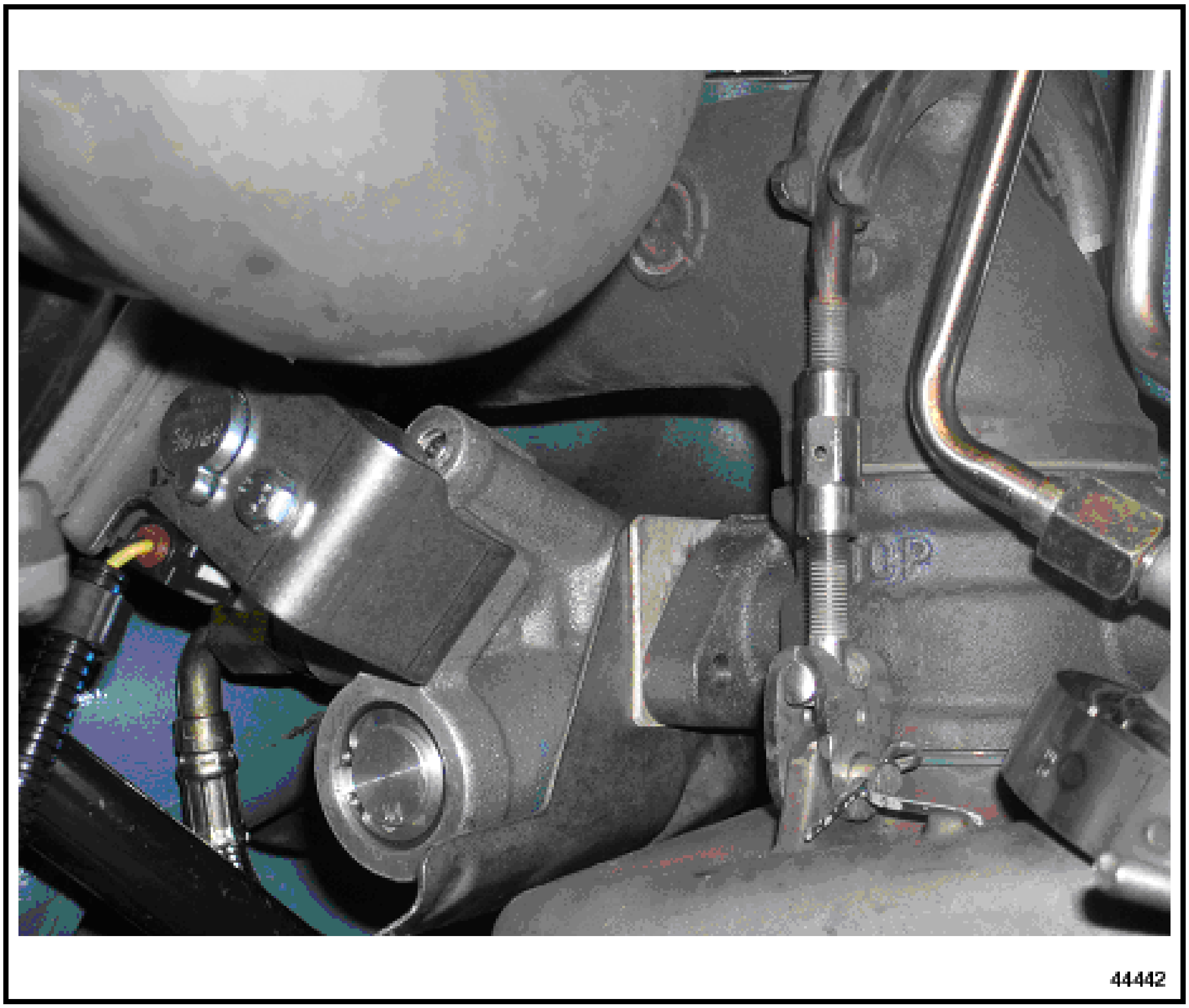


Figure 8-22 Hydraulic Actuator with Solenoid

EGR Temperature Sensor

The ECU uses the EGR Temperature Sensor to monitor exhaust gas temperatures in the EGR delivery pipe and uses exhaust temperature and delta pressure across the venturi tube to determine rate of EGR flow. The temperature sensor is supplied a 5-volt reference signal from the ECU and returns a voltage signal to the ECU relative to exhaust gas temperatures in the EGR delivery pipe. The sensor return voltage decreases as exhaust gas temperature increases (sensor operating values are 0.10-5.0 V). See Figure 8-23 to view the sensor with connector.

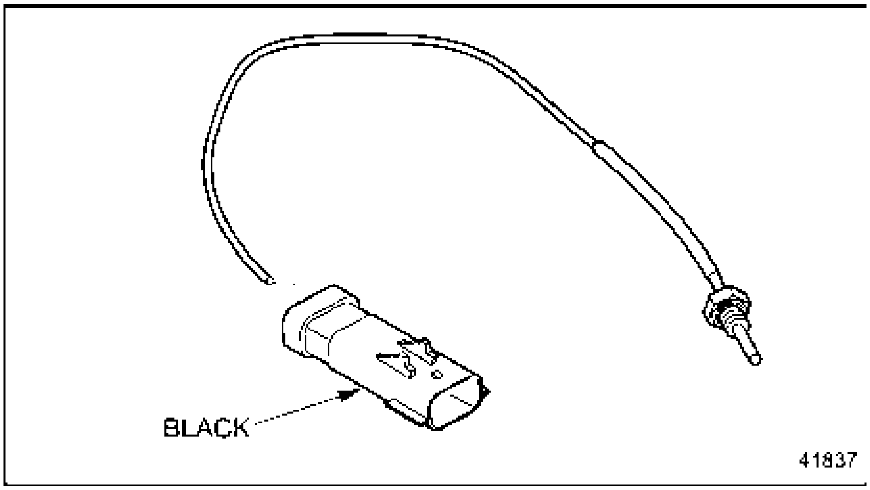
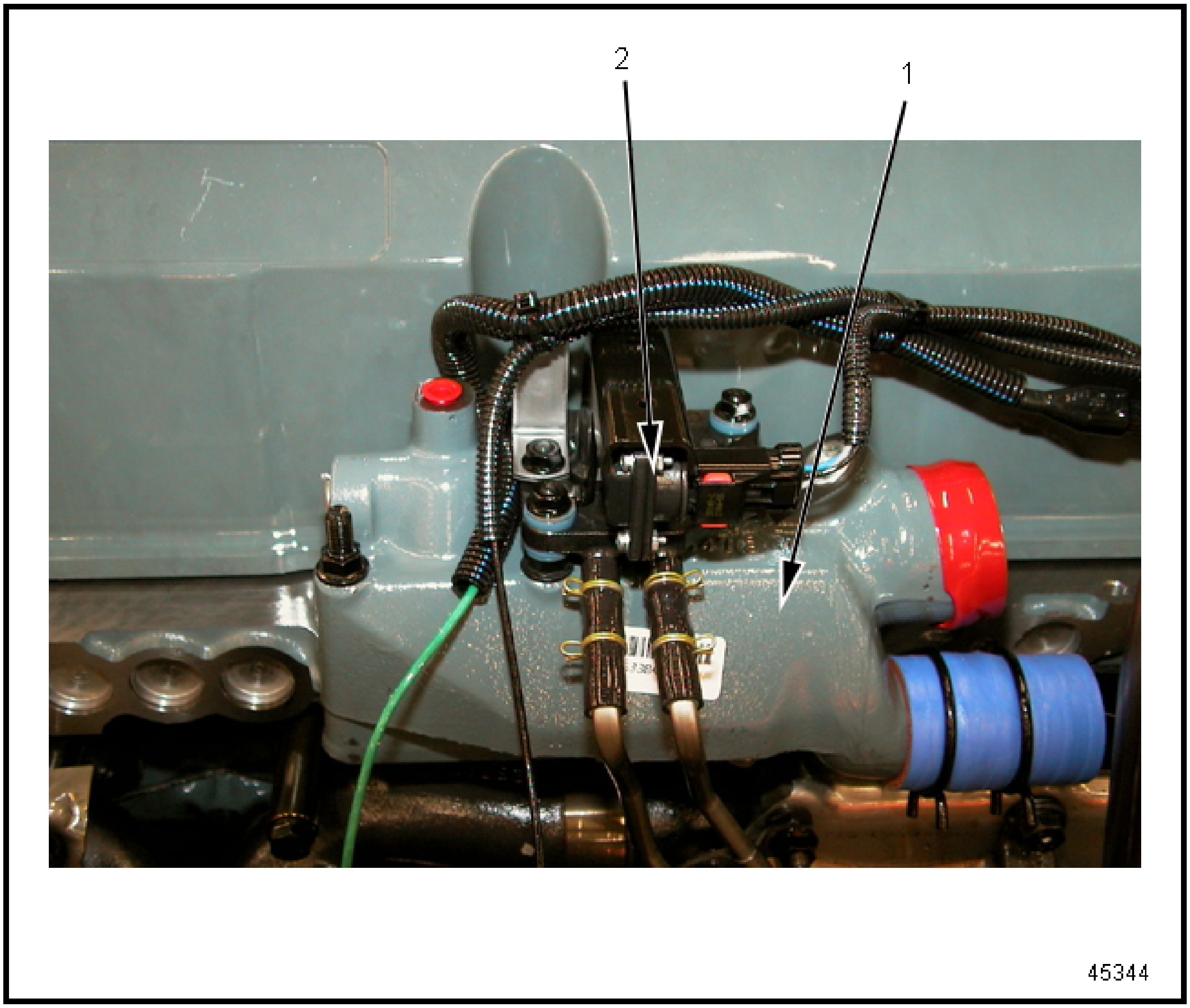


Figure 8-23 EGR Tempertaure Sensor

Delta P Sensor

The Delta P Sensor monitors the pressure differential across the venturi (in the EGR delivery pipe at the EGR cooler outlet) and uses the delta pressure and exhaust temperature to determine the rate of EGR flow. See Figure 8-24. The sensor is supplied a 5-volt reference signal from the ECU and returns a voltage signal to ECU relative to pressure difference across the Venturi tube. Return sensor voltage increases as pressure differential increases during engine operation (operating values are 0.23-4.77 V).



1. Thermostat Housing
2. Delta P Sensor

Figure 8-24 Delta P Sensor

Intake Manifold Pressure Sensor

The Intake Manifold Pressure Sensor (IMP Sensor), see Figure 8-25, is used to monitor air pressure in the intake manifold. The DDEC V ECU uses this air pressure data for fuel management during engine acceleration. The IMP Sensor sensor is supplied a 5-volt reference signal by ECU and returns a voltage signal to the ECU relative to turbo boost pressure. Return voltage increases as boost pressure increases. Operating values are 0.10-5.0 V during normal engine operation.

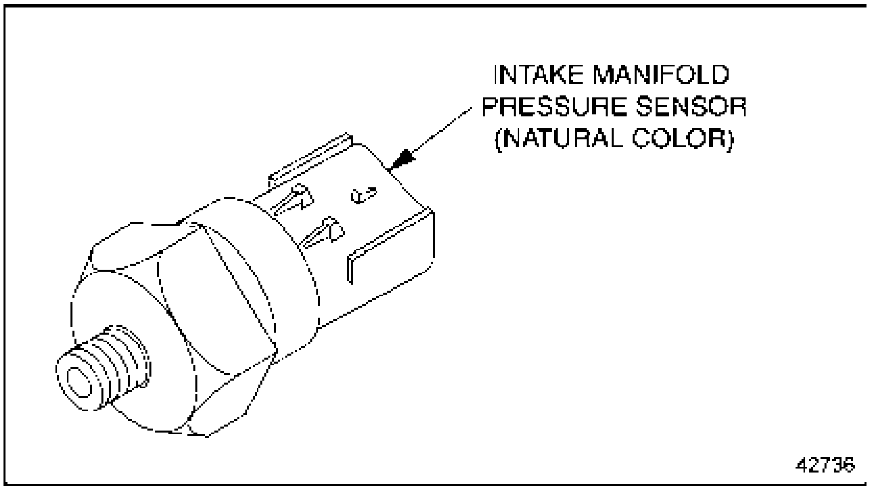


Figure 8-25 Turbocharger Boost Sensor

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9 DDEC V CODES

To read DDEC V codes, use the Detroit Diesel Diagnostic Link (DDDL). The DDDL will display active and inactive fault codes which are listed in Table 9-1.

NOTE:
Some vehicle dashboard displays will show SAE faults.

- Yellow= Sensor
- Red= Protection
- Blue = Logic
- Green = MAS (Maintenance Alert System)

DDC Code # (Flashed)	PID	SID	FMI	Description
11	187	-	4	Variable Speed Governor Sensor Voltage Low
11	187	-	7	Variable Speed Governor Switch System Not Responding
12	187	-	3	Variable Speed Governor Sensor Voltage High
13	111	-	4	Coolant Level Sensor Input Voltage Low
13	111	-	6	Add Coolant Level Sensor Input Voltage Low
13	-	146	6	EGR Valve Current Too High
14	110	-	3	Coolant Temperature Sensor Input Voltage High
14	175	-	3	Oil Temperature Sensor Input Voltage High
15	110	-	4	Coolant Temperature Sensor Input Voltage Low
15	175	-	4	Oil Temperature Sensor Input Voltage Low
16	111	-	3	Coolant Level Sensor Input Voltage High
16	111	-	5	Add Coolant Level Sensor Input Voltage High
16	-	146	5	EGR Valve Current Too Low
21	91	-	3	Throttle Position Sensor Input Voltage High
22	91	-	4	Throttle Position Sensor Input Voltage Low
23	174	-	3	Fuel Temperature Sensor Input Voltage High
24	174	-	4	Fuel Temperature Sensor Input Voltage Low
25	-	-	-	Reserved for “No Codes"
26	-	25	11	Aux. Shutdown #1 Active
26	-	61	11	Aux. Shutdown #2 Active

DDC Code # (Flashed)	PID	SID	FMI	Description
27	105	-	3	Intake Manifold Temperature Sensor Input Voltage High
27	171	-	3	Ambient Air Temperature Sensor Input Voltage High
27	172	-	3	Air Temperature Sensor Input Voltage High
28	105	-	4	Intake Manifold Temperature Sensor Input Voltage Low
28	171	-	4	Ambient Air Temperature Sensor Input Voltage Low
28	172	-	4	Air Temperature Sensor Input Voltage Low
29	351	-	4	TCI Temperature Circuit Failed Low
29	404	-	4	Turbo Compressor Temperature Out Sensor Input Voltage Low
31	-	51	3	Aux. Output #3 Open Circuit (High Side) - E49
31	-	51	4	Aux. Output #3 Short To Ground (High Side) - E49
31	-	51	7	Aux. Output #3 Mechanical System Fail - E49
31	-	52	3	Aux. Output #4 Open Circuit (High Side) - E48
31	-	52	4	Aux. Output #4 Short to Ground (High Side) - E48
31	-	52	7	Aux. Output #4 Mechanical System Failure - E48
31	-	260	3	Aux. Output #12 (E46) Open Circuit (High Side)
31	-	260	4	Aux. Output #12 (E46) Short To Ground (High Side)
31	-	260	7	Aux. Output #12 (E46) Mechanical System Failure (High Side)
31	-	261	3	Aux. Output #13 (E47) Open Circuit (High Side)
31	-	261	4	Aux. Output #13 (E47) Short To Ground (High Side)
31	-	261	7	Aux. Output #13 (E47) Mechanical System Failure
31	-	262	3	Aux. Output #14 (E50) Open Circuit (High Side)
31	-	262	4	Aux. Output #14 (E50) Short To Ground (High Side)
31	-	262	7	Aux. Output #14 (E50) Mechanical System Failure (High Side)
31	-	263	3	Aux. Output #15 (E51) Open Circuit (High Side)
31	-	263	4	Aux. Output #15 (E51) Short To Ground (High Side)
31	-	263	7	Aux. Output #15 (E51) Mechanical System Failure
31	-	264	3	Aux. Output #16 (E52) Open Circuit (High Side)
31	-	264	4	Aux. Output #16 (E52) Short To Ground (High Side)
31	-	264	7	Aux. Output #16 (E52) Mechanical System Failure
31	-	265	3	Aux. Output #17 (E53) Open Circuit (High Side)
31	-	265	4	Aux. Output #17 (E53) Short To Ground (High Side)
31	-	265	7	Aux. Output #17 (E53) Mechanical System Failure
32	-	238	3	RSL Short to Battery (+)
32	-	238	4	RSL Open Circuit
32	-	239	3	AWL Short to Battery (+)
32	-	239	4	AWL Open Circuit
33	102	-	3	Turbo Boost Pressure Sensor Input Voltage High
34	102	-	4	Turbo Boost Pressure Sensor Input Voltage Low
35	100	-	3	Oil Pressure Sensor Input Voltage Low

DDC Code # (Flashed)	PID	SID	FMI	Description
36	100	-	4	Oil Pressure Sensor Input Voltage Low
37	94	-	3	Fuel Pressure Sensor Input Voltage High
37	95	-	3	Fuel Restriction Sensor Input Voltage High
38	94	-	4	Fuel Pressure Sensor Input Voltage Low
38	95	-	4	Fuel Restriction Sensor Input Voltage Low
39	-	146	2	EGR Leak - Boost Power
39	-	146	7	EGR Valve Not Responding
39	-	146	12	EGR Leak - Boost Jake
39	-	147	2	Low or High Boost-Boost Mode VNT Vanes not responding-Boost Mode
39	-	147	7	Excessive EGR Flow-EGR Mode VNT Vanes not responding-EGR Mode
39	-	147	11	VNT Vanes at Max - Jake
39	-	147	12	Low or High Boost during Jake Operation VNT Vanes not responding-Jake Mode
39	-	147	14	EGR Flow too Low
41	-	21	0	Too Many SRS (missing TRS)
42	-	21	1	Too few SRS (missing SRS)
43	111	-	1	Coolant Level Low
44	105	-	0	Intake Manifold Temperature High
44	105	-	14	Engine Power Derate Due To Intake Manifold Temperature
44	110	-	0	Coolant Temperature High
44	110	-	14	Engine Power Derate Due To Coolant Temperature
44	172	-	0	Air Inlet Temperature High
44	175	-	0	Oil Temperature High
44	175	—	14	Oil Temperature Derate
45	100	-	1	Oil Pressure Low
46	-	155	4	Injector Vreg Voltage Failed Low
46	168	-	1	ECU Battery Voltage Low
46	-	211	1	Vehicle Sensor Supply Voltage Low
46	-	212	4	Injector Vslope Voltage Failed Low
46	-	214	1	RTC Backup Battery Voltage Low
46	-	221	4	Injector ILpullin Voltage Failed Low
46	-	232	1	Sensor Supply Voltage Low
47	94	-	0	Fuel Pressure High
47	102	-	14	Engine Power Derate Due To Boost Pressure
47	102	-	0	Turbo Boost Pressure High
47	106	-	0	Air Inlet Pressure High
48	94	-	1	Fuel Pressure Low
48	106	-	1	Air Inlet Pressure Low
48	351	-	1	TCI Temperature Below Range
48	404	-	1	Turbo Compressor Temperature Out Low

