2007-2009 AFTERTREATMENT UNIQUE DIAGNOSTICS AND SERVICE INFORMATION

MAXXFORCE®

- Study manual carefully before servicing engine.
- Pay close attention to all notes and cautions.
- Comply with all warnings.

EGES-540

NAVISTAR®

FOREWORD

This publication is intended to provide technicians and service personnel with an overview of diagnostics for the 2007-2009 Aftertreatment system. This booklet covers the following engines:
Medium Duty–MaxxForce® 5, 7, DT, 9, and 10
Big Bore–MaxxForce® 11 & 13
Note: Refer to the Engine Diagnostic Manual for Engine Performance and Electrical Diagnostics. This booklet only covers Aftertreatment diagnostics.

Safety Information

This manual provides general and specific service procedures and repair methods essential for your safety and the reliable operation of the engine. Since many variations in tools, procedures, and service parts are involved, advice for all of the possible safety conditions and hazards cannot be stated.

Departure from the instructions in this manual or disregard of warnings and cautions can lead to injury, death, or both, and damage to the engine or vehicle.

Read the safety instructions below before doing service and test procedures in this manual for the engine or vehicle. See related application manuals for more information.

Safety Instructions

Vehicle

Shift transmission to park or neutral, set parking brake, and block wheels before doing diagnostic or service procedures.

Work Area

- Keep the work area clean, dry, and organized.
- Keep tools and parts off the floor.
- Make sure the work area is ventilated and well lit.
- Make sure a First Aid Kit is available.

Safety Equipment

- Use the correct lifting devices.
- Use the proper safety blocks and stands.

Protective Measures

- Wear protective glasses and safety shoes (do not work in bare feet, sandals, or sneakers).
- Wear the appropriate hearing protection.
- Wear the correct clothing.
- Do not wear rings, watches, or other jewelry.
- Restrain long hair.

Tools

- Make sure all tools are in good condition.
- Make sure all standard electrical tools are grounded.
- Check for frayed power cords before using power tools.

Fire Prevention

NOTE: Check the classification of each fire extinguisher to ensure that the following fire types can be extinguished:

1. Type A — Wood, paper, textiles, and rubbish
2. Type B — Flammable liquids
3. Type C — Electrical equipment

- Make sure that charged fire extinguishers are in the work area.

Batteries

- Batteries produce highly flammable gas during and after charging.
- Always disconnect the main negative battery cable first.
- Always connect the main negative battery cable last.
- Avoid leaning over batteries.
- Protect your eyes.
- Do not expose batteries to open flames or sparks.
- Do not smoke in workplace.

Compressed Air

- Limit shop air pressure for blow gun to 30 psi (207 kPa).
- Use approved equipment.
- Do not direct air at body or clothing.
- Wear safety glasses or goggles.
- Wear hearing protection.
- Use shielding to protect others in the work area.

Fluids Under Pressure

- Use extreme caution when working on systems under pressure.
- Follow approved procedures only.

Fuel

- Do not over fill fuel tank. Over fill creates a fire hazard.
- Do not smoke in the work area.
- Do not refuel the tank when the engine is running.

Removal of Tools, Parts, and Equipment

- Reinstall all safety guards, shields, and covers after servicing the engine.
- Make sure all tools, parts, and service equipment are removed from the engine and vehicle after all work is done.

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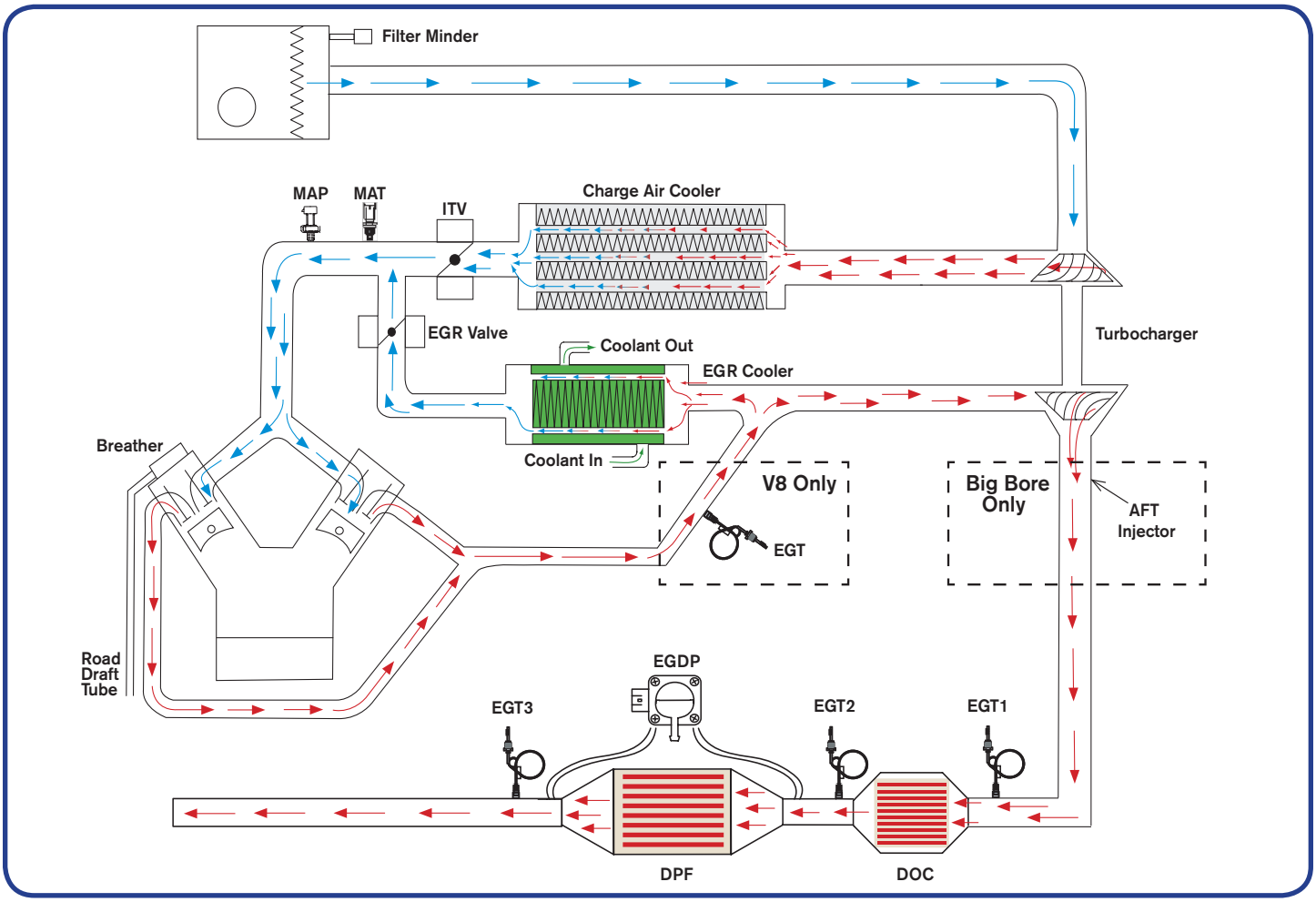


- Exhaust Gas Temperature 1 (EGT1) Sensor
- Exhaust Gas Temperature (EGT) Sensor
- Exhaust Gas Temperature 2 (EGT2) Sensor
- Exhaust Gas Temperature 3 (EGT3) Sensor
- Exhaust Gas Differential Pressure (EGDP) Sensor
- Diesel Oxidation Catalyst (DOC)
- Diesel Particulate Filter (DPF)
- Exhaust Gas Recirculation (EGR) Valve
- Exhaust Gas Recirculation (EGR) Cooler
- Intake Throttle Valve (ITV)
- Aftertreatment (AFT) Injector
- Manifold Air Pressure (MAP) Sensor
- Manifold Air Temperature (MAT) Sensor

AFTERTREATMENT SYSTEM OPERATION

Aftertreatment System Operation

The purpose of the Aftertreatment (AFT) System is to catalyze Carbon Monoxide (CO), Oxides of Nitrogen (NO_x), and Hydrocarbons (HC). The Diesel Particulate Filter (DPF) will capture soot and other particulates exiting the exhaust pipe.

Although the Diesel Oxidation Catalyst (DOC) should not require regular maintenance the DPF does require occasional regeration to remove soot and off-board cleaning to remove ash.

Accumulated soot in the DPF can be converted to carbon dioxide and removed by a self-cleaning process known as regeneration (Regen). Regen is done either passively from the exhaust heat during normal engine operation, or actively by forcing a Regen where very high heat is created in the exhaust system by injecting fuel. During a forced Regen the temperature at the face of the DPF is raised to approximately 1000 °F (538 °C) for a period of time, depending on the amount of soot that accumulated within the DPF. Regen time is calculated by the Engine Gas Differential Pressure (EGDP) feedback.

The Regen may take place as the vehicle is in operation under a steady state heavy engine loading condition, or by forcing a Stationary Regen process.

During a Stationary Regen, the engine speed is increased, while the Engine Control Module (ECM) controls the fuel injection system to post-inject fuel. The Big Bore does not post-inject, it injects fuel directly into the exhaust using an injector just before the DOC. The Exhaust Gas Recirculation (EGR) and Intake Throttle Control (ITV) are also controlled to increase the heat entering the DPF so that soot can be converted to carbon dioxide. Other particulates are burnt to ash and do not leave the DPF.

