2010 MaxxForce® DT, MaxxForce® 9 and MaxxForce® 10 Engine Training Program

Study Guide
TMT-121101

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Introduction

Welcome to 2010 MaxxForce® DT, 9, and 10 engine training.

Upon completion of this course, you will be able to; identify engine features, identify and locate engine systems, and identify the operation of the various engine systems and components.

This program covers the MaxxForce® DT, 9, and 10 series of engines. Externally these engines may look almost identical, however, there are some critical component differences that are covered in this program.

This course is divided into this introduction, and five engine system modules. Before you begin the lubrication system, let's take a brief look at the engine.

Beginning on the right side, the exhaust brake is located in the turbo downpipe. The brake control valve is near the valve cover. The engine has dual turbos bolted to the exhaust manifold. The aftertreatment fuel injector is on the turbo downpipe. The oil cooler and breather are located on the lower part of the crankcase. The Exhaust Gas Recirculation or EGR cooler is below the turbo assembly.

"The Exhaust Brake is located in the turbo downpipe."

On the front of the engine, is the camshaft position sensor.

"...the electric fuel pump and filter are both located in one module."

On the left side of the engine, the electric fuel pump and filter are both located in one module. The EGR valve and mixing duct are above the intake manifold. The aftertreatment fuel metering unit is mounted at the rear of the intake manifold.

At the rear of the engine is the EGR crossover tube. The crankshaft position sensor is on the flywheel housing.

"The intercooler is on engines rated at 245 horsepower and above."

The intercooler is at the top of the engine, mounted to the valve cover. This cooler is on engines rated at 245 horsepower and above. The emissions label is also located on the valve cover. The engine serial number can be found on the label. The serial number is also on the crankcase behind the EGR cooler. The first three digits of the number are 466 for the MaxxForce® DT, and 570 for the MaxxForce® 9 and MaxxForce® 10.

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Lubrication System Module 1

Overview

Let's discuss the features and operation of the lubrication system. The key components of the system are: the pickup tube, the oil pump, and the oil filter/cooler module.

The pump draws through the pickup tube and forces the oil to the filter-cooler module. The module cools, filters, and regulates the flow before the oil passes to internal passages and external lines. Then the passages deliver oil to the moving components within the engine, and the lines feed oil to the air compressor and turbochargers.

Although it isn't used on the DT, the MaxxForce® 9, and 10 engines have a second, remote-mounted bypass filter.

"...the MaxxForce® 9, and 10 engines have a second, remote-mounted bypass filter."

Oil Pump

The crankshaft driven oil pump is located behind the vibration damper. Oil is drawn into the pump through the pickup tube and a front cover passage. The oil pump on the MaxxForce® DT is different than the pump on the MaxxForce® 9, and 10. The 9, and 10 engines use a wider rotor set.

Oil Filter/Cooler Module

Oil from the pump flows through a passage in the front cover and crankcase to the filter/cooler module. Oil flow is controlled by three valves. The thermal valve, the pressure regulator, and the filter bypass valve.

The oil pressure regulator valve is used to relieve excess pressure in the system. It is located at the rear of the module. This location allows the valve to be removed while the module is still attached to the crankcase.

"Above 232° Fahrenheit, or 97° Celsius, the thermal valve routes oil through the cooler."

The thermal valve is mounted on the top of the module. This valve controls the flow of oil through the cooler. If the oil temperature is below 207° Fahrenheit, or 97° Celsius, the oil flows directly to the filter. Above 232° Fahrenheit, or 111° Celsius, the thermal valve routes oil through the cooler before the filter. The cooler uses engine coolant to lower the temperature of the oil before it enters the filter.

The bypass valve is located in the filter. The valve opens if the flow of oil through the filter is restricted.

Oil exits the filter/cooler module and enters the main oil gallery in the crankcase.

Piston Cooling Jets

The piston cooling jets connect to the main oil gallery. Each jet provides a stream of oil to lubricate the piston pin and reduce the temperature of the piston crown.