DDC Code # (Flashed)	PID	SID	FMI	Description
48	411	-	1	EGR Delta Pressure Low
48	412	-	1	EGR Temperature Low
49	351	-	0	TCI Temperature Above Range
49	404	-	0	Turbo Compressor Out Temperature High
49	404	14	-	Engine Power Derate Due To TCO Temperature
51	351	-	3	TCI Temperature Circuit Failed High
51	404	-	3	Turbo Compressor Out Temperature Sensor Input Voltage High
52	-	254	12	A/D Conversion Fail
53	-	253	2	Memory Check Failed On Startup
53	-	253	12	Memory Write Error - Single Location
53	-	253	13	Calibration Memory Error
53	-	253	14	Memory Write Error - All Locations
54	84	-	12	Vehicle Speed Sensor Fault
55	-	216	14	Other ECU Fault (This fault is logged in conjunction with another fault to indicate missing information from another ECU.)
55	-	231	12	J1939 Data Link Fault
58	40	-	9	Engine Retarder Switch Not Responding
58	40	-	12	Engine Retarder Switch Failed
58	70	-	9	Park Brake/Safety Loop Switch Not Responding
58	70	-	12	Park Brake/Safety Loop Switch Failed
58	92	-	0	Torque Overload
58	-	216	7	ECU Information Not Responding (Mux'd Dashboard Devices)
58	-	242	9	Cruise Control Resume/Accel Switch Not Responding
58	-	242	12	Cruise Control Resume/Accel Switch Failed
58	-	243	9	Cruise Control Set/Coast Switch Not Responding
58	-	243	12	Cruise Control Set/Coast Switch Failed
58	-	244	9	Cruise Control Enable Switch Not Responding
58	-	244	12	Cruise Control Enable Switch Failed
58	-	245	9	Clutch Pedal Switch Not Responding
58	-	245	12	Clutch Pedal Switch Failed
58	-	246	9	Service Brake Pedal Switch Not Responding
58	-	246	12	Service Brake Pedal Switch Failed
61	-	xxx	0	Injector xxx Response Time Long
61	-	1	6	Injector #1 Circuit Short To Ground
61	-	2	6	Injector #2 Circuit Short To Ground
61	-	3	6	Injector #3 Circuit Short To Ground
61	-	4	6	Injector #4 Circuit Short To Ground
61	-	5	6	Injector #5 Circuit Short To Ground
61	-	6	6	Injector #6 Circuit Short To Ground
62	-	26	3	Aux. Output #1 Short to Battery (+) - V4

DDC Code # (Flashed)	PID	SID	FMI	Description
62	-	26	4	Aux. Output #1 Open Circuit - V4
62	-	26	7	Aux. Output #1 Mechanical System Not Responding Properly -V4
62	-	40	3	Aux. Output #2 Short to Battery (+) - V5
62	-	40	4	Aux. Output #2 Open Circuit - V5
62	-	40	7	Aux. Output #2 Mechanical System Not Responding Properly - V5
62	-	53	3	Aux. Output #5 Short to Battery (+) -V6
62	-	53	4	Aux. Output #5 Open Circuit - V6
62	-	53	7	Aux. Output #5 Mechanical System Not Responding Properly - V6
62	-	54	3	Aux. Output #6 Short to Battery (+) - V7
62	-	54	4	Aux. Output #6 Open Circuit - V7
62	-	54	7	Aux. Output #6 Mechanical System Not Responding Properly - V7
62	-	55	3	Aux. Output #7 Short to Battery (+) - V40
62	-	55	4	Aux. Output #7 Open Circuit - V40
62	-	55	7	Aux. Output #7 Mechanical System Not Responding Properly - V40
62	-	56	3	Aux. Output #8 Short to Battery (+) - V53
62	-	56	4	Aux. Output #8 Open Circuit - V53
62	-	56	7	Aux. Output #8 Mechanical System Not Responding Properly - V53
62	-	250	12	J1587 Data Link Fault
62	-	257	3	Aux.Output #9 (V54) Short To Battery
62	-	257	4	Aux.Output #9 (V54) Open Circuit
62	-	257	7	Aux.Output #9 (V54) Mechanical System Failure-Pin Top 2
62	-	258	3	Aux.Output #10 (V55) Short To Battery
62	-	258	4	Aux.Output #10 (V55) Open Circuit)
62	-	258	7	Aux.Output #10 (V55) Mechanical System Failure Top 2
62	-	259	3	Aux.Output #11 (E13) Short To Battery
62	-	259	4	Aux.Output #11 (E13) Open Circuit
62	-	259	7	Aux.Output #11 (E13) Mechanical System Failure
63	-	57	0	PWM #1 (V52) Above Normal Range
63	-	57	1	PWM #1 (V52) Below Normal Range
63	-	57	3	PWM #1 (V52) Short to Battery (+)
63	-	57	4	PWM #1 (V52) Open Circuit
63	-	57	7	PWM #1 (V52) Mechanical System Failre
63	-	58	0	PWM #2 (V46) Above Normal Range
63	-	58	1	PWM #2 (V46) Below Normal Range
63	-	58	3	PWM #2 (V46) Short to Battery (+)
63	-	58	4	PWM #2 (46) Open Circuit
63	-	58	7	PWM #1 (V46) Mechanical System Failre

DDC Code # (Flashed)	PID	SID	FMI	Description
63	-	59	0	PWM #3 (E01) Above Normal Range
63	-	59	1	PWM #3 (E01) Below Normal Range
63	-	59	3	PWM #3 (E01) Short to Battery (+)
63	-	59	4	PWM #3 (E01) Open Circuit
63	-	59	7	PWM #3 (E01) Mechanical System Failure
63	-	60	0	PWM #4 (E04) Above Normal Range
63	-	60	1	PWM #4 (E04) Below Normal Range
63	-	60	3	PWM #4 (E04) Short to Battery (+)
63	-	60	4	PWM #4 (E04) Open Circuit
63	-	60	7	PWM #4 (E04) Mechanical System Failure
63	-	267	0	PWM #5 (E08) Above Normal Range
63	-	267	1	PWM #5 (E08) Below Normal Range
63	-	267	3	PWM #5 (E08) Short To Battery
63	-	267	4	PWM #5 (E08) Open Circuit
63	-	267	7	PWM #5 (E08) Mechanical System Failure
63	-	268	0	PWM #6 (E11) Above Normal Range
63	-	268	1	PWM #6 (E11) Below Normal Range
63	-	268	3	PWM #6 (E11) Short To Battery
63	-	268	4	PWM #6 (E11) Open Circuit
63	-	268	7	PWM #6 (E11) Mechanical System Failure
64	103	-	0	Turbo Overspeed
64	103	-	8	Turbo Speed Sensor Input Failure - Abnormal Period
65	107	-	3	Air Filter Restriction Sensor Voltage High
65	107	-	4	Air Filter Restriction Sensor Voltage Low
66	99	-	3	Oil Filter Restriction Sensor Voltage High
66	99	-	4	Oil Filter Restriction Sensor Voltage Low
67	106	-	3	Air Inlet Pressure Sensor Input Voltage High
67	106	-	4	Air Inlet Pressure Sensor Input Voltage Low
67	109	-	3	Coolant Pressure Circuit Failed High
67	109	-	4	Coolant Pressure Circuit Failed Low
68	-	230	5	TPS Idle Validation Circuit Fault (open circuit)
68	-	230	6	TPS Idle Validation Circuit Fault (short to ground)
71	-	xxx	1	Injector xxx Response Time Short
72	84	-	0	Vehicle Overspeed
72	84	-	11	Vehicle Overspeed (Absolute)
74	70	-	4	Optimized Idle Safety Loop Short to Ground
74	99	-	0	Oil Filter Restriction High
75	-	155	3	Injector Vreg Voltage Failed High
75	168	-	0	ECU Battery Voltage High
75	-	211	0	Vehicle Sensor Supply Voltage High
75	-	212	3	Injector Vslope Voltage Failed High

DDC Code # (Flashed)	PID	SID	FMI	Description
75	-	214	0	RTC Backup Battery Voltage High
75	-	221	3	Injector Ipullin Voltage Failed High
75	-	232	0	Sensor Supply Voltage High
76	121	-	0	Engine Overspeed With Engine Brake
77	21	-	0	ECU Temperature Above Range
77	21	-	1	ECU Temperature Below Range
77	21	-	3	ECU Temperature Failed High
77	21	-	4	ECU Temperature Failed Low
77	73	-	1	Fire Pump Pressure Low
77	81	-	0	Exhaust Back Pressure High
77	81	-	1	Exhaust Back Pressure Low
77	81	-	3	Exhaust Back Pressure Sensor Voltage High
77	81	-	4	Exhaust Back Pressure Sensor Voltage Low
77	81	-	12	Exhaust Back Pressure at Rampdown Threshold
77	95	-	1	Fuel Filter Differential Pressure Low
77	99	-	1	Oil Filter Differential Pressure Low
77	100	-	0	Engine Oil Pressure High
77	102	-	1	Turbo Boost Pressure Low
77	105	-	1	Inlet Manifold Temperature Low
77	107	-	1	Air filter Restriction Pressure Low
77	108	-	0	Barometric Pressure High
77	108	-	1	Barometric Pressure Low
77	109	-	0	Coolant Pressure High
77	110	-	1	Coolant Temperature Low
77	111	-	0	Coolant Level High
77	-	151	11	Service Now Lamp Fault Expiration
77	171	-	0	Ambient Air Temperature High
77	171	-	1	Ambient Air Temperature Low
77	172	-	1	Air Inlet Temperature Low
77	174	-	0	Fuel Temperature High
77	174	-	1	Fuel Temperature Low
77	175	-	1	Engine Oil Temperature Low
77	177	-	0	Transmission Oil Temperature High
77	177	-	1	Transmission Oil Temperature Low
77	177	-	3	Transmission Oil Temperature Failed High
77	177	-	4	Transmission Oil Temperature Failed Low
77	-	151	11	Service Now Lamp Fault Expiration
78	86	-	14	Cruise Control/Adaptive Cruise Control Fault
81	98	-	3	Oil Level Sensor Input Voltage High
81	173	-	3	Exhaust Temperature Sensor Input Voltage High
81	355	-	3	Engine Oil Life Sensor Circuit Failed High
81	411	-	3	EGR Delta Pressure Circuit Failed High

DDC Code # (Flashed)	PID	SID	FMI	Description
81	412	-	3	EGR Temperature Circuit Failed High
81	355	-	3	Engine Oil Life Sensor Circuit Failed High
82	98	-	4	Oil Level Sensor Input Voltage Low
82	101	-	4	Crankcase Pressure Sensor Input Voltage Low
82	153	-	4	Extended Crankcase Pressure Input Voltage Low
82	173	-	4	Exhaust Temperature Sensor Input Voltage Low
82	355	-	4	Engine Oil Life Sensor Circuit Failed Low
82	411	-	4	EGR Delta Pressure Circuit Failed low
82	412	-	4	EGR Temperature Circuit Failed Low
83	73	-	0	Aux. Pump Pressure High
83	98	-	0	Oil Level High
83	101	-	0	Crankcase Pressure High
83	153	-	0	Extended Crankcase Pressure High
83	173	-	0	Exhaust Temperature High
83	355	-	9	Coolant In Oil Detected
83	355	-	14	Change Oil Now
83	411	-	0	EGR Delta Pressure High
83	412	-	0	EGR Temperature High
84	98	-	1	Oil Level Low
84	355	-	1	Change Oil Soon
85	190	-	0	Engine Overspeed
85	190	-	14	Engine Overspeed Signal
86	73	-	3	Aux. Pump Pressure Sensor Input Voltage High
86	108	-	3	Barometric Pressure Sensor Input Voltage High
87	73	-	4	Pump Pressure Sensor Input Voltage Low
87	108	-	4	Barometric Pressure Sensor Input Voltage Low
89	95	-	0	Fuel Filter Restriction High
89	111	-	12	Maintenance Alert Coolant Level Fault
-	-	240	2	ECU Checksum Incorrect
-	-	240	13	ECU Checksum Incorrect
-	-	253	2	Calibration Checksum Incorrect
-	-	253	9	Calibartion Checks Invalid
-	-	253	13	Calibration Versions Invalid
-	-	254	0	External RAM Failed
-	-	254	1	Internal RAM Failed
-	-	254	6	Module Forced To Boot Mode
-	-	254	12	Boot Code Checksum INcorrect

Table 9-1 Flash Codes, SAE Codes, Descriptions

LOGIC CODES (MECHANICAL FAILURES)

Logic codes indicate the detection of mechanical failures by the DDEC V system. The response will be a Flash Code.

Diagnosing Flash Code 13

Failure Mode: **SID 146, FMI 6**

Indicates: **EGR valve electric current is too high.**

Response: Perform the following steps if the EGR valve current is too high.

1. Check for a short circuit.
2. Disconnect the harness connector from the actuator control valve coil.
3. Measure the coil resistance between pins A and B. See Figure 9-1 for pin locations and compare the measured ohm values to the ohm values listed in Table 9-29–2.
   [a] If the coil resistance is too low replace the actuator assembly.
   [b] If the coil resistance is acceptable, go to step 4.
4. Disconnect engine harness at ECU and at 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 Detroit Diesel Customer Support Center at 313-592–5800.

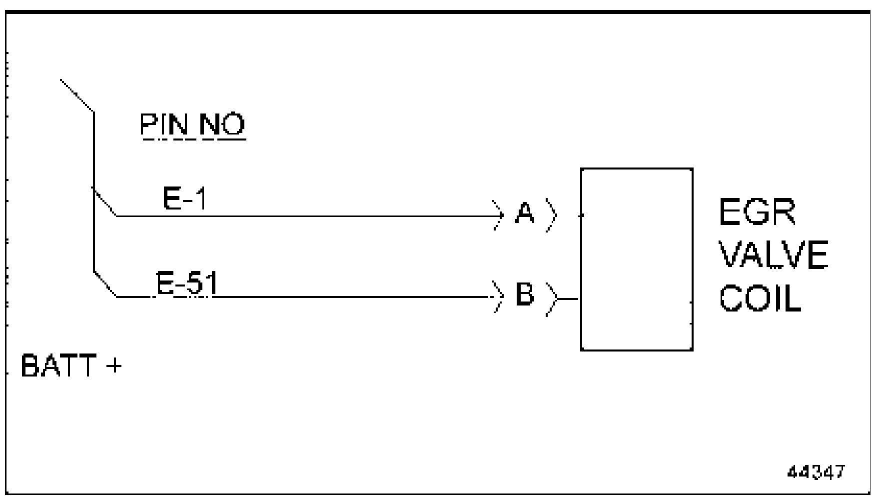

Figure 9-1 EGR Valve Coil Wiring

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 9-2 Ranges Allowed (Ohms)

Possible Causes:

- **Wires shorted together.**
- **Positive wire shorted to ground.**
- **Low resistance in the solenoid.**

NOTE:

This symptom may be improved with reprogramming.

Reprogram the ECU if the ECU has not been reprogrammed since the dates listed below.

- 12 L — 02–23–04
- 14 L — 03–08–04

NOTE:
There is an update program for the DDEC V troubleshooting in 6.0 DDDL.

EGR Valve Electric Current

Failure Mode: **SID 146, FMI 5 & 6**

EGR valve electric current is too low (FMI 5) or EGR valve electric current is too high (FMI 6)

The CEL (AWL) will be illuminated and the engine will operate in boost mode.

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10 DDEC V TESTING

PROBABLE COMPLAINTS

The following probable complaints are based on conditions identified by the Detroit Diesel Customer Support Center.

- Flash Code 13
- Flash Code 16
- Flash Code 39
- Flash Code 61
- Black Smoke
- Black Fuel
- Engine Misfire, Engine Backfire, Intermittent Smoke Issues
- Slobbering from Exhaust Pipe
- Poor Engine Performance
- Cab Odors
- Loss of Engine Coolant

TESTING PROCEDURES

The following testing procedures are based on conditions identified by the Detroit Diesel Customer Support Center.

- Test A go to page 10-10
- Test B go to page 10-12
- Test C go to page 10-13
- Test D go to page 10-20
- Test E go to page 10-20
- Test F go to page 10-21
- Test G go to page 10-23

TROUBLESHOOTING TASKS

The following ordered tasks are recommendations to troubleshoot specific operational concerns.

FLASH CODE 13 (SID 146/FMI 6) EGR VALVE CURRENT TOO HIGH

Troubleshooting steps are as follows.

1. Using DDDL, check for Flash Code 13 (SID 146/FMI 6).
   [a] If Flash Code 13 (SID 146/FMI 6) was logged, perform TEST E.
   [b] If Flash Code 13 (SID 111/FMI 4 or 6) was logged, refer to the proper code section of the *DDEC V Single ECU Troubleshooting Guide*, (6SE565) to troubleshoot that code.
2. Once troubleshooting is done, verify that troubleshooting step 1[a] or step 1[b] resolved the problem.
   [a] If Flash Code 13 (SID 146/FMI 6) is still logged, contact the Detroit Diesel Customer Support Center at 313-592-5800.
   [b] If Flash Code 13 (SID 146/FMI 6) is not logged, troubleshooting task is complete.

FLASH CODE 16 (SID 146/FMI5) EGR VALVE CURRENT TOO LOW

Troubleshooting steps are as follows.

1. Using DDDL, check for Flash Code 16 (SID 146/FMI 5).
   [a] If Flash Code 16 (SID 146/FMI 5) was logged, perform TEST E.
   [b] If Flash Code 16 (SID 111/FMI 5) was logged, refer to the proper code section of the *DDEC V Single ECU Troubleshooting Guide*, (6SE565) to troubleshoot that code.
2. Once troubleshooting is done, verify that troubleshooting step 1[a] or step 1[b] resolved the problem.
   [a] If Flash Code 16 (SID 146/FMI 5) is still logged, contact the Detroit Diesel Customer Support Center at 313-592-5800.
   [b] If Flash Code 16 (SID 146/FMI 5) is not logged, troubleshooting task is complete.