The health of the system and the Regen processes are monitored by three Exhaust Gas Temperature (EGT) sensors and an Exhaust Gas Differential Pressure (EGDP) sensor. The EGDP measures the pressure difference across the DPF. The temperature sensors measures the temperature differences across the DOC and DPF.

The DPF, and/or the DOC may fail or plug prematurely for several reasons. It is important to pinpoint the root cause and repair the failure before replacing the DOC or DPF. Failure to do so could result in destroying a newly replaced component.

CRITICAL ENGINE CONTROLS

Engine Controls that are Critical for a Regen

The following controls do not prevent a Regen from occurring although they do need to function properly to ensure a successful Regen.

Exhaust Gas Recirculation (EGR) Valve

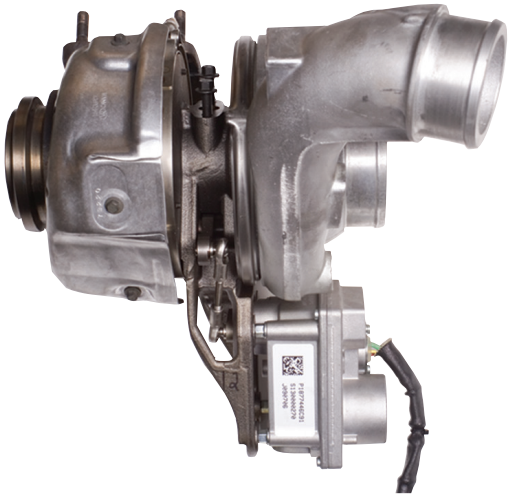
- The EGR system is used to reduce the amount of NO_x created by the engine. The EGR valve re-circulates exhaust back into the intake stream. This cools the combustion process and reduces the formation of NO_x.

Intake Throttle Valve (ITV)

- The ITV is used to control air/fuel mixture during a DPF Regen process. Even though a fault from this component does not inhibit a Regen, it does need to function properly to ensure a successful Regen.

Variable Geometry Turbocharger (VGT)

- The VGT is only used on the MaxxForce® 7, DT, 9, and 10 (medium duty) engines. The VGT is used to control air/fuel mixture during a DPF Regen process. Even though a fault from this component does not inhibit a Regen, it does need to function properly to ensure a successful Regen.



AFTERTREATMENT COMPONENTS

MaxxForce® 5, 7, DT, 9, 10, 11, and 13

The following components are on all vehicles with a MaxxForce® 5, 7, DT, 9, 10, 11, and 13 engine.

Diesel Oxidation Catalyst (DOC)

The DOC oxidizes HC during DPF Regen. It also reduces HC, CO, and NO_x emissions during normal (non-Regen) operation.

Diesel Particulate Filter (DPF)

The DPF is a porous ceramic filter housed in stainless steel that replaces the muffler. Flow requirements force the inlet and outlet to be on opposite ends. Alternate channels of the filter are plugged, forcing the exhaust gas to flow through the porous wall capturing the soot particles. The DPF burns soot with Oxygen (O_2) and NO_x and catches the ash from burnt oil.

The AFT system monitors the efficiency of the DPF. A Regen keeps the DPF functioning properly between the regular ash clean-out maintenance intervals that must be performed by Service Technicians. An optimal DPF size was chosen for low backpressure and to maximize ash storage capacity between periodic cleanings.

Exhaust Gas Temperature 1 (EGT1) sensor

The EGT1 measures exhaust temperature before entering the DOC.

Exhaust Gas Temperature 2 (EGT2) sensor

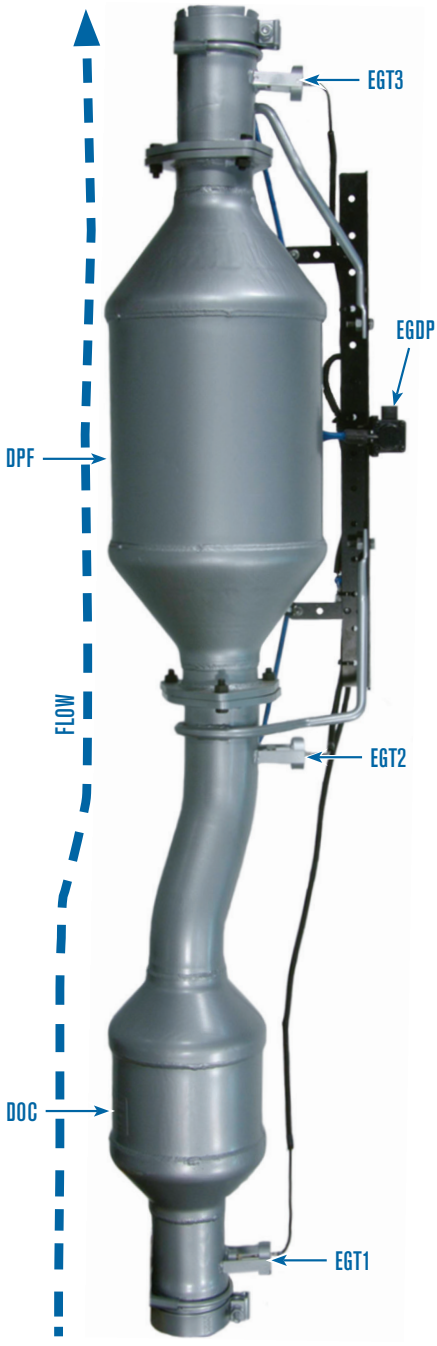
The EGT2 measures exhaust temperature between the DOC and the DPF.

Exhaust Gas Temperature 3 (EGT3) sensor

The EGT3 measures exhaust temperature exiting the DPF.

Exhaust Gas Differential Pressure (EGDP) sensor

The EGDP measures pressure difference across the DPF.



Exhaust System (Typical)
(shown in vertical position)

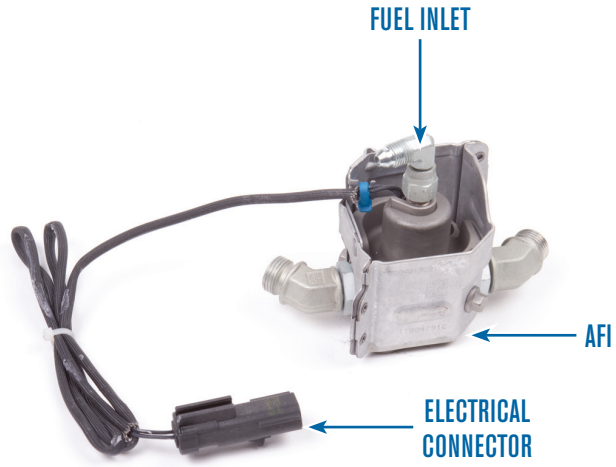
AFTERTREATMENT COMPONENTS

Additional MaxxForce® 11 and 13 (big bore) Engine Components

Additional Components for MaxxForce® Big Bore Engines

Aftertreatment Fuel Injector (AFI)

- The AFI is also known as the Doser. During a DPF Regen, fuel is injected into the exhaust system before the DOC. Only Big Bore engines use this method. Medium duty engines use post-injection.



Aftertreatment Fuel Supply (AFS) valve

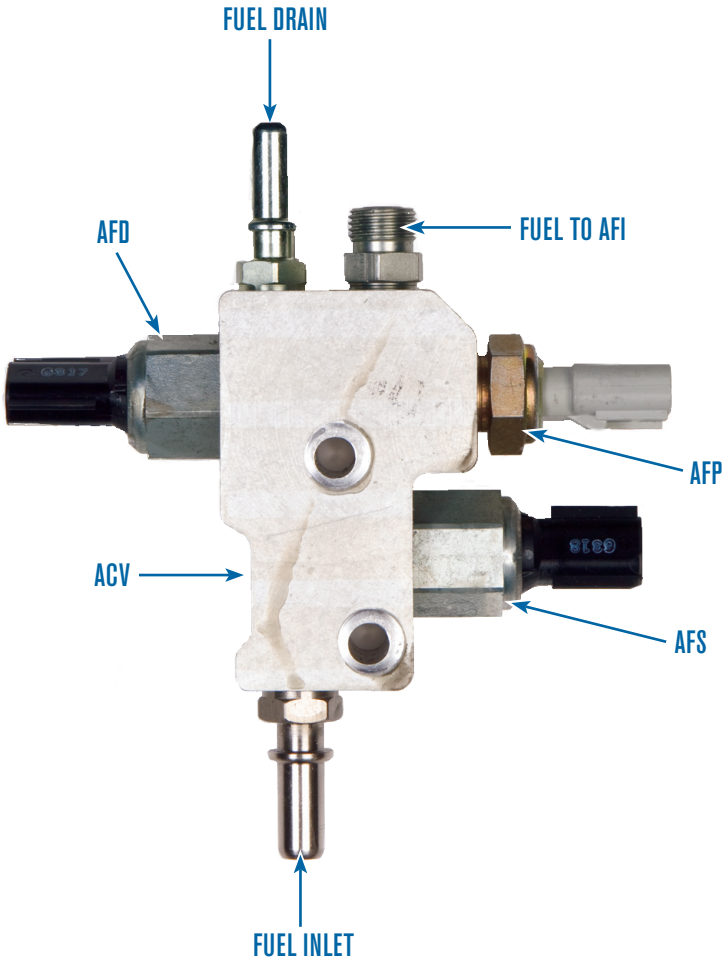
- The AFS opens fuel supply to the AFI during a DPF Regen.

