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**Conclusion**

**Course Navigation**

To skip the navigation instructions and continue with the course, click on the **“SKIP”** button near the upper right-hand corner of the screen.

Navigation of this course may be performed in several ways. At the bottom of the screen are the **“NEXT,”** **“PREVIOUS,”** and **“REPLAY”** buttons. Clicking either the **“NEXT”** or **“PREVIOUS”** buttons will take you to the next or previously viewed course topic. After all information on a topic has been covered, the arrow on the **“NEXT”** button will pulse red to indicate you are ready to continue.

Clicking the **“REPLAY”** button will replay the topic you are currently viewing.

Near the bottom right-hand corner of the screen are the **“PAUSE/PLAY”** and **“NOTES”** buttons. Clicking the **“PAUSE/PLAY”** button allows you to pause the course and resume when you’re ready to continue.

Clicking the **“NOTES”** button will bring up a small window containing the narrated text for the currently viewed topic. Click the **“NOTES”** button again to hide this window.

That's all for course navigation. Click the **“NEXT”** button to continue.

**Course Overview**

The goal of this course is to introduce technicians to the Engine Aftertreatment System of the 2013 N13 engine.

**Objectives**

Upon the completion of this course, you will be able to identify the 2013 N13 engine, identify the 2013 N13 Engine Aftertreatment System Components, and identify proper operation of the 2013 N13 Engine Aftertreatment System.

- **Identify engine**
- **Identify proper operation of the Aftertreatment System**

**Modules**

This course consists of this introduction and the following three modules: Engine Identification, Exhaust Gas Recirculation, and Aftertreatment Fuel Injection.

- **Module 1: Engine Identification**
- **Module 2: Exhaust Gas Recirculation**
- **Module 3: Aftertreatment Fuel Injection**

Click the **“NEXT”** button when you’re ready to begin Module 1.
MODULE 1: ENGINE IDENTIFICATION

Engine Identification

There are several different ways you can identify the 2013 N13 engine, the first of which is by locating the Engine Serial Number. The Engine Serial Number, or ESN, is stamped on the upper left-hand side of the crankcase just above the high-pressure fuel pump.

The ESN is also printed on the engine emissions label located on the top of the valve cover near the front of the engine.

In addition to the ESN, the emissions label also contains engine information including the model year, engine family, engine displacement, advertised brake horsepower and torque ratings, emission family and control systems, and valve lash specifications.

• Model Year
• Engine Family
• Engine Displacement
• Advertised Brake Horsepower And Torque Ratings
• Emission Family And Control Systems
• Valve Lash Specifications

Conclusion

This concludes Module 1.

Click the NEXT button to continue to Module 2: Exhaust Gas Recirculation System.
MODULE 2: EXHAUST GAS RECIRCULATION SYSTEM

This module is divided into four subsections: Overview, Components, Exhaust Flow, and Coolant Flow.

Overview

The Exhaust Gas Recirculation (EGR) System reduces the engine’s emission of NOx by circulating cooled, inert exhaust into the combustion chamber. The cooled exhaust gas absorbs some of the heat generated during combustion, which lowers peak exhaust temperatures and decreases NOx formation.

NOTE

Although the NOx in sensor is engine mounted, it is not used for EGR control. Instead, this sensor is used as an input to the Aftertreatment Control Module (ACM) to control Diesel Exhaust Fluid (DEF) injection.

Components

The EGR System consists of the Engine Throttle Valve, EGR Cooler Assembly, Oxygen Sensor, Temperature Sensors, and EGR Valve.

- **The EGR Valve** is mounted to the inlet of the EGR Cooler Assembly and is used to control the flow of exhaust gas through the EGR system. The EGR Valve consists of a motor, two butterfly valves, and an internal position sensor. The ECM uses inputs from the internal position sensor of the EGR Valve to precisely control the EGR Valve motor and position of the butterfly valves. Engine coolant is circulated through the EGR valve to increase the durability of the actuator by preventing overheating.

  Depending on the production date, a jumper harness may be secured with epoxy to the EGR Valve connector bolted to the top of the EGR Valve. If the EGR Valve connector needs to be disconnected, only do so at the new EGR Valve connector service location. Refer to TSI-13-12-16 for service information.

- **The Coolant Control Valve (CCV)** consists of a Coolant Flow Valve and a Coolant Mixer Valve. During operation, the Coolant Flow Valve (CFV) regulates the coolant flow through the Low-Temperature EGR Cooler along with the Low-Pressure Charge-Air-Cooler (LPCAC). The Coolant Mixer Valve (CMV) controls the amount of coolant that passes through the Low-Temperature Radiator (LTR).