The 2010 MaxxForce® 9, and 10 jets are identical, however the DT jet is unique. The MaxxForce® DT jet is matched to a longer DT connecting rod and aluminum piston. The MaxxForce® 9, and 10 jet is matched to a shorter connecting rod and steel piston. The MaxxForce® 9, and 10 jet can be identified by a knurled area at the base of the tube.

Neither the previous DT jet nor the 2010 MaxxForce® 9, and 10 jet can be used in the 2010 DT engine. Either of these could lead to engine damage.

"The previos DT jet nor the 2010 9, and 10 jet can be used in the 2010 DT engine."

External Component Lube

An external hose supplies oil from crankcase to the air compressor. Oil drains from the compressor sump through a hose to the bottom of the engine crankcase.

Oil flows to the turbochargers through a steel line from the filter/cooler module. Oil drains from the turbos to the breather and then to the crankcase.

High Pressure Oil Reservoir and Pump

"The fuel system high pressure pump requires lube oil to operate."

The fuel system high pressure pump requires lube oil to operate. An oil reservoir for this pump is formed by the two halves of the front cover. The volume of oil is continuously maintained by the lube oil pump as the high pressure pump draws oil from the reservoir.

Remote Oil Filter

"The centrifugal forces seperate soot and fine contaminants."

The remote-mounted bypass filter receives non-filtered oil from a port on the filter/cooler module. Oil enters this centrifugal filter element and passes through two opposing nozzles. This action causes the element to spin at high speed. The centrifugal forces separate soot and fine contaminants. Filtered oil then returns to the pan through a drain port on the right side of the crankcase.

The element is changed at each oil change interval.

Electrical Components

The lubrication system has two sensors. One for engine oil temperature and the other for engine oil pressure.

The temperature sensor is mounted on the back of the front cover. This sensor measures the temperature of the oil in the high pressure pump reservoir. The ECM uses this information for fueling calculations.

The pressure sensor is located on the left side of the crankcase. It provides an input to the ECM for the oil pressure gauge and the Engine Warning and Protection system.

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Cooling System Module 2

Overview

Now, let's go over the features and operation of the cooling system. Coolant flows through the following key components: The water pump the front cover, the crankcase, the cylinder head, the thermostat, and the radiator.

Coolant is supplied to the oil cooler, the EGR cooler, the aftertreatment injector, and the air compressor.

On engines rated at 245 horsepower and above, coolant is also supplied to a low temperature radiator, a thermostat for the low temperature radiator, and an intercooler.

The water pump circulates coolant through the crankcase and cylinder head passages. If the thermostat is open, coolant is directed to the radiator. If the thermostat is closed, coolant bypasses the radiator and returns to the pump. Ports on the crankcase supply coolant to the air compressor and oil cooler. The air compressor returns its coolant to the crankcase, while the oil cooler returns coolant to the coolant supply housing.

"If the thermostat is open, coolant is directed to the radiator."

Coolant flows from the water pump to the EGR Cooler and the aftertreatment injector and returns through external lines. Coolant flows externally to the cooler, the low temperature thermostat, and low temperature radiator.

Thermostat

The thermostat is located under the coolant outlet tube at the front of the cylinder head. If the coolant temperature is below 190° Fahrenheit, or 88° Celsius, coolant bypasses the radiator and returns to the water pump. If the coolant temperature is above 205° Fahrenheit, or 96° Celsius, the thermostat allows full coolant flow to the radiator.

EGR Cooler

"The cooler receives and returns coolant through individual steel tubes."

The EGR cooler is located on the right side of the engine. The cooler receives and returns coolant through individual steel tubes. The upper tube connects the outlet side of the water pump to the cooler. The lower tube returns coolant to the inlet side of the pump.

A hose attaches to the de-aeration port at the top of the cooler. This fitting allows air in the system to escape to the de-aeration tank.

Aftertreatment Injector

The aftertreatment injector is located on the turbo downpipe. A portion of the coolant in the EGR cooler is routed to the aftertreatment injector, and then flows back to the cooler.

"A portion of the coolant in the EGR cooler is routed to the aftertreatment injector."

Intercooler

Engines with an intercooler have a remotely mounted low temperature radiator, or LTR, and a thermostat dedicated to the intercooler.