Aftertreatment Fuel Drain (AFD) valve

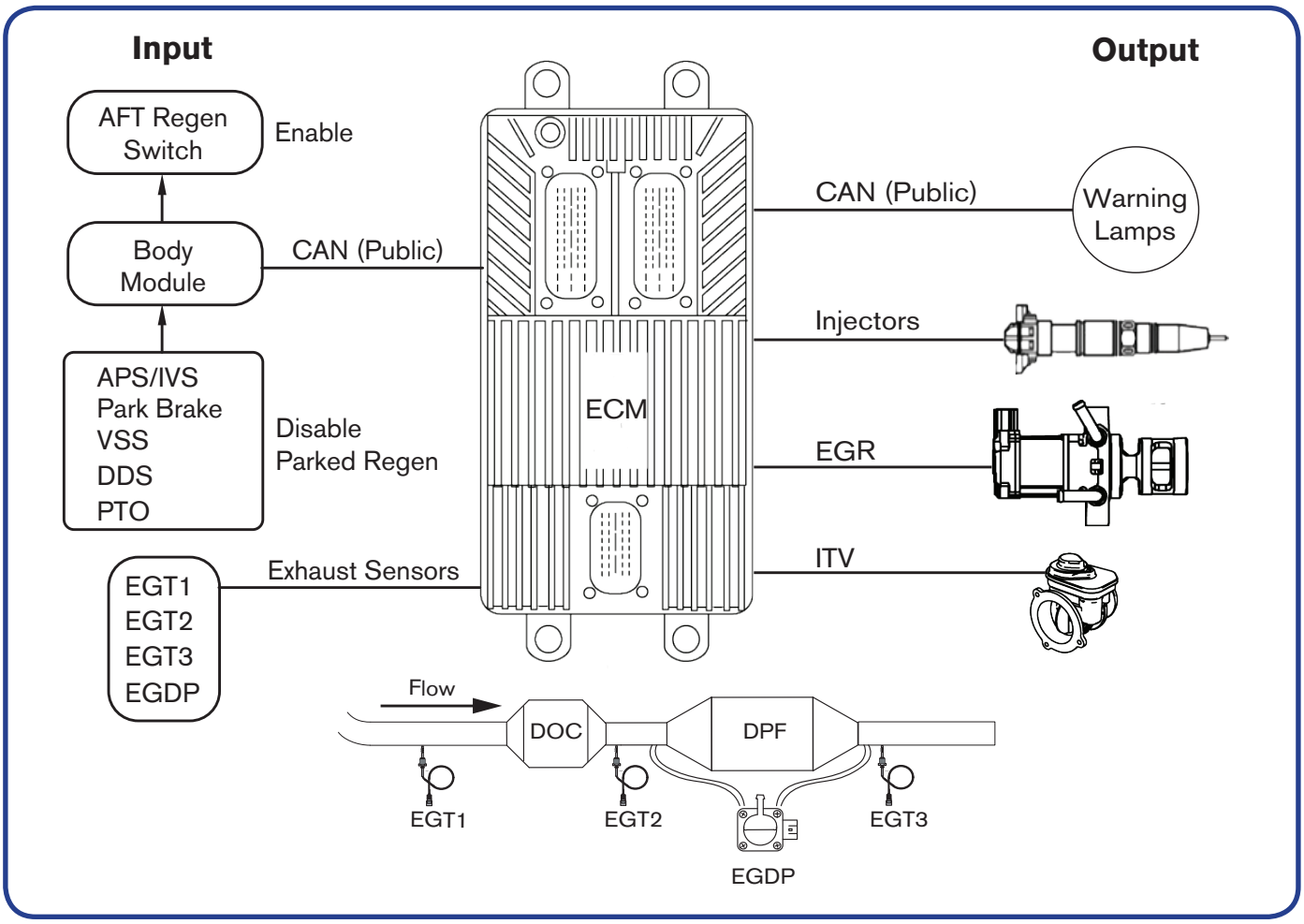
- The AFD valve drains all supply fuel to the AFI back into the fuel system when not in Regen mode.

Aftertreatment Fuel Pressure (AFP) sensor

- The AFP continuously monitors the fuel pressure supplied to the AFI.

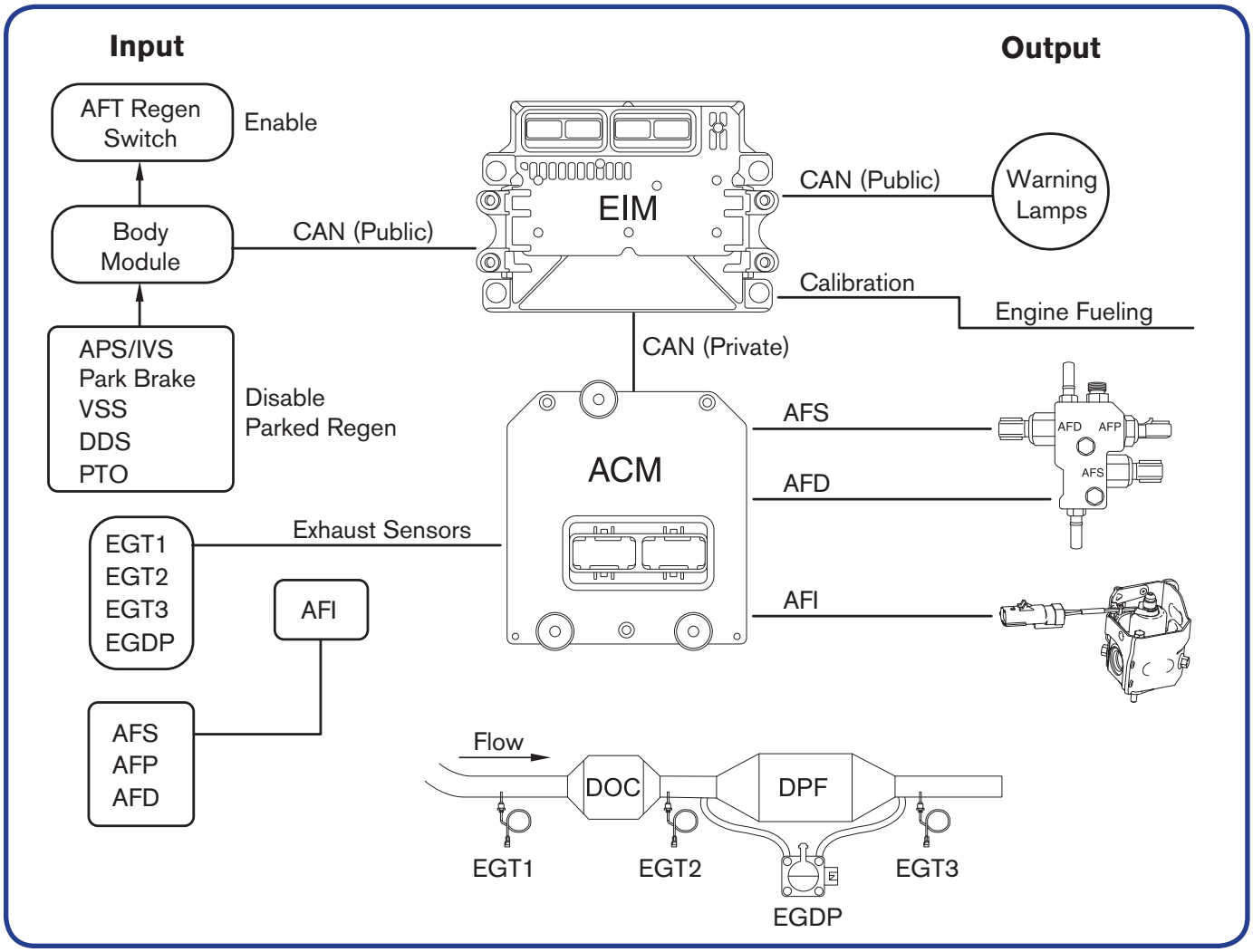


MEDIUM DUTY ENGINE AFT FUNCTIONAL DIAGRAM



- Engine Control Module (ECM)
- Electronic System Control (ESC) Module
- Multiplex System Module (MSM)
- Accel Pedal Sensor/Idle Validation Switch (APS/IVS)
- Vehicle Speed Sensor (VSS)
- Driveline Disconnect Switch (DDS)
- Power Take Off Switch (PTO)
- Exhaust Gas Temperature 1 (EGT1) Sensor
- Exhaust Gas Temperature 2 (EGT2) Sensor
- Exhaust Gas Temperature 3 (EGT3) Sensor
- Exhaust Gas Differential Pressure (EGDP) Sensor
- Diesel Oxidation Catalyst (DOC)
- Diesel Particulate Filter (DPF)
- Injectors (INJs)
- Exhaust Gas Recirculation (EGR) Valve
- Intake Throttle Valve (ITV)
- Controller Area Network (CAN)

BIG BORE ENGINE AFT FUNCTIONAL DIAGRAM



- Engine Interface Module (EIM)
- Aftertreatment Control Module (ACM)
- Accel Pedal Sensor/Idle Validation Switch (APS/IVS)
- Vehicle Speed Sensor (VSS)
- Driveline Disconnect Switch (DDS)
- Power Take Off Switch (PTO)
- Exhaust Gas Temperature 1 (EGT1) Sensor
- Exhaust Gas Temperature 2 (EGT2) Sensor
- Exhaust Gas Temperature 3 (EGT3) Sensor
- Exhaust Gas Differential Pressure (EGDP) Sensor
- Diesel Oxidation Catalyst (DOC)
- Diesel Particulate Filter (DPF)
- Aftertreatment Fuel Injector (AFI)
- Aftertreatment Fuel Supply (AFS) Valve
- Aftertreatment Fuel Drain (AFD) Valve
- Aftertreatment Fuel Pressure (AFP) Sensor
- Controller Area Network (CAN)