FLASH CODE 39

Troubleshooting steps are as follows.

1. Verify ECU program software version. Perform TEST E.
2. Inspect the VPOD air supply for leaks. Perform TEST G.
3. Perform TEST C.
4. Test drive the vehicle and perform a DDDL snapshot.
5. Perform TEST B.
6. Once service is done, verify that the problem has been resolved.
   [a] If the problem has been resolved, no further testing is required.
   [b] If the problem has not been resolved, contact the Detroit Diesel Customer Support Center at 313-592-5800.

FLASH CODE 61

Troubleshooting steps are as follows.

1. Using DDDL, check for Flash Code 61.
   [a] If Flash Code 61 was logged, perform step 2.
   [b] If Flash Code 61 was not logged, no further troubleshooting is required.
2. Verify that Modification Bulletin 05M-2, Series 60 EPA 04 Fuel System have been performed.
   [a] If the procedures in Modification Bulletin 05M-2, Series 60 EPA 04 Fuel System have not been performed, do so now. To print a copy of 05M-2, please visit the *Detroit Diesel Modification Letter Web Page* at http://192.135.85.10/cust/mods/05mods/Index05.asp.
   [b] If the procedures in Modification Bulletin 05M-2, Series 60 EPA 04 Fuel System have been performed, contact the Detroit Diesel Customer Support Center at 313-592-5800.
3. Once service is done, verify that the problem has been resolved.

BLACK SMOKE

Troubleshooting steps are as follows.

1. Visually inspect the air filter element for excess dirt, blocked filter elements, and damage. Refer to the “Air Cleaner” section of the *Series 60 Service Manual*, (6SE483) for removal, inspection, and installation steps.
2. Visually inspect the air intake system for dirt and debris which is restricting proper fresh air flow. Refer to the “Cleaning of Intake Manifold“ section of the *Series 60 Service Manual*, (6SE483) for inspection steps.
3. Visuall inspect the exhaust system for dirt and debris which is restricting proper exhaust gas flow. Refer to OEM guidelines for inspection procedures.
4. Perform a turbocharger inspection. Refer to the “Inspection of Turbocharger” section of the *Series 60 Service Manual*, (6SE483) for inspection steps.
5. Perform the procedures in section TEST A.
6. Once service is done, verify that the problem has been resolved.

BLACK FUEL

Troubleshooting steps are as follows.

1. Visually inspect the fuel tank for black fuel.
   [a] If black fuel is present in the fuel tank, perform step 2.
   [b] If black fuel is not present in the fuel tank, no further troubleshooting is required.
2. Verify that Modification Bulletin 05M-2, Series 60 EPA 04 Fuel System have been performed.
   [a] If the procedures in Modification Bulletin 05M-2, Series 60 EPA 04 Fuel System have not been performed, do so now. To print a copy of 05M-2, please visit the *Detroit Diesel Modification Letter Web Page* at http://192.135.85.10/cust/mods/05mods/Index05.asp.
   [b] If the procedures in Modification Bulletin 05M-2, Series 60 EPA 04 Fuel System have been performed, contact the Detroit Diesel Customer Support Center at 313-592-5800.
3. Once service is done, verify that the problem has been resolved.

ENGINE MISFIRE, ENGINE BACKFIRE, INTERMITTENT SMOKE ISSUES

Troubleshooting steps are as follows.

1. Start and run the engine to verify an engine misfire, engine backfire, and intermittent smoke issues are present.
   [a] If the engine misfired, backfired, and had intermittent white, black or blue exhaust smoke from the tailpipe, perform step 2.
   [b] If the engine did not misfire, backfire, and had no intermittent white, black or blue exhaust smoke from the tailpipe, no further troubleshooting is required.
2. Verify that Modification Bulletin 05M-2, Series 60 EPA 04 Fuel System have been performed.
   [a] If the procedures in Modification Bulletin 05M-2, Series 60 EPA 04 Fuel System have not been performed, do so now. To print a copy of 05M-2, please visit the *Detroit Diesel Modification Letter Web Page* at http://192.135.85.10/cust/mods/05mods/Index05.asp.
   [b] If the procedures in Modification Bulletin 05M-2, Series 60 EPA 04 Fuel System have been performed, contact the Detroit Diesel Customer Support Center at 313-592-5800.
3. Once service is done, verify that the problem has been resolved.

SLOBBERING FROM EXHAUST PIPE

Troubleshooting steps are as follows.

1. Using DDDL, perform a DDC Extraction of DDEC Reports. Review extraction data for excessive idle time.
   [a] If the idle times were 35% and higher, which are considered to be excessive, reduce engine idle time. Proceed step 2.
   [b] If the idle times were less than 35%, proceed to step 2.
2. Using DDDL, verify the engine coolant temperature.
   [a] If the coolant temperature was below recommended operating parameters, refer to the "Coolant" section of the *Series 60 Service Manual*, (6SE483) coolant analysis program information.
   [b] If the coolant temperature was at recommended operating parameters, proceed to step 3.
3. Verify that none of the fuel injectors are leaking fuel. Refer to the "N3 Electronic Unit Injector" section of the *Series 60 Service Manual*, (6SE483) for removal, inspection, and replacement steps.
4. Verify valve lash clearances. Refer to section "Valve Clearance and Injector Timing" section of the *Series 60 Service Manual*, (6SE483) for inspection steps.
5. Check for worn cylinders.
   [a] Perform a crankcase pressure test. Refer to the proper service section of the *Series 60 Service Manual*, (6SE483) for test procedures.
   [b] Perform a compression test. Refer to the proper service section of the *Series 60 Service Manual*, (6SE483) for test procedures.
6. Verify that the VNT turbocharger is operating correctly. Refer to the "Turbocharger" section of the *Series 60 Service Manual*, (6SE483) for removal, inspection, and replacement steps.

POOR ENGINE PERFORMANCE

Troubleshooting steps are as follows.

1. What version of software is the DDEC V ECU running?
   - [a] If the software version is lower than Level 2, reprogram the ECU. Perform TEST E. 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 if the engine has been campaigned or modified to the latest version, please contact the Detroit Diesel Customer Support Center at 313-592-5800.
   - [b] If you are able 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 *Series 60 Service Manual*, (6SE483) for inspection steps.
4. Visually inspect the air filter element for excess dirt, blocked filter elements, and damage. Refer to the "Air Cleaner" section of the *Series 60 Service Manual*, (6SE483) for removal, inspection, and installation steps.
5. 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 TEST D to test the Barometric Pressure Sensor. Once the test has been completed, proceed to step 7.
7. Perform TEST A 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 task 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 at 313-592-5800.

CAB ODORS

Troubleshooting steps are as follows.

1. Visually inspect the muffler, flex pipe to exhaust manifold, and exhaust system joints for excessive wear, holes, lose clamps, and for black soot indicating an exhaust gas leak.
   [a] If any damage was found, refer to OEM guidelines for corrective service actions. Once these problems have been resolved, proceed to step 2.
   [b] If no damage was found, proceed to step 2.
2. Inspect the exhaust manifold for damage and exhaust gas leaks. Refer to the "Exhaust Manifold" section of the *Series 60 Service Manual*, (6SE483) for inspection steps.
   [a] If damage was found, resolve the problems and proceed to step 3.
   [b] If no damage was found, proceed to step 3.
3. Verify repairs have resolved the cab odor problem.
   [a] If cab odor problems have not been resolved, please contact the Detroit Diesel Customer Support Center at 313-592-5800.
   [b] If the cab odor problems have been resolved, the troubleshooting task has been completed.

LOSS OF ENGINE COOLANT

Troubleshooting steps are as follows.

1. Visually inspect the coolant for oil contamination.
   [a] If the coolant has been contaminated, please contact the Detroit Diesel Customer Support Center at 313-592-5800 for instructions.
   [b] If the coolant has not been contaminated, proceed to 2.
2. Visually inspect the coolant hose clamps to ensure that they are installed properly, securely fastened to the hose, and not damaged.
   [a] If the coolant hose clamps are not installed or secured properly and are damaged. Refer to the proper service sections of the *Series 60 Service Manual*, (6SE483) for repair procedures. Once the problems have been resolved, proceed to step 3.
   [b] If the coolant hose clamps were installed and secured properly and were not damaged, proceed to step 3.
3. Visually inspect the coolant hoses for excessive wear, cracks, and damage.
   [a] If the coolant hoses are worn, broken, and damaged. Refer to the proper service sections of the *Series 60 Service Manual*, (6SE483) for repair procedures. Once the problems have been resolved, proceed to step 4.
   [b] If the coolant hoses are not worn, broken, and damaged, proceed to step 4.
4. Visually inspect the cylinder head to cylinder block for coolant leaks.
   [a] If cylinder head to cylinder block coolant leaks were detected. Refer to the proper service sections of the *Series 60 Service Manual*, (6SE483) for repair procedures. Once the problems have been resolved, proceed to step 5.
   [b] If cylinder head to cylinder block coolant leaks were not detected, proceed to step 5.
5. Perform TEST F. Once the test has been perfromed, proceed to step 6.
6. Verify that the troubleshooting task has resolved the problem.
   [a] If the problem has not been resolved, please contact the Detroit Diesel Customer Support Center at 313-592-5800.
   [b] If the problem has been resolved, the troubleshooting task is complete.

TESTS

The following tests support the recommended troubleshooting flow for specific operational concerns.

TEST A

Test A steps are as follows.

NOTE:
Two regulated air supply lines will be required to perform this test.

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 pressure (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 line.

NOTE:
The oil line fitting is a 37 degree JIC #6 fitting.

5. Connect a regulated air supply line to the EGR actuator regulated to 69 kPa (10 psi).
6. Using DDDL, activate the EGR Valve (PWM #2) to 90%.
7. Monitor the boost pressure for pressure drops when the EGR valve opens.

NOTE:
The pressure should have dropped significantly to approximately 62 kPa (9 psi).

[a] If the air pressure dropped to 62 kPa (9 psi), no further testing is required. Test A has been completed.

[b] If the pressure dropped slightly, perform steps 8 through step 10.

8. Physically inspect the EGR valve for a mechanical failure. If the EGR valve is not functioning correctly, replace the EGR valve.
9. Visually inspect the EGR cooler for restrictions. If the EGR cooler is restricted, replace the EGR cooler.
10. Visually check the delivery pipe for restrictions. Clean the pipe as necessary to remove restrictions.
11. Verify repairs.

TEST B

Test B steps are as follows and should be performed in order as written.

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° F (76° C) coolant temperature).
2. Activate the VPOD outputs to 50% duty cycle using the DDDL. Visually inspect the VNT and EGR valve for proper rod travel.
   [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 or *Detroit Diesel Special Publications Web Page* at http://192.135.85.10/public/sp/spnav.asp and browse for Special Publication Number 18SP604.
   [b] If the VNT is functioning properly, no further troubleshooting is required.

NOTE:
Repeat this step three times.

3. Verify repairs.

TEST C

Test C has eight basic tests and are as follows.

- Delta P Sensor
- VPOD Output Pressure
- Barometric Sensor (Test D)
- VPOD Input Pressure
- VPOD Part Number and Supply Voltage
- VPOD Wiring
- Active Codes
- Final Test

The following tools are required to perform the six basic tests.

- Low wattage 1,000 Ω resistor
- DDDL version 4.2 or higher or DDR suite 8
- Volt Ohm Meter (VOM)
- Pressure gage 1379 kPa (0-200 psi)
- Pressure gage 690 kPa (0-100 psi)

Delta P Sensor Test

Perform the following steps to check the Delta P Sensor.

1. Turn ignition On.
2. Connect either a Detroit Diesel Diagnostic Link® (DDDL) or a Diagnostic Data Reader (DDR) to read the Delta P counts.
3. Record the Delta P counts.
   [a] If the recorded Delta P counts are 86-135, verify that the Venturi ports are not plugged and that the Venturi Tube-to-Delta P sensor, see Figure 10-1, are correctly installed and are not damaged. Repair as necessary, verify repairs. If no problem was found, proceed to step 3[b].

NOTE:
Reversed and damaged tubes and Venturi ports will have an adverse effect on engine performance resulting in black exhaust smoke and engine surging.

   [b] If the recorded Delta P counts are 86-135, visually inspect the delivery pipe for damage and proper assembly. If no damage or improper assembly were detected, perform a VPOD Output Pressure Test.

   [c] If the recorded counts were not within a range of 86-135, replace the Delta-P Sensor and verify repairs. Proceed to TEST D.

VPOD Output Pressure Test

Test steps are as follows:

1. Disconnect the air hose from the VNT actuator. See Figure 10-1.

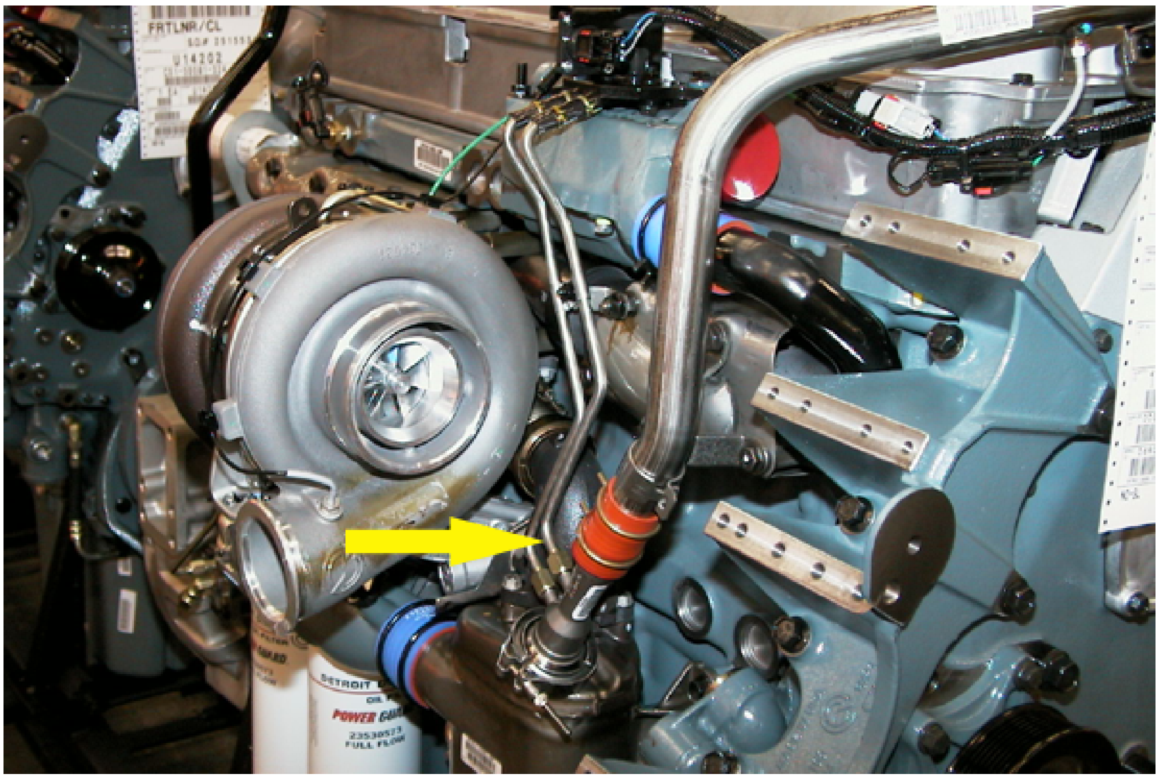

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Figure 10-1 Location of Venturi Tube Hoses

2. Install gage at the outlet of the VNT air line. See Figure 10-2.

NOTE:
The gage should be accurate to within 1.4 kPa (0.2 psi).

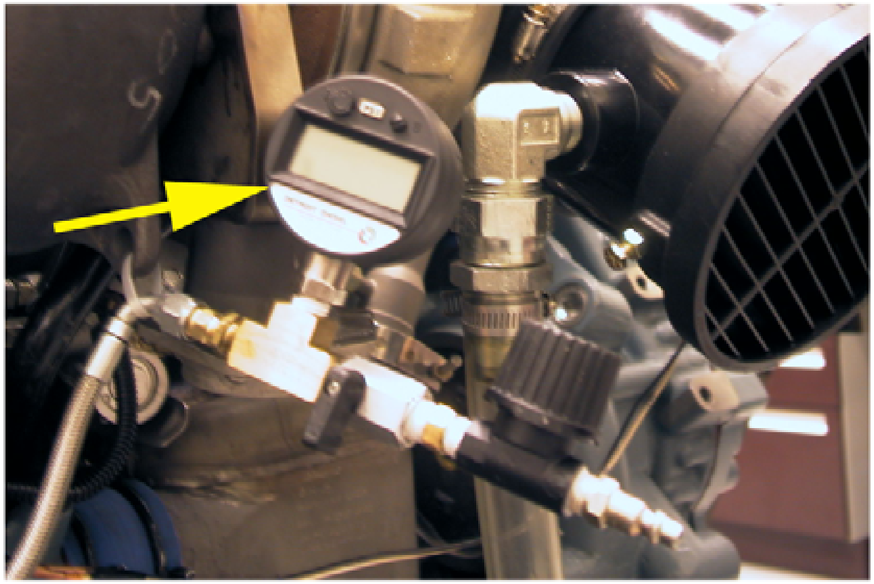

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Figure 10-2 Gage Setup

3. Using either DDDL or DDR, activate PWM #2 and PWM #4 duty cycles and monitor the output pressure from the VPOD. Activate the duty cycle to 50%. Pressure should equal 305-315 kPa (42-47 psi @ VPOD).

NOTE:
Both activations must have full linkage travel.

4. Repeat step 3 a total of 3 times.

NOTICE:
Ensure that the VPOD air supply line fitting is not crossed-thread when connecting the VPOD air supply to the EGR actuator. If the air supply line fitting is not properly seated, the EGR actuator will not function properly.

5. Connect VPOD air supply line to the EGR actuator. Perform a VPOD Input Pressure Test.

VPOD Input Pressure Test

Perform the following steps to test the VPOD input pressure.

1. 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 VPOD Part Number and Supply Voltage Test.
2. Verify repairs.

VPOD Part Number and Supply Voltage Test and Part Number Check

Perform the follow steps to verify the VPOD part number and supply voltage.