Coolant flow to the LTR thermostat is supplied by a tee in the EGR cooler supply line. If the coolant temperature is below 194° Fahrenheit, or 90° Celsius, the thermostat routes the flow directly to the intercooler.

"Coolant flow to the LTR thermostat is supplied by a tee in the EGR cooler supply line."

When the temperature reaches 194° Fahrenheit, or 90° Celsius, the thermostat directs some coolant to the LTR. At 208° Fahrenheit, or 98° Celsius, the thermostat directs all of the flow to the low temperature radiator. From the LTR, the coolant passes through the intercooler and returns to the inlet side of the water pump.

Oil Cooler

The oil cooler is mounted on the right side of the crankcase below the EGR cooler. The coolant, is supplied to the filter/cooler module through a port on the crankcase. Coolant passes through the cooler then returns through a pipe to the supply housing. The supply housing is mounted to the upper right side of the cylinder head and directs return coolant to the thermostat.

Air Compressor Cooling

"Hoses to and from the crankcase provide a constant flow of coolant through the compressor."

The air compressor is mounted on the left side of the front cover. Hoses to and from the crankcase provide a constant flow of coolant through the compressor.

Optional Block Heater

The optional block heater is mounted on the left side of the crankcase. This AC powered heater warms the engine coolant as a starting aid.

Coolant Temperature Sensor

The coolant temperature sensor is located on the coolant supply housing. This sensor provides an input to the ECM for many of its calculations.

Extended Life Coolant

Long life coolant is used with these engines. Refer to the Operator's Manual for details about coolant servicing.

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Fuel Management System Module 3

Overview

Next, Let's cover the features and operation of the fuel management system. Fuel flows through the following components: The fuel pump and strainer, the fuel filter, and the injectors. High-pressure oil is provided by the high-pressure oil pump and flows through the injection pressure regulator, the high-pressure oil manifold, and the injectors.

The fuel management system is composed of three subsystems: supply, high-pressure oil, and the injectors.

Fuel from the tank is supplied to the filter module through the supply line. The pump draws fuel through the strainer and pushes it to the filter and the pressure regulator. When necessary, the regulator relieves excess fuel pressure through a return line to the fuel tank. Fuel passes through the filter and into the intake manifold. Individual passages in the manifold and cylinder head deliver fuel to the injectors. The nominal fuel pressure that is available at the injectors is 90 psi, or 620 kilopascal.

"The regulator relieves excess fuel pressure through a return line to the fuel tank."

The high-pressure oil pump draws from the reservoir and delivers the oil through a high pressure hose to the cylinder head. From the cylinder head, the oil travels through the high-pressure manifold to each injector. Here the oil pressure is used to amplify the fuel pressure to the high levels required for injection.

Supply System

The supply system consists of the fuel tank, lines, the filter module, and the fuel rail.

The fuel filter module is mounted to the intake manifold on the left side of the engine. The module has the following internal components: the strainer, the pump, the filter, and the pressure regulator. The external components are the test port and the drain valve. There are also three electrical components: the fuel delivery pressure sensor, the Water-In-Fuel sensor, and the optional fuel heater.

"The optional fuel heater is mounted to the bottom of the filter module."

The optional fuel heater is mounted to the bottom of the filter module. The element of the heater extends into the fuel supply passage. Fuel that enters the module passes over the element.

At key On, the fuel heater relay delivers battery voltage to the element. When the fuel temperature is below 45° Fahrenheit, or 7° Celsius, a switch within the element turns on the heater and the element warms the fuel. If the fuel reaches 70° Fahrenheit, or 21° Celsius, the heater switches off.

The fuel strainer can be seen when the pump is removed from the filter module. The strainer is attached with an adapter and surrounds the pump body.

"The strainer should be serviced at the filter replacement interval."

The electric fuel pump is mounted into the top of the filter module. At key On, the ECM closes the fuel pump relay and battery voltage is supplied to the pump. The pump will run for ten seconds. During that time, if the ECM does not detect crankshaft rotation, it switches the relay off. If the ECM detects rotation, the pump will continue to run.

After replacing a filter, the pump will prime the system at key On. This eliminates the need for a manual primer pump.