AFT SYSTEM FAULT CODES

DTC	SPN-FMI	CONDITION	POSSIBLE CAUSES
1729	3251-4	EGDP signal out of range LOW	EGDP sensor tube(s) restricted, open or reversed EGDP signal circuit open or short to GND, or failed sensor
2688	8302-0	DPF over temperature – possible filter damage	Restricted DPF Restricted exhaust Engine over fueling Biased EGT2 sensor or circuit
2699	3251-1	EGDP below desired level	EGDP sensor tube(s) restricted, open or reversed Biased EGDP sensor or circuit
2772	3524-0	Excessive time a manual inhibit was set for DPF Regen	Excessive time a manual inhibit was set to prevent a DPF Regen
2782	8317-13	DPF Servicing required	Level 1 soot loading at 80% DPF Regen required
2783	8318-13	DPF load: above warning level	Level 2 soot loading at 100% DPF Regen required
2784	8319-13	DPF load: above critical level 1 – engine de-rate	Critical level 1 soot loading over 100%, DPF Regen required
2785	8320-13	DPF load: above critical level 2 – further engine de-rate	Critical level 2 soot loading over 100%, Engine shut down enabled. DPF Regen, cleaning, or replace required
3786	8326-2	DPF Test – test unsuccessful	Test was aborted due to an active DTC or inhibit trigger

- Diagnostic Trouble Code (DTC)
- Subject Parameter Number (SPN) - Failure Mode Indicator (FMI)

AFT SYSTEM EVENT CHART

ENGINE	AFT SYSTEM	COMMUNICATION	DRIVER RESPONSE
Engine out of Regen mode EGDP monitors soot level	DPF collects soot produced by engine	DTC: None Lamp: Hot Exhaust System Temperature (HEST) lamp if EGT3 is above 400 °C and under 5 mph	No response needed
Engine in Regen mode Big Bore Only: Changes in Air Management and Fuel. Fuel is injected into the exhaust system EGT sensors are monitored	Soot level threshold is reached, System triggers DPF regeneration		
	DOC converts fuel to increase DPF temp		
	Soot burns as elevated temp is reached		
Engine in Regen mode	Soot may continue to increase in the DPF due to inability to properly regenerate the filter	Level 1 Warning SPN 3719 FMI 13 DPF Lamp solid	Drive at highway speeds or start Parked Regen
Engine in Regen mode Engine De-rated to 70% of normal engine power		Level 2 Warning SPN 3719 FMI 15 DPF Lamp flashing	Perform Parked Regen
Engine in Regen mode Engine De-rated to 80% of normal engine power		Level 3 Warning SPN 3719 FMI 16 DPF Lamp flashing Audible: Buzzer	Perform Parked Regen
		Level 4 Warning SPN 3719 FMI 0 RSL Lamp solid Audible: Buzzer	Medium Duty: Perform Parked Regen Big Bore: Remove DPF for servicing

AFT SYSTEM LAMPS AND CODES

Fault Codes and Lamps

Fault codes that require a Regen are better understood as **alert** codes. This is a normal condition used to alert the operator or technician that the soot level in the DPF has reached a set point and the system is running or needs to run a DPF Regen.

Exhaust Temperature HOT

Hot Exhaust System Temperature (HEST) lamp ON solid

HEST lamp is above 752 °F (400 °C) and vehicle speed is below 5 mph.

Operator Action: Be aware of area around the vehicle. The exhaust is very hot.

Technician Action: None

DTC 2782 DPF Servicing Required

DPF lamp ON solid

DPF soot level 1, DPF lamp ON solid. This notifies the operator the Aftertreatment system is cleaning the DPF.

The system is unable to finish the cleaning process due to driving conditions (low load, short trip) or if there is a problem with the system. The soot level continues to build in the DPF and triggers the next soot level DTC.

Operator Action: Drive at highway speed until lamp goes out, or perform a Parked Regen.

Technician Action: None

DTC 2783 DPF Load: Above Warning Level

DPF lamp flashing

DPF soot level 2, DPF lamp flashing. This notifies the operator the soot level is reaching a much higher level and the system is not completing a Regen through the operators current drive cycle. If this alert is ignored, the soot level continues to build, and sets the next level DTC.

Operator Action: Perform a Parked Regen.

Technician Action: Verify the system is working without fault.
Refer to:

- Medium Duty Conditions for a Park Regen.
- Big Bore Condition for a Park Regen.

DTC 2784 DPF Load: Above Critical Level 1 – Engine De-Rate

DPF lamp flashing and buzzer sounding
Amber Warning Lamp ON solid

DPF soot level 3, DPF lamp flashing and the buzzer sounding. This alert notifies the operator the soot level has reached a critical level and the engine is now de-rated to 70% of normal power.

Operator Action: Perform a Parked Regen.

Technician Action: Verify the system is working without fault.
Refer to:

- Medium Duty Conditions for a Park Regen.
- Big Bore Condition for a Park Regen.

AFT SYSTEM LAMPS AND CODES (CONT)

DTC 2785 DPF Load: Above Critical Level 2 – Further Engine De-Rate

Stop Alert Lamp ON solid

DPF soot level 4, Stop Alert Lamp ON solid. This alert notifies the operator the soot level has reached a critical level and the engine has been de-rated to 80% of normal power. On Big Bore engines, the DPF soot level is too high to do a Parked Regen and the DPF must be removed and cleaned or replaced.

Operator Action: Shut down engine and tow to service.

Technician Action:

- Check history for other failures that could damage the DPF such as oil, coolant, or fuel.
    - Run Parked Regen (Medium Duty only)
    - A Parked Regen cannot be run at this stage. The DPF must be removed for servicing. (Big Bore only).
    - If filter is too full to run this test, remove DPF for external cleaning.
    - Verify the system is working without fault. Refer to:
        - Medium Duty Conditions for a Park Regen.
        - Big Bore Condition for a Park Regen.

DTC 3786 DPF Test - Unsuccessful

This DTC sets when the Onboard Filter Cleanliness Test has failed or is interrupted.

Technician Action:

- Check air management system (EGR, ITV, and VGT) and exhaust sensors.
- Check for fault codes that can inhibit a Regen.
- Check Inhibitors that inhibit a Regen.

DTC 2699 EGDP Stuck In-Range Fault

This DTC sets if the EGDP feedback is less than the minimum expected differential pressure at a current exhaust flow rate. This could be a sensor in-range fault, or sensor hose routed in reverse or leaking, or a cracked DPF that allows exhaust gas to by-pass the filter.

This DTC can also be set if EGDP feedback is more than the maximum expected differential pressure at a current exhaust flow rate. This could be an in-range fault or due to excessive soot in or on the face of the DPF.

Technician Action:

- Check the EGDP sensor and hoses for proper hose routing and for leaks.
- Check engine for problems that would cause a rich or over-fueling condition.

AFT SYSTEM LAMPS AND CODES

DTC 1729 EGDP Signal Out of Range LOW

This DTC sets when the differential pressure is below 0 psi (0 kPa). This can be caused by a circuit or sensor fault or a sensor that has the hoses reversed.

DTC 3788 Over Temperature – Possible Filter Damage

This DTC sets if the exhaust temperature after the DPF is higher than the maximum set point. This can be cause by a restricted exhaust or overloaded DPF. This could also be cause by biased exhaust sensor or the engine over-fueling due to failed injector(s).

DPF Regen Inhibit Conditions

A DPF Regen can be inhibited by disabling switches, or if the entry conditions have not yet been met to start the Regen process.

Fault Code Regen Inhibitors

Fault codes that can inhibit a Regen do not allow a Regen process to take place. The ECM continuously monitors for system faults. If a fault is detected, the Malfunction Indicator Lamp (MIL) lights and a DTC is set.

If a fault is detected that can damage the system or prevent a successful Regen, the system is inhibited and sets one or more of the following fault codes.

Note: The following DTCs prevent a Regen from starting.

- DTC 1741 EGT2 Signal Out of Range LOW
- DTC 1742 EGT2 Signal Out of Range HIGH
- DTC 2674 EGT2 Signal In-Range Fault

Big Bore Only:

- DTC 5558 AFP VREF Out of Range
- DTC 5560 AFP Signal Out of Range LOW
- DTC 5561 AFP Signal Out of Range HIGH
- DTC 6315 ACM CAN Message Not Received from ECM
- DTC 6316 ACM CAN Message Not Received from EIM
- DTC 6317 EIM CAN Message Not Received from ACM
- DTC 6813 EGT1 or EGT2 High Temp without Regen
- DTC 6814 EGT2 Temp Above Maximum Severe
- DTC 6900 AFI Circuit Fault
- DTC 6901 AFS Valve Circuit Fault
- DTC 6902 AFD Valve Circuit Fault
- DTC 6905 Aftertreatment Fuel Leak: Fuel Line, AFD, or AFI
- DTC 6906 AFS Valve and AFD Valve Connections Reversed
- DTC 6910 AFD Valve Fail to OPEN
- DTC 6912 AFP Above Normal with AFS CLOSED
- DTC 6913 AFP Above Normal with AFD OPEN
- DTC 6914 AFP Below Normal During DPF Regen

MEDIUM DUTY ENGINE AFT OPERATION

Medium Duty Conditions for a Rolling Regen

When the ECM determines the soot level threshold is reached, the system triggers DPF regeneration.
Note: Short trips, stop-and-go driving could prevent a successful Regen.