1. Check VPOD label to determine if it is + 12 V or + 24 V system.

NOTE:
A 1,000 Ω resistor or a volt Ohm meter is required to perform step 2.

2. Unplug the VPOD wire connectors and insert the 1,000 Ω resistor between cavities 1 and 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 part number and voltage and the ECU voltage correct?
   - [a] If the VPOD part number and voltage and the ECU voltage are correct, perform a VPOD Wiring Test.
   - [b] If the VPOD part number and voltage and the ECU voltage were not correct, match the VPOD component to the ECU voltage and perform a VPOD Wiring Test.

VPOD Wiring Test

Perform the following steps to test the VPOD wiring.

NOTE:
VPOD power should have been verified during the VPOD and Supply Voltage Test and Part Number Check. If not, perform a VPOD Part Number and 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 that activating 50 % duty cycle: VDC = 50% of the VPOD supply voltage ± 1 volt. (e.g. voltage to VPOD = 13.8 V * 0.5 = 6.8 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, go to step 7.
   - [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 at 313-592-5800.
7. Verify repairs. Perform an Active Codes Test.

Active Codes Test

Perform the following steps to test for active codes.

1. Turn ignition ON.
2. Connect either a DDDL or a DDR reader.
3. Read active codes.
4. Record or print codes. Ensure that PID, SID, and FMI are recorded. Refer to the proper code section of the *DDEC V Single ECU Troubleshooting Guide*, (6SE565) 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 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 ECU to protect other engine components.

5. If the issue is not related to the EGR system components, or if technical support is required, contact the Detroit Diesel Customer Support Center at 313-592-5800.
6. Perform a Final Test.

Final Test

Follow these steps for a final test:

1. Reconnect all disconnected sensors and wiring harnesses and assemble all disassembled components.
2. Start and run the engine.
3. Perform a road test to try and duplicate the original complaint.
   [a] If original symptoms and codes are not detected, repairs are complete.
   [b] If any original codes are detected, review this section again and contact the Detroit Diesel Customer Support Center at 313-592-5800.

TEST D

Test D steps are as follows.

NOTE:
Engines built from February 2004 (Serial Number: 06R0761470) through the end of July 2004 (Serial Number: 06R0788688) may be affected.

1. Turn the ignition ON but leave the engine OFF.
2. Connect either a Detroit Diesel Diagnostic Link® (DDDL) or a Diagnostic Data Reader (DDR) to measure the barometric pressure and the air inlet pressure. Compare the results of the measured values.
   [a] If the difference is greater than 4.1 kPa (0.6 psi), replace the Barometric Pressure Sensor.
   [b] If the difference is less than 4.1 kPa (0.6 psi), contact the Detroit Diesel Customer Support Center at 313-592-5800.
3. Verify repair.
   [a] If Flash Code 39 (SID 147/FMI 2) is not logged, repair is complete.
   [b] If Flash Code 39 (SID 147/FMI 2) is logged, contact the Detroit Diesel Customer Support Center at 313-592-5800.

TEST E

Test E steps are as follows.

1. Verify ECU program software version.
   [a] If the ECU software version is not Level 2.0, perform step 2 and 3.
   [b] If the ECU software is Level 2.0 or higher, TEST E is complete.
2. Download the mainframe file for particular engine serial number (no mainframe changes required).
3. Program the ECU.

TEST F

Engines equipped with a tube and shell bolted flanged cooler that have a coolant-lost complaint need to be inspected for leaks from other sources. The spring wire hose clamps are a possible coolant leak path, and should be inspected. If the spring wire clamps are damaged, service kits are available to replace the damaged components.

A standard test to pressurize the coolant system and investigation of overall coolant system should have been performed prior to inspecting the cooler. There may be other components of the engine that are responsible for the loss of engine coolant.

NOTE:
Coolers with internal leaks usually show signs of a white coolant drop-out at the exhaust side of the cooler, the Delta P Sensor lines, or at the delivery pipe to intake manifold connector.

If the entire system has been tested, perform the following steps to inspect the cooler:

1. Use hoses, clamps, plugs, and a regulator to seal the cooler water inlet and water outlet ports. See Figure 10-3.

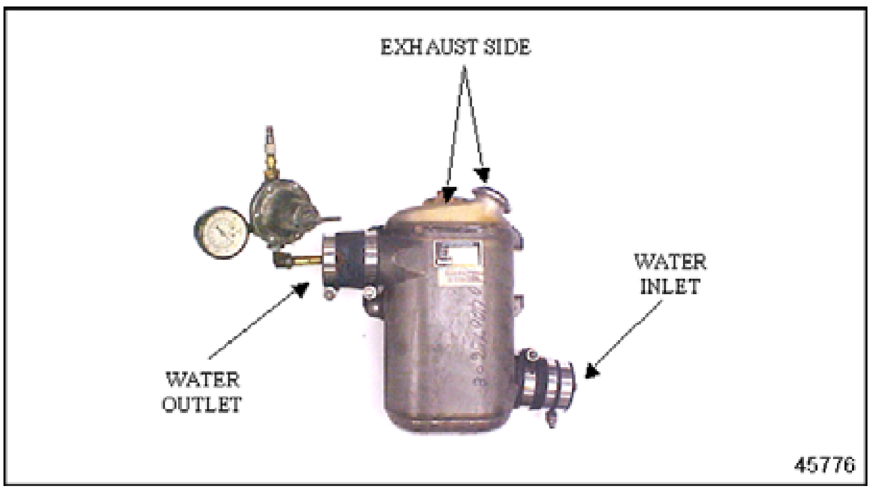


Figure 10-3 EGR Cooler Ports Setup

2. Fill the exhaust side of the cooler with hot tap water. Allow the water to overflow until the loose carbon has floated away allowing for a clear viewing of any bubbles. See Figure 10-4.

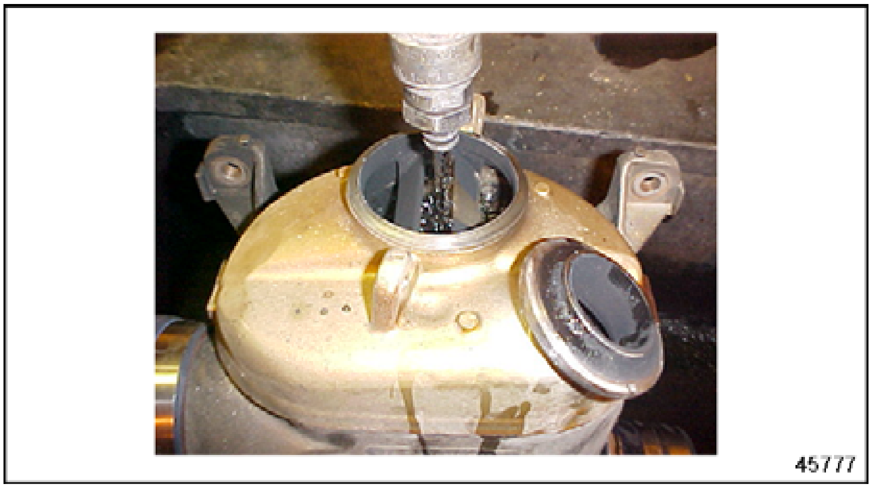


Figure 10-4 Filling the EGR Cooler with Tap Water

3. Apply 207 kPa (30 psi) of regulated air to the regulator for three minutes. See Figure 10-3
4. Disconnect the regulated air supply from the regulator and watch for bubbles on the exhaust side of the cooler. See Figure 10-5.
    [a] If bubbles were observed, replace the cooler.
    [b] If no bubbles were observed, contact the Detroit Diesel Customer Support Center for further information (313-592-5800).

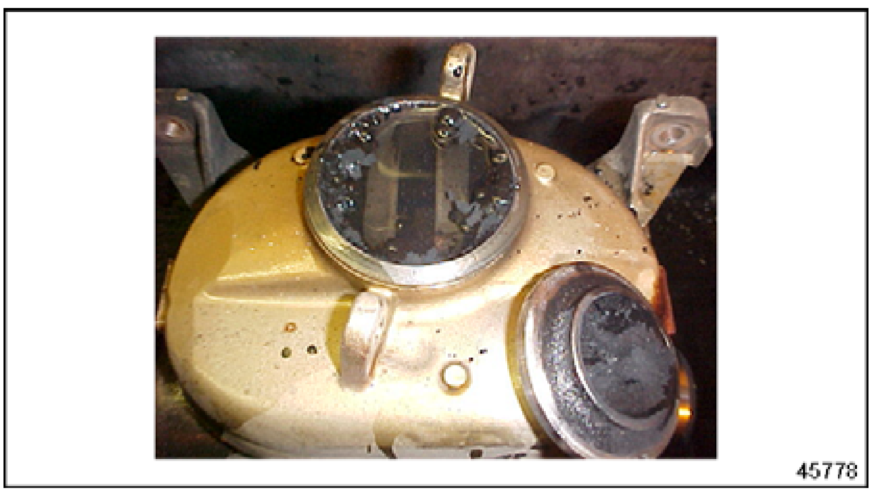


Figure 10-5 Observing the EGR Cooler for Bubbles

TEST G

The air supply line which connects to the VPOD must be a dedicated air supply line. To ensure that the air supply line is a dedicated air supply line, please read Freightliner Service Information Bulletin 01–81 (see Figure 10-6, see Figure 10-7, and see Figure 10-8).

Incorrect Detroit Diesel VPOD Plumbing — 01-81

Freightliner Service Bulletin

FLA COE
FLB COE
> FLD Conventional
Business Class
FLC 112 Conventional
> Century Class Conventional
> Argosy COE
Cargo
> Columbia
Condor
> Coronado
Business Class M2

General Information

The air supply line for the Variable Pressure Output Device (VPOD) on Detroit Diesel Series 60 engines was incorrectly plumbed at the plant. The 1/2-inch diameter supply line to the VPOD must be a dedicated air line. The current plumbing configuration has the supply line connected to a pressure protection valve along with the junction block supply line on the secondary air tank. This can result in engine misfires and "stumbling" of the engine.

To correct this situation, remove the air line from the existing pressure protection valve and connect it by itself to a new pressure protection valve in an unused port on the secondary air tank. Follow the instructions below.

Parts Required

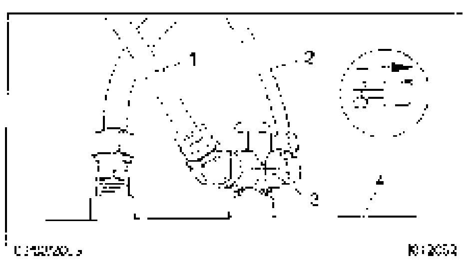
Parts are available from the PDCs. See Table 1.

Part Number	Description	Qty.
PH VS211P 6	Plug, 3/8-inch NPT	1
GTD 223 455V	Pressure Protection Valve	1

Table 1, Parts Required

Procedure

1. Park the vehicle on a level surface, apply the parking brakes, shut down the engine, and chock the tires.
2. Drain the air system.
3. Find the yellow, 1/2-inch diameter VPOD air line on the secondary air tank, on the left side of the vehicle. It should be connected to a pressure protection valve along with the junction block supply line. See Fig. 1.



1 VPOD Air Line (1/2-inch, yellow)
2 Junction Block Supply Line
3 Pressure Protection Valve
4 Secondary Air Tank

Fig. 1, Existing Location of the VPOD Air Line (typical)

4. Trace the VPOD air line back to the right side of the engine to verify that it connects to the VPOD. See Fig. 2.
5. Find an unused port on the secondary air tank.

Freightliner Service Bulletin, April 2005 — Page 1

Figure 10-6 Freightliner Service Bulletin 01–81 (Page One of Three)

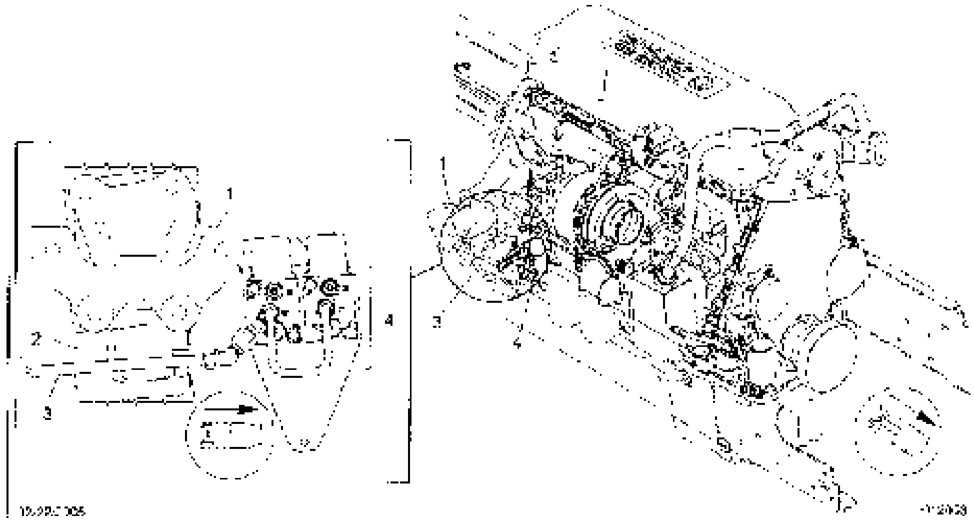
01-81 Incorrect Detroit Diesel VPOD Plumbing

Freightliner Service Bulletin

FLA COE
FLB COE
> FLD Conventional
Business Class

FLC 112 Conventional
> Century Class Conventional
> Argosy COE
Cargo

> Columbia
Condor
> Coronado
Business Class M2



1 Right Rear Engine Mount
2 Flywheel Housing
3 VPOD Air Line
4 VPOD Assembly

Fig. 2, VPOD and Air Line on the Engine

IMPORTANT: If there is not an unused port available on the secondary air tank, contact your District Service Manager. Do not proceed with these instructions without doing so.

6. If there is an unused port on the secondary air tank, disconnect the yellow VPOD supply line from the quick-disconnect fitting on the pressure protection valve.
7. Remove and save the quick-disconnect fitting.
8. Apply Teflon® tape to the threads of the new 3/8-inch plug and install it in the existing pressure protection valve where the quick-disconnect fitting and the VPOD line were.
9. Find an unused port on the secondary air tank and remove the 3/8-inch NPT plug from it. Save the plug.
10. Apply Teflon tape to the threads of the new pressure protection valve, then install it in the unused port of the secondary air tank.
11. Install the previously removed quick-disconnect fitting in one of the ports of the new pressure protection valve.
12. Apply Teflon tape to the threads of the 3/8-inch NPT plug previously removed from the port in the secondary air tank, then install it in the other port of the new pressure protection valve.
13. Loosen a suitable length of the VPOD air supply line and connect it to the new pressure protection valve. See Fig. 3.

    If necessary, secure the air line with tie straps.

Page 2 — Freightliner Service Bulletin, Apr 2005

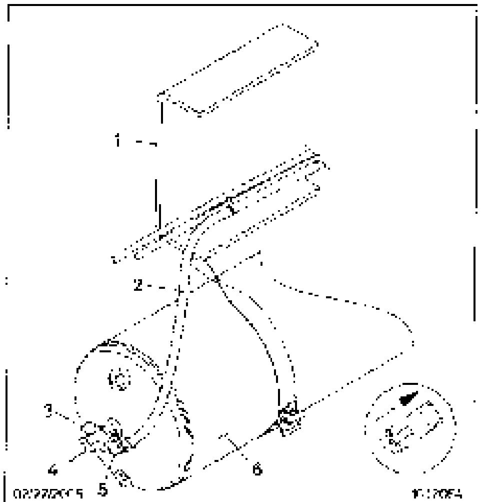
Figure 10-7 Freightliner Service Bulletin 01–81 (Page Two of Three)

Incorrect Detroit Diesel VPOD Plumbing

01-81

Freightliner Service Bulletin

FLA COE
FLB COE
> FLD Conventional
Business Class
FLC 112 Conventional
> Century Class Conventional
> Argosy COE
Cargo
> Columbia
Condor
> Coronado
Business Class M2



1. Left Frame Rail
2. VPOD Air Line
3. NPT Plug, 3/8"
4. New Pressure Protection Valve
5. Quick-Disconnect Fitting
6. Secondary Air Tank

Fig. 3, New Location for VPOD Air Line

14. Start the engine, build the air system pressure to the operating level, and check the connections for leaks.

    If leaks are detected, shut down the engine, drain the air tanks, and tighten any connections and fittings as needed.

    If no leaks are detected, shut down the engine.

15. Remove the chocks from the tires.

Warranty

Normal warranty applies. Use the damage code and time guide information in **Table 2**. Refer to this bulletin by number in the story of the claim and enter GTD 223 455 as the failed part number.

Damage Code and Time Guide Information			
Damage Code	**Operation Number**	**Description**	**Time: hours**
101-060334940	101-5035A	VPOD Supply Line Rerouting	0.4

Table 2, Damage Code and Time Guide Information

Figure 10-8 Freightliner Service Bulletin 01–81 (Page Three of Three)

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APPENDIX A: LIST OF ACRONYMS

Starting with DDEC V, DDC has begun using the nomenclature found in SAE J2403 which is industry standard. The previously used names and the SAE J2403 names are listed in Table A-1.