"After replacing a filter, the pump will prime the system at key On."

The pump is internally protected from excessive current draw. When current limiting protection is triggered, the pump will cycle on and off causing the system pressure to fluctuate until the overload condition is resolved.

The ECM monitors the fuel delivery pressure sensor located on the bottom of the fuel filter housing. If the ECM determines that the pressure is low, or there is a restriction before the sensor, a diagnostic trouble code is set.

"If the lamp is on, the water should be drained through the valve."

The Water-In-Fuel sensor and drain valve are both located on the front of the filter housing. When the ECM determines that water has been detected, a lamp on the instrument panel is illuminated. If the lamp is on, the water should be drained through the valve.

The fuel pressure regulator valve and spring are accessible through a cover plate on the bottom of the filter housing. If unfiltered fuel pressure exceeds 95 psi, or 655 kilopascal, the regulator opens. Excess pressure is then relieved as fuel drains through the return line back to the tank.

The fuel filter is located under the cap on the module. Fuel flows through the filter and down the standpipe. There is an orifice on the top of the filter that allows air and a small quantity of fuel to constantly bypass the filter and drain to the fuel return line.

Fuel that passes through the filter exits the back of the filter module and enters the fuel rail. The fuel rail is a passage in the intake manifold that branches to deliver fuel to the cylinder head and then to the six injectors.

"The fuel rail is a passage in the intake manifold that branches to deliver fuel to the cylinder head and the six injectors."

High Pressure Oil System

The high-pressure oil system consists of the pump, the hose, the oil manifold, the injection pressure regulator, and the injection control pressure sensor.

The high-pressure oil pump is mounted to the back of the front cover on the left side of the engine. The pump is driven by the front gear train. Oil is drawn from the reservoir and is sent through a hose to the cylinder head.

The injection pressure regulator valve is mounted on the rear of the pump and regulates the Injection Control Pressure, or ICP. The range of operating pressures is from, 870 psi or 6 mega-Pascal at idle, to 4641 psi or 32 mega-Pascal, at full load at rated speed.

"The high-pressure oil manifold is used to distribute oil to the injectors."

The high-pressure oil manifold is located under the valve cover and is used to distribute oil to the injectors. If the optional compression brake is present, the components mount to the oil rail including the control valve, the brake control pressure sensor, relief valve, and the six brake pistons.

The injection control pressure sensor is mounted at the rear of the manifold. The sensor monitors oil pressure in the rail. The ECM varies the signal to the injection pressure regulator in response to the signal from the sensor.

Injectors

"The injectors require both fuel supply pressure and high-pressure oil to operate."

The injectors are located under the valve cover. The injectors require both fuel supply pressure and high-pressure oil to operate. Fuel fills the barrel area of the injector and the oil provides the pressure required to force the plunger down.

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Air Management System Module 4

Overview

Next, let's discuss the features and operation of the air management system. Beginning on the left side of the engine, the mixer housing is located above the intake manifold. The EGR valve and engine throttle valve are both on the mixer.

On the right side, the turbocharger assembly is mounted to the exhaust manifold and the boost control valve is located in front of the turbos. The EGR cooler is below the turbos, and the intercooler is above the valve cover. The crankcase breather is mounted to the lower right side of the crankcase, and the charge air cooler is mounted remotely.

The air management system can be divided into three subsystems: air induction, exhaust gas recirculation, and crankcase ventilation.

The system starts with air induction and the air filter element. The low-pressure turbo compresses the filtered air and directs it to the intercooler. The intercooler reduces the air temperature and directs it to the high-pressure turbo. The high-pressure turbo

"The low-pressure turbo compresses the filtered air and directs it to the intercooler."

compresses the air and directs it to the charge-air-cooler. The cooled air then flows through the throttle valve, then into the mixer housing. The mixer housing directs the charge-air into the intake manifold.

"The high-pressure turbo outlet is connected directly to the low-pressure turbo inlet."

On the turbine side, exhaust leaves the manifold and enters the high-pressure turbo. The high-pressure turbo outlet is connected directly to the low-pressure turbo inlet. After passing through the low-pressure turbo, the exhaust enters the turbo downpipe.