The following conditions are required for an Rolling Regen.

- DPF soot level reaches threshold
- Red stop engine lamp not ON
- Coolant temperature above 170 °F (75 °C)
- Inhibit DTCs must not be active: Refer to the Fault Code Regen Inhibitors on page 11
- Regen inhibit switch not active (switch must be OFF)
- PTO not active (switch must be OFF) (If applicable)
- Engine retarder OFF
- Exhaust Gas Temperature sensors below safe thresholds
  - EGT1 below 932 °F (500 °C)
  - EGT2 below 1202 °F (650 °C)
  - EGT3 below 1382 °F (750 °C)

If the soot level is above EGDP threshold and vehicle is unable to perform a Rolling Regen, perform the Diagnostic Test Procedure on page 15.

Medium Duty Conditions for a Parked Regen

A Parked Regen can only be performed when the DPF soot level threshold is reached. The DPF lamp flashes or stays ON solid, signaling the need for Regen.

The following conditions are required for a Parked Regen.

- Engine Running
- DPF lamp is ON
- Parked Regen switch ON
- Coolant temperature above 170 °F (75 °C)
- Vehicle stationary
- DPF soot level reaches threshold
- Red stop engine lamp not ON
- Inhibit DTCs must not be active: Refer to the Fault Code Regen Inhibitors on page 11
- PTO not active (switch must be OFF)
- Regen inhibit switch not active (switch must be OFF)
- Engine retarder OFF
- Parking brake must be applied
- Brake pedal not depressed
- Accelerator pedal not depressed
- Driveline disengaged
- Exhaust Gas Temperature sensors below safe thresholds
  - EGT2 below 1202 °F (650 °C)
  - EGT3 below 1292 °F (700 °C)

If the soot level is above EGDP threshold and vehicle is unable to perform a Parked Regen, perform the Diagnostic Test Procedure on page 15.

Medium Duty Onboard Filter Cleanliness Test

This test checks the status of the DPF if the soot level is within a needed Regen limit. The test automatically starts a Parked Regen.

NOTE: You must run the Key ON Engine Running (KOER) Standard Test before performing this test.

Engine speed is ramped up to increase exhaust flow through the DPF while the EGDP sensor monitors the differential pressure across the DPF. The test runs for about 20 minutes. If a Regen is needed, the engine ramps up for another 20 minutes, but this time it runs a DPF Regen cycle.

The following conditions are required for a Onboard Filter Cleanliness Test.

- Engine Running
- Coolant temperature above 170 °F (75 °C)
- Vehicle stationary
- Inhibit DTCs must not be active: Refer to the Fault Code Regen Inhibitors on page 11
- PTO not active (switch must be OFF)
- Regen inhibit switch not active (switch must be OFF)
- Engine retarder OFF
- Parking brake must be applied
- Brake pedal not depressed
- Accelerator pedal not depressed
- Driveline disengaged

- If the soot level is within normal range, the test completes and displays *Test Completed Successful*. No further action is required.
- If the soot level is above the threshold, the engine idles down for three seconds, sets a DTC, then ramps up rpm again and starts a Parked Regen.
- If the test is aborted, perform the Diagnostic Procedure on page 15.

BIG BORE ENGINE AFT OPERATION

Big Bore Conditions for a Rolling Regen

When the ECM determines the soot level threshold is reached, the System triggers a DPF regeneration.
Note: Short trips, stop-and-go driving could prevent a successful Regen.

The following conditions are required for a Rolling Regen.

- DPF soot level reaches threshold 2.47 oz. (70 g) or eight hours since last DPF Regen
- Red stop engine lamp not ON
- Coolant temperature above 170 °F (75 °C)
- Inhibit DTCs must not be active: See Fault Code Regen Inhibitors on page 11
- Regen inhibit switch not active (switch must be OFF)
- PTO not active (switch must be OFF).
- Engine retarder OFF
- Exhaust Gas Temperature sensors below safe thresholds
  - EGT1 Between 464 °F (240 °C) and 932 °F (500 °C)
  - EGT2 below 1202 °F (650 °C)
  - EGT3 below 1382 °F (750 °C)

If the soot level is above EGDP threshold and vehicle is unable to perform a Rolling Regen, perform the Diagnostic Test Procedure on page 15.

Big Bore Conditions for a Parked Regen

A Parked Regen can only be performed when the DPF soot level threshold is reached. The DPF lamp will flash or stay ON solid, signaling the signaling the need for Regen.

The following entry conditions are required for a Parked Regen.

- Engine Running
- DPF regen lamp ON
- Parked Regen switch ON
- Coolant temperature above 170 °F (75 °C)
- Vehicle stationary
- DPF soot level reaches threshold
- Red stop engine lamp not ON
- Inhibit DTCs must not be active: refer to the Fault Code Regen Inhibitors on page 11
- PTO not active (switch must be OFF)
- Regen inhibit switch not active (switch must be OFF)
- Engine retarder OFF
- Parking brake must be applied
- Brake pedal not depressed
- Accelerator pedal not depressed
- Driveline disengaged
- Exhaust Gas Temperature sensors below safe thresholds
  - EGT2 below 1202 °F (650 °C)
  - EGT3 below 1292 °F (700 °C)

If the soot level is above EGDP threshold and vehicle is unable to perform a Parked Regen, perform the Diagnostic Test Procedure on page 15.

Big Bore Onboard Filter Cleanliness Test

This test performs a complete Parked Regen
See Big Bore Conditions for a Parked Regen (above)

Diagnostic Test Procedure

Note: References to other diagnostics outside of this publication are located on International Service Information Solutions (ISIS®).

- MaxxForce® 5 (EGES-395)
- MaxxForce® 7 (EGES-350-2)
- MaxxForce® DT, 9, and 10 (EGES-370-2)
- MaxxForce® 11 & 13 (EGES-420-2)

If engine does not start due to a plugged DPF:

1. Remove the DPF and inspect for oil or coolant in the exhaust. Repair any problems before continuing. See DPF Inspection on page 22.
2. Perform all of the tests except the Parked Regen Test. Repair any problems before continuing.
3. Interview the operator about his/her drive cycle. The system may not be able to complete the DPF Regen because of driving conditions (low load, short trip).
4. Install a DPF and perform the Onboard Filter Cleanliness Test.

Sensor Compare Checks

1. Connect the Electronic Service Tool (EST) and verify sensors are within specifications.
2. Key ON Engine OFF (KOEO). Cold soak at about 70 °F (21 °C).

Check	Expected Results	Comments
S_EGT1 Volts	0.88 V ± 0.10 V	If voltage is much higher or lower than the other EGT sensors, refer to ISIS®, Electronic Control System Diagnostics – EGT1 Sensor
S_EGT2 Volts	0.88 V± 0.10 V	If voltage is much higher or lower than the other EGT sensors, refer to ISIS®, Electronic Control System Diagnostics – EGT2 Sensor
S_EGT3 Volts	0.88 V ± 0.10 V	If voltage is much higher or lower than the other EGT sensors, refer to ISIS®, Electronic Control System Diagnostics – EGT3 Sensor
S_EGDP Volts	0.70 V ± 0.10 V	If not within spec, refer to ISIS®, Electronic Control System Diagnostics – EGDP sensor.
S_EBP Volts	0.70 V ± 0.10 V	If not within spec, refer to ISIS®, Electronic Control System Diagnostics – EBP sensor.
If the sensors are within specifications, go to Fault Code check and DPF status.		

Fault Code Check and Regen Status

Connect EST, check for fault codes and DPF status.

NOTE: Inhibit codes prevent the system from running a DPF Regen, but other failure can cause an unsuccessful DPF Regen.

Check	Expected Results	Comments
DPF Status	Not Needed	If signal reads *Not Needed*, the system cannot be commanded to run a DPF Regen. If signal reads *Regen Needed* and there are no active inhibitors, the system can be commanded to run a Parked Regen.
Active DTCs	No DTC	If active DTC, repair fault.
Inactive DTCs	No DTC	Inactive DTCs are indicators of past issues. The DPF may be over-loaded due to other failures.
If no codes are present and DPF status displays *Regen Needed*, go to Parked Regen Checks.		

Exhaust Restriction Test

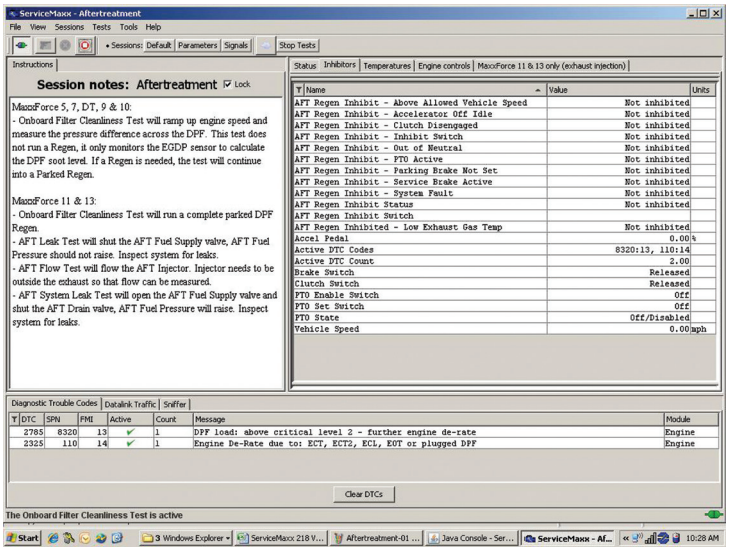
1. Connect EST.
2. Open the Performance session.
3. Run engine at high idle while monitoring exhaust back pressure, and exhaust gas differential pressure.