DDEC IV	DDEC V
Add Coolant Level Sensor (ACLS)	Add Engine Coolant Level Sensor (AECL Sensor)
Air Filter Restriction Sensor	Air Filter Restriction Sensor (AFR Sensor)
(Intake) Air Temperature Sensor (ATS)	Intake Air Temperature Sensor (IAT Sensor)
Barometric Pressure Sensor	Barometric Pressure Sensor (Baro Sensor)
Check Engine Light (CEL)	Amber Warning Lamp (AWL)
Coolant Level Sensor (CLS)	Engine Coolant Level Sensor (ECL Sensor)
Coolant Temperature Sensor (CTS)	Engine Coolant Temperature Sensor (ECT Sensor)
EGR Delta Pressure Sensor (EGR Delta P)	EGR Delta Pressure Sensor (EGR Delta P)
EGR Temperature Sensor	EGR Temperature Sensor (EGRT Sensor)
Electronic Control Module (ECM)	Electronic Control Unit (ECU)
Electronic Foot Pedal Assembly (EFPS)	Accelerator Pedal (AP)
Engine Sensor Harness (ESH)	Engine Harness (EH)
Fire Truck Pump Pressure Sensor	Fire Truck Pump Pressure Sensor
Fuel Restriction Sensor (FRS)	Fuel Restriction Sensor
Fuel Temperature Sensor (FTS)	Supply Fuel Temperature Sensor (SFT Sensor)
Limiting Speed Governor (LSG)	Automotive Limiting Speed Governor (ALSG)
Oil Level Sensor (OLS)	Engine Oil Level (EOL Sensor)
Oil Pressure Sensor (OPS)	Engine Oil Pressure Sensor (EOP Sensor)
Oil Temperature Sensor (OTS)	Engine Oil Temperature Sensor (EOT Sensor)
Relative Humidity/Turbo Compressor Inlet (TCI) Temperature Sensor	Turbo Compressor Inlet Temperature Sensor (TCIT Sensor)
Stop Engine Light (SEL)	Red Stop Lamp (RSL)
Synchronous Reference Sensor (SRS)	Camshaft Position Sensor (CMP)
Timing Reference Sensor (TRS)	Crankshaft Position Sensor (CKP)
Throttle Position Sensor (TPS)	Accelerator Pedal Sensor (AP Sensor)
Turbo Boost Sensor (TBS)	Intake Manifold Pressure Sensor(IMP Sensor)
Turbo Compressor Out Temperature Sensor	Turbo Compressor Out Temperature Sensor (TCOT Sensor)
Turbo Speed Sensor (TSS)	Turbo Speed Sensor (TSS)
Vehicle Speed Sensor (VSS)	Vehicle Speed Sensor (VSS)

Table A-1 DDEC IV to DDEC V

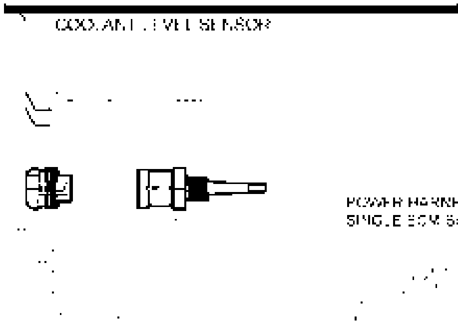
APPENDIX B: DDEC IV WIRING SCHEMATICS

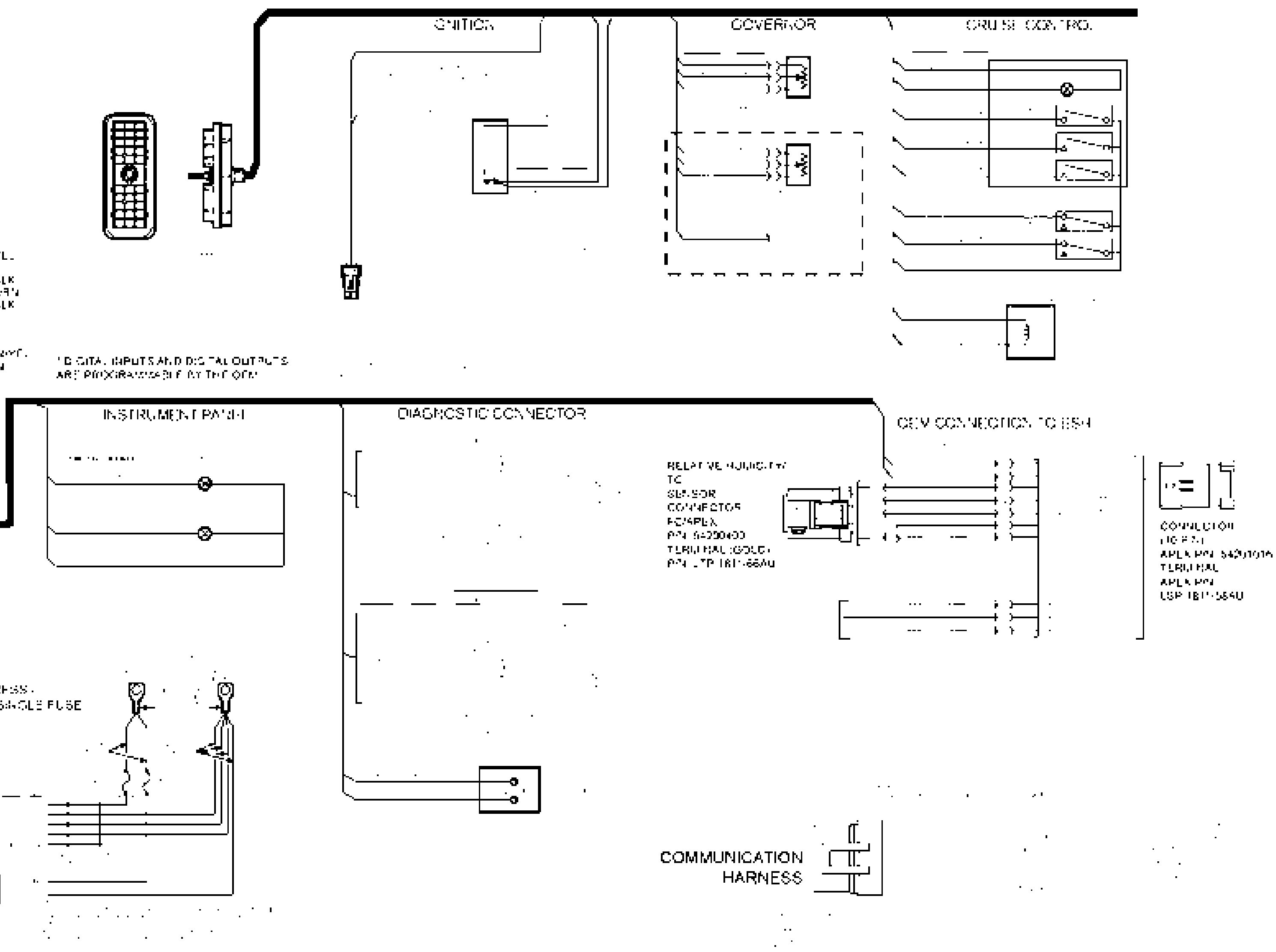
- DDEC IV Vehicle Harness
- DDEC IV Engine Wiring Diagram
- DDEC V Engine Harness
- DDEC V Vehicle Interface Harness

SERIES 60 DDEC IV MY2003 EGR VEHICLE INTERFACE HARNESS

OEM RESPONSIBILITY

LABEL	WIRE NO.	CAVITY	COLOR
COOLANT LEVEL	115	H-3	ORN
LIMITING SPEED GOVERNOR	417	D-2	DK BLUE
CHECK ENGINE LIGHT	419	B-1	PPL/WHT
IGNITION	439	B-3	PNK
DIGITAL INPUT F-1	451	F-1	LT GRN
DIGITAL OUTPUT F-3	499	F-3	LT BLU
TACHOMETER DRIVE	505	K-1	GRA
STOP ENGINE LIGHT	509	B-2	PPL
OI THERMOSTAT OR PTO OR EXHAUST BACK PRESSURE (COACH ONLY)	510	D-1	BRN
DIGITAL INPUT H-1	523	H-1	GRA/RED
DIGITAL INPUT H-2	524	H-2	GRA
DIGITAL INPUT G-1	528	G-1	BRN/RED
DIGITAL INPUT J-2	531	J-2	ORN
DIGITAL INPUT J-1	541	J-1	YEL/RED
DIGITAL INPUT E-1	542	E-1	YEL
DIGITAL INPUT G-2	543	G-2	ORN/BLK
DIGITAL INPUT E-2	544	E-2	BRN/WHT
DIGITAL INPUT G-3	545	G-3	LT BLU/YEL
DIGITAL OUTPUT A-2	564	A-2	TAN
VEHICLE SPEED (+)	556	L-2	LT BLU/BLK
VEHICLE SPEED (-)	557	E-3	LT BLU/ORN
DIGITAL INPUT K-2	583	K-2	LT BLU/BLK
ESS TRANSDUCER OR FIRE TRUCK PUMP PRESSURE OR EXHAUST TEMP	749	D-3	YEL
DATA LINK (+)	900	C-2	DK GREEN/WHT
DATA LINK (-)	901	C-1	DK GREEN
PWM FAN OR QUALAMATIC OR PWM TRANSMISSION	[illegible]	[illegible]	WHT
SENSOR SUPPLY (5VDC)	416	A-3	RED/PPL
SENSOR RETURN	952	C-3	BLK
DIGITAL INPUT K-3	979	K-3	WHT
DIGITAL OUTPUT A-1	988	A-1	GRA
IGNITION CONNECTOR			
+12V FROM BATTERY	440	A	ORN
BATTERY GROUND	953	B	BLK/WHT

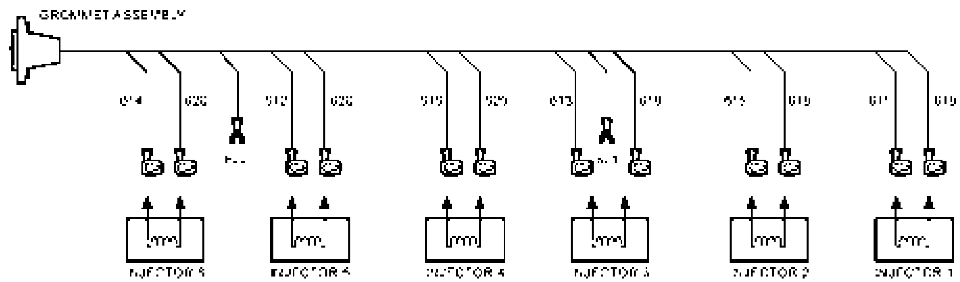




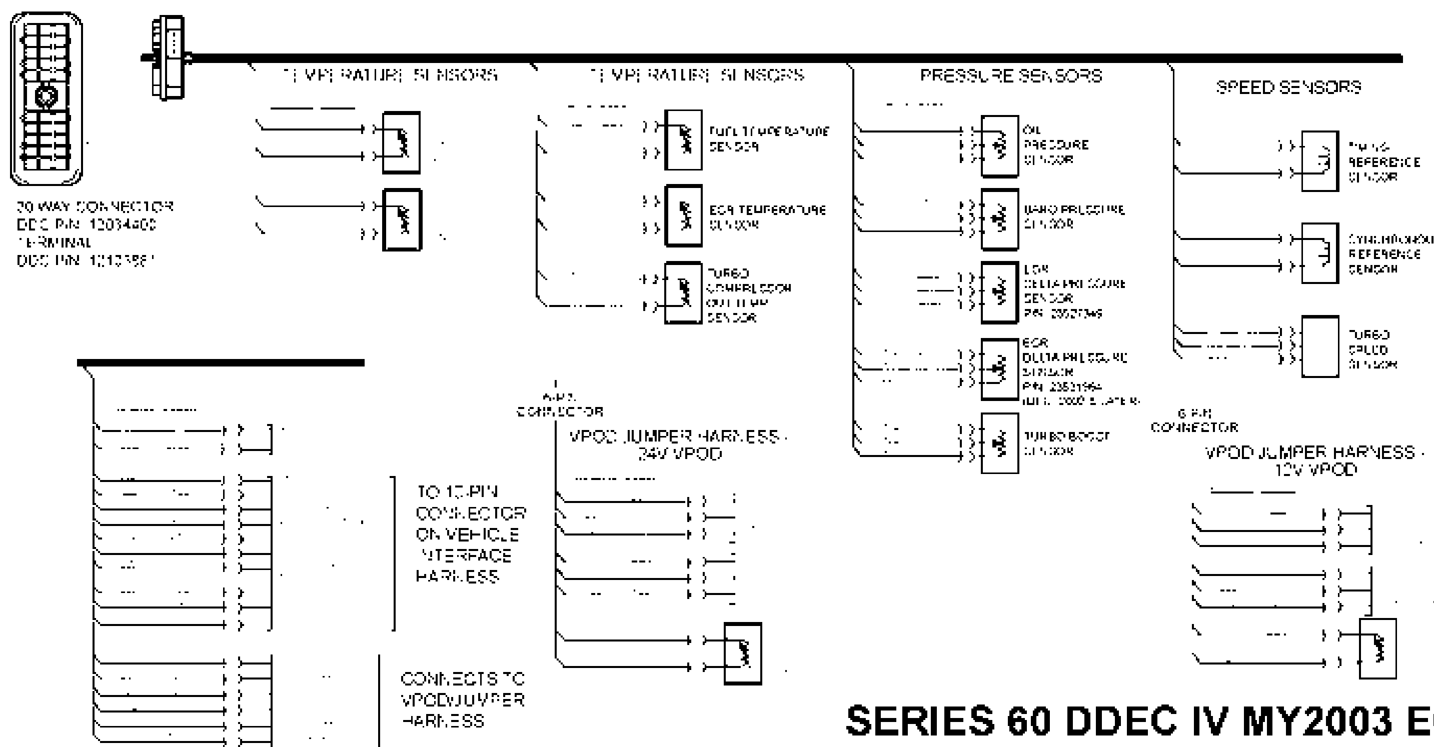
44300

DDEC IV WIRING DIAGRAM

DDC RESPONSIBILITY



INJECTOR HARNESS SCHEMATIC (SERIES 60 WITH JAKE BRAKES SHOWN)



LABEL	WIRE NO	CAVITY	COLOR
TRS (+)	109	T-1	PPL
TRS (-)	110	T-2	DK GRN
SRS (+)	111	S-2	LT BLU
SRS (-)	112	S-1	WHT
OIL TEMPERATURE	120	R-2	TAN
INLET AIR TEMPERATURE	132	W-2	WHT
COOLANT TEMPERATURE	133	P-3	YEL
SENSOR SUPPLY (+5V)	416	W-1	GRA
TURBO BOOST	432	P-1	LT GRN
SENSOR RETURN (ENGINE)	452	Y-2	BLACK
FUEL TEMPERATURE	472	R-3	ORN
OIL PRESSURE	530	P-2	BRN
ENGINE BRAKE MED	561	U-3	BLU
ENGINE BRAKE LO	562	T-3	ORN
DIGITAL OUTPUT W-3	563	W-3	YEL
DIGITAL OUTPUT X-3	564	X-3	TAN/BLK
DIGITAL OUTPUT Y-3	565	Y-3	RED
TURBO SPEED	570	X-1	BRN
BAROMETRIC PRESSURE	904	L-1	PNK
TURBO COMPRESSOR INLET TEMP	905	V-1	YEL
TURBO COMPRESSOR OUT TEMPERATURE	906	N-1	DK BLU
EGR TEMPERATURE	907	R-1	DK GRN
EGR CONTROL	909	Y-1	WHT
[illegible]	910	W-2	ORN
VGT CONTROL	911	X-2	WHT
EGR DELTA PRESSURE	920	N-2	DK BLU
RELATIVE HUMIDITY	926	L-2	WHT
UNUSED	925	L-3	
UNUSED	926	N-3	–
UNUSED	927	N-3	

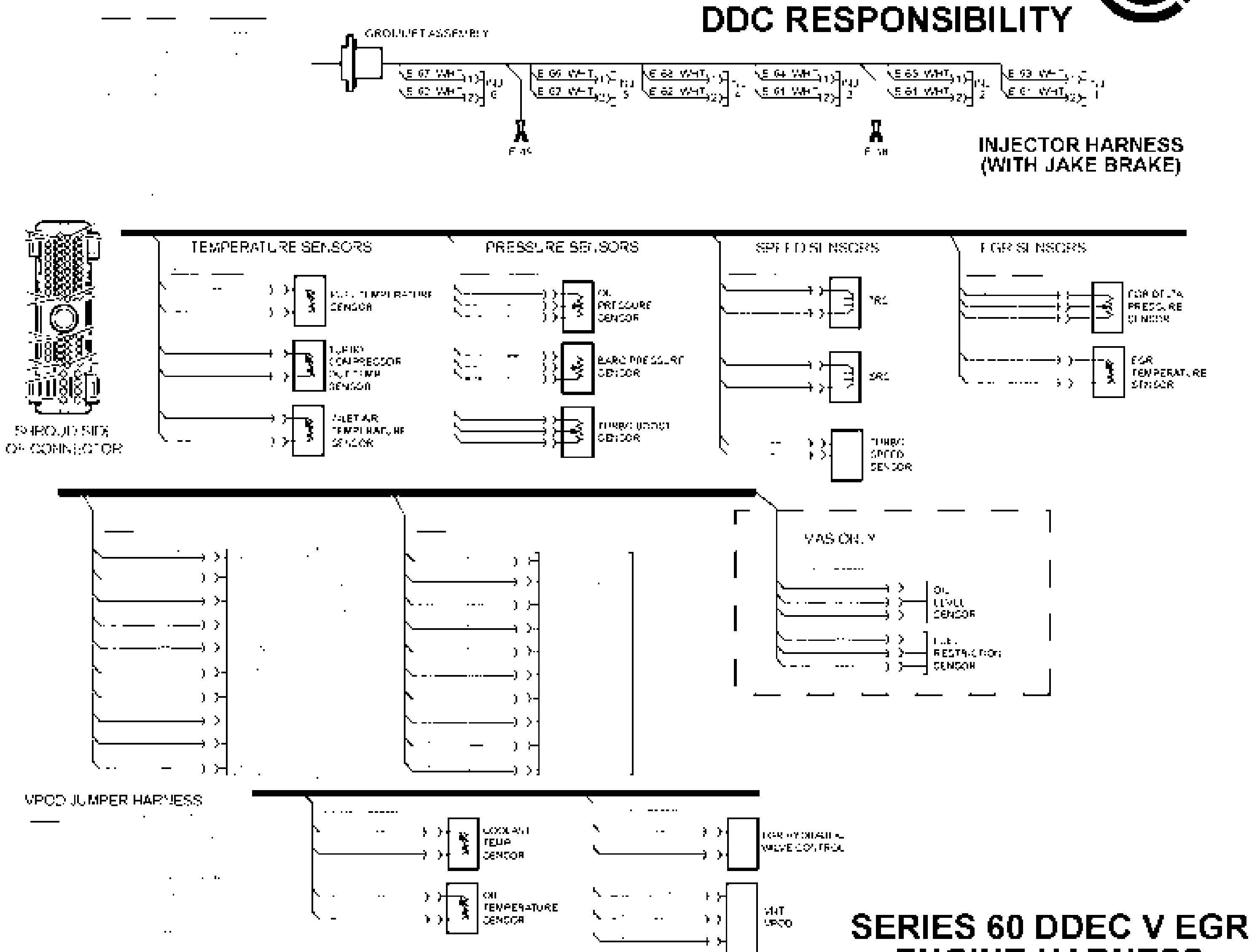
All information subject to change without notice. (Rev. 3/03)