Some of the flow that leaves the exhaust manifold is diverted to the EGR system. The diverted exhaust enters the EGR cooler from a cast iron elbow, then exits through the crossover tube to a passage in the intake manifold that leads to the EGR valve . The EGR valve blends the cooled exhaust gases with the charge-air.

"The centrifugal breather seperates oil from the gases which then flow to the turbo inlet."

To ventilate the crankcase, gases exit the valve cover and flow through a tube to the breather module. The centrifugal breather separates oil from the gases which then flow to the turbo inlet.

Mass Air Flow Sensor

The mass air flow sensor is located on the remotely mounted air filter housing. The sensor measures both air flow and inlet air temperature. The ECM monitors the sensor output to calculate EGR flow and control the position of the engine throttle and the EGR valve.

Dual Turbochargers

These engines use dual turbochargers. Both turbos are mounted on the right side of the engine with the high-pressure turbo located above the low-pressure turbo.

On the charge-air side, the low pressure turbo draws in air through the filter element. On engines without an intercooler, the air is compressed and pushed out to the High-Pressure turbo. The high pressure turbo then forces the air through the charge-air-cooler, and then to the mixer housing.

"...the low-pressure turbo draws in air through the filter element."

Intercooler

On engines with an intercooler, the compressed air from the low pressure turbo passes through an air-to-water intercooler mounted over the valve cover. From the intercooler, air flows to the high pressure turbo, and then to the remotely mounted charge-air-cooler.

Mixer Housing/Intake Manifold/Inlet Air Heater

The mixer housing is mounted on top of the intake manifold. The mixer contains the throttle valve, the inlet air heater, and the EGR valve. Air from the charge-air-cooler passes through the throttle valve housing and enters the mixer. From there, the air flows through the inlet air heater and into the intake manifold.

"The inlet air heater is used to warm the air during start up.."

The inlet air heater is used to warm the air during start up. The heater element is located at the bottom of the mixer housing. A relay mounts on a bracket bolted to the intake manifold. Depending on ambient conditions, the ECM energizes the relay at Key-On and illuminates the WAIT TO START symbol on the instrument panel as the element is heating. When the lamp turns off, the engine can be started.

Intake Manifold Temperature/ Pressure Sensors

Two sensors are located on the intake manifold: The intake manifold temperature sensor and the intake manifold pressure sensor.

The ECM uses the intake manifold temperature to determine the best position for the EGR valve, given engine load and operating conditions.

The ECM uses the intake manifold pressure sensor to measure engine boost.

Exhaust Manifold

The two-piece exhaust manifold is mounted to the right side of the cylinder head. The center port directs exhaust into the high-pressure turbocharger. The rear port directs exhaust to the EGR cooler.

The rear exhaust port and the joint between the front and rear halves of the manifold have ring seals. The seals are thin metal rings installed into two grooves cut in the manifold. Four rings are located in each groove.

Exhaust Back Pressure / Exhaust Gas Temp Sensors

The exhaust back pressure sensor is connected to the exhaust manifold with a pipe. The ECM uses the exhaust back pressure to monitor EGR valve and wastegate actuator positions. The exhaust gas temperature sensor is located on the forward section of the manifold. The temperature sensor signal is an input into the desired EGR valve position.

Wastegate

"An actuator controls the wastegate position."

The high-pressure turbo has a wastegate on the turbine side. An actuator controls the wastegate position. When opened, the wastegate allows a portion of the exhaust to bypass the high-pressure turbine and flow directly to the low-pressure turbine. Opening and closing the wastegate is accomplished with the spring loaded wastegate actuator.

Boost Control Valve

The boost control valve is mounted in front of the high-pressure turbo. The valve has three air ports: actuator, vent, and pressure. The turbo actuator is connected to the actuator port, and the vent port is connected to the turbo inlet duct. The pressure port receives boost from the intake manifold. The valve either directs pressure to the actuator, or allows the pressure to vent to the turbo inlet duct. Directing boost pressure to the actuator opens the wastegate, while venting the pressure closes the wastegate.