- **The Oxygen Sensor (O2S)** is a wideband oxygen sensor and is installed in the exhaust pipe in front of the Aftertreatment Fuel Injector. The O2S is used to monitor the oxygen level of the exhaust gas exiting the Low Pressure Turbo.

- **The Engine Throttle Valve (ETV)** is mounted to the cylinder head near the front-left side of the engine and is used to restrict intake airflow and assist EGR operation. The ETV consists of a motor, a butterfly valve, and an internal position sensor. The ECM uses inputs from the internal position sensor of the ETV to precisely control the ETV motor and position of the butterfly valve.
MODULE 2: EXHAUST GAS RECIRCULATION SYSTEM

• The Engine Coolant Temperature 2 (ECT2) Sensor is mounted to the Low-Temperature EGR Cooler Manifold and is used to measure the temperature of the coolant being sent to the LPCAC.

• The Intake Manifold Temperature (IMT) Sensor is located on the Intake Manifold and measures the temperature of charge-air inside of the manifold.

• The EGR Temperature (EGRT) Sensor is located at the front of the EGR Cooler Assembly and measures the exhaust gas temperature exiting the EGR cooler.

• The EGR Cooler Assembly is a two-stage heat exchanger mounted to the right side of the engine. The assembly consists of a high-temperature section and a low-temperature section. The high-temperature section is the back half of the EGR Cooler and the low-temperature section is the front half. Engine coolant is used to absorb heat and lower the temperature of exhaust gas as the gases flow through the high and low-temperature sections of the EGR Cooler Assembly.

Now that you know what components the EGR System consists of, let’s move on to the next section on Exhaust Flow.

Click the NEXT button when you’re ready to continue.

Exhaust Flow

During engine operation, EGR flow is controlled by the ECM based on the data it receives from multiple sensor inputs. These inputs include engine load, coolant temperature, manifold temperature, boost pressure, oxygen levels in the exhaust, and various inputs from the Aftertreatment Control Module.

When EGR flow is required, the ECM commands the EGR valve to open, allowing exhaust gas from the exhaust manifold to enter the High-Temperature section of the EGR Cooler. As the hot exhaust gas flows through the EGR Cooler Assembly, heat from the gas is transferred to the cooler and then absorbed by engine coolant.

The cooled exhaust gas flows from the Low-Temperature EGR Cooler into the mixing duct and then mixes with intake air. The ECM may also command the Engine Throttle Valve to restrict intake air flow and aid in EGR flow.

Click the REPLAY button if you’d like a review of the Exhaust Flow, or click the NEXT button to move on to Coolant Flow.

Coolant Flow

As discussed earlier, the EGR Cooler Assembly is divided into two sections: a Low Temperature EGR Cooler section at the front and a High Temperature EGR Cooler section at the back.

Coolant from the Rear Coolant Crossover Tube supplies the High Temperature EGR Cooler. After flowing through the High Temperature EGR Cooler, the heated coolant is directed to the EGR Cooler spacer plate and then to a dedicated coolant passage within the Low Temperature EGR Cooler. This passage runs the length of the Low Temperature EGR Cooler and returns the heated coolant from the High-Temperature EGR Cooler to the thermostat housing.
MODULE 2: EXHAUST GAS RECIRCULATION SYSTEM

While the Low Temperature EGR Cooler has a dedicated coolant passage that allows the coolant from the High Temperature EGR Cooler to exit to the thermostat housing, the coolant passages in the High and Low Temperature EGR Coolers are independent from each other.

The Low Temperature EGR Cooler is supplied with coolant directly from the Water Distribution Housing. After flowing through Low-Temperature EGR Cooler, heated coolant exits through the EGR Cooler Manifold to the Coolant Control Valve.

Depending on the temperature of engine coolant, the Coolant Mixer Valve and Coolant Flow Valve are commanded into various states. At low coolant temperatures, the Coolant Mixer Valve bypasses coolant flow past the Low-Temperature Radiator and sends the coolant directly to the Low-Pressure Charge-Air-Cooler.

When required, the Coolant Mixer Valve will direct up to 100% of the coolant flow to the LTR for additional cooling. At the same time, the Coolant Flow Valve will regulate the volume of coolant that passing through the Low Temperature EGR Cooler and the LPCAC. The flow minimum is 20% and will increase up to 100% as conditions require.

The “Y” fitting on the Low Temperature EGR Cooler Manifold combines the coolant flow from the CCV and the LTR. Coolant flows from the “Y” fitting to the back of the Low Temperature EGR Cooler Manifold, passes the Engine Coolant Temperature 2 Sensor, and then is sent to the LPCAC.