SERIES 60 DDEC IV MY2003 EGR ENGINE SENSOR HARNESS

44355

DDEC V WIRING DIAGRAM

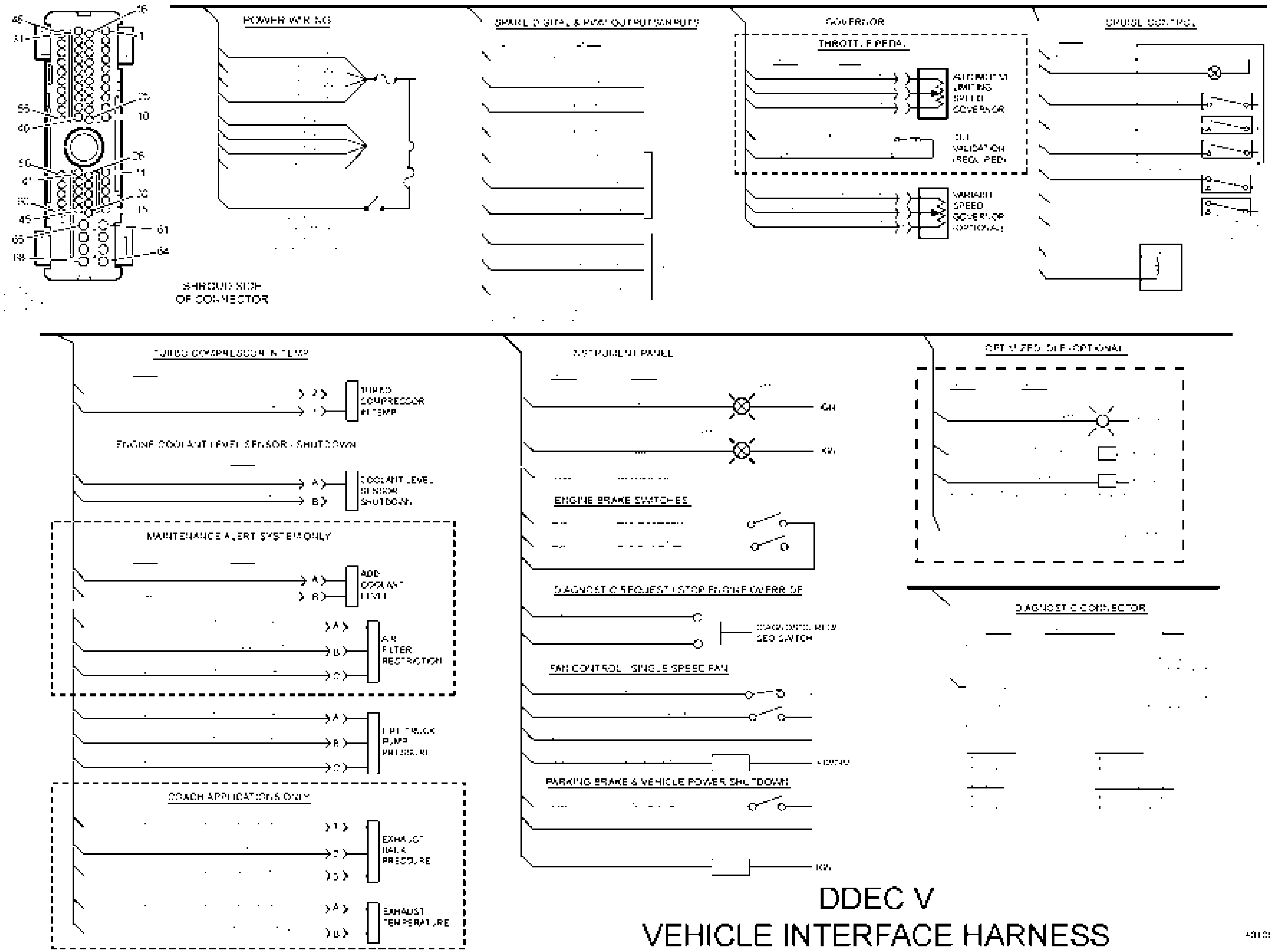
PIN NO.	WIRE COLOR	DESCRIPTION
E-1	BLK	EGR HYDRAULIC VALVE CONTROL
E-2	WHT	AIR TEMP
E-3	–	SPARE
E-4	BLK	VNT VPOD CONTROL
E-5	YEL	COOLANT TEMP
E-6	–	SPARE
E-7	TAN	OIL TEMP
E-8	–	SPARE
E-9	ORN	FUEL TEMP
E-10	DK GRN	EGR TEMP
E-11	–	SPARE
E-12	GRA	SENSOR SUPPLY
E-13	–	SPARE
E-14	BLK	SENSOR RETURN
E-15	BLK	SENSOR RETURN
E-16	YEL	FUEL RESTRICTION - MAS
E-17	PURPLE	TRS–
E-18	DK GRN	TRS+
E-19	LT BLU	SRS+
E-20	WHT	SRS–
E-21	DK GRN	OIL LEVEL - MAS
E-22	DK BLU	COMPRESSOR TEMP OUT
E-23	–	SPARE
E-24	–	SPARE
E-25	–	SPARE
E-26	–	SENSOR SUPPLY
E-27	–	SPARE
E-28	–	GROUND - SPARE
E-29	–	GROUND - SPARE
E-30	–	GROUND - SPARE
E-31	PNK	OIL PRESSURE
E-32	–	SPARE
E-33	–	SPARE
E-34	PNK	TURBO SPEED SENSOR+
E-35	BLK	TURBO SPEED SENSOR–
E-36	–	SPARE
E-37	PNK	BAROMETRIC PRESSURE
E-38	DK BLU	EGR DELTA PRESSURE
E-39	LT GRN	TURBO BOOST
E-40	–	CAN2+
E-41	–	SPARE
E-42	BLK	GROUND - VNT VPOD
E-43	–	GROUND - SPARE
E-44	–	GROUND - SPARE
E-45	–	GROUND - SPARE
E-46	LT GRN	SWITCHED BATTERY+ - VNT
E-47	–	SPARE
E-48	RED	JAKE MEDIUM
E-49	ORN	JAKE LOW/HI
E-50	–	SPARE
E-51	YEL	SWITCHED BATTERY+ - EGR VALVE
E-52	–	SWITCHED BATTERY (+) - SPARE
E-53	–	SPARE
E-54	–	CAN2–
E-55	BLK	CAN2 SHIELD
E-56	–	SPARE
E-57	–	SPARE
E-58	–	SPARE
E-59	–	EXTERNAL RTC BATTERY+
E-60	–	GROUND PIN - SPARE
E-61	WHT	CSV COMMON CYL #1 2 3
E-62	WHT	CSV COMMON CYL #4 5 6
E-63	WHT	CSV CYL #1
E-64	WHT	CSV CYL #3
E-65	WHT	CSV CYL #2
E-66	WHT	CSV CYL #5
E-67	WHT	CSV CYL #6
E-68	WHT	CSV CYL #4



SERIES 60 DDEC V EGR
ENGINE HARNESS

Information subject to change without notice. (Rev. 11/03)

LABEL	CAVITY
AMBER WARNING LAMP	V-1
RED STOP LAMP	V-2
SERVICE BRAKE RELEASED	V-3
FAN CONTROL #1	V-4
DIGITAL OUTPUT	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
VSG	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
AIR FILTER RESTRICTION	V-22
EXHAUST TEMPERATURE	V-23
SEC/DIAG REQUEST	V-24
A/C STATUS	V-25
ANALOG INPUT - 1.5k PULLUP	V-26
TURBO COMPRESSOR IN TEMP	V-27
NO CONNECTION	V-28
EXHAUST BACK PRESSURE OR FIRE TRUCK PUMP PRESSURE	V-29
NO CONNECTION	V-30
TACHOMETER	V-31
FREQUENCY - SPARE	V-32
FREQUENCY - SPARE	V-33
NO CONNECTION	V-34
NO CONNECTION	V-35
NO CONNECTION	V-36
ADD COOLANT LEVEL	V-37
COOLANT LEVEL - SHUTDOWN	V-38
ENGINE BRAKE LOW	V-39
OIL ALARM	V-40
AUX SHUTDOWN #1	V-41
OI THERMOSTAT	V-42
J1939 DL (+)	V-43
J1939 DL SHIELD	V-44
NO CONNECTION	V-45
PWM OUTPUT	V-46
SET/COAST	V-47
ANALOG INPUT - 1.5k PULLUP	V-48
FAN CONTROL OVERRIDE	V-49
PARK BRAKE	V-50
ENG BRAKE MED	V-51
PWM OUTPUT	V-52
ETHER START	V-53
OI STARTER	V-54
OI ACTIVE LAMP	V-55
J1587 +	V-56
J1587 -	V-57
J1939 DL (-)	V-58
SENSOR RETURN #2	V-59
SENSOR RETURN #1	V-60
+12V / +24V	V-61
+12V / +24V	V-62
BATTERY GROUND	V-63
BATTERY GROUND	V-64
+12V / +24V	V-65
+12V / +24V	V-66
BATTERY GROUND	V-67
BATTERY GROUND	V-68



DDEC V
VEHICLE INTERFACE HARNESS

APPENDIX C: ENGINE DIAGNOSTIC QUESTIONNAIRE

- □ Engine Diagnostic Questionnaire

Engine Diagnostic Questionnaire **RO #**

Customer Name: ______________________________

Contact Person: ______________________

LOW POWER/POOR FUEL ECONOMY:

Does check engine light come on? Yes No
Does the engine miss, run rough, hard starting? Miss Run Rough Hard Starting
Power Loss sudden or has decreased with time? Sudden Decreased with time
Excessive engine exhaust smoke (see #3)? Yes No
If yes, what color? Black Blue White
Heard any unusual engine noise? Yes ____________________ No
Power loss occurs on Foot Cruise Both
Have injectors been replaced recently? Yes No
When was last tune up? Mileage__________________Date____________
Comments: ____

____

ANY INTERMITTENT PROBLEMS:

Last time it happened:____
Does the check engine light come on? Yes No
Does the problem occur only in damp or rainy conditions? Yes No
When the vehicle hits a bump or rough road? Yes No
Does the engine: Miss Drop to idle Quit running
Gauge Sweep Hard Starting
Comments: ____

____
e.g. Does the driver do anything to correct the problem?

SMOKING:

Where is the smoke coming from?____
What color is the smoke? Blue Black White Bl/White
When does it smoke? Start-up Cold Eng. Hot Eng. U.Load
Have you noticed any oil consumption? Yes No
Have you noticed a miss in the engine? Yes No
Was the smoke intermittent?- Start all at once? Been getting worse over time?
Comments: ____

____

COOLANT LOSS

Has the oil level risen? Yes No
Have you noticed any coolant leaks? Yes No
How often do you add coolant?________________________How Much?________________
What kind of coolant do you use?____
What kind of inhibitor do you use?____
Comments: ____

OIL CONSUMPTION:

How much oil are you adding?________________________How often (miles)?____________
Have you noticed any oil leaks? Yes No
Have you noticed any smoke out the exhaust? Yes No
At Idle Light or no load Heavy load
How often do you change oil?________________________What Brand?________________
Have you changed brands recently? Yes No
How & when do you check your oil?____
Comments: ____

APPENDIX D: SERVICE INFORMATION LETTERS

- Technical Service Letter 03 TS-23
- Technical Service Letter 03 TS-23
- Technical Service Letter 03 TS-44
- Technical Service Letter 03 TS-44
- Technical Service Letter 03 TS-44
- Technical Service Letter 03 TS-44
- Technical Service Letter 04 TS-17
- Technical Service Letter 04 TS-16
- Technical Service Letter 04 TS-16
- Technical Service Letter 04 TS-16
- Technical Service Letter 04 TS-16

DETROIT DIESEL

A DaimlerChrysler Powersystems Company

NO.: 03 TS - 23
May 28, 2003

TO: All Distributors, Branches and Dealers

ATTN.: Service Manager, Class of 2003 Representative

FROM: M. F. Kubiak

SUBJECT: **S60 EGR De-rating Due to Higher Temperatures – Air and Coolant**

DDEC's engine protection operation is designed to provide protection to the engine and vehicle from damage due to high temperatures, low pressure or low levels.

From its initial release in the mid 1980's the technology DDC uses has remained for the most part unchanged. This letter is intended to introduce you to technology enhancements designed for 2003 engines and beyond and the differences you must understand.

Current on highway Series 60 engines utilize Exhaust Gas Recirculation (EGR) technology. The introduction of EGR into the intake system increases the temperature of air in the intake system and adds heat to the coolant. Under some conditions, engine fan operation is used to keep coolant and charge air temperatures within a recommended range. Under certain more demanding operating conditions, (e.g. high ambient, high loads, high altitudes etc) vehicle cooling system components alone may not be able to respond to the rapidly generated heat. This can be especially true when operating an EGR equipped vehicle on a chassis dynamometer since normal ram air for cooling is absent.

If the cooling system (fan, radiator, charge air cooler, etc.) is not able to maintain proper temperatures of the air, and coolant, the DDEC system is programmed to reduce fueling (power) for a short time to reduce air and coolant temperatures. A small amount of reduction is done within the engine calibration without any notification to the operator. Once the affected temperature (e.g. coolant or air) returns to normal levels, the maximum fueling is restored.

The DDEC system will store an information code indicating that this event occurred. No corrective action is required as this action is intended and is designed to reduce operating temperatures without a noticeable affect on vehicle performance. It is possible that the driver may notice a slight change in the engine's sound during the time the derate occurs.

These information codes (FMI 14) will not illuminate a check or stop engine light, nor broadcast a message to the dash. These information codes will only be seen when viewing codes with a diagnostic tool, or in data downloaded via DDEC Reports. Codes that should be of concern are those with a failure mode identifier (FMI) of 0 (High). FMI 0 codes will illuminate check and/or stop engine lights alerting the user to a problem that needs attention. Today three temperatures are monitored for use in derating strategies.

Coolant temperature:

- Flash code 44

PID 110 FMI 14 De-rate for temperature control
PID 110 FMI 0 Above limits – attention required

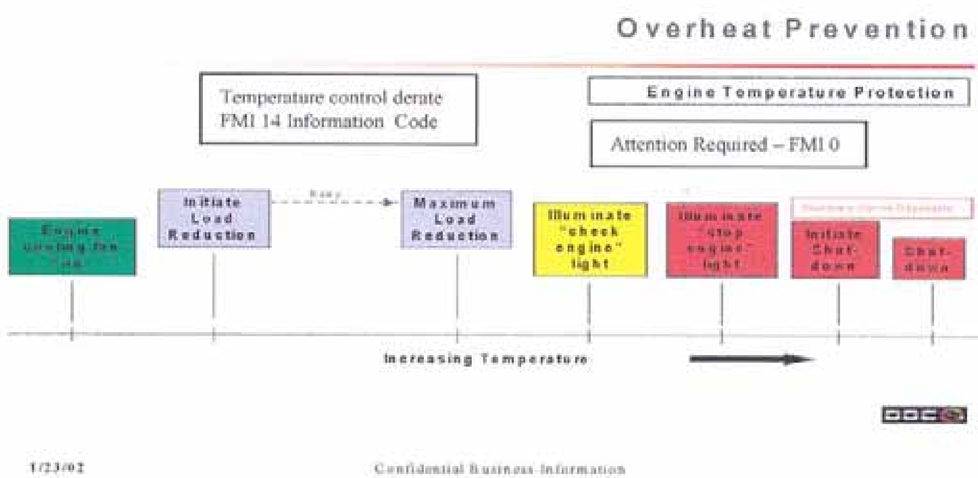
- Intake Manifold temperature:

Flash Code 44
PID 105 FMI 14 – Derate for temperature control
PID 105 FMI 0 - Above limits– attention required

- Turbocharger Compressor Outlet (TCO) temperature :

Flash code 49
PID 404 FMI 14 – De-rate for temperature control
PID 404 FMI 0 - Above limits– attention required

Again, the FMI 14 is for information only and is not indicative of a fault requiring any attention.
In the event that high heat load conditions are so severe that the derate temperature control strategy cannot prevent continued temperature rise, DDEC's engine protection will take over and illuminate the Check or Stop engine light and proceed to the level of protection programmed (shutdown, warning). Operation of this protection is detailed in the following graph.



Temperature limits are not published for this example. Certain parameters may not initiate a shutdown and the graph is used to simply illustrate the logic used to provide proper engine and vehicle protection.

M. F. Kubiak
Customer Assurance

NO.: 03 TS - 44
September 10, 2003

TO: All Distributors & Branches – U.S. & Canada

ATTN.: Service Manager/Parts Manager/Dealer Representative

FROM: Nahum Veach

SUBJECT: **Series 60 EGR Turbocharger Service Parts and VNT Actuator Calibration**

The following service parts have been released to service the Series 60 EGR Turbocharger:

23505493	Compressor V-band kit
23531930	VNT actuator
23531929	Actuator bracket
23530252	Turbo speed sensor
23531926	Crank pin kit

For warranty repairs, it is now required to replace these components when found to be defective instead of replacing the turbocharger assembly.

When troubleshooting the EGR system, it is now required that the technician check the VNT actuator calibration. The following procedure describes actuator calibration and should be used in conjunction with DDEC III/IV Single ECM Troubleshooting Guide, Section 10.18:

1. Disconnect the air hose to the VNT actuator.
2. Connect a regulated air supply to the VNT actuator fitting.
3. Slowly adjust air pressure from 0 – 482 kPa (0 – 71 psig) and watch actuator rod travel. Actuator rod should not bind and travel should be smooth.
    a. if air is heard escaping from the actuator, indicating a blown diaphragm, replace the actuator assembly
    b. if actuator rod does not move when air pressure is applied, disconnect the actuator arm from the crank pin and rotate the crank.
        i. if crank is seized, replace turbocharger assembly.
        ii. if crank rotates freely, then the actuator is seized. Replace the actuator assembly.
    c. if the rod end touches the minimum stop screw between 475 – 489 kPa (69.0 - 71.0 psig), then the actuator is calibrated correctly. Continue with the troubleshooting process.

d. if the rod end does not touch the minimum stop screw between 475 – 489 kPa (69.0 – 71.0 psig), actuator calibration is necessary.