Checks	Expected Results	Comments
Exhaust Gas Differential Pressure	< 1.5 psi (10.34 kPa)	If > 1.5 psi (10.34 kPa), the DPF is plugged, go to Parked Regen.
Exhaust Back Pressure (EBP)	< 45 psi (310.26 kPa)	If EBP is > 45 psi (310.26 kPa) and EGDP is < 1.5 psi (10.34 kPa), check VGT vanes for sticking, perform the KOEO Standard Test, KOER Air Management Test and KOER VGT Low, Med, and High Tests. If above tests don't find a problem, remove DOC and inspect DPF for face plugging.
If EBP and EGDP are within expected range, but the DPF Status reads *Regen Needed*, go to Parked Regen Checks. If the DPF is face plugged, measure the distance between the filter and outlet. If the measurement is not within specification, replace the DPF. Refer to the DPF Ceramic Filter Measurement from Outlet chart, on page 28.		

AFT SYSTEM DIAGNOSTICS

Check Rolling Regen Inhibitors

1. Connect the EST.
2. Open the Aftertreatment session.
3. Open the inhibitors tab.
4. Start engine and run vehicle speed above 5 mph.
5. Check for active inhibitors.



Checks	Expected Results	Comments
AFT Regen Inhibit Status	Not Inhibited	If inhibited, correct the cause. Check switches and any DTC that may be causing the Regen inhibit.
Red Stop Alert Lamp	OFF	If ON, Regen cannot be performed. Replace the DPF before continuing.
Regen Inhibit Switch	OFF	If ON, turn OFF switch. If switch does not turn OFF, diagnose circuit fault.
PTO Enable Switch	OFF	If ON, turn OFF switch. If switch does not turn OFF, diagnose circuit fault.
PTO Switch	OFF	If ON, turn OFF switch. If switch does not turn OFF, diagnose circuit fault.
If no inhibitors are active and Regen is needed, go to Parked Regen Checks.		

Check Parked Regen Inhibitors

Connect EST, open the Aftertreatment session and check for Inhibitors and open the inhibitors tab.

Checks	Expected Results	Comments
AFT Regen Inhibit Status	Not Inhibited	If inhibited, correct the cause. Check switches and any DTC that may be causing the Regen inhibit.
Red Stop Alert Lamp	OFF	If ON, Regen cannot be performed. Replace the DPF before continuing.
Regen inhibit switch	OFF	If ON, turn OFF switch. If switch does not turn OFF, diagnose circuit fault.
PTO Enable Switch	OFF	If ON, turn OFF switch. If switch does not turn OFF, diagnose circuit fault.
PTO Switch	OFF	If ON, turn OFF switch. If switch does not turn OFF, diagnose circuit fault.
Parking Brake Switch	ON	If ON, turn OFF switch. If switch does not turn OFF, diagnose circuit fault.
Brake Pedal Switch	OFF	If ON and foot is off pedal, diagnose circuit fault.
Accelerator Pedal	0%	If above 0%, and foot is OFF pedal, diagnose circuit fault.
Clutch Pedal Switch	OFF	If ON and foot is OFF pedal, diagnose circuit fault.
Transmission Position	Park (P) or Neutral (N)	If engaged, disengage, or diagnose circuit fault.
If no inhibitors and a Regen is needed, go to Parked Regen Checks.		

Parked Regen Checks

During a Parked Regen, the engine speed ramps up to 1200-1800 rpm depending on engine displacement (MaxxForce® 5, 7, DT, 9, 10).

Typical Readings

- ITV: 80% CLOSED
- EGR Valve Position: 0% (CLOSED)
- EGT1: 482-572 °F (250-300 °C)
- EGT2: 1022-1112 °F (550-600 °C) after 5-10 minutes
- EGT3: 1112-1202 °F (600-650 °C) after 10-15 minutes
- EGDP: Decreasing steadily when EGT2 and EGT3 are steady and above 1022 °F (550 °C).

Connect the EST, open the Aftertreatment session. Start a Parked Regen and monitor the signals

Checks	Expected Results	Comments
Engine Condition	Smooth, not stumbling	If engine does not run smoothly, diagnose engine performance problem. Refer to Performance Diagnostics.
DPF Status	Regen Needed	If signal reads *Not Needed*, a Regen cannot be performed.
Coolant Temp	Above 150 °F (66 °C)	If below 150 °F (66 °C), warm engine above set point.
AFT Regen Status	Active	If signal reads *Not Active*, go to Fault code inhibitors and Parked Regen Inhibitors.
EGR Position	• CLOSED	If not CLOSED, refer to ISIS®, Electronic System Diagnostic – EGR Valve.
ITV Position	80% ± 5%	If not within specification, refer to ISIS®, Electronic Control System Diagnostic – ITV.
EGT1 Temp	482-572 °F (250-300 °C)	If below 482 °F (250 °C), perform the KOER Standard Test and the KOER Air Management Test. If above 572 °F (300 °C), check for proper ITV operation and if engine is over fueling.
EGT2 Temp	After 5-10 minutes above 986 °F (530 °C)	If below 986 °F (530 °C), replace the DOC and inspect the DPF for soot leaking through the filter.
EGT3 Temp	Below 1292 °F (700 °C)	If above 1292 °F (700 °C), replace the DPF.
EGDP	Below 0.5 psi (3.45 kPa)	If above 0.5 psi (3.45 kPa) after the system completes a full Parked Regen, replace the DPF.
If the DPF is face plugged, measure the distance between the filter and outlet. If not within specification, replace the filter. Refer to the DPF Ceramic Filter Measurement from Outlet chart, on page 28.		

Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) Standard Test

Connect the EST and run KOEO Standard test to verify EGR and VGT and are actuating properly.

Checks	Expected Results	Comments
DTCs	No DTCs	If any DTCs, repair fault.
EGR Valve Output State High Output State Low	90% 0%	If the valve does not meet spec, refer to ISIS®, Electronic Diagnostic Control System.
VGT Actuator Output State High Output State Low	80% 5%	If valve does not meet spec, refer to ISIS®, Electronic Diagnostic Control System.
IVT Actuator Output State High Output State Low	80% 5%	If valve does not meet spec, refer to ISIS®, Electronic Diagnostic Control System.
If no problems are located, go to KOER Standard Test.		

KOER Standard Test

Connect the EST and run KOEO Standard test to verify EGR and VGT are functioning properly.

Checks	Expected Results	Comments
DTCs	No DTCs	If any DTCs, repair fault.
If no problems are located, go to KOER Air Management Test.		

KOER Air Management Test

Connect the EST and run KOER Air Management test to verify EGR is functioning properly.

Checks	Expected Results	Comments
DTCs	No DTCs	If any DTCs, repair fault.
If no problems are located, go to KOER VGT Low, Medium, and High Test.		

KOER VGT Low, Medium, and High Test

Connect the EST and run KOER VGT Low, Medium, and High test to verify the vanes are not sticking. There should be a noticeable change between Low, Medium, and High.

Checks	Expected Results	Comments
VGT Ctrl Low	0%	If EGR valve does not meet specification, inspect valve for sticking.
VGT Ctrl Med	50%	If EGR valve does not meet specification, inspect valve for sticking.
VGT Ctrl High	80%	If EGR valve does not meet specification, inspect valve for sticking.
If EGR valve movement is within specification, VGT is working okay.		

BIG BORE ENGINE AFT DIAGNOSTICS

Parked Regen Checks

During a Parked Regen, the engine speed ramps up to 1650 to 1700 rpm.