The valve receives power from the actuator power relay and an electrical ground through the ECM. The ECM supplies the ground when boost should enter the actuator. The ground is removed to vent the actuator.

Exhaust Gas Recirculation

These engines use EGR to reduce exhaust emissions. The key components of the EGR system are the EGR cooler, crossover tube, and the EGR valve.

The EGR cooler is mounted on the crankcase below the turbochargers. During engine operation, exhaust flows from the exhaust manifold, through the cooler, and into the crossover tube. The tube directs the exhaust around the rear of the engine to the intake manifold. The crossover tube has a seal at the intake manifold and a gasket at the EGR cooler.

The mixer housing is mounted on top of the intake manifold. The mixer contains the EGR valve. A passage in the manifold directs the exhaust through the mixer to the EGR valve.

“A passage in the manifold directs the exhaust through the mixer to the EGR valve.”

The ECM controls the EGR valve and the engine throttle valve. When the EGR valve opens, the difference between exhaust back pressure and boost pressure causes exhaust to flow into the mixer housing. When required, the ECM partially closes the engine throttle valve to increase exhaust flow.

Crankcase Ventilation

The closed crankcase ventilation system uses a centrifugal breather to remove oil mist from the crankcase gases. The breather is mounted on the right front side of the crankcase and is driven by lube oil pressure. Crankcase gases exit the valve cover and flow through a tube to the breather. The centrifugal force of the spinning breather element separates the oil from the gases. Oil drains to the crankcase, and the gases enter the turbocharger inlet.

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Aftertreatment System Module 5

Overview

The final system we will discuss is Aftertreatment. Aftertreatment components on the right side of the engine are: the turbo downpipe with the engine exhaust brake, and the aftertreatment injector. Components on the left side are: the engine throttle valve and the fuel metering unit. Other components are located remotely: the Aftertreatment control module, the pre diesel-oxidation-catalyst, the diesel-oxidation-catalyst, and the diesel particulate filter.

The aftertreatment system is designed to capture and oxidize soot in the exhaust. During engine operation, exhaust exits the turbo downpipe and flows through the Pre-Diesel Oxidation Catalyst, the Diesel Oxidation Catalyst, then into the Diesel Particulate Filter. The Particulate filter captures the particulate matter or soot in the exhaust. Under certain operating conditions, part of the soot is continuously reduced through a process called passive regeneration. Passive regeneration of the DPF does not require action from the ECM or the Aftertreatment Control Module.

“The aftertreatment system is designed to capture and oxidize soot in the exhaust.”

Under some operating conditions, the soot is not sufficiently reduced, through passive regeneration, and begins to accumulate in the DPF. The system is constantly monitoring the soot load in the DPF. When it reaches a certain level the ECM and the Aftertreatment Control Module, work together to initiate strategies to oxidize soot in the DPF. These include the use of downstream injection, the intake throttle valve, the exhaust brake, and other engine parameters. This process is called active regeneration.

"When the soot load reaches a certain level the engine cannot operate."

When the soot load reaches a certain level the engine cannot operate under a constant load and stationary regeneration must be used to oxidize the soot.

PDOC/DOC/DPF

Downstream of the injector is the Pre-Diesel Oxidation Catalyst, or PDOC, followed by the Diesel Oxidation Catalyst, or DOC, then the Diesel Particulate Filter, or DPF.

The PDOC and DOC have a series of small passages that pass through the catalyst. As exhaust flows through the passages, any unburned fuel reacts with the catalyst. The reaction generates heat, increasing the temperature of the exhaust.

The DPF is located in the exhaust system after the diesel Oxidation Catalyst. The DPF passages are plugged at one end. Half of the passages are plugged at the forward end, the other half are plugged at the other end. This allows the DPF to act as a filter and traps the soot.

"The DPF passages are plugged at one end."

All three components are coated with precious metals that react with both the particulate matter, and the unburned fuel in the exhaust. These metals allow the system to oxidize the soot and reduce any other solids to ash for storage in the DPF.

Active & Stationary Devices & Strategies

Engine Throttle Valve & Exhaust Brake

Let's take a closer look at the devices and strategies used during active and stationary regeneration.