Series 60 VNT Actuator Removal and Replacement Procedure

Caution

1. **Under no conditions should the actuator canister be opened** in an attempt to rebuild. There is a powerful coil spring compressed inside the can to a load of 150 – 500 lbs., which can cause physical harm. The actuators are serviced as an assembly and internal parts are not available.
2. Exercise caution in both handling and in positioning the turbocharger assembly on the workbench to avoid damage to external parts. Be sure the speed sensor electrical connector/lead wire does not become trapped under the turbocharger. Avoid any mechanical damage to the actuator canisters and air pressure fittings.
3. The minimum crank stop (stop screw and lock nut) has been preset at the factory and sealed with a special paint. Under no circumstances should this stop be readjusted in the field. If tampered with, all warranties, expressed and implied, are void and damage to the engine could occur.

VNT Actuator Removal (Refer to Figure 1)

1. Locally clean the area around actuator and VNT external linkage to remove oily grease, dirt, or paint deposits.
2. Carefully remove the actuator rod end retaining ring.
3. Pressurize the actuator to 267 kPa (40 psig) and remove the clevis pin from the external crank.
4. Remove pressure from the actuator.
5. Loosen and remove the three lock nuts that fasten the actuator to the bracket and remove the actuator.
6. Using a pocket scale, measure and record the approximate distance from the rod end to the base of the actuator can (See Figure 2).

VNT Actuator Installation and Calibration

1. Assemble the replacement actuator. Ensure that the rod end and actuator rod are threaded into the adjuster body equal distances. Turn the adjuster body to achieve the same value recorded in step 6 above.
2. Assemble the replacement actuator to the bracket and torque nuts to 6.2-7.9 N-m (55 – 70 in-lbs).
3. Attach the air hose from the pressure regulator to the actuator fitting. Apply approximately 267 kPa (40 psig) to the actuator.
4. Rotate the clevis and align the clevis and rod end holes and insert pin.
5. Carefully reinstall the retaining clip.
6. Slowly increase the pressure to the actuator to 441± 3.5 kPa (64 ± 0.5 psig). If pressure reaches above 444.5 kPa (64.5 psig), reduce pressure to 276 kPa (40 psig) and repeat this step. Allow the pressure to stabilize for 10 seconds. The actuator rod should extend and be at, or near, the minimum stop screw.
7. Rotate the ***adjuster body*** (see Figure 1) until a 0.004 inch ± 0.001 (0.10 ± .0250 mm) gap is achieved between the stop screw and clevis. Without allowing the adjuster body to rotate, tighten the lock nuts to 6.2 – 7.9 N-m (55 – 70 in-lbs).

8. Cycle pressure from 0 psig to 441 kPa (64 psig) and check for proper operation. Set pressure to 276 kPa (40 psig) and slowly increase pressure to 441 kPa (64 psig) and recheck the gap between the stop screw and the clevis. You should be able to fit a feeler gage of 0.10mm (0.004 inches) between them. If the gap is not between .003 - .005 inches, repeat process in step 7.

9. Cycle pressure a few times from 0 to 441 kPa (64 psig) until satisfied that the rod position at minimum stop has been satisfactorily set and the actuator is stroking from one stop to the other.

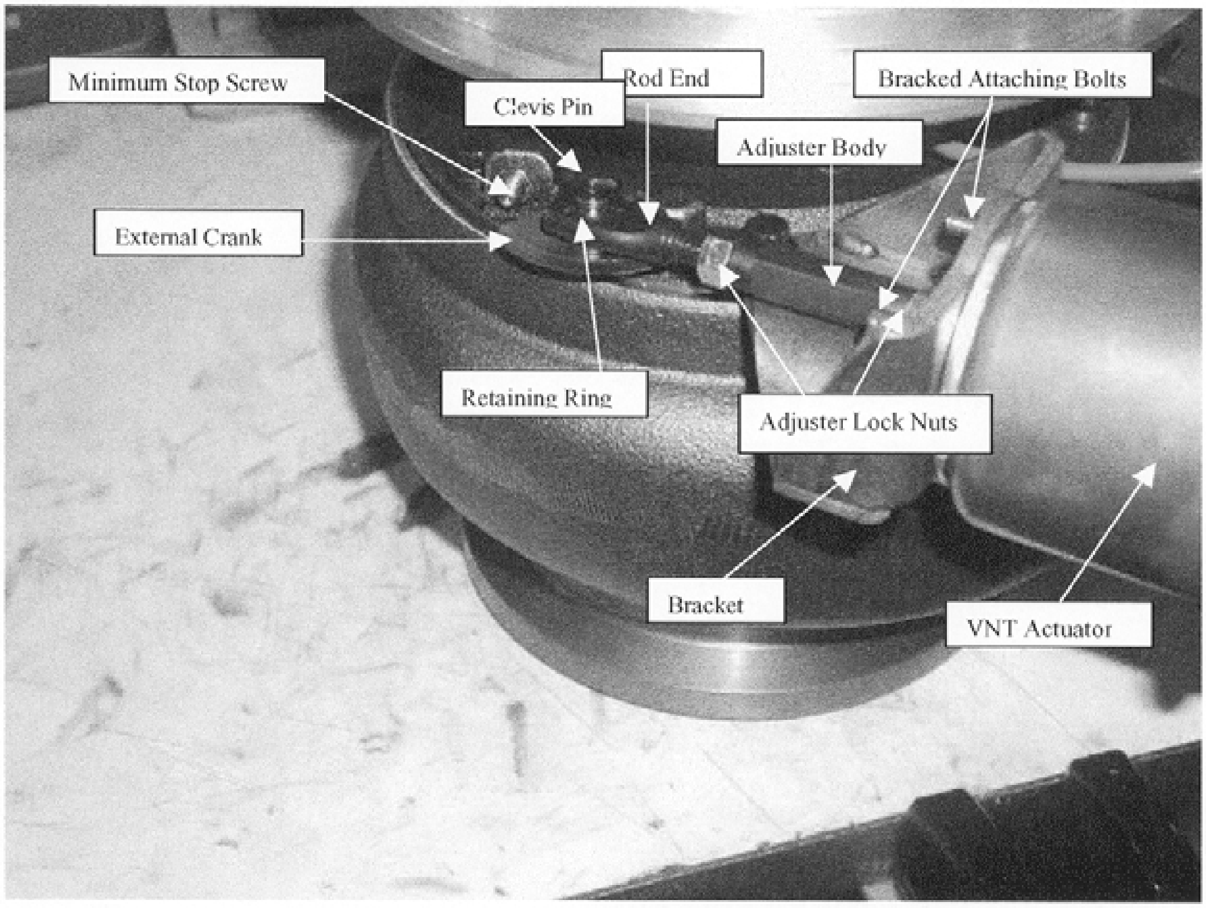


Figure 1

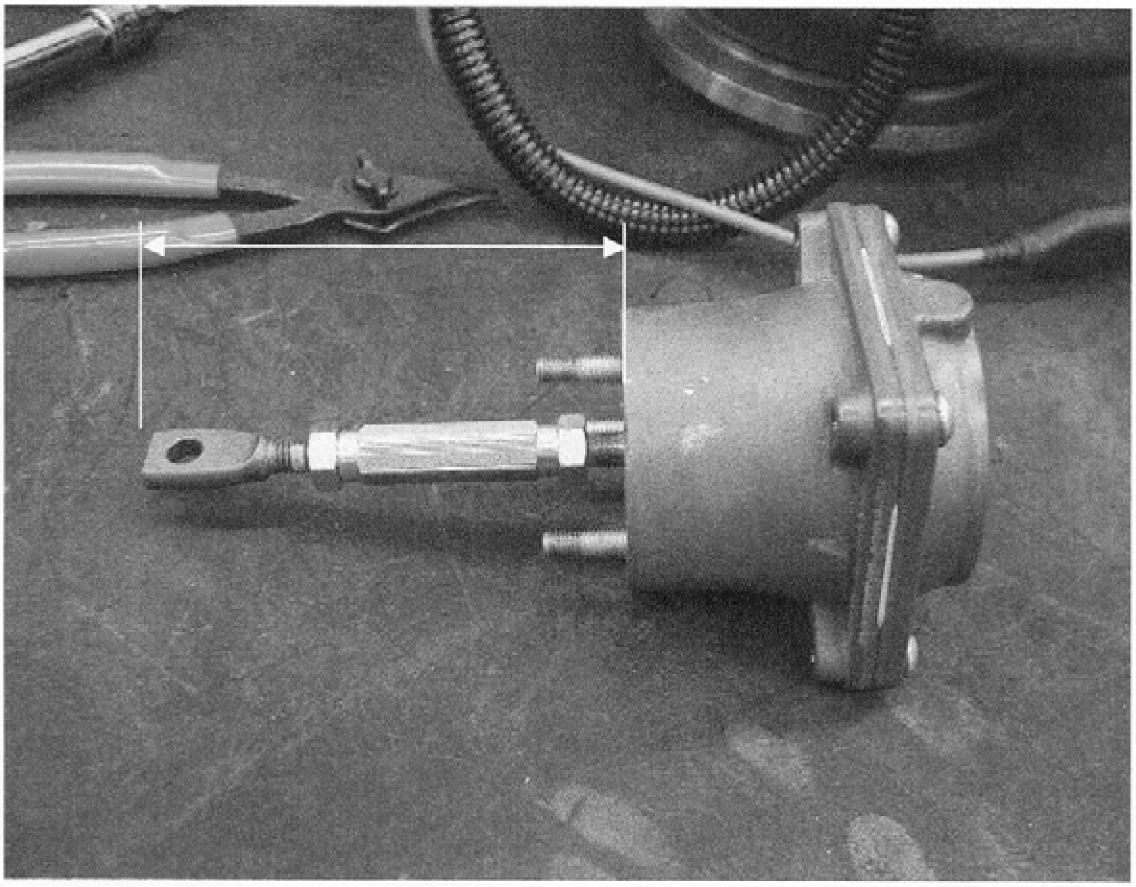


Figure 2

No.: 04 TS - 17
March 26, 2004

TO: All Distributors, Branches and Dealers

ATTN.: Service Manager

FROM: M. F. Kubiak

SUBJECT: **Flash code 13 & 16 – DDEC V, EGR Valve Current High or Low**

Two new codes were added to these flash codes with the release of DDEC V.

Flash code 13 is defined as146 / 6 EGR valve current too high
Flash code 16 is defined as146 /5 EGR valve current too low

These codes are designed to diagnose faults with the new EGR valve.

These codes have been logged without an actual failure of the valve or wiring.

On March 8 2004, a change was made to all Series 60 DDEC V calibrations to prevent false code 13 or 16 from turning on the check engine light (amber warning lamp). Any programming performed after this date will prevent this code from being logged.

There was not a change to the ECM software, only the calibrations were modified.

If this (these) code(s) are encountered, the first step in troubleshooting should be to first program the ECM.

Thank you for your assistance and support.

Marty Kubiak
Customer Assurance

No.: 04 TS - 16
April 19, 2004

TO: All Distributors, Dealers & Their Branches – U.S. & Canada

ATTN.: Service Manager

FROM: Nahum Veach

SUBJECT: **Series 60 EGR VNT Actuator Seal Installation (Supercedes 03 TS-44)**

The following service parts have been released to service the Series 60 EGR Turbocharger:

23505493	Compressor V-band kit
23531930	VNT actuator Kit
23531929	Actuator bracket
23530252	DDEC IV turbo speed sensor
23531531	DDEC V turbo speed sensor
23531926	Crank pin kit

Series 60 VNT Actuator Removal and Replacement Procedure

Caution

1. **Under no condition should the actuator canister be opened** in an attempt to rebuild. There is a powerful coil spring compressed inside the can to a load of 150 – 500 lbs., which can cause physical harm. The actuators are serviced as an assembly, and internal parts are not available.
2. If the turbocharger is removed from the engine during actuator replacement, exercise caution in both handling and in positioning the turbocharger assembly on the workbench to avoid damage to external parts. Be sure the speed sensor electrical connector/lead wire does not become trapped under the turbocharger. Avoid any mechanical damage to the actuator canisters and air pressure fittings.
3. The minimum crank stop (stop screw and lock nut) has been preset at the factory and sealed with a special paint. Under no circumstances should this stop be readjusted in the field. If tampered with, all warranties, expressed and implied, are void and damage to the engine could occur.

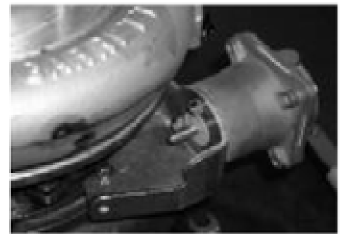
VNT Actuator Removal (Refer to Figure 1)

1. Locally clean the area around actuator and VNT external linkage to remove oily grease, dirt, or paint deposits
2. Carefully remove the actuator rod-end retaining ring.
3. Pressurize the actuator to 267 kPa (40 psig) and remove the clevis pin from the external crank.
4. Remove pressure from the actuator.

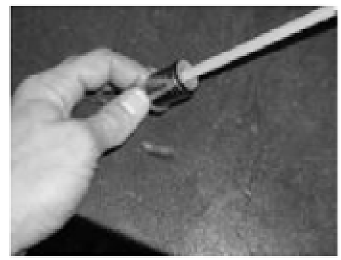
5. Using a pocket scale, measure and record the approximate distance from the inside surface of the bracket to the adjuster (shown as L_1 in Figure 2) and to the rod-end (shown as L_2 in Figure 2).
6. Loosen and remove the three lock nuts that fasten the actuator to the bracket and remove the actuator.

VNT Actuator Installation and Calibration

Note: Lost or missing washer is not a reason to replace the actuator.



1. Loosely attach the new actuator with the three nuts provided. Remove the adjuster body and lock nut from the new actuator to allow installation of the sliding and sealing washers. Only the threaded portion of the actuator rod should protrude as shown. Slide the larger washer (sliding washer) all the way down the threaded actuator rod until it rests on the actuator bracket.



2. Form the smaller washer before installation using a standard pencil and any 3/8" drive socket. If a pencil is unavailable, a small pen or Phillips screwdriver may be used as long as the diameter does not exceed 5/16". A socket is required to place uniform pressure on the washer during installation. If the washer becomes distorted, it will not seal properly. Place the washer on the pointed end of the pencil to start it and use the socket drive (square hole side) to push the washer onto the pencil as shown. After the washer is formed, remove it from the pencil by sliding it back over the pointed end.

3. Slide the smaller washer over the threaded rod to about ¼" away from the inside of the bracket using the socket as shown. The bow in the smaller washer should be pointed outward away form the actuator. Once the smaller washer has been pushed on, it cannot be pulled off. Doing so will damage the washer and prevent a proper seal.
4. Torque the three actuator nuts to 6.2-7.9 N-m (55-70 in-lbs).
5. Start the M8 lock nut and the adjuster body on the actuator rod to its approximate original position, then the M7 lock nut onto the rod end and then the rod end into the adjuster body. Ensure that the rod end and actuator rod are threaded into the adjuster body equal distances. Turn the adjuster body to achieve the same value recorded in step 6 above.
6. Attach an air hose from the pressure regulator to the actuator fitting. Apply approximately 267 kPa (40 psig) to the actuator.
7. Rotate the clevis and align the clevis and rod end holes and insert pin.
8. Carefully reinstall the retaining clip.
9. Slowly increase the pressure to the actuator to 441 ± 3.5 kPa (64 ± 0.5 psig). If pressure reaches above 444.5 kPa (64.5 psig), reduce pressure to 276 kPa (40 psig) and repeat this step. Allow the pressure to stabilize for 10 seconds. The actuator rod should extend and be at, or near, the minimum stop screw.
10. Rotate the ***adjuster body*** (see Figure 1) until a 0.004 inch ± 0.001 (0.10 ± .0250 mm) gap is achieved between the stop screw and clevis. Without allowing the adjuster body to rotate, tighten the lock nuts to 6.2 -7.9 N-m (55-70 in-lbs). *Note: Rotating the actuator body will allow for fine adjustment. If proper gap is not achieved by rotating the adjuster body, it is required that the rod end be removed from the clevis pin and rotated to provide course adjustment.*

11. Cycle pressure from 0 psig to 441 kPa (64 psig) and check for proper operation. Set pressure to 276 kPa (40 psig) and slowly increase pressure to 441 kPa (64 psig) and recheck the gap between the stop screw and the clevis. You should be able to fit a feeler gage of 0.10mm (0.004 inches) between them. If the gap is not between .003-.005 inches, repeat calibration process.
12. Cycle pressure a few times from 0 to 441 kPa (64 psig) until satisfied that the rod position at minimum stop has been satisfactorily set and the actuator is moving freely from one stop to the other.
13. Remove pressure from the actuator. Use a 3/8" open-end wrench to push the small (sealing) washer tight against the larger (sliding) washer. Failure to remove all pressure from the actuator in this stage will result in permanent washer damage.