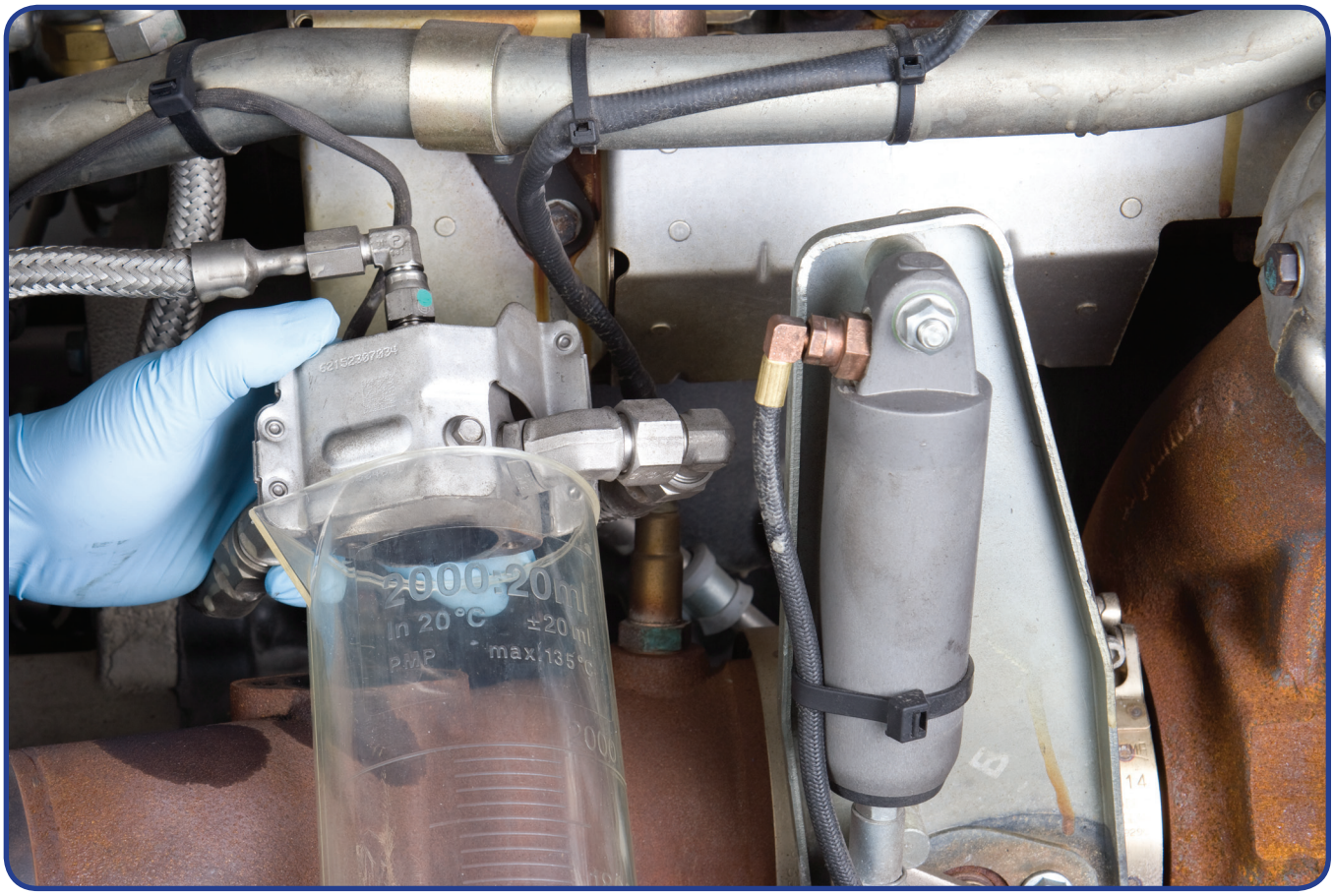
Typical Readings

- ITV: 76% CLOSED
- EGR Valve position: 5-11% (CLOSED)
- Boost Control Valve: 28-46%
- EGT1: 482-662 °F (250-350 °C)
- EGT2: 986-1112 °F (530-600 °C) after 5-10 minutes
- EGT3: 1112-1202 °F (600-650 °C) after 10-15 minutes
- EGDP: Decreasing steadily when EGT2 and EGT3 are steady and above 1022 °F (550 °C).

Connect the EST, open the Aftertreatment session. Start a Parked Regen and monitor the signals.

Checks	Expected Results	Comments
Engine Condition	Smooth, not stumbling	If engine does not run smoothly, diagnose engine performance problem. Refer to ISIS®, Performance Diagnostics.
DPF Status	Regen Needed	If signal reads *Not needed*, a Regen cannot be performed.
Coolant Temp	Above 150 °F (66 °C)	If below 150 °F (66 °C), warm engine above set point.
AFT Regen Status	Active	If signal reads *Not Active*, go to fault code inhibitors and Parked Regen Inhibitors.
EGR Position	5-11%	If not within specification, refer to ISIS®, Electronic System Diagnostic – EGR Valve.
ITV Position	76%	If not within specification, refer to ISIS®, Electronic Control System Diagnostic – ITV.
Boost Control Solenoid (BCS)	28-46%	If not within specification, refer to ISIS®, Boost Control Solenoid Diagnostics.
EGT1 Temp	482-662 °F (250-350 °C)	If below 482 °F (250 °C), diagnose engine performance problem, fueling and air management. Refer to ISIS®, Performance Diagnostics. If above 662 °F (350 °C), check for proper ITV operation and engine for over fueling.
EGT2 Temp	After 5-10 minutes above 986 °F (530 °C)	If below 986 °F (530 °C) after 5 to 10 minutes, run AFT injector flow test. If AFT Injector Flow is within specification, remove the DOC and inspect the DPF for soot leaking through the filter.
EGT3 Temp	Below 1292 °F (700 °C)	If above 1292 °F (700 °C), replace DPF.
EGDP	Below 0.5 psi (3.45 kPa)	If above 0.5 psi (3.45 kPa), after the system completes a full Parked Regen, replace the DPF.

BIG BORE ENGINE AFT DIAGNOSTICS



AFT Injector Flow Test

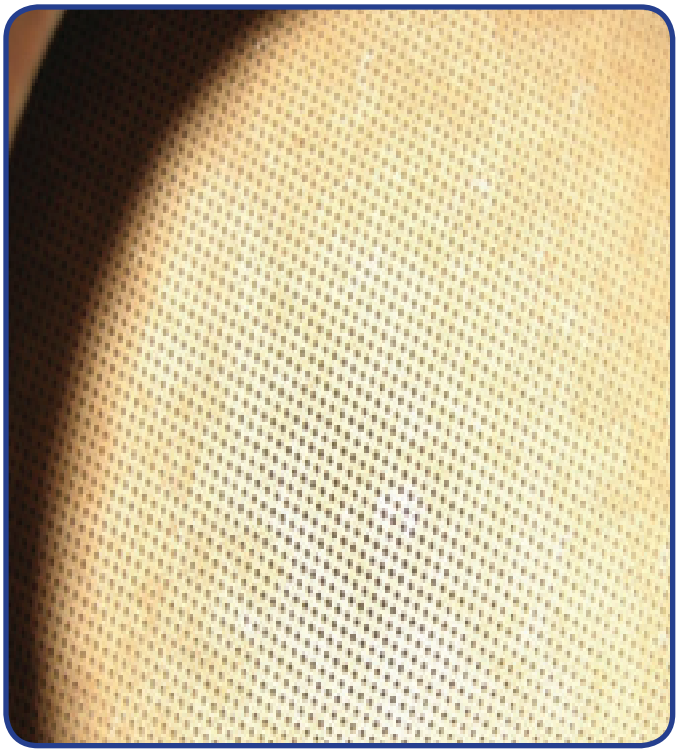
Note: A 400 ml (13.5 oz) clear measuring bottle is required to perform the AFT injector flow test.

Disconnect AFT Injector from exhaust pipe and place it into a clear measuring bottle. Connect EST and run the AFT Injector Flow test to verify the Injector is supplying the proper amount of fuel.

Checks	Expected Results	Comments
AFT Fuel Pressure	Above 60 psi (413.69 kPa)	If below 60 psi (413.69 kPa), perform an AFT System Leak Test to verify the valves are working correctly.
AFT Injector Flow	6 oz (170.1 g) of fuel	If below expected results, refer to ISIS®, Electronic Control System Diagnostic.

DPF INSPECTION

DPF Inlet



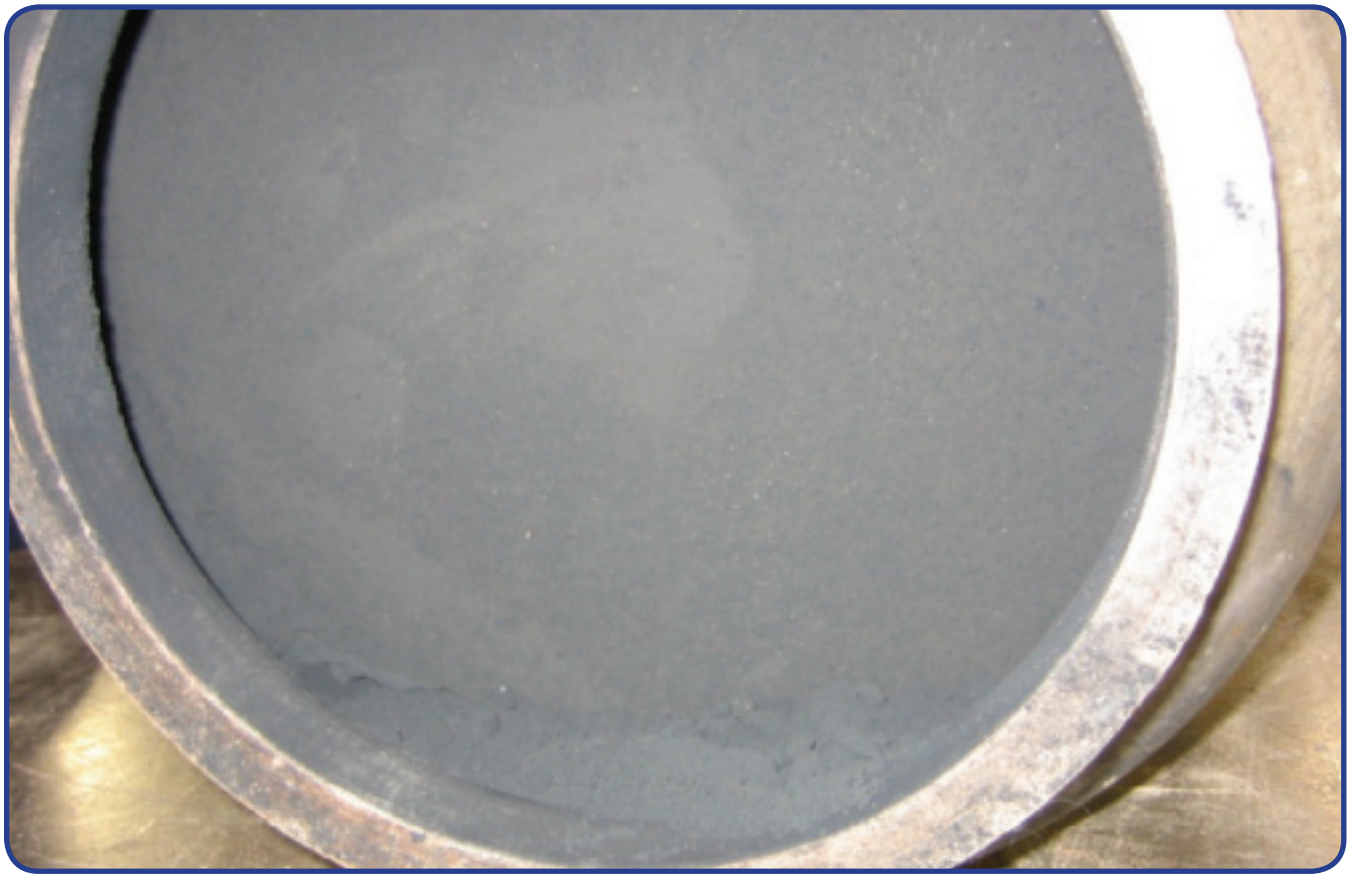
DPF Outlet

Normal DPF

Inspect the inlet and outlet of the DPF.