The intake throttle valve and exhaust brake may be used to restrict air intake and exhaust flow. The ECM partially closes the throttle valve which results in an increase in exhaust temperature. Under low load conditions, such as idle, the ECM partially closes the brake, which helps to increase the exhaust temperature.

To position the brake, the ECM signals the exhaust-brake control valve. The valve, which is located on the right side of the engine, uses a remote air supply to operate the brake's pneumatic cylinder. Air pressure from the valve overcomes the return spring in the cylinder to partially close the throttle plate. When the control valve vents the air pressure, the return spring forces the throttle plate to the open position.

"The ECM monitors the turbine outlet pressure to aid in the positioning of the exhaust brake."

The ECM monitors the turbine outlet pressure to aid in the positioning of the exhaust brake. A sensor is located inside the exhaust brake control valve. A tube connects the sensor to the turbine outlet pipe. This sensor is specifically for exhaust brake operation.

Downstream Injection

Downstream injection adds fuel to the exhaust stream before the exhaust enters the PDOC and Diesel Oxidation Catalyst, or DOC. This fuel reacts with these catalysts, increasing the exhaust temperature to promote oxidation of the soot.

The components used for downstream injection are: the fuel metering unit, the fuel lines, and the aftertreatment injector. The aftertreatment control module, controls the injection through the metering unit.

The metering unit includes a shut off valve, doser valve, and 2 sensors. To achieve injection, the aftertreatment control module opens the fuel shutoff valve. At the same time, the module uses a fuel inlet sensor to monitor the pressure and temperature of the fuel entering the metering unit.

The aftertreatment control module signals the doser valve to open, and a specific amount of fuel enters the injector supply line. Fuel pressure in the supply line causes a pintle in the injector to lift, allowing fuel to spray out of the injector nozzle into the exhaust stream. When the dosing valve closes, pressure in the supply line decreases, the pintle in the injector closes. The module monitors feedback from the fuel-pressure-2 sensor to verify that dosing is complete.

"When the dosing valve closes, pressure in the supply line decreases."

The fuel supply line routes fuel from the metering unit to the aftertreatment injector. The line is located on the rear of the engine, and has very precise length, inside diameter, and tubing thickness specifications.

The aftertreatment injector is mounted downstream of the exhaust brake on the turbo downpipe. A metal gasket and two special, high temperature bolts seal the injector to the turbo downpipe.

Refer to the Service Manual on ISIS when servicing.

There are four exhaust sensors in the aftertreatment system: one differential pressure sensor and three temperature sensors.

The DPF Differential Pressure sensor is located on a bracket mounted to the DPF. This sensor compares the inlet and the outlet pressures of the DPF. When the soot load is high, the passages in the DPF are restricted and the pressure difference is high. The sensor allows the ECM to estimate the soot load in the DPF.

The DOC inlet temperature sensor monitors the exhaust before the DOC. This sensor allows the ECM to determine if the exhaust temperature is high enough to perform downstream injection.

The DOC outlet temperature sensor is located after the DOC. The ECM uses this signal to determine if the DOC is functioning effectively. The DPF outlet temperature sensor is located after the DPF.

The DPF outlet temperature, when compared to the DOC outlet temperature, determines if regeneration occurred. For an active regeneration to be successful, exhaust temperature must be within the range of approximately 950 to 1,100° Fahrenheit, or 500 to 600° Celsius. If the temperature is too great at the DPF outlet, the ECM limits downstream injection.

Stationary Regen

When the passive and active regen strategies do not sufficiently reduce the soot in the DPF, stationary regen, is needed. The aftertreatment system notifies the operator that a manually activated stationary regen is required. Refer to the operator's manual for the proper procedure to initiate a stationary regen.

"When the passive and active regen strategies do not sufficiently reduce the soot in the DPF, stationary regen is needed."

During a stationary regen, the ECM controls engine speed, partially closes the intake and exhaust throttles, and delivers fuel into the exhaust. With the increased heat, the DPF soot load will be reduced.

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Conclusion

This concludes the 2010 MaxxForce®
DT, 9, and 10 Engine Training Program.

Thanks for your participation.

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