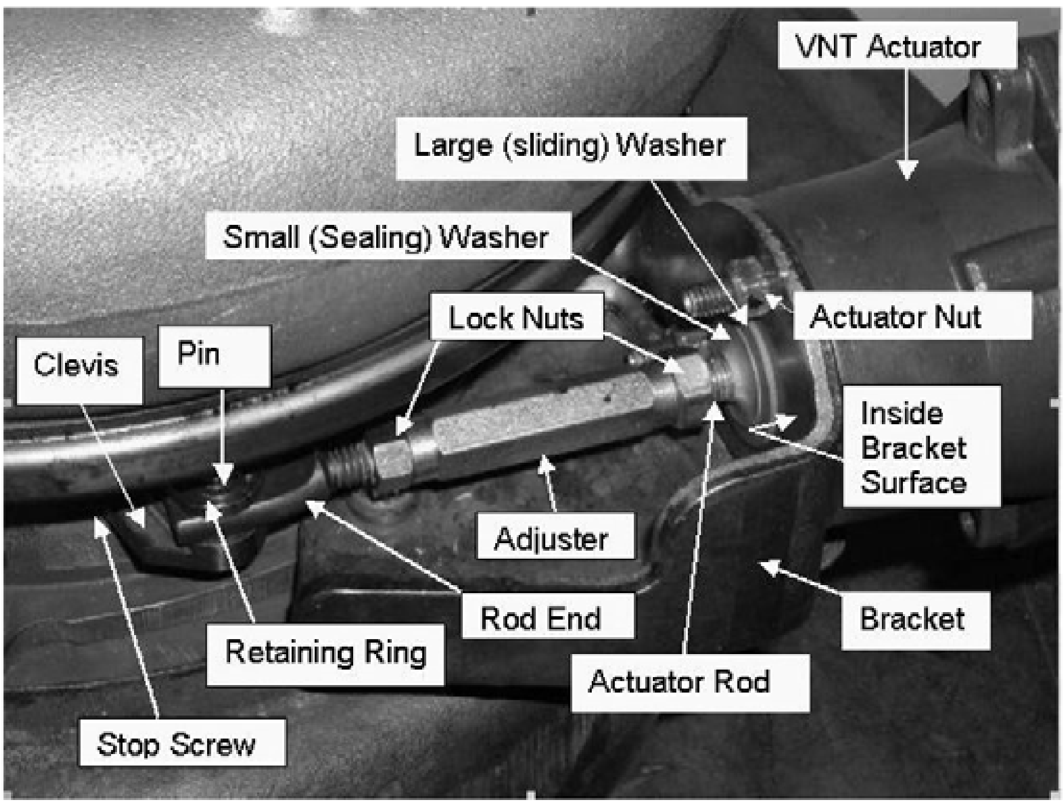


Figure 1

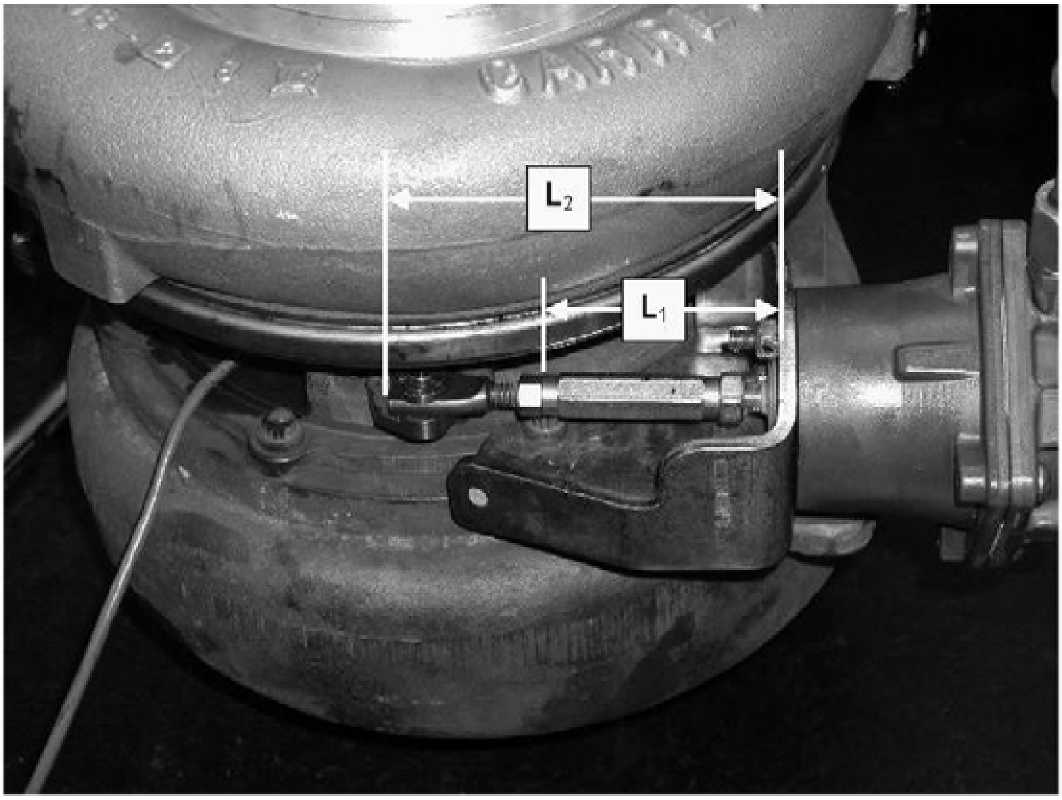


Figure 2

APPENDIX E: DDEC IV ECM OVERVIEW AND VEHICLE INTERFACE HARNESS

- □ DDEC IV ECM Front Side View - see Figure E-1
- □ ECM Engine Harness Connector View - see Figure E-2
- □ Engine Harness Connector Pin Locations - see Figure E-3
- □ Vehicle Interface Harness Connector - see Figure E-4
- □ Vehicle Interface Harness Connector Pin Locations - see Figure E-5

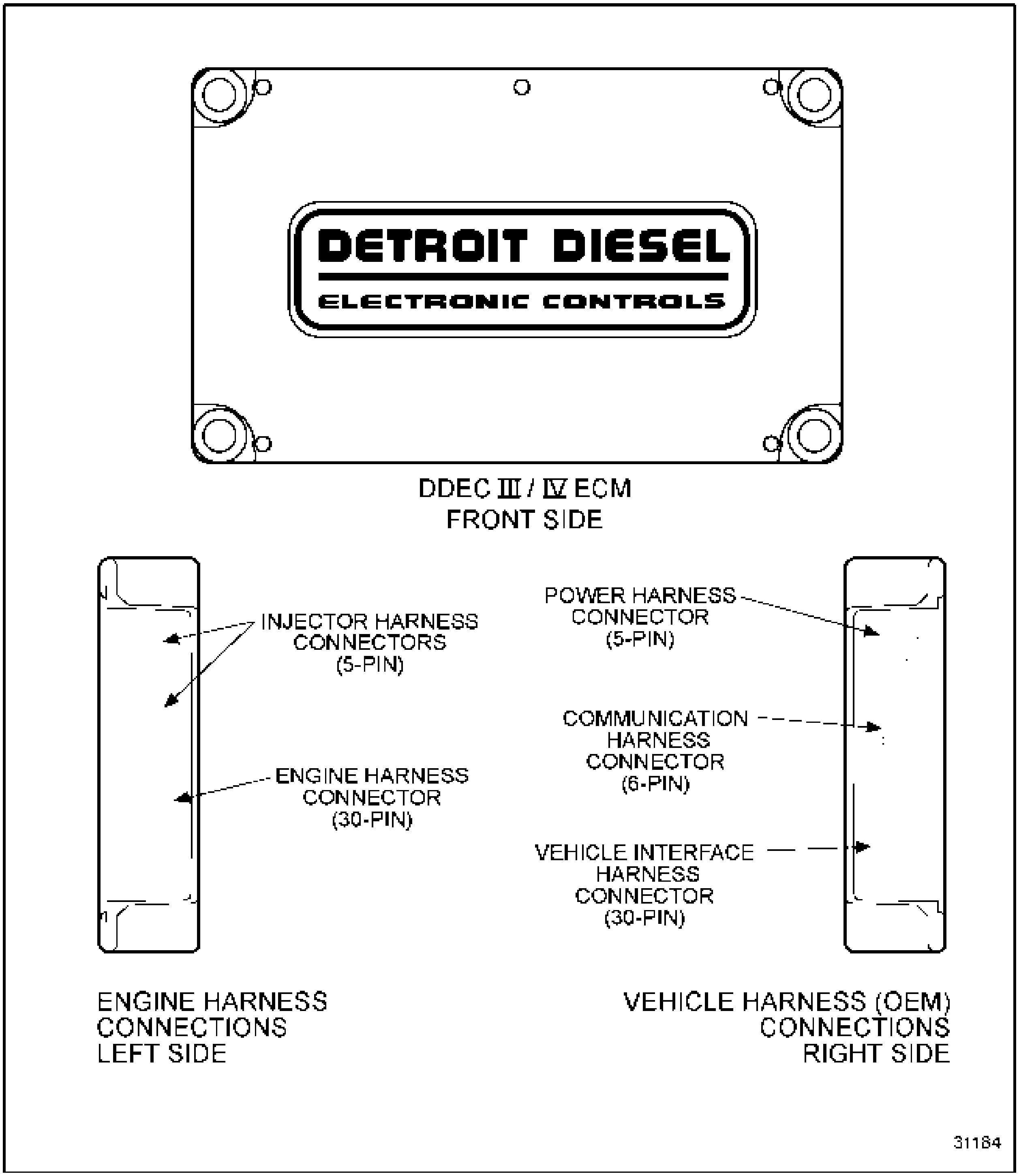


Figure E-1 DDEC IV ECM Front Side View

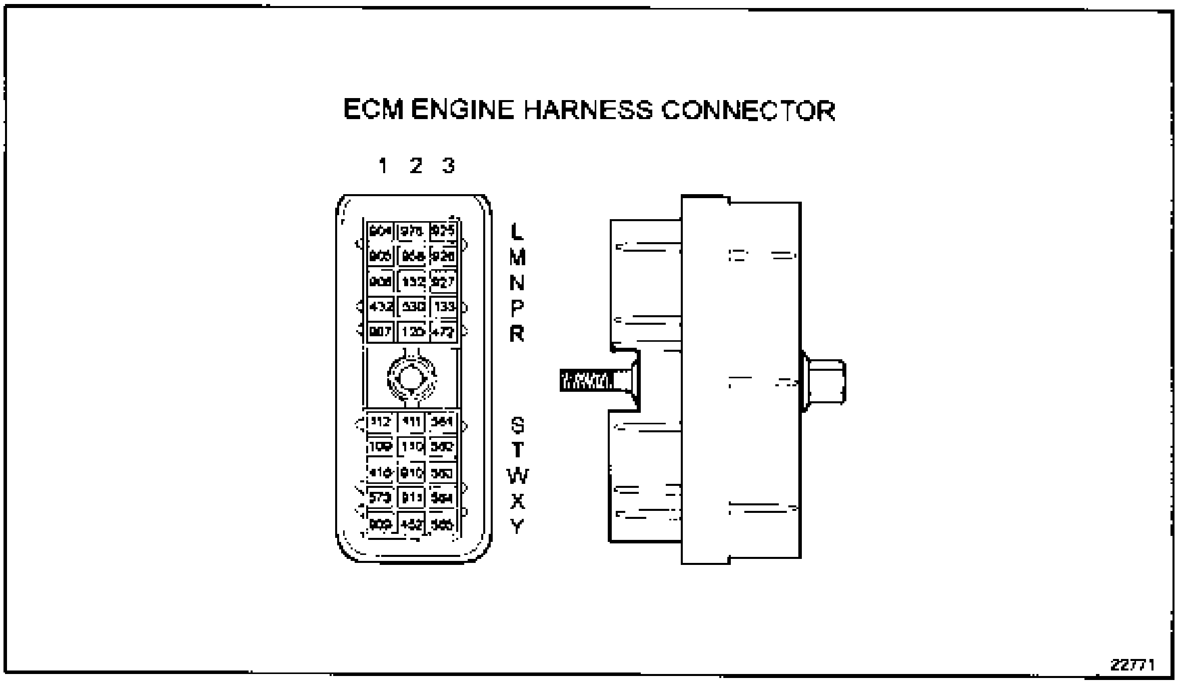


Figure E-2 ECM Engine Harness Connector View

LABEL	WIRE NO	CAVITY	COLOR
TRS (–)	109	T–1	PPL
TRS (+)	110	T–2	DK GRN
SRS (+)	111	S–2	LT BLU
SRS (–)	112	S–1	WHT
OIL TEMPERATURE	120	R–2	TAN
AIR TEMPERATURE	132	N–2	YEL/RED
COOLANT TEMP	133	P–3	PNK
SENSOR SUPPLY (5VDC)	416	W–1	GRA
TURBO BOOST	432	P–1	ORN
SENSOR RETURN (ENGINE)	452	Y–2	BLACK
FUEL TEMP	472	R–3	ORN
OIL PRESSURE	530	P–2	BRN
ENGINE BRAKE MED	561	S–3	LT BLU
ENGINE BRAKE LO	562	T–3	LT GRN
DIGITAL OUTPUT W–3	563	W–3	YEL
DIGITAL OUTPUT X–3	564	X–3	TAN/BLK
DIGITAL OUTPUT Y–3	565	Y–3	RED
TIMED INPUT	573	X–1	BRN
BARO PRESSURE	904	L–1	PPL/WHT
FUEL PRESSURE	905	M–1	YEL
ANALOG INPUT #3	906	N–1	ORN
ANALOG INPUT #6	907	R–1	DK GRN
PWM OUT #2	909	Y–1	LT GRN/YEL
PWM OUT #3	910	W–2	ORN
PWM OUT #4	911	X–2	PNK
J1939 (+)	925	L–3	DK BLU
J1939 (–)	926	M–3	DK BLU/WHT
J1939 SHIELD	927	N–3	WHT/BLU
ANALOG INPUT #5	958	M–2	BLU
ANALOG INPUT #4	976	L–2	DK GRN

GO TO A

24614

Figure E-3 Engine Harness Connector Pin Locations

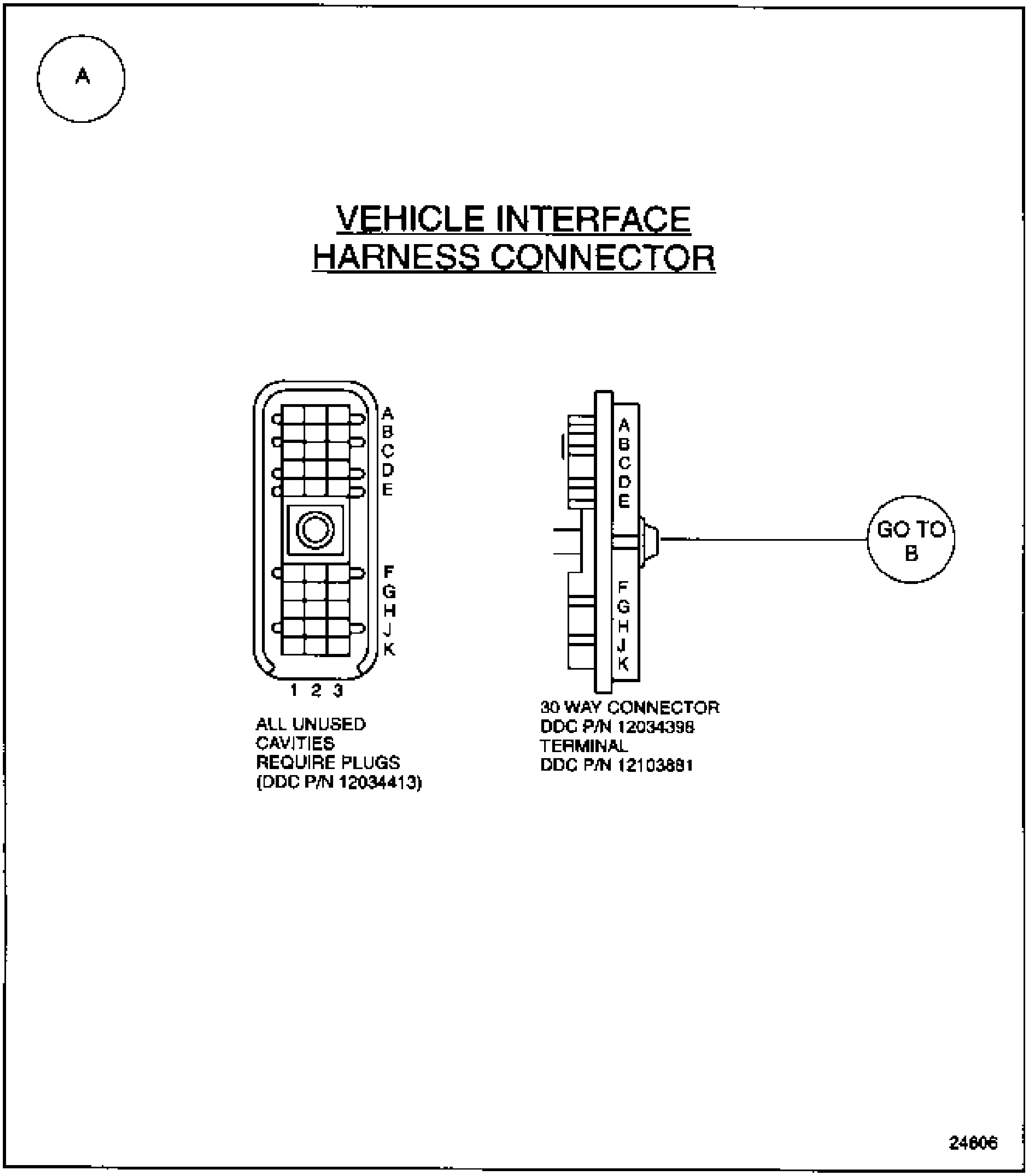


Figure E-4 Vehicle Interface Harness Connector

LABEL	WIRE NO	CAVITY	COLOR
COOLANT LEVEL	115	H–3	ORN
LIMITING SPEED GOVERNOR	417	D–2	DK BLUE
CHECK ENGINE LIGHT	419	B–1	PPL/WHT
IGNITION	439	B–3	PNK
DIGITAL INPUT E–1	451	E–1	LT GRN
DIGITAL OUTPUT F–3	499	F–3	LT BLU
TACHOMETER DRIVE	505	K–1	GRA
STOP ENGINE LIGHT	509	B–2	PPL
VARIABLE SPEED GOVERNOR	510	D–1	BRN
DIGITAL INPUT H–1	523	H–1	GRA/RED
DIGITAL INPUT H–2	524	H–2	GRA
DIGITAL INPUT G–1	528	G–1	BRN/RED
DIGITAL INPUT J–2	531	J–2	ORN
DIGITAL INPUT J–1	541	J–1	YEL/RED
DIGITAL INPUT F–1	542	F–1	YEL
DIGITAL INPUT G–2	543	G–2	ORN/BLK
DIGITAL INPUT F–2	544	F–2	BRN/WHT
DIGITAL INPUT G–3	545	G–3	LT BLUE/YEL
DIGITAL OUTPUT A–2	555	A–2	TAN
VEHICLE SPEED (+)	556	E–2	LT BLUE/BLK
VEHICLE SPEED (–)	557	E–3	LT BLUE/ORN
DIGITAL INPUT K–2	583	K–2	LT BLUE/BLK
ANALOG INPUT #7	749	D–3	YEL
DATA LINK (+)	900	C–2	DK GREEN/YEL
DATA LINK (–)	901	C–1	DK GREEN
PWM #1 OUTPUT	908	J–3	WHT
SENSOR SUPPLY (5VDC)	916	A–3	RED/BLK
SENSOR RETURN	952	C–3	BLK
DIGITAL INPUT K–3	979	K–3	WHT
DIGITAL OUTPUT A–1	988	A–1	GRA

GO TO A

IGNITION CONNECTOR

+12 V FROM BATTERY	440	A	ORN
BATTERY GROUND	953	B	BLK/WHT

24605

Figure E-5 Vehicle Interface Harness Connector Pin Locations