All inlet channels should be visible, and there should be a light soot coating over the whole inlet face that can easily be wiped away with a finger. The amount of soot on the face can vary depending on the time since last DPF regeneration, but should be less than 1/8 in. (3.175 mm).

DPF INSPECTION



DPF Face Plugged

Inspect the DPF inlet and measure filter position in the DPF housing. Refer to the DPF Ceramic Filter Measurement from Outlet chart, on page 28.

If no channels are visible and/or the face of the DPF has a thick layer of soot, more than 1/8 in. (3.175 mm) remove the DPF for external cleaning.

Possible Causes	Action
• Drive Cycle (Unable to Complete Regen) • Engine Over Fueling • Boost Problem • Intake Throttle Problem	1. Interview the operator about his/her driving habits. 2. Verify there are no inhibitors (DTCs or switches). If the distance between the filter and outlet are not within specification, the filter cannot be cleaned. It must be replaced. Refer to the DPF Ceramic Filter Measurement from Outlet chart, on page 28.

DPF INSPECTION

Coolant Contamination

Inspect the inlet and outlet of the DPF.

If coolant is flowing through exhaust system, the face of the DPF will have red coolant stains on it.

Possible Causes	Action
• Coolant Flowing Through Exhaust • Failed Interstage Cooler • Failed EGR Cooler • Failed Injector Sleeve • Leaking Cylinder Head Cup Plugs • Cylinder Head Porosity	1. Repair coolant problem. 2. The DPF cannot be cleaned. It must be replaced.

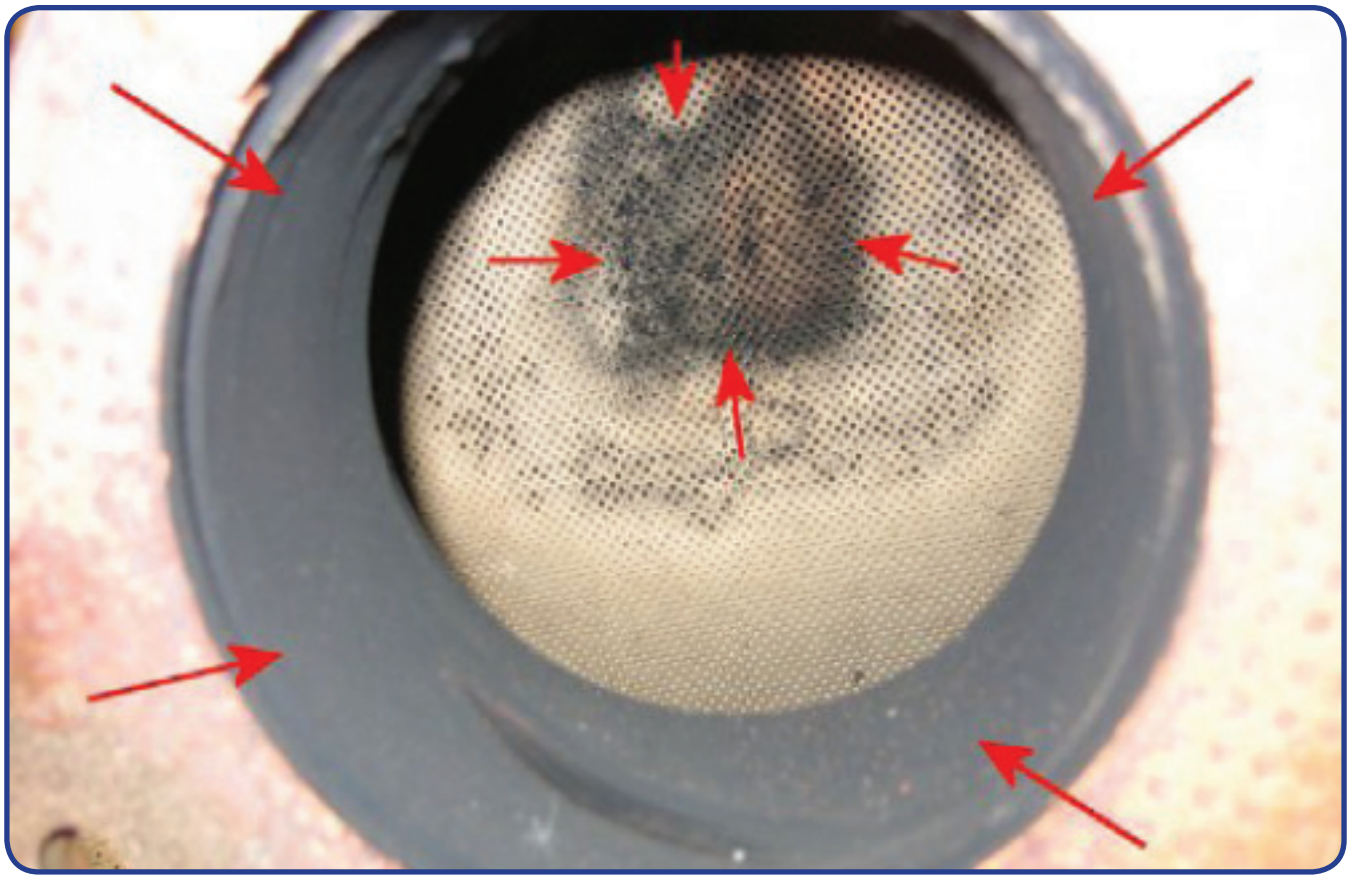
DPF INSPECTION

Engine Oil Contamination, Soot Leakage

DPF will show signs of soot leakage and oil.

Possible Causes	Action
• Failed Turbocharger • Failed Piston Rings • Failed Cylinder Sleeves • Failed Valve Guides	1. Repair engine oil problem. 2. The DPF cannot be cleaned. It must be replaced. 3. Inspect the DOC for damage and replace if necessary.

DPF INSPECTION



DPF Damage, Soot Leakage

Check for signs of soot leakage.

Possible Causes	Action
• Damaged DPF	1. The DPF cannot be cleaned. It must be replaced. 2. Inspect the DOC for damage and replace if necessary.

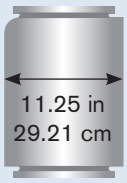
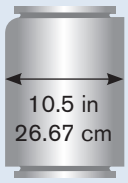
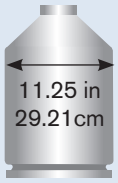
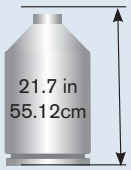
DPF INSPECTION

Can Damage

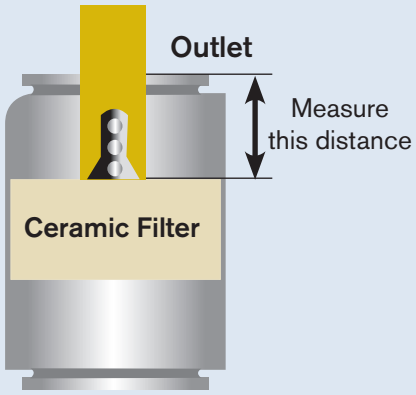
Check the DPF for signs of damage such as dents or cracks.

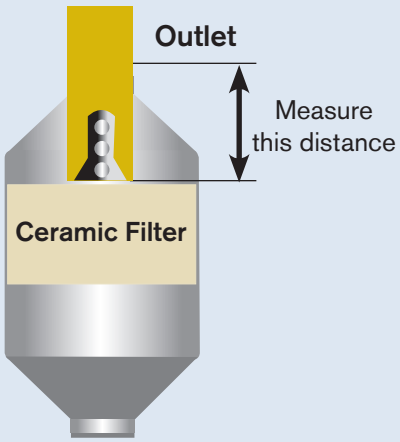
Possible Causes	Action
• Road Debris • Vehicle Accident	1. Replace the DPF.

DPF INSPECTION

						
2594165C91	2594131C91	2594356C91	2593981C91	2594363C91	2594369C91	2595055C91
Filter to Outlet	**Filter to Outlet**	**Filter to Outlet**	**Filter to Outlet**	**Filter to Outlet**	**Filter to Outlet**	**Filter to Outlet**

cm	inch	cm	inch	cm	inch	cm	inch	cm	inch	cm	inch	cm	inch
7.76	3.06	7.76	3.06	19.53	7.69	19.33	7.61	7.62	3.00	7.62	3.00	18.69	7.36





DPF Ceramic Filter Measurement from Outlet

Inspect outlet of the DPF and measure the distance between ceramic filter and outlet. If the distance is less than the specification, replace the DPF.

Possible Causes	Action
• Face Plugged	If the distance is less than the specification, replace the DPF.

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