Lastly, a vent on the Low Temperature EGR Cooler Manifold serves dual purposes: to cool the EGR Valve, and to purge air to the Deaeration Tank.

Conclusion

This concludes the description of Coolant Flow and brings us to the end of Module 2.

Click the **NEXT** button to continue to Module 3.
MODULE 3: AFTERTREATMENT FUEL INJECTION

The Aftertreatment Fuel Injection Module is divided into four subsections: Overview, Components, Injection Stage Operation, and Purging Stage Operation.

Overview

The Aftertreatment Fuel Injection system is used to inject fuel into the exhaust system to aid in aftertreatment regeneration. The fuel, which is injected after the turbochargers, reacts with the aftertreatment system catalysts and causes an increase in exhaust temperature. This increase in exhaust temperature promotes oxidation of the soot trapped within the various components of the Aftertreatment System.

Components

The components used in the Aftertreatment Fuel Injection System are the Aftertreatment Fuel Dosing Module, Aftertreatment Purge Air valve, Aftertreatment Fuel Injection fuel lines, Aftertreatment Fuel Injector, and the Aftertreatment Control Module.

Click the NEXT button to view a description of each component.

• The Aftertreatment Fuel Dosing Module is mounted on the left side of the engine and contains the Aftertreatment Fuel Shutoff Valve and the Aftertreatment Fuel Pressure 1 Sensor. Filtered, low-pressure fuel is supplied to the Aftertreatment Fuel Dosing Module from the Secondary Fuel Filter Module.

• The Aftertreatment Purge Air Valve (AFTPAV) is mounted on the left side of the engine and uses vehicle air pressure to purge fuel from the Aftertreatment Fuel Supply lines.

• The Aftertreatment Fuel Supply Line routes fuel from the Aftertreatment Fuel Dosing Module to the Aftertreatment Fuel Injector. This line is located on the rear of the engine and has very precise length, inside diameter, and tubing thickness specifications.

• The Aftertreatment Fuel Injector (AFTFI) is located on the right side of the engine and is installed on the Exhaust Back Pressure Valve Housing, downstream of the Exhaust Backpressure Valve. The Aftertreatment Control Module will command the AFTFI “ON” when injection is needed to aid with DPF Regeneration. A metal gasket, ceramic insulator, and two special high-temperature bolts seal the injector to the Exhaust Back Pressure Valve Housing. To protect the AFTFI’s internal components, engine coolant continuously flows through the AFTFI. This coolant is provided by external coolant supply and return lines.

• The Aftertreatment Control Module, or ACM, is remotely mounted and controls the Aftertreatment Fuel Injection and the Selective Catalyst Reduction, or SCR, Aftertreatment system. The ACM and ECM communicate through two J1939 Controller Area Network (CAN) datalinks, the Private Aftertreatment CAN, and the Public CAN. The ACM and ECM communicate with various components of the aftertreatment system over the Private Aftertreatment CAN datalink. The Public CAN datalink is used by the ACM and ECM for diagnostics, programming, and communications with other modules such as the Body Control Module, Gauge Cluster, and Transmission.

Now that you are familiar with the components of the Aftertreatment Fuel Injection System, let’s move on to the next section on Injection Stage Operation.

Click the NEXT button when you’re ready to continue.
Injection Stage Operation

When the ACM has identified that Aftertreatment Fuel Injection is required, it will communicate with the ECM via the Private Aftertreatment CAN datalink to initiate the Aftertreatment Fuel Injection process.

The ACM commands the Aftertreatment Fuel Shutoff Valve open, allowing filtered, low-pressure fuel from the Secondary Fuel Filter Module to flow to the AFTFI.

With the Aftertreatment Fuel Shutoff Valve open and fuel supplied to the AFTFI, the ACM will command the AFTFI to pulse, injecting fuel into the exhaust stream.

Purging Stage Operation

When Aftertreatment Fuel Injection is no longer required, the Aftertreatment Purge Air Valve is used to purge out any fuel remaining in the system. With the Aftertreatment Fuel Shutoff Valve closed, both the Aftertreatment Purge Air Valve and the AFTFI are commanded “ON” allowing vehicle air pressure to pass through the Aftertreatment Purge Air Valve and purge fuel remaining in the system out through the AFTFI.

Conclusion

This concludes the Navistar training course on the 2010 EPA, 2013 N13 Engine Aftertreatment System. Thank you for your participation.

Close this window and return to the Course Grade Book to take the final test.